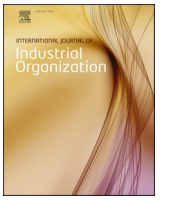
International Journal of Industrial Organization 103 (2025) 103201

Contents lists available at ScienceDirect

International Journal of Industrial Organization

journal homepage: www.elsevier.com/locate/ijio



Export market entry of Chinese SMEs: The role of scale economies and outstanding trade credit

Johannes Van Biesebroeck [a], Honghao Zheng [b,*]

[a] KU Leuven and CEPR, Belgium
[b] School of Applied Economics, Renmin University of China, China

ARTICLE INFO

JEL codes:
D2
F1
L6
O3

Keywords:
Increasing returns to scale
Productivity
International trade

ABSTRACT

This paper uses data on Chinese manufacturing firms to evaluate the link between financial constraints, export market entry and productive efficiency. We show, first, that many small firms operate below minimum efficient scale at a point with increasing returns to scale and, second, that small firms selling only domestically extend the most trade credit to their clients, even though they are most financially constrained themselves. Entering the export market provides a way to expand output and reduce trade credit by taking advantage of more favorable contracting institutions and payment terms available only for exports. Firms with a higher outstanding balance of trade credit and with a more adverse institutional environment expand output most when they start exporting. It allows them to exploit scale economies and improve productivity. Our findings highlight trade credit as a previously overlooked mechanism behind the distribution of firm sizes and provide new insights into the learning-by-exporting literature.

1. Introduction

It is well-known that the size distribution of firms in less-developed countries is dominated by small firms, both in terms of employment or output (Tybout, 2000). This is true at the point of entry, but Hsieh and Klenow (2014) find an even more pronounced difference among mature plants comparing the size distribution in the United States to India and Mexico. Many small firms also operate informally. Informality is associated with both small entry size and a lack of firm dynamics for many reasons, but greater difficulty of accessing the necessary credit for expansion is likely to be an important factor (Ulyssea, 2020). The preponderance of small firms in these economies is inefficient as it traps resources in low-productivity firms.

We use firm-level data for the Chinese manufacturing sector between 1998 and 2007 to document three important patterns. First, in the majority of industries, many small firms operate below minimum efficient scale. We estimate a flexible production function using the control function approach of Ackerberg, Caves and Frazer (2015) that allows for variable returns to scale over the relevant range of firm sizes. The results indicate that small firms are not only less productive, but they also face increasing returns to scale. As such, they operate at a sub-optimal point on their own production frontier and raising their scale of operations would raise allocative efficiency in

Comments by seminar participants at the IADB, University of Birmingham, LSE, BOFIT, PSE, Stockholm, CUHK, HKIMR, Stanford, Gent, HKU and EARIE are greatly appreciated. Financial support by the East-West Center, the Interamerican Development Bank, the Bank of Finland Institute for Economies in Transition (BOFIT), the Hong Kong Institute for Monetary Economics (HKIMR) and Methusalem grant METH/21/01 is gratefully acknowledged.

* Corresponding author.
E-mail addresses: jo.vanbiesebroeck@kuleuven.be (J. Van Biesebroeck), honghao.zheng@ruc.edu.cn (H. Zheng).

https://doi.org/10.1016/j.ijindorg.2025.103201
Received 5 July 2025; Received in revised form 15 September 2025; Accepted 18 September 2025
Available online 20 September 2025

the economy.

Second, while a large literature documents the difficulties that small firms face in accessing credit, we show that small exporters in particular are the least likely to report facing financial constraints. The same distinction between firms operating only domestically and exporters appears in the extension of trade credit to clients. While small businesses extend the most trade credit overall, small exporters carry the lowest balances of outstanding accounts receivables.[1] The model of Burkhart and Ellingson (2004) predicts that trade credit will be especially important for small firms and in developing economies where firms have less access to formal sources of financing.

Third, when firms enter the export market for the first time, they experience strong sales growth, but most importantly, this sales boost disproportionately favors firms that had previously awarded a lot of trade credit. The positive effect on sales for new exporters is strongly increasing in the amount of outstanding accounts receivable. This pattern shows up especially clearly if we instrument for export market entry using the export market experience of neighboring firms.

The fact that firms grow strongly following export market entry is not surprising by itself. In the seminal model of Melitz (2003), a fall in the fixed cost of exporting would induce the most productive firms that served only the domestic market to self-select into exporting.[2] They would enjoy a growth spurt to achieve their new optimal scale, now serving both the domestic and foreign markets. However, the above three facts taken together are consistent with an alternative mechanism that leads to sales growth and efficiency gains following export market entry. As shown in the literature and confirmed in our data, firms tend to have access to better contracting institutions and payment terms on export markets. Exporters are more likely to be paid in advance (Antràs and Foley, 2015), have better access to bank-intermediated forms of payment (Niepmann and Schmidt-Eisenlohr, 2017), and governments often provide export insurance subsidies (Mah, 2006). Especially for firms that have accumulated a large balance of trade credit which might be reluctant to make additional domestic sales, exporting provides a lower-risk way of expansion. For small firms operating below minimum efficient scale, this has the additional advantage of allowing them to exploit unrealized scale economies.

Two further pieces of evidence support this alternative mechanism. First, firms' outstanding balances of trade credit decline following their export market entry. It suggests that these are not merely firms that generously award credit to boost sales, but that the common practice of awarding trade credit on the domestic market poses a financial burden. This is not surprising as the difficulty for small, private firms to obtain credit, is compounded with imperfect contract enforcement in the unreliable Chinese court system. Once a firm has extended a large balance of trade credit, it faces some default risks and may become reluctant to expand further.[3] Second, the tendency for firms with large balances of trade credit to increase sales after export market entry is especially strong in situations where contract enforcement problems or financial constraints are likely to be most severe: for small or privately-owned firms, in industries with increasing returns to scale, and in provinces with weak institutions.

Our analysis contributes to two literatures. First, the literature that studies the prevalence of small firms in developing countries and the institutional reasons behind it spans many fields of economics. It has considered many mechanisms, but never the role of trade credit. Capital constraints are naturally the topic of many studies, as are financial, legal or corruption problems that constrain growth especially for small firms (Beck, Demirgüç-Kunt and Maksimovic, 2005). Much of this work focuses on reasons for informality, such as avoiding registration, taxes, and regulations (Ulyssea, 2020). At the same time, Greenaway, Guariglia and Kneller (2007) show that exporting has the potential to improve a firm's overall financial health. While Do and Levchenko (2007) provide aggregate evidence for the same channel, i.e., showing that export success improves financial development at the country-level.

Second, the literature that investigates the reasons behind the positive correlation between firm-level productivity and export status has found evidence for both directions of causality. Evidence of self-selection of the most productive firms into exporting is found in all countries, while evidence for the reverse causation, which is called the learning-by-exporting hypothesis, comes predominantly from developing countries, see Wagner (2007) and ISGEP (2008) for literature reviews and a meta-analysis. Fafchamps, El Hamine and Zeufack (2008) is a rare example of a study that investigates a specific underlying mechanism, namely learning about market demand. The topic has also received attention in the IO literature. In particular, innovative activities are shown to increase already before (Cassiman et al., 2010) or following (Salomon and Shaver, 2005) export market entry, respectively providing support for preparing-to-export or learning-by-exporting effects. The mechanism that we propose provides an alternative link from exporting to higher productivity. Small firms with large outstanding balances of trade credit start exporting to benefit from better payment terms or more secure contract institutions. If they face increasing returns to scale, the increase in their scale of operations also raises their measured productivity level.

The remainder of the paper is organized as follows. In Section 2 we first introduce the two data sources that are used in our empirical analysis. We next document evidence for two important underlying patterns: in almost all industries there is an important share of firms that produce at a point with unrealized returns to scale, shown in Section 3; and exporting gives small firms that face most financing constraints access to specific institutions that facilitate expansion, shown in Section 4. The main empirical results are discussed in Section 5 and the implications for learning-by-exporting in Section 6. We conclude in Section 7 with some takeaways for the literature and for policy.

[1] In most countries and industries, standard payment terms oblige clients to pay a sales invoice only after one to three months, which implies that sales come with a short term credit that is awarded by the seller to the buyer.

[2] Given that it is a static model, it predicts no systematic firm-level growth and firm-size is entirely determined by each firm's constant level of productivity.

[3] In the model of Burkhart & Ellingson (2004), credit constraints and the need to pre-finance production put an upper limit on the amount of outstanding trade credit some firms can bear.

