Exports, Productivity, and Credit Constraints: A Firm-Level Empirical Investigation for China*

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Abstract

This paper examines how credit constraints affect firm's export decision. It shows that firms with higher productivity and consequently lower interest rates when they raise funds externally and firms that are easier to get policy supported bank loans are easier in entering the export market, all else equal. We test this hypothesis using firm-level data from Chinese manufacturing industries and find strong evidence supporting it.

JEL: F1, F2, F3, D9, G2

Keywords: Credit Constraints, Heterogeneous Firms, Trade

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1 Introduction

The widely accepted explanation of firms' different export behavior is that firms with larger productivity would generate larger revenue and thus would be able to shoulder the fixed costs of market entry (Melitz 2003). This explanation abstracts from financial frictions that may arise from firms' different accesses to liquidity or to outside finance. In the presence of financial frictions, however, the amount that firms need to borrowed and the borrowing constraints vary across firms and affect their capability to finance the upfront export entry fixed cost. Firms that need to borrow to finance the entry fixed cost but would incur higher cost for external funds would be restricted from entering the export market or have to export less if if firms face credit constraints in the financing of variable costs as well.

This paper provides a general equilibrium model that enable us to analyse the impact of heterogeneous external finance cost on firms export and shows empirical evidence that access to external finance is an important determinant of international trade. Using Chinese firm level dataset from 2000-2007, we show that firms would export more if they face less credit constraints. Moreover, we show that Foreign-Invested-Enterprises (hereafter FIEs) export more compared to non-FIE firms, and their export is less sensitive to availability of internal funds, indicating their advantage in access to external finance.

We first construct a theoretical model that highlights heterogeneous external-fiancing cost across firms, along with heterogeneous productivity and liquidity endowment. Firms' export project faces different success posibility and this different possibility leads to different interest rates that financial intermediates demand for repayments[1]. Another dimention that causes different credit constraints to firms is alternative sources of external finance othter than borrowing from financial intermediates. We specifically consider FIEs that could receive capitals from their parent firms which allows FIEs to bypass the domestic financial constraints. In equilibrium, we show that firms that need to pay higher interest for the external fund, or non-FIE firms are financially more constrained and thus would be more likely to be prevented from exporting.

The intuition of this effect is that when firms need to borrow from financial intermediates the extra interest costs demanded by these intermediates to cover their risk in investment add to the export revenue requirement to survive. Thus firms that otherwise are productive enough to export could be prevented from entering the export market since they need to pay the extra interest costs. Firms that need to pay higher interest rates are more likely to be prevented from exporting than firms that are paying lower interest rates. FIEs that have access to external finance from their parent firms need to borrow less and pay less extra interest costs when they export and thus they are less credit constrained.

We evaluate the importance of access to external finance to firms' export behavior by testing two hypothesis, (1) firms that are easier to borrow from financial intermeidates are more likely to export and can export more, (2) FIEs are more likely to export and can export more and they are less sensitive to the availability of internaly funds. Since direct measure of external financing cost is not available, we use interest expenditure as a proxy of the external financing cost by maintaining an assumption that firms with lower

[1] We assume symmetric information of the project success probability.

external financing cost would borrow more and pay more interests, all else equal. The firms' exposition to foreign direct investment is measured using two ways, firm type when they are registered and the foreign capital share. To measure and control firm productivity, we use the augmented Olley-Pakes (1996) approach to estimate and calculate firms' TFP which overcomes the simultanity bias and selection bias of conventional measure of TFP. We test the relation between interest expenditure, exposition of foreign capital and export using different specifications. Specifically, to avoide endogeneity problem of the interest expenditure, we use weighted money supply as an instrument. Moreover, to precisely target the impact of foreign capital exposition to export through credit constraints only, we make use of the different sensitivity of export to internal fund between non-FIEs and FIEs. The results are of expected sign and statistically significant and robust to different specifications.

The results suggest that firms with higher interest expenditure export more and FIEs export more than non-FIEs. Specifically, we find that one percentage increase of firm's interest expenditure is associated with 0.285 percentage increase in its exports in our benchmark regression. In regressions that control endogeneity problems, interest expenditure has even greater impact on firms' export: the elasticity of firm's interest expenditure on its exports is around 0.7-0.8. In terms of impact of foreign capital, our results suggest that FIEs export about 0.5 to 0.7 percentage more than non-FIEs. Also, we shows that FIEs' exports are much less sensitive to internal finance indicating that present of foreign capital does alleviate the credit constraints faced by domestic firms.

These findings are of special interests for the case of China given the fact that Chinese firms face severe finance constraints and that Chinese export is growing at an precedentless growth rate. According to the World Business Environment Survey (WBES) during 1999-2000 and the Investment Climate Assessment surveys (ICAs) in 1999 and 2002, China is among the group of countries that have worst financing obstacles (Claessens and Tzioumis, 2006). Our results suggest that providing easier access to external finance and having better finance institution in China would significantly push the already astonishing export level of China even higher (Figure [1] and Figure [2] give a flavor of this, which show that across year or across industries, higher interest expenditure is associated with higher export level). Moreover, our results also indicate the importance of foreign direct investment in China's export growth. Table [10] shows the growth rate of China's export by all type of firms and the growth rate of China export by FIE firms for years 2000-2007. Although China's export is growing at 26% annually from 2000-2007, export by FIEs are growing even faster at 29% annually in the same period. The role played by FIEs in alleviating the credit constraints suggested by our study helps to understand parts of the phenomenal increase of China's export.

[insert table 10 here]

Our findings contribute to a growing literature on finance and international trade. In particular, Chaney (2005), along the lines of Melitz (2003), studies liquidity-constrained heterogeneous firms and theoretically predicts that firms with higher liquidity shock would face less financial constraint and consequently would be easier to enter export market. However, it only studies the impact of internal fund and does not model financial contracts explicitly. Besides, no empirical evidence is provided. Manova (2006) considers financial contracts and asset tangibility in a framework with firm heterogeneity and finds that industries in more financially developed countries are more likely to export bilaterally and to ship greater volumes, using sector level panel data of bilateral exports. Despite the model being at the firm level, the empirical focus of the paper is on the countries' and sectors' level. Muuls (2008) combines both liquidity shocks and external financial contract into one general equilibrium model and shows that credit rating, the Coface score from a credit insuring company, has significant effect on firms' exports. Although its empirical study focuses on impact of different credit ratings for different firms, the theoretical model (and in Manova(2006) as well) assumes equal cost of external finance. I.e. once firms need to borrow, they can always borrow from banks and the costs of borrowing are homogeneous across firms. Firms are different only in terms of the amount of money they need to borrow. To capture the fact that external fiancing cost is heterogeneous across firms, our paper explicitly models the heterogeneous borrowing costs by introducing project risk. Finally, Buch et al. (2008) studies the impact of credit constraints on export and FDI including firm heterogeneity in borrowing cost. However, their model is a partial equilibrium model, while our model provides general equilibrium predictions.

Our work also contributes to the studies about the effect of open capital market on international trade. Manova (2008) shows that equity market liberalizations of 91 countries in the 1980–1997 period have significant effect on countries export. Foreign equity flows associated with liberalization are substitutes for an underdeveloped domestic financial system so that firms would have accesses of external finance after liberalization if they can not get fund from domestic market. Hericourt and Poncet (2009) shows that incoming foreign investment in China plays an important role in alleviating domestic firms' credit constraints. Similar evidence is provided by Harrison and McMillan (2003) using data from the Ivory Coast. However, they do not study FDI's effect on export. Our paper shows that foreign investment does help firms to expand their exports via providing external funds.

The remainder of the paper is organized as follows. The next section constructs a model introducing firm heterogeneous access to external finance and its impact on firm's export. Section 3 describes the ecnometric specification, the data and presents some motivating descriptive statistics. Sections 4 study the impact of external finance on export using panel analysis. Sections 5 discusses endogeneity considerations and alternative measures. The last section concludes.

2 The Model

2.1 Domestic Demand and Production

The economy consists of two countries, Home and Foreign (the latter is hereafter denoted with an asterisk $*$). The only factor of production is labor, and population is of size L at home. There are two sectors. One sector produce a single homogeneous good which is freely traded. Production in this sector is characterised by constant returns to scale with $q_0 = wl_0$. $l_0$is the labor used to produce quantity q_0 of the good. Thus labor productivity in this sector determines the wage level, w at home and w^* in foreign. We assume both countries produce in this sector and wages are thus fixed by the productivity in this sector. The second sector produces a continuum of differentiated goods as in Melitz (2003). Each firm supplies one of these goods and is a monopolist for its variety.

As in Melitz (2003), consumers are endowed with one unit of labor and the preference over the differentiated good displays a constant elasticity of substitution (CES). The utility function of the representative consumer can be represented by U:

$$U \equiv q_0^{1-\mu} \left(\int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}\mu}$$

ω denotes each variety and Ω is the overall set of varieties available to the consumer. The constant elasticity of substitution between any two varieties of the differentiated good is denoted by $\sigma\,(> 1)$. The price index at home is thus

$$P = \left(\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$$

where $p\,(\omega)$ is the price of each variety. As widely known of this setting from Melitz(2003), the demand for each variety is

$$q(\omega) = \mu w L \left(\frac{p(\omega)^{-\sigma}}{P^{1-\sigma}} \right)$$

and the revenue of each firm is

$$r(\omega) = \mu w L \left(\frac{p(\omega)}{P} \right)^{1-\sigma}$$

where wL is the total expenditure in the differentiated good at home.

Firms face a fixed cost of entering domestic market (C_d), and we assume that firms have enough cashflow to internally finance it. The cost function of serving the domestic market is

$$c_d(q_d) = q_d \frac{w}{x} + wC_d$$

where x is the productivity of the firm. Given that firms are monopolists for their own variety, they set the price with a constant mark-up $\left(\frac{\sigma}{\sigma-1}\right)$ over the unit cost

$$p_d(x) = \frac{\sigma}{\sigma - 1}\frac{w}{x}$$

Therefore the firms generate profits at home

$$\pi_d(x) = \frac{r_d(x)}{\sigma} - wC_d = \frac{\mu}{\sigma}wL\left(\frac{\sigma}{\sigma - 1}\frac{w}{xP}\right)^{1-\sigma} - wC_d$$

In order to survive the domestic market, firms must have high enough productivity so that they can make positive profit. The cut-off productivity level ($\overline{x}_d$) is determined by zero profit condition

$$\pi_d(\overline{x}_d) = 0$$

or

$$\overline{x}_d = \frac{\sigma}{\sigma - 1}\frac{w}{P}\left(\frac{\sigma C_d}{\mu L}\right)^{\frac{1}{\sigma-1}} \tag{1}$$

2.2 Export Decision

When firms want to export, the upfront real fixed cost, C_E, need to be either financed internally with the domestic profit π_d, or with an firm-specific liquidity endowment wA, where A is the real liquidity endowment denominated in units of domestic labor, or raise funds externally in the form of debt from financial intermediaries in the economy.

When firms borrow funds from investors, they face different costs. First, the export project is subject to a firm-specific uncertainty (public knowledge), $\lambda(x)$, denoting the success probability of the export project for an individual firm with productivity x, and assumed to be increasing in x. Investors would demand different level of repayment, $G(x)$, based on the project uncertainty to cover the risk of failure of the project.

Second, firms' types affect their access to credits. For example, FIEs might also get easier funds from their foreign partner. For simplicity, we model this extra external finance for FIEs as a certain amount zero-interest loan from foreign partners. I.e. foreign partner might provide firms a fraction of the export fixed cost without interests. If the project is successful, the firm pays back this special loan from its partner. Otherwise, the lost will be covered by its partner. The fraction, δ_i, $i = F, NF$, varies according to firm type, where F, NF represent FIEs and nonFIEs respectively. We assume that $\delta_F > \delta_{NF}$.

The external funds lent by investors require pleagable colleteral in case the project fails. Colleteral that a firm can provide is a fraction of the domestic fixed cost, twC_d, where wC_d is the total domestic fixed cost, and t is the fraction of the fixed cost that is pleagable.

The firm will never default the repayment to investors, $G(x)$, if the project is successful. If the project fails, investors could get back the colloteral of the firm.

The firms thus maximize their expected profits if they export, subject to constraints:

$$
\begin{aligned}
E(\pi(x)) &= \lambda(x)\left(p(x)q(x) - \frac{q(x)\tau w}{x} - (1-k_E)w^*C_E - G_E(x)\right) - (1-\lambda(x))twC_d \\
\text{s.t.} &\quad \lambda(x)G_E(x) + (1-\lambda(x))twC_d = k_E w^* C_E \\
&\quad p(x)q(x) - \frac{q(x)\tau w}{x} - (1-k_E)w^*C_E \geq G_E(x) \\
&\quad \frac{\pi_d(x) + wA + \delta_i w^* C_E}{w^* C_E} = 1 - k_E
\end{aligned}
$$

where τ is the iceberg transportation cost, w^*C_E is the total fixed cost of export[2]; $1 - k_E$ is the fraction of the fixed cost that could be financed internally and by the government loan; and $G_E(x)$ is the total repayment to investors if the project is successful.

The first constraint is investor breakeven equation, stating that investors are perfectly competitive so they receive zero profits. The second constraint indicates that if the project is successful the firm must have enough net revenue to pay back the repayment $G(x)$ to the investors. Notice that if expected profit is greater than or equal to zero, this constraint is not binding. The last constraint specifies the portion of funds that need to be externally financed (besides the part covered by government loan). Firms could use doemstic sale, liquidity endownment and the government loan to cover part of the fixed cost of export while need to externally raise the amount of $k_E w^* C_E$ to cover the leftover of the fixed cost.

Investor breakeven equation determines the repayment that investors demand:

$$G_E(x) = twC_d + \frac{1}{\lambda(x)} \left(k_E w^* C_E - twC_d\right) \tag{2}$$

Substitute (2) into firms' expected profits

$$E\left(\pi_E(x)\right) = \lambda(x) \left(p(x)q(x) - \frac{q(x)\tau w}{x} - w^* C_E\right) - (1 - \lambda(x)) k_E w^* C_E$$

This expected profit indicates that as long as firms need to borrow money from investors (besides the government loan), they must have a higher expected profit to survive the export market. The extra cost due to credit constraint depend on the amount they borrowed ($k_E w^* C_E$) and the success probability of the project ($\lambda(x)$).

[2]The fixed cost of the export projects take the form of foreign wage times the number of foreign labor needed (eg. setting up distribution network in foreign country, etc.)

The expected profit maximization problem for firms is thus equivalent to maximizing:

$$\left(p(x)q(x) - \frac{q(x)\tau w}{x} - w^* C_E\right) - \left(\frac{1}{\lambda(x)} - 1\right)\left(\left(1-\delta_i\right) w^* C_E - \pi_d(x) - wA\right) \qquad (3)$$

Defining operating profit as

$$\pi_E(x) \equiv p(x)q(x) - \frac{q(x)\tau w}{x} - w^* C_E \qquad (4)$$

, the maximization problem is in turn equivalent to maximization of the operating profit since productivity, domestic profit, liquidity endowment and the fraction of fixed cost covered by government loan are predetermined from the perspective of firms when they make decision of export.

Consequently, the Melitz results, such as optimal quantity, price, operating profit and revenue, hold for the operating exporters,

$$\begin{aligned}
p_E(x) &= \frac{\sigma}{\sigma-1}\frac{\tau w}{x} \\
q_E(x) &= \left(\frac{\sigma}{\sigma-1}\frac{\tau w}{x}\right)^{-\sigma} \frac{\mu w^* L^*}{P^{*1-\sigma}} \\
\pi_E(x) &= \frac{r_E(x)}{\sigma} - w^* C_E = \frac{\mu}{\sigma} w^* L^* \left(\frac{\sigma}{\sigma-1}\frac{\tau w}{x P^*}\right)^{1-\sigma} - w^* C_E \\
r_E(x) &= \mu w^* L^* \left(\frac{\sigma}{\sigma-1}\frac{\tau w}{x P^*}\right)^{1-\sigma}
\end{aligned}$$

Firms might or might not be restricted by credit constrain. If firms have high enough productivity so that they can generate high enough domestic profit which can be used to finance their export fixed cost, or if the liquidity endownment or policy-oriented loan are high enough, firms may not be subject to credit constrains.