2. Data

We use the publicly available sample of the World Bank Enterprise Survey for China to illustrate a few patterns related to Chinese firms' finances and financial problems. This data source contains 2700 firms that were interviewed between December 2011 and February 2013. Firms are asked for quantitative information on their operations, but also on the type of problems they face. The sample covers firms from all sectors of the economy and comparable data exists for most countries around the world. The underlying firm-level data and a report with an overview of the responses for each country are available online.[4]

The main empirical analysis uses information from the annual survey of above-scale industrial establishments conducted by China's National Bureau of Statistics (NBS). We focus on firms in the manufacturing sector. The sample contains all state-owned firms, as well as privately-owned firms or firms with mixed-ownership with annual output of at least five million RMB over the 1998–2008 period.[5] In total we observe 2.3 million firm-year observations from 603,053 unique firms. We observe the average firm for five to six years. Brandt, Van Biesebroeck and Zhang (2012, 2014) provide detailed information on the sample composition and summary statistics.

Given our interest in the experience of small firms, we verify that the sample inclusion threshold does not exclude all firms that potentially operate below minimum efficient scale. Fig. 1 shows the firm size distribution for 2007, separately for exporters and non-exporters. It shows the histogram of all sampled firms using employment categories with 25-employee bins. We truncate the distribution at 500 employees, lumping all remaining firms in the 500+ category which contains 4 percent of sampled firms. Approximately 40 % of firms have fewer than 50 workers, and 70 % employ at most 100 workers. Exporters are much less likely to come from the first two size categories and much more likely to count more than 500 employees. Still, almost half of all exporters employ at most 100 workers. Slightly less than 30 % of firms export directly at some point during the sample period. We observe 59,985 instances of export market entry.

3. Scale economies

3.1. Production function estimation with variable returns to scale

In a typical economics textbook, firms are shown with a U-shaped marginal cost curve. The expectation is that in the long run under free entry and exit, cost minimizing firms will produce at the minimum of the average cost curve. The curve might show the same low cost for a range of output levels, i.e., have a flat section at the minimum cost, allowing for a range of optimal firm sizes. With firm-level differences in productivity—which move variable costs down for more productive firms and move the minimum of their average total cost curve to the right—it is possible to rationalize an even wider range of optimal firm sizes. Importantly, to the left of the minimum, the average cost curve slopes downward, indicating the presence of increasing returns to scale. Small firms can lower their average costs by expanding and, for example, spreading their fixed costs over a larger sales volume.[6]

We first evaluate to what extent there are scale economies in different Chinese manufacturing industries that small firms can exploit when they start exporting and expand their scale of operations. To investigate this possibility, we need a specification for technology that allows for variable returns to scale. We estimate the following translog production function:

$$\begin{aligned}\ln Q_{it} = {} & \beta_l \ln L_{it} + \beta_{ll} (\ln L_{it})^2 + \beta_m \ln M_{it} + \beta_{mm} (\ln M_{it})^2 + \beta_k \ln K_{it} + \beta_{kk} (\ln K_{it})^2 \\ & + \beta_{lm} \ln L_{it} \ln M_{it} + \beta_{lk} \ln L_{it} \ln K_{it} + \beta_{mk} \ln M_{it} \ln K_{it} \\ & + \beta_{lmk} \ln L_{it} \ln M_{it} \ln K_{it} + \omega_{it} + \epsilon_{it}. \end{aligned} \tag{1}$$

Returns to scale are then defined as

$$\begin{aligned} RTS = {} & \frac{\partial \ln Q(\lambda L, \lambda M, \lambda K)}{\partial \ln \lambda} \Big]_{\lambda=1} \\ = {} & \beta_l + \beta_m + \beta_k + 2\beta_{ll} \ln L_{it} + 2\beta_{mm} \ln M_{it} + 2\beta_{kk} \ln K_{it} + \beta_{lm} (\ln L_{it} + \ln M_{it}) + \beta_{lk} (\ln L_{it} + \ln K_{it}) + \beta_{mk} (\ln M_{it} + \ln K_{it}) \\ & + \beta_{lmk} (\ln L_{it} \ln M_{it} + \ln L_{it} \ln K_{it} + \ln M_{it} \ln K_{it}), \end{aligned} \tag{2}$$

which captures how a firm's output changes when all inputs are increased proportionally (Varian, 1992, p. 14). Depending on the higher order parameters and the input levels a firm chooses, the returns to scale it faces can be increasing or decreasing. The way returns to scale vary with firm size will also vary across industries depending on the parameter estimates.

[4] Data are available at http://www.enterprisesurveys.org/. The online documentation incudes the full questionnaire and discusses the stratified-random sampling frame in detail.

[5] Five million RMB approximately equals $650,000 during the sample period. Firms with mixed ownership include public-private joint ventures, collectively-owned enterprises and township and village enterprises.

[6] Eventually, returns to scale will be decreasing for very large firms because of congestion in production or diminishing returns to fixed inputs, such as managerial quality.

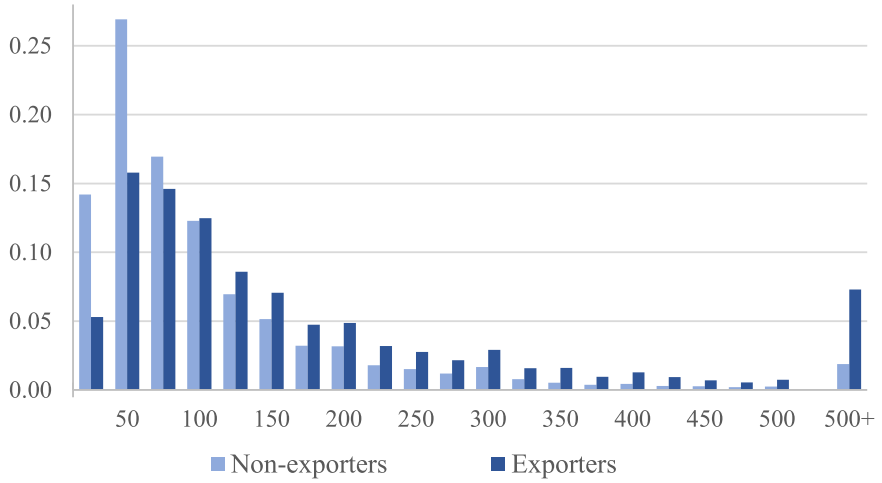


Fig. 1. Distribution of firms by employment size and export status (2007).

We estimate the production function separately for each two-digit industry using the generalized method of moments (GMM) estimator of Ackerberg, Caves and Frazer (2015). Specifically, we rely on a control function that is derived from the material input demand equation $m_{it} = m_t(l_{it},\ k_{it},\ \omega_{it},\ \mathbf{z}_{it})$ to proxy for the unobserved Hicks-neutral productivity ω_{it}. The lower case variables are logarithms of the level variables, and the vector $\mathbf{z}_{it}$ contains all other variables that affect material demand, as well as year, industry, and ownership-type fixed effects. Following Brandt et al. (2017), we specifically include variables that capture the effects of the major trade liberalization shock that China experienced over the sample period, such as import tariffs on output and inputs which are likely to move material demand around. We invert the material demand equation to obtain the control function for the Hicks-neutral productivity term $\omega_{it} = h_t(l_{it},\ m_{it},\ k_{it},\ \mathbf{z}_{it})$, where $h_t(.)$ is a nonparametric function.

Crucially, to allow for the possibility of an endogenous productivity evolution associated with exporting, we include the firm's lagged export status in the law of motion of productivity (Van Biesebroeck, 2005; De Loecker, 2013). This follows a first-order Markov process,

$$\omega_{it} = g(\omega_{it-1},\ \boldsymbol{E}_{it-1}) + \xi_{it},$$

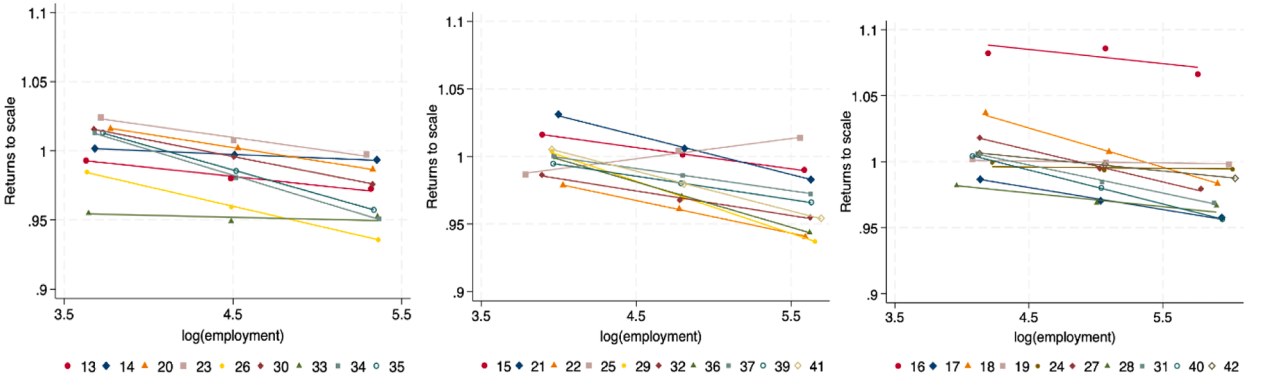
where ξ_{it} is the innovation in productivity and $\boldsymbol{E}_{it-1}$ is a vector capturing a firm's export status as well as output and input tariffs.[7] We use a third-order polynomial in lagged productivity and interactions with $\boldsymbol{E}_{it-1}$ to approximate the nonparametric productivity process $g(.)$.