Without credit constraints, the threshold productivity level of the exporter, $\overline{x}_E$, is determined by $\pi_E(\overline{x}_E) = 0$, or

$$\overline{x}_E^{\sigma-1} = \left(\frac{\sigma}{\sigma-1}\frac{1}{P^*}\right)^{\sigma-1}\frac{\sigma}{\mu}\frac{1}{L^*}\frac{C_E}{(\tau w)^{1-\sigma}} \tag{5}$$

For firms that do not have enough internal funds to finance export fixed cost, borrowing money from investors would bring in credit constraints. Firms, with productivity level x such that $(1-\delta_i)\,w^*C_E - \pi_d(x) - wA > 0$, need to borrow money so that they can enter export market. Within these firms, only a subset could successfully enter the export market by making a positive expected export profit, i.e., firms must have a productivity level x such that

$$\pi_E(x) - \left(\frac{1}{\lambda(x)} - 1\right)\left((1-\delta_i)\,w^*C_E - \pi_d(x) - wA\right) \geq 0$$

to survive the export market. Consequently, the cut-off productivity of exporting firms that are subject to credit constrain is determined by

$$\pi_E(\overline{x}_{CE}) - \left(\frac{1}{\lambda(\overline{x}_{CE})} - 1\right)\left((1-\delta_i)\,w^*C_E - \pi_d(\overline{x}_{CE}) - wA\right) = 0 \tag{6}$$

Compare to the cutoff conditions without credit constraint in equation 5, credit constraints virtrually "increase" the fixed cost of export for marginal firms, and hence the difficulty of entering the market. Solving this equation[3], the cutoff productivity for credit constrained

[3] See appendix A.

firms is then[4]

$$\overline{x}_{CE} = \frac{\sigma}{\sigma-1}\left(\frac{\sigma}{\mu}\right)^{\frac{1}{\sigma-1}}\left(\frac{(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i)\,w^*C_E}{\lambda(\overline{x}_{CE})}-\left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)(wA-wC_d)\right)^{\frac{1}{\sigma-1}}$$
$$\left(w^*L^*\left(\frac{\tau w}{P^*}\right)^{1-\sigma}+\left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)wL\left(\frac{w}{P}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \quad (7)$$

. Firms with productivities below $\overline{x}_{CE}$ can not export due to credit constraints, despite some of them being sufficiently productive to do so profitably if without credit constraints.

In the framework developed above the prediction that, credit constraints restrict the number of firms that become exporters but do not affect the amount that firms export once they export, soly depends on the assumption that only export entry fixed cost need to be financed. If instead firms face credit constraints in finacing the variable costs or if there is capacity related fixed cost that depends on the quantity produced, then the intensive margin will also change due to credit constraints.

2.3 Open Economy Equilibrium

We are now ready to study the open economy equilibrium. Following Muuls(2008) and Chaney(2005), we assume that the price index only depends on local firms' prices and that foreign firms do not face any liquidity constraints. Prices set by foreign firms for the varieties they sell at home only have a small impact on the general price index. In a relatively closed economy, it is a reasonable approximation. This assumption indicates that

$$P \approx \left(\int_{x\geqslant\overline{x}_d} p_d(x)^{1-\sigma}LdF_x(x)\right)^{\frac{1}{1-\sigma}}$$

[4] In our setting, $\overline{x}_{CE}$ is different for state-owned firms and private-owned firms.

where L is the population in home country, and define the function $h(\cdot)$ by:

$$h(\cdot) : \overline{x}^{\sigma-1} = \left(\frac{\sigma}{\mu} \int\limits_{x \geqslant \overline{x}} x^{\sigma-1} dF_x(x) \right) C \Longleftrightarrow \overline{x} = h(C)$$

with $h' > 0$. Assume that distribution of productivity is the same in foreign country as at home, i.e. $F_x(x) = F_x^*(x)$, the function $h(\cdot)$ will be the same for foreign country.

It follows that the cutoffs in equations 1, 5 and 7 are solved as[5]:

$$\overline{x}_d = h(C_d) \tag{8}$$

$$\overline{x}_E = \left(\frac{C_E}{C_d^*} \right)^{\frac{1}{\sigma-1}} \frac{\tau w}{w^*} h(C_d^*) \tag{9}$$

$$\overline{x}_{CE} = \left(\frac{(1 - \delta_i + \lambda(\overline{x}_{CE})\delta_i) \frac{w^* C_E}{w} - (1 - \lambda(\overline{x}_{CE}))(A - C_d)}{\tau^{1-\sigma} \left(\frac{w^*}{w}\right)^{\sigma} \lambda(\overline{x}_{CE}) C_d^* h^{1-\sigma}(C_d^*) + (1 - \lambda(\overline{x}_{CE})) C_d h^{1-\sigma}(C_d)} \right)^{\frac{1}{\sigma-1}} \tag{10}$$

where equation 10 indicates that $\overline{x}_{CE}$ is an implicit decreasing function of δ_i and A. Hereafter we denote it as $\overline{x}_{CE}(A, \delta_i)$.

All firms with productivity above $\overline{x}_d$ will be producing for domestic consumers. Firms with a productivity above $\max\{\overline{x}_E, \overline{x}_{CE}(A, \delta_i)\}$ will be able to export because they are both productive enough and have sufficient liquidity to cover the fixed cost. Firms with productivity in between of $\overline{x}_E \leq x \leq \overline{x}_{CE}(A, \delta_i)$ could potentially profitably export but are prevented from doing so because the expected profit is less than zero.

From solutions 9 and 10, it is easy to show that If $\lambda = 1$, $\overline{x}_{CE} = \overline{x}_E$. And if $\lambda = 0$, then $\overline{x}_{CE}(0, \delta_i)$ is the solution of equation $(1 - \delta_i) w^* C_E = \pi_d(x)$. When $\lambda \in (0, 1)$, $\overline{x}_{CE}(0, \delta_i)$

[5] For details, see appendix A

is in between of $\overline{x}_E$ and the solution of $(1-\delta_i)\, w^* C_E = \pi_d(x)$. From this fact, we can identify the sufficient condition that there are some potential exporting firms prevented from exporting as stated in the following proposition.

Proposition 1 *If x and A are continuously distributed from $[0, \infty]$, and if*

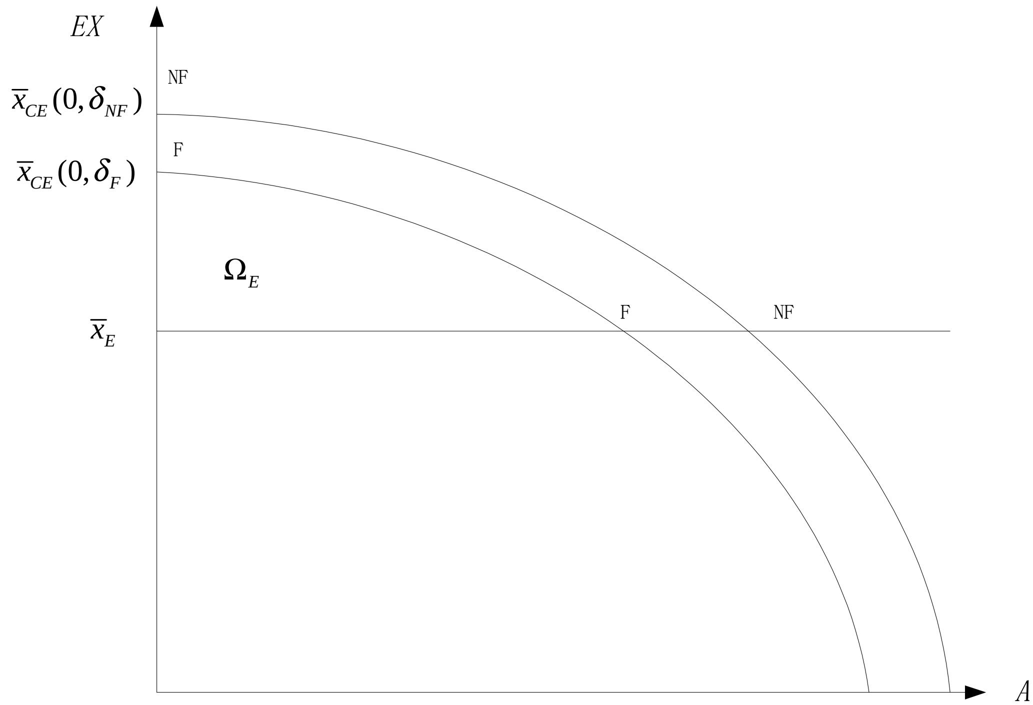
$$\left((1-\delta_i)\, \frac{w^* C_d^*}{w C_d} + \frac{C_d^*}{C_E} \right)^{\frac{1}{\sigma-1}} \left(\frac{h(C_d)}{h(C_d^*)} \right) > \frac{\tau w}{w^*}$$

then there is non empty set of firms (denoted as Ω_E) which are prevented from export even though they are profitably enough to do so without credit constraints.

Proof. *It can be easily proved by subsituting equation 10 and 9 into inequality $\overline{x}_E < \overline{x}_{CE}\,(0, \delta_i)$ and making $\lambda = 0$.* ■

Given that Ω_E is non-empty, firms with different level of productivity (x) and liquidity endowment (A) are shown in the following graph. Firms with a productivity level lower than $\overline{x}_E$ will never export. FIEs with productivity level and endownment level (x, A) beyond FF curve are not subject to credit constraint and are able to successfully enter export market even though some of them might need to borrow external funds. FIEs below FF curve but above $\overline{x}_E$ level are potential exporters that are prevented from exporting due to credit constraints. Similarly, curve $NF - NF$ separate nonFIEs that are prevented from entering export market from those are not.

Firms are facing different level of credit constraints. Their domestic profit are different due to different productivity or their liquidity endownment might be different. These two factors affect the amount of liquidity that can be used to finance the export fixed cost and



are studied in Chaney (2005). Besides these two, two other factors also have impact on the export decisions of firms.

First, the interest costs firms face are different when they raise funds externally. Equation (6) indicates that if the interest rates firms need to pay $\frac{1}{\lambda(\overline{x}_{CE})} - 1$ for the amount of money borrowed are higher, then the cut-off productivity is higher and more firms are prevented from entering the export market due to higher cost of external finance. Although in our model we assume that interest rates are a function of firms productivity for simplicity, it might not be true in practice. I.e. interest rates that financial intermediates demand for a firm might be determined by lots of factors such asto customer insolvency, bad debts, overdue accounts, commercial risks and political risks etc. However, the link assumed between productivity and interest rate provides another channel that productivity might affect the marginal exporters besides its impact through domestic profit.

Second, the firm type (FIE vs non-FIE) and alternative access to external finance also affect firms' export decision. Since $\overline{x}_{CE}(A, \delta_i)$ is a decreasing function of δ_i, firms that get larger support from the foreign partner would have lower requirement of productivity level to profitably export. If $\delta_F > \delta_{NF}$ as we assumed, firms with the same level of productivity and liquidity endownment (x, A) might be able to export if it is FIE, while otherwise would be prevented from exporting. Thus we have the following proposition:

Proposition 2 *All else equal, firms are easier in entering the export market if (1) they have higher productivity; and (2) consequently lower interest rates when they raise funds externally; or (3) FIE firms.*

3 Econometrics, Data, and Measures

In this section, we first describe the datasets used in the paper, followed by a discussion of the empirical specfication. We then address the possible endogeneity problem. Finally, we close the section with various robustness checks.

3.1 Empirical Specfication

Our theoretical model introduced above clearly predicts that firms with more interest expenditure have more exports. In addition, firms with higher productivity also export more. We therefore consider a specification as follows:

$$\ln Export_{it} = \beta_0 + \beta_1 \ln interest_{it} + \beta_2 \ln productivity_{it} + \beta_3 FIE_i + \boldsymbol{\theta}\mathbf{X}_{it} + \varsigma_i + \vartheta_t + \epsilon_{it}, \quad (11)$$

where i is firm and t denotes year, FIE_i is a dummy to mesure whether or not the firm i is a foreign-invested-enterprise (FIE), $\mathbf{X}_{it}$ denotes other control variables for firm i in year t such as firm's tenure and firm's profit. The error term is decomposed into three components: (1) firm-specific fixed effects ς_i to control for time-invariant factors; (2) year-specific fixed effects ϑ_t to control for firm-invariant factors; and (3) an idiosyncratic effect ϵ_{ijt} with normal distribution $\epsilon_{ijt} \sim N(0, \sigma_{ij}^2)$ to control for other unspecified factors. Guided from the theoretical proposition (3), the coefficients of β_1, β_2 and β_3 are expected to be positive. Also, higher firm's profit are expected to be associated with higher exports. Our main interest of this specification is the sign and magnitude of the coefficient $\hat{\beta}_1$.

3.2 Data

The sample used in this paper comes from a rich firm-level panel dataset which covers more than 270,000 manufacturing firms per year for the years 2000-2007.[6] Such data were collected and maintaned by China's National Bureau of Statistics as an annual survey for manufacturing enterprises. It covers more than 100 financial variables listed in the main accounting sheets of all "above scale" industrial firms whose sales are more than five million *yuan* per year.[7]

Table 1 provides some basic statistical information about the Chinese firm data. Although this data set contains rich information, a few samples in the data set are noisy and misleading due, in large part, to the mis-reporting by some firms (See Holz, 2004, for a

[6]Following Levinsohn and Petrin (2003), plants were treated as firms. In the present paper, we do not capture scope economics due to their multi-plant nature. This remains a topic for future research.

[7]Indeed, aggregated data of the industrial sector in the annual *China's Statistical Yearbook* by the Natural Bureau of Statistics (NBS) is compiled from such a data set.

discussion about possible problems of using China's data). For example, data information for some family-based firms, which usually did not set up a formal accounting system, is based on a unit of one yuan, whereas the official requirement is a unit of 1,000 yuan.

Following Jefferson, Rawski, and Zhang (2008), we clean the sample and rule out outliers by using the following cretiria: First, obseravations whose key financial variables (such as total assets, net value of fixed assets, sales, gross value of industrial output) cannot be missing, otherwise, they will be dropped. Second, we will drop observations whose operation scales are smaller than the "above-scale" threhold. In particular, the observations were dropped if (1) the number of employees hired for a firm is less than 10 people[8]; or (2) the value of total assets is below RMB 5 million; or (3) the value of fixed assets is below 5 million yuan. Finally, since we also care about the tenue of a firm, so observations which open year is after 2007 or open month is higher than 12 or lower than 1 are dropped as well.

Following Cai and Liu (2009) and guided by the General Accepted Accounting Principles (GAAP), we delete observations if any of the following rules are violated: (1) total assets must be higher than liquid assets; (2) total assets must be larger than total fixed assets; and (3) total assets must be larger than net value of fixed assets. In addition, observations whose identification number is missing are dropped from the sample.

After this very rigorous filter, we obtain a sample of 1,313,405 observations from the original sample of 1,898,958, which acounts for 69.2% of the original dataset. All monterary

[8] Levinsohn and Petrin (2003) suggest covering all Chilean plants with at least 10 workers. Here we follow their cretiria.

terms are orignially measured in current Chinese yuan. We therefore use the produce price index by sector, which is measured at Chinese industrial classification 2-digit level and obtained from National Bureau Statistics, as the GDP deflator by choosing year 2000 as the base year. After this manipulation, all data are in 2000 constant Chinese yuan.

Following previous studies such as Cai and Liu (2009), three dummy variables are used to describe the ownership status for a firm: Dummy for domestic firms (*Domestic*), dummy for Hongkong/Macau/Taiwan-owned firms ($HKMATW$), and dummy for foreign-invested firms ($FIEs$). As seen in Table 1, foreign-invested enterprises (FIEs)[9] account for around 10.2% of all firms in each year. In contrast, domestic firms account for 79%. The rest of 10.8% is those firms that invested from Hong Kong, Macao, or Taiwan.

[Insert Table 1 Here]

We then report the basic statistical information in Table 2. In this paper we measure firm's productivity by using both total factor productivity (TFP) or labor productivity. The two measures require that firms' output are measured by physical terms but not monetary terms by definition of productivity. Following Amiti and Konings (2007), we therefore use China's ex-factory price index of industrial products by SIC 2-digit sectors as the deflator to convert data from monetary term to physical terms. To be consistent with other data, the base year of the deflator is chosen as 2000.

[Insert Table 2 Here]

[9] By definition, FIEs are those firms which receive foreign investment.

We first plot the logarithm of exports against the logarithm of interest expenditure at the 2-digit industry level as shown in Figure 2. One can clearly observe a positive correlation between exports and interest expenditure across different sectors. It seems hard to find obvous outliers in the scatter plots. This suggests that the positive correlation between the two is hard to be affected by outliers.

[Insert Figure 2 Here]

3.3 Measures of TFP

As introduced in previous works like Yu (2009), much of the existing work on measuring TFP is imprecise and biased. TFP is usually measured as the Solow residual, defined as the difference between the observed output and its fitted value calculated via OLS. However, this method suffers from two bias: simultanity bias and selection bias. The first bias comes from the fact that a profit-maximizing firm would re-adjust its input decision as a response of the productivity shocks which are observed by firms but not by econometricians. Second, all firms covered in the samples are those that have relatively high productivity and survived during the period of investigation. Those firms that have low productivity, shut down, and left the market were not observed nor included in the samples. Put another way, the samples covered in regressions are not randomly selected. Hence, related estimates suffer from selection bias.