The timing of input adjustments determines the selection of instruments. In line with most of the literature, we assume that capital is chosen at time *t-1,* but labor and material are chosen in the current period *t*. Hence, the current values of capital and lagged variable inputs are orthogonal to the contemporary productivity shocks ξ_{it} and are used as instruments to form the moments to estimate the production function parameters.

3.2. Scale economies for Chinese manufacturing firms

After estimating the production function coefficients, we can calculate firm-level returns to scale according to Eq. (2). The higher order terms in the translog function are estimated significantly different from zero in most sectors, which implies that different input choices lead to differences in the scale economies that firms face. While the vast majority of firm-year observations operate with returns to scale that range between 0.93 and 1.03, almost half of the firms produce on a point of the production function with increasing returns to scale. Naturally, this fraction varies by sector and is dominated by small firms that operate below minimum efficient scale.

[7] Including lagged export status in the productivity evolution is necessary to allow for the endogenous productivity changes. Export status depends on productivity itself, but lagged productivity is already explicitly controlled for in the Markov process. De Loecker (2013) is devoted to showing the necessity and the possibility of including lagged export status in this equation.



(a) Small average firm-size (b) Medium average firm-size (c) Large average firm-size

Fig. 2. Correlation between returns to scale and firm size by industry.
Notes: Each panel shows the binned scatterplots for one third of industries, which are categorized in three groups by average firm size. Each bin uses one third of the firms in the respective industry. The markers are the average values for returns to scale and firm size (proxied by employment, after controlling for capital and material input). The lines are fitted through the three points by OLS.

Fig. 2 illustrates for all two-digit manufacturing industries in the Chinese Industrial Classification industries how returns to scale vary with firm size.[8] For clarity, we classify all industries into three groups based on their average firm size: small, medium, or large. To highlight two important patterns that hold almost everywhere, we use binned scatterplots to visualize the average relationship rather than showing the full cloud with thousands of observations per industry. To obtain an easy to interpret unidimensional measure of firm size in a context with many inputs, we regress log employment on the two other inputs and take the residual. All firms are then categorized in bins of equal size and we average both employment and returns to scale within each bin.

Fig. 2 presents the results using three bins for each industry, showing a scatterplot of the aggregated datapoints representing the bottom, middle, and top tercile in the firm size distribution.[9] The lines are a simple linear fit to illustrate how average returns to scale vary with employment, holding capital and material inputs constant.

The scatterplots in Fig. 2 highlight two important patterns. First, the leftmost marker for most industries is above one on the vertical axis. It indicates that the smallest one third of firms tend to produce at a point of the production function where they face increasing returns to scale. In only 2 of the 29 industries are the average returns to scale for the smallest tenth of firms noticeably below unity. Even in that case, it is important to keep in mind that there is variation within each bin. Even if the average is below one, some firms will still face increasing returns to scale.[10,11] Clearly, a lot of Chinese manufacturing firms produce with unexploited scale economies.

Second, in all but one industry, the middle and top tercile of firms in the size distribution face lower average returns to scale than the firms in the first tercile. The fitted lines tend to show a negative correlation between returns to scale and size. It implies that when small firms expand, they will exploit and benefit from the scale economies that the technology allows. Of course, scale economies eventually get exhausted. In only 2 industries out of 29, the largest third of firms still produce with increasing returns to scale.[12]

The first anomalous industry is CIC 25 "Processing of Petroleum, Coking, and Nuclear Fuel" in the middle panel (b) which has returns to scale increasing with firm size. Such a pattern indicates a natural monopoly which is not unreasonable for this highly regulated industry that is dominated by large state-owned enterprises. The second industry with increasing returns to scale even for larger firms, but the usual negative relationship between firm size and scale economies, is CIC 16 "Tobacco Products." This is yet another industry dominated by state-owned enterprises, and Rubens (2023) also found strongly increasing returns to scale in this industry in China.

The overall pattern is consistent with the textbook U-shaped marginal cost curve. Many small firms still produce at a point where they face unexploited returns to scale. Most larger firms have exhausted the efficiency gains that the production technology allows. Decreasing returns for some firms are not that unexpected for a revenue production function as larger firms may face a downward-sloping demand curve and need to lower their price to make additional sales. Even if a large size eventually leads to some production efficiencies, scale may bring other benefits that make the large size worthwhile. Furthermore, some short-term deviations from the long-run expectation of constant returns to scale will be due to adjustments in products or production technology, or due to frictions or distortions in factor and product markets in China, as documented in Hsieh and Klenow (2009).

4. Key facts on trade credit and exporting

Fact #1: Small exporters are least likely to report facing financial difficulties

When firms in developing countries are asked about the challenges they face that hold back their growth, access to finance is the most commonly reported obstacle. In the World Bank Enterprise Survey, one fifth of Chinese firms mention it as their single most important concern, ahead of lack of educated workers, competition from the informal sector, and taxes. More than half of Chinese firms report at least some degree of financing constraints. In Table 1, we compare the likelihood that firms face difficulties in obtaining finance between different firm categories based on firm size and export status.

Remarkably, small exporters mention fewer 'access to finance' problems than any of the other three firm categories. This is rather

[8] The two-digit industry codes are: 13-Agriculture Food Processing, 14-Other Food Production, 15-Beverages, 16-Tobacco Products, 17-Textiles, 18-Wearing Apparel, Footwear and Caps, 19-Leather, Fur, Feather and Related Products, 20-Processing of Timber, Articles of Wood, Bamboo, Rattan, Palm and Straw, 21-Furniture, 22-Paper and Paper Products, 23-Printing and Reproduction of Recording Media, 24-Cultural, Educational, Arts and Crafts, Sports and Entertainment Products, 25-Processing of Petroleum, Coking and Nuclear Fuel, 26-Chemicals and Chemical Products, 27-Pharmaceutical Products, 28-Man-made Fibres, 29-Rubber Products, 30-Plastics Products, 31-Non-metallic Mineral Products, 32-Smelting and Processing of Ferrous Metals, 33-Smelting and Processing of Non-ferrous Metals, 34-Metal Products, 35-General-purpose Machinery, 36-Special-purpose Machinery, 37-Transport Equipment, 39-Electrical Machinery and Equipment, 40-Communication Equipment, Computer and Other Electronic Equipment, 41-Measuring Instruments and Machinery for Cultural Activity and Office Work, 42-Artwork and Other Manufacturing.

[9] Fig. A.1 in the Appendix shows similar binned scatterplots using ten bins. The patterns are very similar to those in Fig. 2, but now each bin represents 10% of the firms in the size distribution of an industry. Table A.1 in the Appendix lists for each industry the average estimated returns to scale for firms at the 10^{th} and 90^{th} percentile in the size distribution. In only a single industry—CIC33 "Smelting and Processing of Non-ferrous Metals"—have firms at the 10^{th} percentile an average estimated returns to scale below 0.98.

[10] Moreover, some scale economies may also be due to fixed costs that are unrelated to the measured variable inputs and thus not captured by the estimated production function. They provide further incentives for firms to expand in size.

[11] Results in Table A.1 in the Appendix show the bootstrapped 95% confidence intervals for the returns to scale of firms at the 10^{th} and 90^{th} percentile of the firm size distribution. The entire confidence interval for the small firms lies in the increasing returns to scale interval for 10 of the 29 industries. The reverse pattern, i.e., the entire confidence interval showing decreasing returns to scale, is true for only a single industry.

[12] Results in Table A.1 in the Appendix show that the difference in returns to scale faced by firms at the 10^{th} and 90^{th} percentile of the firm distribution is statistically significant for 22 of the 29 industries.

surprising. A priori, we expect exporters to face more problems than firms that only focus on the domestic market because exporting is a capital intensive activity that raises the demand for financing, see for example Feenstra et al. (2014). We also expect financing problems to diminish with firm size because access to formal sources of finance, especially bank loans and overdrafts, tends to be better for larger firms. This leads to an expectation that small exporters should have suffered the most acute 'access to finance' problems.

Comparing within each row, among larger firms exporters report only slightly fewer difficulties than non-exporters, while for smaller firms the difference is large and statistically significant.[13] Comparing within each column, the responses indicate that finance needs grow more rapidly with firm size than access to finance. The difference between small and large firms is much more pronounced for exporters (8.9 %) than for non-exporters (1.3 %). This is not entirely unexpected as larger firms also operate more capital-intensively and ship their products over longer distances which is likely to raise their capital demand.[14]

Fact #2: Small firms that only sell domestically bear the largest trade credit burden

Given the widespread problems of accessing formal sources of finance in developing countries, many firms rely on trade credit from their suppliers as a more informal financing channel. Of course, this helps some firms, but comes at the expense of other firms. It could hinder suppliers' expansion and ultimately lead them to produce at a suboptimally small scale. In most countries and industries, standard payment terms involve extending trade credit to clients for one to three months. If access to other financing options is limited, as is the case in most developing countries, extending trade credit will be costly as it ties up working capital and it exposes firms to repayment risks.

The NBS firm-level dataset contains information on the outstanding balance of trade credit, and we use the ratio of this balance relative to annual sales to construct the trade credit ratio (TCR). Note that the sales measure used to normalize trade credit differs from the output measure that will be used as dependent variable for the main regressions below. It includes goods purchased from external firms and resold, as well as sales from inventory. It is more appropriate than output as a normalization for trade credit, because it is linked directly to client past or future payments.[15] In the NBS sample, the median outstanding balance of trade credit is approximately 10 % of sales, but the distribution has a long right tail. The average outstanding balance is almost twice as high, at 17 %, even when the top and bottom 1 % is trimmed. Almost one tenth of firms have an outstanding balance of trade credit that they extended to their customers that exceeds half of their annual sales.

Fig. 3 shows how the ratio varies by firm size, as proxied by employment. Among firms that only sell domestically (dashed line), smaller firms tend to extend a lot more trade credit. The average outstanding balance for the smallest firm size category is more than double that of the largest size category. Similarly, the fraction of firms with an outstanding balance above one half of annual sales is 10 percentage points higher in the smallest compared to the largest size category. In contrast, for exporters there is hardly any variation in the trade credit ratio by firm size.

Fact #3: Exporters receive more favorable payment terms on international markets

The above patterns prompt the question why small exporters extend so much less trade credit than small non-exporters? One reason is that, on average, payment terms for international transactions tend to differ from domestic transactions. Specific institutions and payment options have been created to deal with contracting problems on the international market and to facilitate firms' exporting activities. Exporting provides a way out of the burden of extending trade credit by offering firms access to better contracting institutions, better payment terms, or even government support (Antràs and Foley, 2015).

Exporting is associated with risks that firms do not face when selling domestically, such as a lack of information about clients, exchange rate volatility, and additional transportation costs and delays related to distance and border crossings. To deal with these obstacles, dedicated institutions have emerged, often supported by governments, to facilitate international commercial exchange. A bill of lading allows exporters to be paid as soon as goods leave port, transferring the risk of non-payment by the buyer to the seller's bank. In many countries a government agency insures and guarantees export sales (Mah, 2006). Importers also tend to be larger and more protective of their reputation than domestic clients. If a foreign client defaults, recourse to courts in another country can be more complicated, but courts in other, more developed, countries may be more reliable. Sellers may rely on courts or other mediation institutions that can help enforce the contract in the country of their client. Hence, especially for firms in developing countries, these institutional arrangements can make export sales a more secure type of transaction than domestic sales.

Antràs and Foley (2015) quantify information on payment terms from a case study of a single exporter. While most domestic sales in the United States occur on an open account basis, which means transactions are settled only weeks or months after the shipment has been received, only 40 % of the firm's international transactions are open account. An equally important way of settling international

[13] This pattern for China mirrors the findings for manufacturing firms in nine sub-Saharan African countries, documented in Van Biesebroeck (2005). In that sample, small exporters report a 7% lower probability than small non-exporters of facing at least moderate financing difficulties, while the difference for large firms was only 2%. Using the World Bank Enterprise Survey, we verified the correlation for several other developing countries with sufficient firm-level observations. The pattern is widespread, e.g., it also holds strongly for Indonesia and Kenya, but it is not ubiquitous.

[14] Interestingly, the pattern in Table 1 does not hold for indirect exporters. These are firms that do not sell directly to foreign clients, but access the export market via specialized trading intermediaries (Ahn et al., 2011). They report more difficulties in obtaining the necessary financing, irrespective of their size. Among small, indirect exporters, 21% report difficulties versus 18% for non-exporters. The difference is smaller than for large firms, but goes in the same direction (27% versus 21%). It indicates that any benefit accessing finance requires operating directly on the export market.

[15] For more than half of all firms in the sample, output and sales differ by more than 10%. This difference attenuates potential simultaneity problem when including TCR in a regression with output growth as dependent variable.

Table 1
Do you face difficulties to obtain financing?.

	Non-exporter	Exporter	Absolute Difference
Smaller firm	19.3 %	11.2 %	8.1 % (4.1 %)**
Larger firm	20.6 %	20.1 %	0.6 % (2.6 %)

Source: World Bank Enterprise Surveys, Chinese survey of 2012.
Notes: The fraction reported is the proportion of firms answering at least "a moderate problem" on the question "How difficult is it to obtain finance?" Firms are split in small and large size categories relative to the median employment of 60. Statistics in brackets in the last column are the standard deviations of a *t*-test for the difference in group means (comparing within the row).

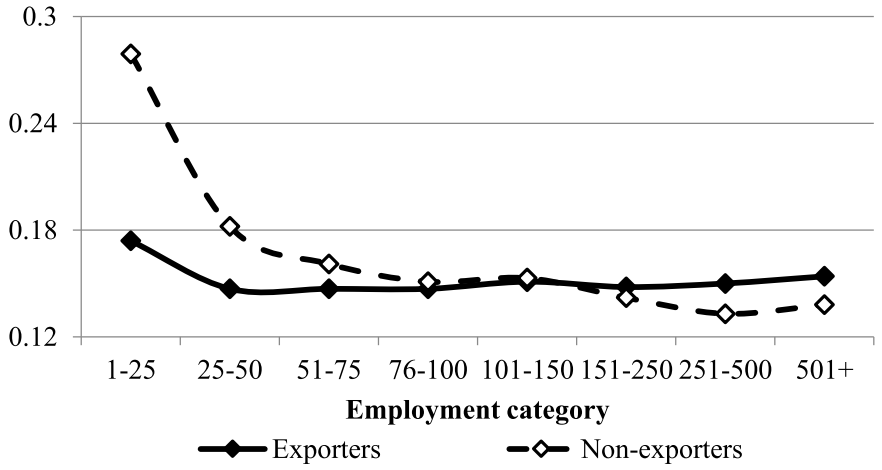


Fig. 3. Outstanding balance of trade credit (accounts receivables) relative to sales.

trade are cash in advance payment terms. This is at the opposite extreme of open account, entirely insulating the seller from payment risk.

The remaining transactions are grouped under a category of "post-shipment terms" which involve some type of bank intermediation. When using a letter of credit, the importer's bank commits to payment in advance and releases the funds as soon as the goods are shipped. When using sight draft terms, a form of documentary collection, the exporter's bank releases title to the goods as soon as the importer's bank pays the associated draft, usually when the goods arrive at the importing port. In both cases, the risk to the exporter is reduced, but this form of trade finance will come at a price. In contrast, domestic transactions almost never rely on these institutions which are specifically created to manage risk associated with international sales.