To overcome these two empirical challenges, we use the augmented Olley-Pakes (1996) approach to estimate and calculate firms' TFP following Amiti and Konings (2007). One of the most important features of the Olley-Pakes approach is to model investment as a function of unobserved productivity as well as the capital input. By assuming that three factor inputs (*i.e.*, capital, labor, and material) are used to produce goods, the Olley-Pakes estimation method includes three steps. First, a semi-parametric empirical method is used to estimate the coefficients of both labor and material inputs. In particular, the unobserved productivity shock is modeled as an inverse function of investment, which is characterized by a fourth-order polynominal. Second, after the coefficient of labor and material inputs are obtained, the coefficient of capital can be estimated by using a non-linear square estimation. By this way, Olley-Pakes (1996) show that the simultaneity problem is well controlled. Third, to control the selection bias problem, we first use a probit function to estimate the probability of firm's survival in the next period. Once the fitted value of firms' survival ratio is obtained, we put it inside into the inverse investment function again to estimate all the three input coefficients. Finally, the residual between the data and the fitted value obtained from the three estimated input coefficients is the Olley-Pakes TFP.

Table 3 reports the estimated results using both OLS and OP approaches. Column (2) of Table 3 reports the estimated firms' survival probability in the next year by industry at the SIC 2-digit level. Their mean of 0.993 suggests that the firm exits are not severe during this this period.[10] The rest of Table 3 reports the difference of the estimated coefficients for labor, material, and capital by using regular OLS approach and the OP methodology. We cover 36 manufacturing industries, coded from 6 to 46 according to China's new industrial

[10] However, one should read it with caution. Here "firm's exit" means a firm either died and hence exited from the market or simply had an annual sale which is lower than the "above-scale" and dropped from the data set. Due to the restriction of the dataset, we are not able to distinguish the difference between the two.

classifications (GB/T4754) which was adopted since 2002.[11] Compared to original firm-level data set, 5 industries are not covered after this filter process.[12]

[Insert Table 3 Here]

4 Empirical Results

4.1 Main Estimation Results

Table 4 reports the estimation results for equation (11). To consider the effect of firm's interest expenditure on its exports, we first run a regression of firm's exports only including firms' interest expenditure and TFP inside as a benchmark. The estimated coefficient of $\hat{\beta}_1$ in equation (11) is 0.285, which is significant at the conventional statistical level. This suggests that one percentage increase of firm's interest expenditure is associated with 0.285 percentage increase in its exports. The benchmark finding is consistent with the simple cross-section plot in Figure 2.

As predicted from the theoretical model above, the FIEs firms would export more, ceteris paribus, possibly due to its easier access to external finance. We therefore include the FIEs dummy into regressions. Estimation results shown in Columns (2)-(4) clear suggest that foreign-invested firms are associated with more exports. It is noted that FIEs could have more exports possibly due to its easier access to external finance. But FIEs have more exports could due to their quick learning, better technology adoption, or higher quality inputs (Amiti and Konings, 2007), or simply because they are designed to serve

[11] Firm data before 2002 was clustered into industrial data by adopting the old industrial classficication, we concord such data so that they are consistent with data after 2002.

[12] The five industries dropped include extraction of petroleum and natural gas (code:7), mining of other ores (11), (12),(38), recycling and disposal of waste (43).

for exporting per se. Thus, the estimated magnitudes here measures the overall effect of FIEs on firm's exports.

In addition, as shown in Columns (3) and (4), firms with higher accounting profit in the previous year would export more. This is exactly consistent with our theoretical presumpton that firm's predetermined profit would be helpful for firm's exports, as shown in (3). Finally, we include firms' tenure, which is measured by number of years, in Column (5). The estimation result suggests that a firm which established earlier instead export less. An economic rationale for this finding is that firms with a longer tenure would be more efficient to expand its domestic sales channel, which in turn make them less reliable to the foreign markets

[Insert Table 4 Here]

Since our data is a panel dataset, in addition to the variables like interest expenditure, total factor productivity, FIEs dummy, firm's profit in the previous year, and firm's tenure, other variables which are not specified in (11) could affect firm's export volume as well. We therefore perform the two-way fixed effects to control for such possible factors. For example, China has experienced Chinese *yuan* (RMB) appreciation since 2005. The RMB revaluation could simply reduce firm's exports. We therefore include year-specific fixed effects to control for those firm-invariant factors. In particular, the firm-specific fixed effects are used to control for time-invariant factors. Table 5 reports the fixed-effect estimation results, which are basically consistent with the findings in Table 4. In terms of economic magnitude, the effect of firm's interest expenditure on its exports in the fixed-effect estimates is less than its counterpart in the OLS estimates in Table 4.

[Insert Table 5 Here]

4.2 Endogeneity

4.2.1 Endogeneity of interest expenditure

Firm's interest expenditure is not exogenously given, but affected by its exports. With more exports, firms need more upfront fixed costs (*e.g.*, firms need to have more distribution network aborad when its exports increase), which in turn require firms to access more credits to do business. One needs to control for the endogeneity of interest expenditure in order to obtain accurate estimated effects of firm's interest expenditure on exports. Otherwise, the related estimates would be suspect. The instrumental variable (IV) estimation is a powerful econometric method that can address this problem.[13]

An economic indicator, firm's weighted monetary supply, is constructed to serve as the instrument for interest expenditure. This indicator is defined as $(\frac{y_{it}}{MFG_t})M1_t$ where y_{it} is firm i's output in year t whereas $M1_t$ is China's base monetary supply (M1) in year t . The nominator MFG_t is the China's manufacturing output in year t . Note that both y_{it} and MFG_t are measured in monetary term (*i.e.*, 2002 current RMB) to avoid any unnecessary disturbtion from inflation.

The economic rationale is as follows. The scale of a firm's interest expenditure mainly depends on two factors: the interest rate and the firm's economic scale per se.[14] However,

[13]The IV approach is a good way to control for endogeneity issues. Wooldridge (2002, Chapter 5) provided a careful scrutiny of this topic.

[14]Note that some Chinese small-size firms have difficultly to access formal financial intermediates like banks. Therefore, these small-size firms could have lower interest expenditure, ceteris paribus. However, all samples covered in this paper are "above-scale" firms which usually do not have difficulty to access formal financial intermediates.

the interest rate is not exogenous given also. More money supply would lead to lower interest rate. As a result, firms would finance more externally. In addition, given an identical interest rate, large firms would borrow more funding from banks and other financial intermediates since they have more financial demand.

Several tests were performed to verify the quality of the instrument. First, we check whether the excluded instrument (*i.e.*, the firm's weighted monetary supply) is "relevant". That is, whether this instrument is correlated with the endogenous regressor (*i.e.*, interest expenditure). In our econometric model, the error term is assumed to be heteroskedastic: $\epsilon_{ijt} \sim N(0, \sigma^2_{ij})$. Therefore, the usual Anderson (1984) canonical correlation likelihood-ratio test is no longer valid since it only works under i.i.d. assumption. Instead, we must use the Kleibergen-Paap(2006) Wald statistic to check whether or not the excluded instrument is correlated with the endogenous regressors (*i.e.*, import penetration ratio). The null hypothesis that the model is under-identified is rejected at the 1% level.

Second, we also take another step to see whether or not the weighted monetary supply is weakly correlated with interest expenditure. If so, then the estimates will perform poorly in this IV estimate. Luckily enough, the Kleibergen-Paap (2006) F-statistics provide strong evidence to reject the null hypothesis that the first stage is weakly identified at a highly significant level.[15] Third, the Anderson and Rubin (1949) χ^2 statistics reject the null hypothesis that the coefficient of the endogenous regressor is equal to zero. In short, such statistical tests give sufficient evidence that the instrument is well performed, and

[15] Note that the Cragg and Donald (1993) F-statistics is no longer valid since it only works under the i.i.d. assumption.

therefore, the specification is well indicated.

[Insert Table 6 Here]

Estimates in Table 6 show that, after controlling for endogeneity, interest expenditure still has a positive effect on firm's exports. In all estimations, the coefficients $\hat{\beta}_1$ are quite stable and much higher than its counterparts without controlling for the endogeneity shown in Table 4. In particular, the elasticity of firm's interest expenditure on its exports is around 0.7-0.8. The coefficient of firm's productivity also have larger effects on its exports as well. We also take one step forward to perform the IV estimates with fixed-effects. The estimation results are shown in Table 7. By way of comparisons, the estimation results in Table 7 are boardly consistent with results in Table 5. After controlling for the fixed effects, the coefficients of interest expenditure seem to have a larger effect than its counterparts in Table 5.