When the exporter sells to a new customer, the fraction of transactions paid in advance are ten percentage points higher, and the probability of bank intermediation is similarly increased. For transactions to destinations that are associated with several types of risk, the cash in advance option is especially popular. This variation, shown in Fig. 4, highlights that payment terms which are more advantageous to the seller are indeed used, but that firms are more likely to resort to them in more risky situations. It suggests that these solutions are costly.[16]

In the World Bank Enterprise Survey, firms are also asked what fraction of their sales are paid in advance. The question does not distinguish between domestic and international transactions, but at least each firm's export status is known. Results in Table 2 indicate that the average share of sales with payment before delivery is higher for exporters of all sizes, consistent with the above evidence. The difference between exporters and non-exporters is by far the largest in the category of smallest firms, i.e., those in the bottom quartile of the size distribution, where it is 8.5 %. The gap is 4.5 % for all firms below median size, which is only slightly higher than the 3.5 % difference for firms above median size. Recall that the reported percentages combine domestic and foreign transactions, which means that the pre-paid share on the international market must exceed 40 %, possibly by a substantial amount.[17]

[16] Niepmann and Schmidt-Eisenlohr (2017) use information from the SWIFT payment network that aggregates messages related to the payment system up to the country-pair level. They provide corroborating evidence from a much broader sample of observations that firms are more likely to use letters of credit and documentary collections when the contract risk increases.

[17] If the average export share is 50% and exporters receive the same fraction of pre-paid sales on the domestic market as non-exporters, the share of pre-payment for export market transactions would be approximately 52% for the smallest firms and 44% for the others.

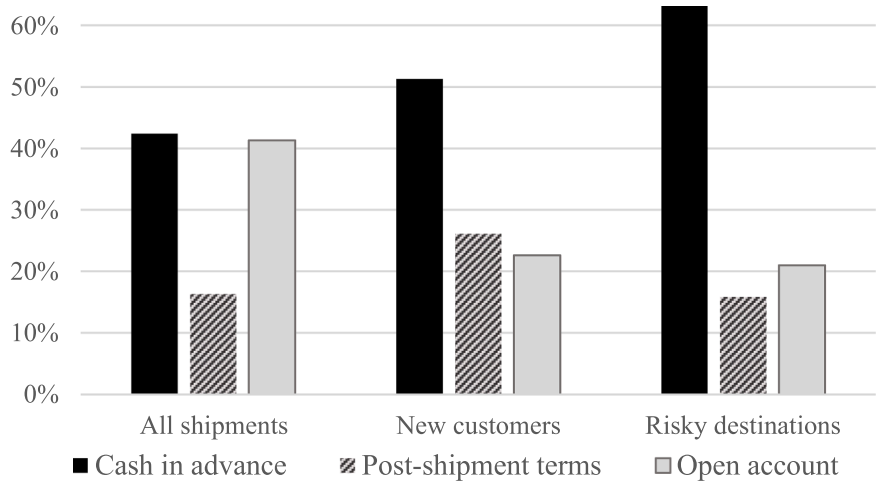


Fig. 4. Case study of payment terms in international trade.
Notes: Post-shipment terms combine Letter of Credit and Documentary Collection, two arrangements involving bank intermediation which are especially popular for export transactions. Risky destinations averages over the payment terms for countries (a) using civil law, (b) with below-median contract viability, (c) with below-median payment delay, and (d) below-median enforceability of contracts.
Source: Antràs and Foley (2015).

Table 2
Fraction of own sales that are paid before delivery.

	Non-exporter	Exporter	Absolute Difference
Smallest firm	34.9 %	43.4 %	8.5 % (4.3 %)**
Smaller firm	34.6 %	39.1 %	4.5 % (3.2 %)
Larger firm	37.0 %	40.4 %	3.5 % (1.9 %)*

Source: World Bank Enterprise Surveys, Chinese survey of 2012.
Notes: The firm-size categories are defined based on employment levels: Smallest = 1–25 (1st quartile); Smaller = 1–60 (below median); Larger = 61-max (above median).

5. Export market entry, trade credit, and growth

5.1. Empirical specification

Thus far, we have established three facts about small Chinese manufacturing firms. First, many operate with increasing returns to scale and could lower their average costs if they expanded their scale of operations. Second, many small non-exporters face access to finance problems that hold back their growth. At the same time, they extend a lot of trade credit to their clients and tend to have higher than average outstanding balances (relative to sales). Third, small exporters report the least problems of access to finance and the highest share of sales with payment on delivery.

Entering the export market could potentially provide small non-exporters with a less risky way to expand in order to exploit scale economies and increase productivity. It would avoid having to extend even more costly and risky trade credit, which is virtually unavoidable on the domestic market, and would ameliorate the financial health of firms with limited access to formal sources of finance. Exporting can accomplish this by providing firms with access to better contracting institutions, better payment terms, and even government support, as surveyed in Section 0.

To examine the potency of this mechanism, we measure output growth after firms enter the export market for the first time. In particular, we regress annualized output growth calculated over a span of two, three, or four years, on a set of indicators that characterize a firm's export market status. We interact these dummy variables with the lagged values of a firm's outstanding balance of trade credit to investigate whether there is any relationship between export market driven output growth and trade credit extended previously on the domestic market:

$$\begin{aligned}\Delta_\tau Y_{it} \;=\; & \alpha_0 + \alpha_X EXP(1,1)_{it} + \alpha_E EXP(0,1)_{it} + (TCR_{it-\tau} - \overline{TCR}) \\ & \times[\delta_N EXP(0,0)_{it} + \delta_X EXP(1,1)_{it} + \delta_E EXP(1,0)_{it}] + \gamma_L \ln L_{it} + \gamma_i + \gamma_{st} + \epsilon_{it},\end{aligned} \tag{3}$$

where $\Delta_\tau Y_{it} = \frac{1}{\tau}\ln(Y_{it} - Y_{it-\tau})$ is τ-year annualized output growth for $\tau \in \{2,3,4\}$. The dummy variables $EXP(\cdot,\cdot)$ indicate the export status or its change for firm i between time $t-\tau$ and t. $EXP(1,1)$ takes a value of one for 'always exporters', i.e., firms that are exporting both in the beginning and end year of the period over which output growth is calculated. $EXP(0,0)$ switches to one for 'never exporters'

and $EXP(0,1)$ is an indicator for 'export starters', firms not exporting at time $t-\tau$, but that have entered the export market by time t.[18]

The α_E coefficient on the last indicator captures the average change in output when a firm starts exporting, but we cannot learn much from it. Gaining access to foreign clients is naturally expected to raise output. However, we also include interactions between all three export status indicators and the lagged value of the trade credit ratio $TCR_{it-\tau}$. It is defined as the outstanding balance of accounts receivable from firm i's clients relative to sales and is measured at $t-\tau$.[19] We normalize this credit ratio by the sample mean, such that the uninteracted coefficients measure average output growth for each firm category. The main coefficient of interest is δ_E, the coefficient on the trade credit interaction for export starters. Finally, the equation also includes a control for firm size (employment), as well as firm and industry-year fixed effects.

One concern is self-selection or the potential endogeneity of the export market entry decision more generally. Firms may anticipate a future output increase, for example after the launch of a promising new product, and time their export market entry accordingly. There are several reasons why this is not such a pressing concern in the current setting. First, we are not interested in the baseline effect for export starters, only in how the output increase varies with the extent to which firms are constrained to expand on the domestic market due to an excessive balance of outstanding trade credit. To the extent that the δ_E estimate picks up any effect of export market entry that is driven by a high *TCR*, we only have to include it in our interpretation of the estimate. It would not invalidate our finding.

Second, before China's accession to the WTO, exporting was severely restricted. Branstetter and Lardy (2006) discuss how initially only trading firms were allowed to sell internationally, and this privilege was only gradually extended, first to state-owned enterprises and only later to private firms. This freeing up of export market access was a condition of China's WTO accession in 2001. Small firms in particular lacked direct export rights up till then. As a result, there was a large pent-up demand and export market entry was likely to depend more on policy and regulation, than on firm productivity or strategy. Third, we control for firm and industry-year fixed effects that absorb productivity differences that are constant across firms or productivity shocks that are common to all firms in an industry.

Nevertheless, we supplement the OLS estimates of Eq. (3) with a robustness check using an instrumental variables (IV) estimator. We base our instruments on the approach used in Fernandes and Tang (2014). They study how firms learn from neighboring firms' experiences to facilitate their own entry into the export market. In particular, they show that the number of firms in the same city that are already exporting has a positive impact on other firms' entry decision and subsequent performance. Given that neighboring firms' export status should be orthogonal to the productivity of firm i, it should satisfy the exclusion restriction. Hence, the IV results are identified by firms self-selecting into exporting, not due to endogenous factors under their own control that determine their unobserved productivity, but due to an exogenous change in their economic environment.