[Insert Table 7 Here]

4.2.2 Endogeneity of FIE

As suggested above, FIEs have more exports could due to their quick learning, better technology adoption, or higher quality inputs (Amiti and Konings, 2007), or simply because they are designed to serve for exporting per se, rather than they have financial advantage than non-FIEs. One possible way to identify foreign investment's effect on firms' external finance and consequent effect on export is to compare the export sensitivity to internal funds for FIEs vs. non-FIEs[16]. Based on our theory, FIEs are less credit constrained than non-FIEs given the same level of liquidity endowment. I.e. exports in FIEs are less sensitive to firms' internal finance than non-FIEs.

We rewirte the specification of our empirical model as

$$\begin{aligned}\ln Export_{it} &= \beta_0 + \beta_1 \ln interest_{it} + \beta_2 \ln productivity_{it} + \beta_3 FIE_i + \beta_4 Cashflow_{it} \\ &\quad + \beta_5 FIE_i * Cashflow_{it} + \boldsymbol{\theta}\mathbf{X}_{it} + \varsigma_i + \vartheta_t + \epsilon_{it},\end{aligned}$$

If FIEs are less sensitive to their internal fund (measured by cash flow), then they are less credit constrained, thus we expect the coefficient, β_5, is negative.

The results of this test is provided in Table [?]

[Insert Table ? Here]

4.3 Additional Robustness Checks

In the previous section, we use total factor productivity (TFP) to measure productivity since it is more close to the reality. However, since our theoretical model essentially is a one-input (*i.e.*, labor) Krugman (1978) model, it is a plus to use labor productivity to measure productivity as well. Table 8 reports the estimation results using labor productivity to measure firm's productivity. As shown in Column (1), the OLS coefficient of labor productivity is smaller than its counterpart in Column (4) of Table 4: 0.775. This makes good economic sense given that labor is only one of the input factors to produce goods. After controlling for the firm-specific and year-specific fixed effects, the fixed-effect

[16] We adopt the approach that is commonly used to evaluate firms' access of finance (Claessens and Tzioumis, 2006).

estimation results in Column (2) find stronger effect of labor productivity on exports. The IV estimate in Column (3) has a unexpected negative sign. We suspect that this is due to the lack of controlling for the fixed effects. The last column of Table 8 again shows that the positive effect of labor productivity on exports. In all of the estimations, firm's interest expenditure is positively associated with its exports.

[Insert Table 8 Here]

Our second robustness check it to use operation profits to measure firm's profit. In previous sections, we use firm's earning before tax to measure firm's accounting profit. Yet we use operating profit to consider firm's maximization problem () in the theoretical model. To be more close to the theoretical model, we therefore adopt firm's operating profit to measure firm's profit instead. The difference between accounting profit and operating profit is that the latter excludes either non-operation revenue or non-operation expenditure. Therefore, it is reasonable to expect that there is a positive correlation between the two. Indeed, their simple correlation is . In addition to use labor productivity to measure productivity, Table 9 reports the estimation results by replacing accounting profit with operating profit. The results in Table 9 are very close to those in Table 8.[17]

[Insert Table 9 Here]

[17] Cai and Liu (2009) argue that firm's imputed profit, which is defined by deducting intermediate inputs from gross output, is also different from accounting profit. We therefore adopt firm's imputed profit to measure firm's profit in the regressions and find similar results. To save space, we don't report the results though available upon request.

5 Concluding Remarks

In this paper we first construct a theoretical model to consider how firm's credit constraints, especially access to external finance, and productivity affect its export volume. We show that a firm would export more if it faces less credit constraints, especially if it has easer access to external finance, or it has higher productivity. Also, compared to non-FIEs firms, FIEs firms are more easier to access to external fund which in turn would export more. Using a very rich Chinese firm-level dataset, we test the theoretical predictions and found strong evidence. First, firms with access to more external finance export more. Second, firms with higher productivity are associated with more exports. Finally, given other constant, FIEs have more exports. These findings are robust to different measures and econometric settings.

Our results contribute to the literature on finance and trade in two important ways. First, we offer firm level evidence that easier access to external finance has significant impact on firms' export. Second, using firm level data, we offer evidence that foreign capital flow has strong effect on firms' external access to fund and consequently affect firms export.

Several extensions and possible generalizations merit special consideration. One of them is to consider foreign direct investment (FDI) into the model in the sense that firms with higher productivity would perform outward FDI in addition to exports. Another possible extension is to consider how policy shocks like exchange rate change affect firm's export and FDI decision with the presence of credit constraints. These are the topics which we will pursue in the future.

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Table 1: Basic Information of Chinese Firms Data

Year	2000	2001	2002	2003	2004	2005	2006	2007	Total
Raw #	162,885	171,256	181,557	196,222	276,474	271,835	301,961	336,768	1,898,9
Filtered #	85,605	88,138	107,732	129,069	200,623	198,616	225,412	258,025	1,302,4
FIE	7,936	8,046	9,918	12,369	21,853	21,667	24,087	27,027	134,109
Domestic	66,625	69,031	84,450	101,597	157,120	156,210	178,865	206,581	1,037,8
HK/MA/TW	11,044	11,193	13,364	15,103	21,649	20,739	22,460	24,417	141,466

Table 2: Summary Statistics (2000-2007)

Variables	Obs.	Mean	Std.Dev.	Min	Max
Year	1,313,405	2,004.4	2.244	2000	2007
Firm's Sale	1,313,405	93,448.2	870,037.8	5,000	1.87e+08
Firm's Valued Added	1,313,405	5,209.0	126,696.5	-5,579,620	5.82e+07
Deflator Index	1,313,405	1.051	.178	.836	2.158
Wage Payable	1,313,405	4,510.9	36,109.41	0	7210385
Raw Fixed Assets	1,313,405	58,727.1	887,878.8	0	1.68e+08
Net Fixed Assets	1,313,405	37,403.7	545,873.4	0	1.50e+08
Materials Input	1,313,405	71,220.3	668,192.6	0	1.73e+08
Log Real Sale	1,313,405	10.105	1.215	7.784	19.225
Log Real Capital	1,309,928	8.814	1.707	-.474	18.787
Log Real Materials Input	1,312,360	9.830	1.267	-.635	19.147
Log Employment	1,100,180	4.752	1.131	0	13.252
Interest Expenditure	1,313,405	1263.386	14967.67	0	5363291
Dummy of Mixed Firms	1,313,405	.006	.080	0	1
FIE Dummy	1,313,405	.102	.303	0	1
Domestic Dummy	1,313,405	.790	.407	0	1
WTO Dummy	1,313,405	.857	.350	0	1
Dummy of Exit Next Year	1,313,405	.003	.055	0	1
Dummy of Exporting Firm	1,313,405	.742	.437	0	1
ln(TFP) – Olley-Pakes	1,093,124	-.016	.313	-9.746	2.561
ln(TFP) – OLS	1,097,047	1.128	.359	-2.729	13.071
Firm's Tenure	1,308,093	10.289	28.651	-.916	
Log Real Profit	1,308,093	5,222.099	125,506	-5,707,230	5.80e+07

Notes: (a) I obtain different real investment by allowing different depreciation rates (depre.), respectively. (b)The ratio of value-added relative to sale is dropped if it is lower than zero.