We calculate three sets of instruments, one for each of the three possible export status, using the corresponding fraction for other firms in the city with the same status as firm i:

$$IV\_EXP(1,1)_{it} = \frac{1}{N_{ct}-1}\left(\sum_{f\in\mathbb{N}_{ct}} EXP(1,1)_{ft} - EXP(1,1)_{it}\right).$$

$\mathbb{N}_{ct}$ is the set of active firms f in city c where firm i is located in year t and N_{ct} is the number of firms in the set. Calculations are similar for $EXP(0,0)$ and $EXP(0,1)$. We further interact the three sets of instruments with the trade credit ratio as an instrument for the corresponding variables with firm i's export status.

5.2. Results

Table 3 presents the estimates of the output growth Eq. (3). The first three columns show OLS results without firm-fixed effects, the next three columns add the firm-fixed effects, and the last three columns contain the IV estimates where export status is instrumented. Not surprisingly, the effect of the export start dummy is estimated to be positive and significantly different from zero in most columns. The point estimates are notably higher for the two-year growth rates which suggests that most of the output boost from exporting materialize very quickly. In the absence of firm-fixed effects, the *TCR* variable for firms that never estimate—which can be interpreted as the baseline category—has a negative association with output growth. Comparing across non-exporters, firms with a large balance of trade credit tend to grow more slowly.

We are most interested in the estimates on the interaction terms between the three export indicators and the trade credit ratio (TCR). For each of the three specifications, output growth is especially elevated for new exporters that had larger trade credit balances and the differences with both other firm categories are always statistically significant. The point estimates are quite a bit larger when firm-fixed effects are included, when the implicit comparison is between different time periods for the same firm. With fixed effects, results are very similar for the OLS and IV specifications.

The magnitude of the point estimate implies that a one standard deviation higher balance of trade credit, is associated with 0.057 log points higher annual output growth in subsequent years. For TCR equal to one, the cumulative growth difference over four years totals 0.684 log points (4*0.171), which is not much higher than output growth over the much shorter two-year period that also spans the export market entry, which is 0.586 (2*0.293). We see again that output growth for new exporters materializes very quickly. Recall

[18] We omit from the sample the few firms that exit the export market. The sample period covers the fastest-growing period in China's economic development and leaving the export market is very rare for surviving firms.

[19] We include the interaction terms with all three export status indicators, rather than including the uninteracted trade credit ratio and using that as a normalization while dropping one of the three interactions.

Table 3
Output growth following export market entry.

	Annual output growth over τ years								
τ =	2 years	3 years	4 years	2 years	3 years	4 years	2 years	3 years	4 years
Always export	0.005***	0.010***	0.015***	-0.002	-0.005**	-0.005***	-1.188***	-1.113***	-0.922***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.074)	(0.073)	(0.084)
Start to export	0.096***	0.081***	0.074***	0.047***	0.032***	0.023***	0.060***	0.012	-0.015**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.012)	(0.008)	(0.006)
TCR * Never exp.	-0.020***	-0.015***	-0.011***	0.277***	0.202***	0.160***	0.307***	0.221***	0.164***
	(0.003)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.007)	(0.006)	(0.005)
TCR * Always exp.	0.035***	0.031***	0.029***	0.226***	0.167***	0.133***	0.201***	0.141***	0.119***
	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)	(0.004)	(0.015)	(0.013)	(0.011)
TCR * Start to exp.	0.086***	0.072***	0.057***	0.293***	0.215***	0.171***	0.249***	0.268***	0.176***
	(0.010)	(0.008)	(0.007)	(0.010)	(0.008)	(0.006)	(0.050)	(0.033)	(0.023)
log Employment	-0.026***	-0.025***	-0.024***	-0.126***	-0.099***	-0.076***	-0.089***	-0.069***	-0.055***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Specification	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV
Firm FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1155,947	842,516	599,835	1076,704	774,892	529,083	1076,679	774,874	529,072

Notes: TCR is the trade credit ratio, normalized by the sample mean. Standard errors are clustered at the firm level. ***: p<0.01; **: p<0.05; *: p<0.1.

from Fig. 3 that the average trade credit balance for the smallest category of firms was 28 %, which implies a 2-year total extra output boost of 18 % after export market entry, or a 4-year boost of 21 %. If outstanding trade credit is interpreted as a constraint on domestic expansion, these results are intuitive and the magnitudes are large, but not implausible.

In Table 4 we explore whether this effect is heterogenous across firms, in particular, whether it is stronger in situations where contract enforcement problems are likely to be more severe. We include triple-interactions, multiplying the start-to-export and trade credit interaction term with several firm characteristic. Results are reported in columns (2) to (5) and the column labels indicate which X variable is used in the triple interaction. To isolate the effect on the coefficient of interest, we include all dual-interaction terms involving the new X variables, as well as the original controls. Results are qualitatively similar for each of the three specifications that we reported in Table 3, and we use the first specification, i.e., the OLS results without firm-fixed effects, for the results reported in

Table 4
Heterogenous effects of export market entry on output growth.

	Annual output growth over two years				
X is		Small	Private	Increasing returns	Province w/ weak instit.
	(1)	(2)	(3)	(4)	(5)
Start export	0.096***	0.096***	0.090***	0.094***	0.084***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Start * Credit ratio	0.086***	0.088***	0.093***	0.107***	0.114***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.017)
Start * Credit ratio * X		0.070**	0.054***	0.100***	0.177***
		(0.035)	(0.020)	(0.022)	(0.062)
X		0.002*	0.050***	0.107***	0.004
		(0.001)	(0.001)	(0.001)	(0.003)
Start * X		0.022***	-0.024***	0.017***	-0.032**
		(0.005)	(0.004)	(0.004)	(0.013)
Credit ratio * X		0.009	0.037***	0.034***	0.015
		(0.006)	(0.004)	(0.005)	(0.013)
Always export	0.005***	0.005***	-0.006***	0.0003	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Credit ratio * Never	-0.020***	-0.022***	-0.026***	-0.014***	0.028***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)
Credit ratio * Always	0.035***	0.034***	0.010**	0.037***	0.074***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.012)
log Employment	-0.026***	-0.025***	-0.023***	-0.023***	-0.028***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Specification	OLS	OLS	OLS	OLS	OLS
Firm FE	No	No	No	No	No
Industry-year FE	Yes	Yes	Yes	Yes	Yes
No. of observations	1155,947	1155,947	1155,947	1155,947	432,451

Notes: Each of the four columns (2) to (5) uses a different interaction variable X to form the triple interaction of interest. (2) Small firms, i.e., with below-median employment (<50); (3) Ownership type is domestic & private; (4) Firms operating at a point of increasing returns to scale; (5) Firms located in provinces with weak institutions, measured by the number of corruption cases per capita. Standard errors are clustered at the firm level. ***: p<0.01; **: p<0.05; *: p<0.1.

Table 5
Evolution of outstanding trade credit for exporters.

	log(Trade credit)		log(Trade credit-to-sales ratio)	
	Full sample	Only starters	Full sample	Only starters
Log sales	0.376***	0.602***	-0.555***	-0.369***
	(0.003)	(0.013)	(0.003)	(0.013)
Log sales * Always	0.203***		0.165***	
	(0.006)		(0.006)	
Log sales * Pre-EXP	-0.016***	-0.009***	-0.015***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Start export * Small	-0.086***	-0.076***	-0.071***	-0.066**
	(0.028)	(0.028)	(0.028)	(0.028)
Start export * Medium	0.048***	-0.020	0.044***	-0.017
	(0.014)	(0.016)	(0.014)	(0.016)
Start export * Large	0.192***	0.055***	0.167***	0.049***
	(0.015)	(0.017)	(0.015)	(0.017)
Industry-year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Number of observations	1030,447	61,040	1020,599	60,848

Notes: Standard errors are clustered at the firm level. ***: p<0.01; **: p<0.05; *: p<0.1.

Table 4.

The coefficients of the triple-interaction terms all have the expected sign. Output growth for new exporters with large outstanding trade credit is especially pronounced for smaller firms. This is consistent with the higher relative incidence of access to finance problems for small non-exporters. The effect of interest is also larger for private firms, either domestically or foreign-owned, consistent with evidence that the formal financing system in China discriminated against private enterprises at that time. The comparison group are state-owned and mixed-ownership firms, such as joint ventures.

The boost in output growth is also significantly higher for firms that operate with increasing returns to scale. The interaction variable is an indicator that captures whether the estimated, firm-specific scale economies exceed one prior to the period over which we measure output growth. The coefficient in column (4) is estimated relatively large and very precisely. It directly captures one motivation for firms to expand, realizing scale economies. Finally, firms operating in provinces where there are more corruption cases per capita also show higher output growth.[20] This variable is intended to pick up a weaker institutional environment and thus a greater relative advantage of export sales.

5.3. *Reverse causality*

We have interpreted the correlation between strong output growth following export market entry for firms with large outstanding balances of trade credit as the solution to a financing problem. However, an alternative interpretation is that some firms award trade credit more generously than other firms, exactly in order to facilitate sales. They have done this in the past on the domestic market, and built up a large trade credit balance, and they continue to do this when they start exporting, which helps them to quickly rack up new sales.

We can easily compare the two interpretations by tracing the evolution of trade credit after firms start exporting. We flexibly control for sales by considering as dependent variables both the level of trade credit and the trade credit-to-sales ratio, in addition to including sales and its interactions with the different possible export status as control variables. We further include firm and industry-year fixed effects to control for unobserved, but constant firm types and for time-varying industry-level demand shocks, etc.

The main variable of interest in Table 5 is the interaction between the start-to-export and small firm indicators. The results of both specifications indicate that small new exporters significantly reduce trade credit after entering the exporting market, compared with non-exporters and with larger firms that start to export. We find almost the same point estimates if we limit the sample to new exporters, comparing only within different firm size categories. This evolution is consistent with a convergence to the equilibrium patterns shown in Table 1 and Fig. 3 and supports our interpretation that exporting can help overcome a financial friction.

The evolution for small new exporters differs notably from the evolution for large new exporters. This is not entirely surprising, as larger exporting firms tend to serve more customers and export to more and farther markets. While small firms might enter the export market to solve a financing problem, large firms are more likely to pursue commercial opportunities and those may not come with as favorable financing terms. The different experience is also consistent with the pattern in Table 1, that large exporters claim more difficulties in access to finance compared with all other firm categories.

[20] This variable is taken from Bai (2013). It is constructed at the province level by dividing registered corruption cased from *China's Procuratorial Yearbook* with total provincial population taken from *China's Statistical Yearbook*.

6. Implications for learning-by-exporting

What drives the growth of small firms after entering export markets? A sizeable literature has investigated whether the positive correlation between productivity and export market activity is solely due to self-selection by the most productive firms, or whether there is any evidence of above-average productivity growth after firms start exporting. The results in this paper have shown that firms increase sales after they start exporting, and that this sales boost is especially pronounced for small firms or for firms operating with increasing returns to scale. This pattern has implications for the learning-by-exporting debate.

The ability to exploit scale economies allows firms to increase output disproportionately relative to inputs which raises the output-to-input ratio. Importantly, most prior studies use a production function that imposes the same returns to scale for all firms in an industry irrespective of their scale of operations, often using the Cobb-Douglas functional form. In that case, the extent to which small firms are able to realize scale economies when they grow internationally will contribute positively to the productivity residual. Strictly speaking, this is not a form of technical change, as it has often been interpreted, but an improvement in allocative efficiency.[21] New exporters only exploit the opportunities that the production technology allows.

If returns to scale are really increasing, productivity growth will be overestimated following firm expansion and it is not surprising that a regression of productivity on a start-to-export dummy often generates a positive coefficient. This provides one explanation for the learning-by-exporting effect that has been found in several developing economies, but which has proven more elusive in more developed countries. If a more flexible functional form is used for the production function that underlies the productivity calculations, some or all of this effect would show up as a movement along the production frontier and not end up in the productivity residual, even though the improvement in the output-to-input ratio is the same.

A similar issue is encountered by Ma, Tang and Zhang (2014) who show that Chinese firms were able to raise firm-level productivity by concentrating export growth in products for which they had the highest level of productivity. By changing the weight over products, a firm's average productivity improves and production factors are deployed more productively. While there is no product-level productivity growth or technical change, there is firm-level productivity growth through greater allocative efficiency across products.

There are two takeaways. First, the interpretation of the same output-generating effect from exporting—as a shift in the production frontier or a shift along the frontier—will depend on the production function that is used. Second, productivity gains can accrue without technical change and without any movement of the production frontier.

7. Conclusions

We have provided evidence for the following facts. First, most Chinese manufacturing industries have a sizeable number of small firms that operate with increasing returns to scale. Second, many firms report that access to finance is the largest obstacle they face, and this is especially true for small firms that only sell domestically. Third, these firms award a disproportionate amount of trade credit to their clients. Fourth, payment terms tend to be more advantageous for sellers on the export market. Fifth, firms raise output when they start exporting, and this jump is particularly pronounced for firms with a large outstanding balance of trade credit.

These facts are consistent with the following mechanism. Small firms in developing countries operate in an environment where most firms lack good access to formal credit. They would like to expand in order to take advantage of scale economies, move down their (U-shaped) marginal cost curve and realize (measured) productivity gains. However, expanding domestically requires them to extend trade credit to unfamiliar clients and exposes them to repayment risk. Given that domestic contract enforcement institutions are often weak, many firms operate below minimum efficient scale. One way out of this situation is to enter the export market and take advantage of the dedicated institutions that exist to mitigate payment risks for international transactions. When selling to foreign clients, firms are more likely to be paid in advance, can resort to bank-intermediated payments, and obtain government insurance against repayment risk. As small firms enter the export market, they can expand and exploit scale economies. This moves them along the production possibilities frontier and improves allocative efficiency.

Our analysis generates three further insights. First, it provides one explanation for the learning-by-exporting effect that has been found in several developing economies, but has proven more elusive in more developed countries. In particular, when using a restrictive production technology to measure firm-level productivity, the above mechanism will manifests itself as a learning-by-exporting effects, a productivity boost after export market entry. Second, export promotion programs that facilitate export market entry of small firms can improve allocative efficiency if weak domestic institutions hold back firm expansion. Third, exporting goods is a way for small, vulnerable firms in countries with weak contract enforcement to import access to better institutions.

CRediT authorship contribution statement

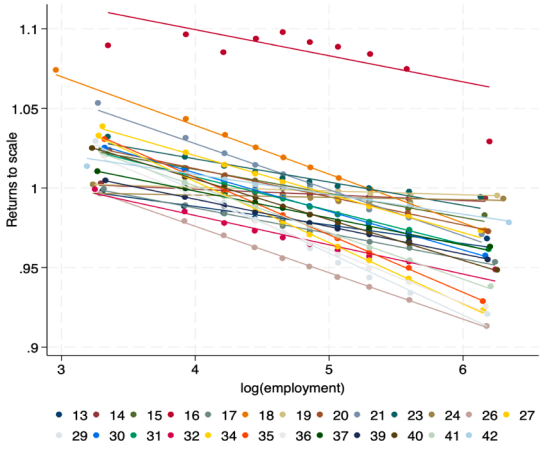
Johannes Van Biesebroeck: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Honghao Zheng:** Writing – review & editing, Visualization, Formal analysis, Data curation.

[21] It leads to higher measured productivity (output per input) without a shift in the production function, i.e., without technological change, but from a movement along the stable production frontier.

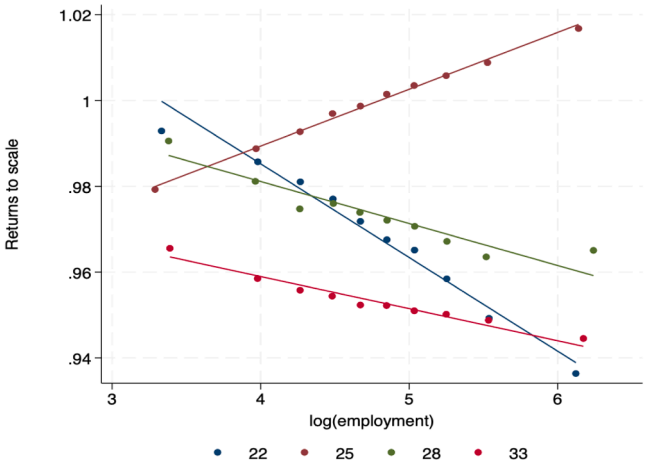
Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijindorg.2025.103201.

Appendix



(a) Industries *with* (weakly) increasing returns to scale for small firms



(b) Industries *without* increasing returns to scale for small firms

Fig. A.1. Correlation between returns to scale and firm size – 10-bin variant.

Table A.1
Range of estimated returns to scale by firm size.