Table 3 Total Factor Productivity of Chinese Plants

Industry (code)	Est.	Labor		Materials		Capital	
	Prob.	OLS	OP	OLS	OP	OLS	OP
Mining & Washing of Coal (6)	.992	.063	.043	.834	.813	.059	.081
Mining & Processing of Ferrous Metal Ores (8)	.998	.096	.092	.872	.898	.040	.038
Mining & Processing of Non-Ferrous Metal (9)	.999	.058	.072	.889	.876	.042	.101
Mining & Processing of Nonmetal Ores (10)	.995	.083	.066	.819	.791	.044	.099
Processing of Food (13)	.994	.068	.043	.833	.890	.048	.058
Manufacture of Foods (14)	.995	.057	.058	.850	.840	.049	.023
Manufacture of Beverages (15)	.994	.089	.068	.820	.855	.052	.044
Manufacture of Tobacco (16)	.999	.053	.048	.848	.854	.161	.182
Manufacture of Textile (17)	.994	.066	.056	.863	.879	.033	.036
Manufacture of Apparel, Footware & Caps (18)	.993	.100	.096	.792	.796	.053	.019
Manufacture of Leather, Fur, & Feather (19)	.989	.082	.082	.846	.842	.043	.078
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm & Straw Products (20)	.989	.074	.051	.841	.881	.038	.045
Manufacture of Furniture (21)	.989	.107	.154	.802	.732	.046	.077
Manufacture of Paper & Paper Products (22)	.990	.066	.061	.851	.849	.044	.048
Printing, Reproduction of Recording Media (23)	.994	.088	.063	.796	.847	.068	.052
Manufacture of Articles For Culture, Education & Sport Activities (24)	.991	.086	.068	.822	.827	.049	.045
Processing of Petroleum, Coking, &Fuel (25)	.992	.035	.041	.864	.906	.062	.061
Manufacture of Raw Chemical Materials (26)	.991	.053	.031	.830	.857	.063	.074
Manufacture of Medicines (27)	.990	.101	.064	.785	.803	.060	.002
Manufacture of Chemical Fibers (28)	.995	.047	.029	.901	.923	.028	.032
Manufacture of Rubber (29)	.996	.078	.089	.801	.729	.067	.142
Manufacture of Plastics (30)	.994	.079	.074	.821	.816	.056	.051
Manufacture of Non-metallic Mineral goods (31)	.993	.049	.038	.858	.870	.040	.870
Smelting & Pressing of Ferrous Metals (32)	.991	.054	.043	.891	.921	.036	.036
Smelting & Pressing of Non-ferrous Metals (33)	.995	.052	.038	.887	.889	.031	.052
Manufacture of Metal Products (34)	.994	.078	.102	.793	.710	.067	.063
Manufacture of General Purpose Machinery (35)	.995	.066	.049	.827	.835	.057	.058
Manufacture of Special Purpose Machinery (36)	.993	.067	.029	.809	.868	.060	.070
Manufacture of Transport Equipment (37)	.992	.086	.077	.809	.804	.065	.058
Electrical Machinery & Equipment (39)	.996	.085	.068	.812	.833	.063	.119
Manufacture of Communication Equipment, Computers & Other Electronic Equipment (40)	.994	.103	.094	.776	.785	.082	.148
Manufacture of Measuring Instruments & Machinery for Cultural Activity & Office Work (41)	.992	.089	.049	.724	.815	.096	.050
Manufacture of Artwork (42)	.992	.084	.073	.821	.849	.046	.045
Electric Power & Heat Power (44)	.996	.156	.140	.611	.590	.219	.217
Production & Supply of Gas (45)	.999	.072	.035	.653	.558	.184	.275
Production & Supply of Water (46)	.981	.046	.019	.671	.636	.172	.163
All industries	.993	.068	.061	.825	.828	.062	.075

Notes: I do not report standard errors for each coefficient to save sapce, which are available upon request.

Table 4: Benchmark Estimates

Firm's Exports (EX_{it})	(1)	(2)	(3)	(4)
Total Factor Productivity ($\ln TFP_{it}^{OP}$)	1.218**	1.150**	0.792**	0.775**
	(63.06)	(61.21)	(32.23)	(31.71)
Interest Expenditure	0.285**	0.284**	0.193**	0.202**
	(144.79)	(145.16)	(67.81)	(69.98)
FIE Dummy		0.587**	0.523**	0.497**
		(66.89)	(47.85)	(45.13)
Firm's Log Profit in previous year			0.219**	0.222**
			(75.04)	(75.71)
Firm's Tenure (years)				-0.009**
				(-16.29)
Observations	199202	199202	125510	125510
Root MSE	1.643	1.625	1.570	1.568
R-square	0.149	0.168	0.221	0.223

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 5 Fixed-Effect Estimations Results

Firm's Exports (EX_{it})	(1)	(2)	(3)	(4)
Total Factor Productivity ($\ln TFP_{it}^{OP}$)	0.504**	0.504**	0.430**	0.430**
	(29.33)	(29.33)	(19.04)	(19.04)
Interest Expenditure	0.115**	0.115**	0.089**	0.089**
	(34.93)	(34.92)	(21.10)	(21.10)
FIE Dummy		0.054**	0.052**	0.052**
		(2.75)	(2.12)	(2.12)
Log Profit in previous year			0.077**	0.077**
			(23.17)	(23.18)
Firm's Tenure (years)				0.000
				(-0.15)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	199202	199202	125510	125510
Prob.>F	0.000	0.000	0.000	0.000
R-square	0.119	0.125	0.183	0.183

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 6: 2SLS Estimation Results

Firm's Exports (EX_{it})	(1)	(2)	(3)	(4)
Total Factor Productivity ($\ln TFP_{it}^{OP}$)	.967**	.909**	0.964**	.913**
	(51.21)	(49.25)	(33.99)	(32.19)
Interest Expenditure	.702**	.687**	.788**	.843**
	(214.59)	(216.26)	(130.12)	(131.72)
FIE Dummy		.562**	.710**	.630**
		(57.92)	(54.14)	(46.81)
Log Profit in Previous Year			-.102**	-.108**
			(-23.82)	(-25.00)
Tenure (years)				-.030**
				(-45.35)
Log Weighted M1 (first-stage)	1.062**	1.069**	1.015**	.990**
	(404.71)	(409.94)	(227.88)	(218.53)
Kleibergen-Paap rk LM statistic	4.0e+04†	4.0e+04†	2.1e+04†	20006.70†
Stock-Wright LM S statistic	29450.93†	29218.16†	5.2e+04†	16055.41†
Anderson-Rubin χ^2 Statistic	75197.29†	74283.92†	28813.51†	30947.40†
Observations	199202	199202	125510	125510
Prob.>χ^2	.000	.000	.000	.000
R-square	0.964	0.965	0.966	0.964

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 7: 2SLS Fixed-Effect Estimation Results

Firm's Exports (EX_{it})	(1)	(2)	(3)	(4)
Total Factor Productivity ($\ln TFP_{it}^{OP}$)	.334**	.334**	.336**	.336**
	(14.17)	(14.17)	(9.51)	(9.51)
Interest Expenditure	1.718**	1.718**	1.947**	1.947**
	(80.64)	(80.63)	(50.61)	(50.61)
FIE Dummy		.014	.024	.024
		(.39)	(0.5)	(0.49)
Log Profit in Previous Year			.018**	.0176**
			(2.67)	(2.66)
Tenure (years)				-.002**
				(-9.42)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	199,202	199,202	125,510	125,510
R-square	0.115	0.115	0.130	0.130

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 8: Robustness Check: Labor Productivity

Firm's Exports (EX_{it})	OLS	FE	2SLS	2SLS+FE
Labor Productivity ($\ln LP_{it}^{OP}$)	.121**	.485**	-.075**	.242**
	(23.15)	(46.34)	(-11.09)	(15.41)
Interest Expenditure	.188**	.073**	.939**	1.696**
	(64.84)	(17.99)	(131.94)	(47.35)
FIE Dummy	.498**	.047**	.687**	.029
	(45.32)	(1.99)	(48.53)	(.68)
Log Profit in Previous Year	.230**	.060**	-.109**	.018**
	(78.98)	(18.88)	(-24.01)	(3.08)
Tenure (years)	-.008**	.001	-.035**	-.001
	(-15.62)	(.33)	(-50.02)	(-.64)
Firm Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
Observations	125,711	125,711	125,711	125,711
R-square	.216	.136	.96	.134

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 9: Robustness Check: Operation Profit and Labor Productivity

Firm's Exports (EX_{it})	OLS	FE	2SLS	2SLS+FE
Labor Productivity ($\ln LP_{it}^{OP}$)	.755**	.486**	-.088**	.238**
	(30.39)	(45.26)	(-12.7)	(14.50)
Interest Expenditure	.196**	.072**	.943**	1.744**
	(67.27)	(17.16)	(128.74)	(45.86)
FIE Dummy	.484**	.050**	.674**	.051
	(43.68)	(2.08)	(47.16)	(1.13)
Log Operation Profit in previous year	.235**	.055**	-.109**	.010*
	(77.81)	(17.31)	(-22.66)	(1.69)
Tenure (years)	-.008**	-2.39e-06	-.034**	-.002
	(-14.36)	(0)	(-46.13)	(-1.22)
Firm Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
Observations	122065	122243	122243	122243
R-square	0.226	0.133	0.961	0.135

Notes: Robust t-values corrected for clustering at the firm level in parentheses. *(**) means significant at the 10(5) percent level.