China's Industrial Classification	Firm size					
	10th percentile		90th percentile		Difference	
13 - Agriculture Food Processing	0.992	[0.99 1.00]	0.968	[0.95 0.97]	0.024	(0.005)
14 - Other Food Production	1.003	[0.98 1.01]	0.991	[0.99 1.02]	0.012	(0.015)
15 - Beverages	1.015	[1.01 1.03]	0.983	[0.98 1.00]	0.032	(0.010)
16 - Tobacco Products	1.093	[0.99 1.15]	1.050	[0.88 1.09]	0.043	(0.049)
17 - Textiles	0.994	[0.98 1.00]	0.962	[0.95 0.97]	0.032	(0.006)
18 - Textile Wearing Apparel, Footwear and Caps	1.052	[1.04 1.07]	0.985	[0.98 0.99]	0.068	(0.010)
19 - Leather, Fur, Feather and Related Products	1.001	[0.99 1.01]	0.995	[0.98 1.01]	0.006	(0.012)
20 - Processing of Timber, Articles of Wood, Bamboo, Rattan, Palm and Straw	1.018	[1.00 1.03]	0.982	[0.96 1.00]	0.036	(0.011)
21 - Furniture	1.040	[1.02 1.07]	0.975	[0.96 1.02]	0.065	(0.012)
22 - Paper and Paper Products	0.981	[0.94 1.02]	0.931	[0.90 0.95]	0.050	(0.019)
23 - Printing and Reproduction of Recording Media	1.023	[1.02 1.04]	0.997	[0.98 1.01]	0.026	(0.008)

(*continued on next page*)

Table A.1 (*continued*)

China's Industrial Classification	Firm size					
	10th percentile		90th percentile		Difference	
24 - Cultural, Educational, Arts and Crafts, Sports and Entertainment Products	0.998	[0.98 1.12]	0.989	[0.97 1.12]	0.009	(0.018)
25 - Processing of Petroleum, Coking and Nuclear Fuel	0.982	[0.89 1.06]	1.019	[0.89 1.11]	-0.036	(0.032)
26 - Chemicals and Chemical Products	0.985	[0.98 1.00]	0.926	[0.92 0.94]	0.060	(0.006)
27 - Pharmaceutical Products	1.028	[1.01 1.04]	0.979	[0.96 1.00]	0.050	(0.015)
28 - Man-made Fibres	0.985	[0.96 1.00]	0.974	[0.95 1.02]	0.012	(0.021)
29 - Rubber Products	1.012	[0.89 1.15]	0.933	[0.79 1.05]	0.079	(0.023)
30 - Plastics Products	1.016	[1.01 1.03]	0.966	[0.95 0.97]	0.050	(0.006)
31 - Non-metallic Mineral Products	1.013	[0.99 1.03]	0.972	[0.95 0.98]	0.041	(0.006)
32 - Smelting and Processing of Ferrous Metals	0.990	[0.98 1.00]	0.954	[0.94 0.97]	0.037	(0.009)
33 - Smelting and Processing of Non-ferrous Metals	0.953	[0.92 0.97]	0.950	[0.90 0.96]	0.004	(0.012)
34 - Metal Products	1.016	[1.01 1.04]	0.937	[0.92 0.95]	0.080	(0.008)
35 - General-purpose Machinery	1.017	[0.98 1.03]	0.945	[0.91 0.95]	0.072	(0.009)
36 - Special-purpose Machinery	1.007	[1.00 1.02]	0.937	[0.93 0.95]	0.069	(0.008)
37 - Transport Equipment	1.005	[1.00 1.02]	0.967	[0.96 0.98]	0.038	(0.007)
39 - Electrical Machinery and Equipment	0.999	[0.98 1.00]	0.965	[0.96 0.98]	0.033	(0.006)
40 - Communication Equipment, Computer and Other Electronic Equipment	1.014	[0.98 1.04]	0.960	[0.93 0.99]	0.055	(0.013)
41 - Measuring Instruments and Machinery for Cultural Activity and Office Work	1.011	[0.95 1.17]	0.952	[0.92 1.14]	0.059	(0.024)
42 - Artwork and Other Manufacturing	1.012	[0.99 1.03]	0.988	[0.98 1.01]	0.024	(0.013)

Notes: Bootstrapped 95 percent confidence intervals are shown in brackets; standard errors are shown in parentheses. The estimated returns to scale are the residuals after controlling for capital and materials, in line with the binned scatterplots shown in the main text.

Data availability

Data will be made available on request.

References

Ackerberg, D.A., Caves, K., Frazer, G., 2015. Identification properties of recent production function estimators. Econometrica 83 (6), 2411–2451.
Ahn, J., Khandelwal, A.K., Wei, S.J., 2011. The role of intermediaries in facilitating trade. J. Int. Econ. 84 (1), 73–85.
Antràs, P., Foley, C.F., 2015. Poultry in motion: a study of international trade finance practices. J. Polit. Econ. 123 (4), 853–901.
Bai, Y., 2013. MA Thesis. KU Leuven.
Beck, T., Demirgüç-Kunt, A., Maksimovic, V., 2005. Financial and legal constraints to growth: does firm size matter? J. Finance 60 (1), 137–177.
Brandt, L., Van Biesebroeck, J., Zhang, Y., 2012. Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. J. Dev. Econ. 97 (2), 339–351.
Brandt, L., Van Biesebroeck, J., Zhang, Y., 2014. Challenges of working with the Chinese NBS firm-level data. China Econ. Rev. 30, 339–352.
Brandt, L., Van Biesebroeck, J., Wang, L., Zhang, Y., 2017. WTO accession and performance of Chinese manufacturing firms. Am. Econ. Rev. 107 (9), 2784–2820.
Branstetter, L.G., Lardy, N.R., 2006. China's embrace of globalization. In: Brandt, L., Rawski, T. (Eds.), China's Great Economic Transformation. Cambridge University Press.
Burkart, M., Ellingsen, T., 2004. In-kind finance: a theory of trade credit. Am. Econ. Rev. 94 (3), 569–590.
Cassiman, B., Golovko, E., Martínez-Ros, E., 2010. Innovation, exports and productivity. Int. J. Ind. Organ. 28 (4), 372–376.
De Loecker, J., 2013. Detecting learning by exporting. Am. Econ. J. 5 (3), 1–21.
Do, Q.-T., Levchenko, A.A., 2007. Comparative advantage, demand for external finance, and financial development. J. Financ. Econ. 86 (3), 796–834.
Fafchamps, M., El Hamine, S., Zeufack, A., 2008. Learning to export: evidence from Moroccan manufacturing. J. Afr. Econ. 17 (2), 305–355.
Feenstra, R.C., Li, Z., Yu, M., 2014. Exports and credit constraints under incomplete information: theory and evidence from China. Rev. Econ. Stat. 96 (4), 729–744.
Fernandes, A.P., Tang, H., 2014. Learning to export from neighbors. J. Int. Econ. 94 (1), 67–84.
Greenaway, D., Guariglia, A., Kneller, R., 2007. Financial factors and exporting decisions. J. Int. Econ. 73 (2), 377–395.
Hsieh, C.-T., Klenow, P.J., 2009. Misallocation and manufacturing TFP in China and India. Q. J. Econ. 124 (4), 1403–1448.
Hsieh, C.-T., Klenow, P.J., 2014. The lifecycle of plants in India and Mexico. Q. J. Econ. 129 (3), 1035–1084.
ISGEP, 2008. Understanding cross-country differences in export – comparable evidence for 14 countries. Rev. World Econ. 144 (4), 596–635.
Ma, Y., Tang, H., Zhang, Y., 2014. Factor intensity, product switching, and productivity: evidence from Chinese exporters. J. Int. Econ. 92 (2), 349–362.
Mah, J.S., 2006. The effect of export insurance subsidy on export supply: the experience of Japan. J. Asian Econ. 17 (4), 646–652.
Melitz, M.J., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71 (6), 1695–1725.
Niepmann, F., Schmidt-Eisenlohr, T., 2017. International trade, risk and the role of banks. J. Int. Econ. 107, 111–126.
Rubens, M., 2023. Market structure, oligopsony power, and productivity. Am. Econ. Rev. 113 (9), 2382–2410.
Salomon, R.M., Shaver, J.M., 2005. Learning by exporting: new insights from examining firm innovation. J. Econ. Manag. Strategy 14 (2), 431–460.
Tybout, J.R., 2000. Manufacturing firms in developing countries: how well do they do, and why? J. Econ. Lit. 38 (1), 11–44.
Ulyssea, G., 2020. Informality: causes and consequences for development. Annu. Rev. Econ. 12 (1), 525–546.
Van Biesebroeck, J., 2005. Exporting raises productivity in sub-Saharan African manufacturing firms. J. Int. Econ. 67 (2), 373–391.
Varian, H.R., 1992. Microeconomic Analysis, 3rd ed. Norton, New York.
Wagner, J., 2007. Exports and productivity: a survey of the evidence from firm-level data. World Econ. 30 (1), 60–82.