Table 10: China export growth 2000-2007

Year	Export ($ billion)	Export by FIEs ($ billion)	FIEshare	Growth rate of export	Growth rate o
2000	249.24	119.46	0.48	0.28	0
2001	266.28	133.19	0.50	0.07	0
2002	325.57	169.94	0.52	0.22	0
2003	438.37	240.34	0.55	0.35	0
2004	593.37	338.61	0.57	0.35	0
2005	762.00	444.21	0.58	0.28	0
2006	969.07	563.83	0.58	0.27	0
2007	1217.94	695.48	0.57	0.26	0

Table 11: Main Notation for the Models

Symbol	Definition
	Panel A: Theoretical Framework
q_0	Quantity of homogeneous good
ω	Variety of differentiated good
Ω	Overall set of varieties available to the consumer
σ	Elasticity of substitution between differentiated goods, $\sigma > 1$
μ	Expenditure share in homogeneous good
p	price of each variety
P	Price index of countries
L, L^*	Home and foreign population
$r(\omega)$	Revenue of each firm producing variety ω
C_d, C_E	Fixed entry cost of domestic market and export market
w, w^*	Home and foreign wage
x	Firm productivity
π	Profit
λ	Success possibility of project
G	Repayment demanded by financial intermediates
δ_i	The portion of fixed entry cost financed by alternative external fund
t	The fraction of the domestic fixed cost pleagable as colleteral
τ	Iceberg transportation cost
	Panel B: Empirical Specification
MFG_t	China manufacturing output in year t
y_{it}	Firm output level
$M1$	China base money supply
ς_i	Firm-specific fixed effect
ϑ_t	Year-specific fixed effect
ϵ_{ijt}	Idiosyncratic error term

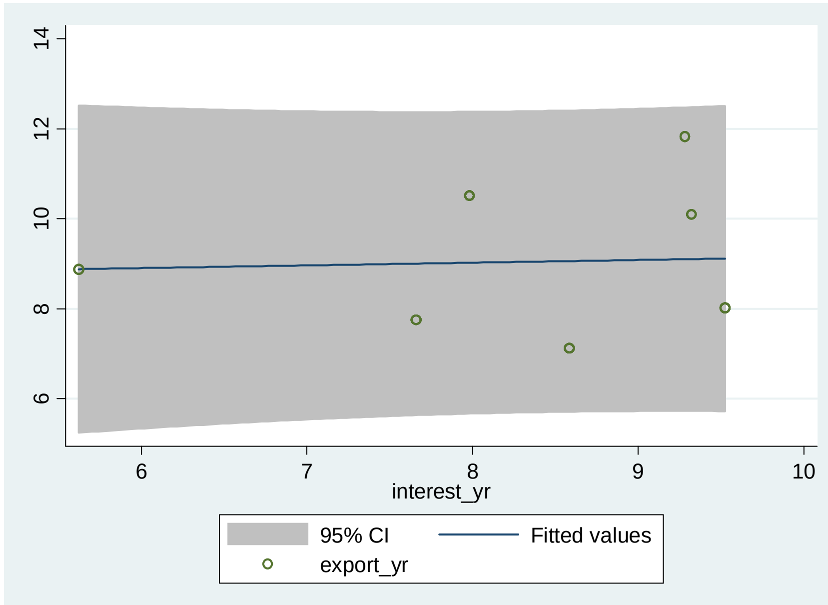

Figure 1: Log Exports vs. Log Interest Expenditure at Annual Level

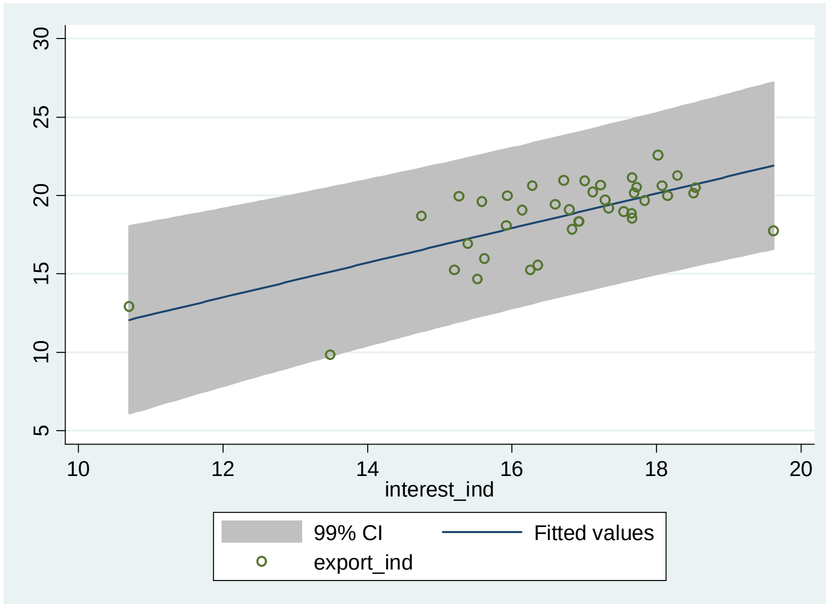

Figure 2: Log Exports vs. Log Interest Expenditure at Two-digit Industry Level

6 Appendix

A Solving the cutoffs

- Domestic cutoff

$$\begin{aligned}\overline{x}_d^{\sigma-1} &= w^{\sigma-1}\frac{\sigma}{\mu L}\left(\frac{\sigma}{\sigma-1}\frac{1}{P}\right)^{\sigma-1}C_d \\ &= w^{\sigma-1}\left(\frac{1}{w}\right)^{\sigma-1}\frac{\sigma}{\mu}\int\limits_{x\geqslant\overline{x}_d} x^{\sigma-1}dF_x(x)C_d \\ &= h^{\sigma-1}(C_d)\end{aligned}$$

- Export cutoffs without credit constraint

$$\begin{aligned}\overline{x}_E^{\sigma-1} &= \frac{\sigma}{\mu L^*}\left(\frac{\sigma}{\sigma-1}\frac{\tau w}{P^*}\right)^{\sigma-1}C_E \\ &= \frac{C_E}{C_d^*}(\tau w)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{\sigma-1}\frac{\sigma}{\mu}\frac{{P^*}^{1-\sigma}C_d^*}{L^*} \\ &= \frac{C_E}{C_d^*}(\tau w)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{\sigma-1}\frac{\sigma}{\mu}\int\limits_{x\geqslant\overline{x}_d^*}\left(\frac{\sigma}{\sigma-1}\frac{w^*}{x}\right)^{1-\sigma}dF_x(x)C_d^* \\ &= \frac{C_E}{C_d^*}\left(\frac{\tau w}{w^*}\right)^{\sigma-1}h^{\sigma-1}(C_d^*)\end{aligned}$$

- Export cutoffs with credit constraint

$$\frac{r_E(\overline{x}_{CE})}{\sigma} - w^*C_E = \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)\left(\left(1-\delta_i\right)w^*C_E - wA - \pi_d(\overline{x}_{CE})\right)$$

$$\frac{r_E(\overline{x}_{CE})}{\sigma} = \frac{\left(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i\right)w^*C_E}{\lambda(\overline{x}_{CE})} - \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)\left(wA+\pi_d(\overline{x}_{CE})\right)$$

Substituting in revenue and profit, we get

$$\begin{aligned}\overline{x}_{CE} \;=\; & \frac{\sigma}{\sigma-1}\left(\frac{\sigma}{\mu}\right)^{\frac{1}{\sigma-1}}\left(\frac{\left(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i\right)w^*C_E}{\lambda(\overline{x}_{CE})} - \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)\left(wA-wC_d\right)\right)^{\frac{1}{\sigma-1}} \\ & \left(w^*L^*\left(\frac{\tau w}{P^*}\right)^{1-\sigma} + \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)wL\left(\frac{w}{P}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}\end{aligned}$$

In equilibrium, substituting in P and P^*, we can solve the cutoffs:

$$\begin{aligned}
\overline{x}_{CE} &= \left(\frac{(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i)\,w^*C_E}{\lambda(\overline{x}_{CE})} - \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)(wA-wC_d)\right)^{\frac{1}{\sigma-1}} \\
&\quad \left(w^*L^*\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\frac{\mu}{\sigma}\left(\frac{\tau w}{P^*}\right)^{1-\sigma} + \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)wL\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\frac{\mu}{\sigma}\left(\frac{w}{P}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \\
&= \left(\frac{(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i)\,w^*C_E}{\lambda(\overline{x}_{CE})} - \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)(wA-wC_d)\right)^{\frac{1}{\sigma-1}} \\
&\quad \left(w^*C_d^*\,(\tau w)^{1-\sigma}\left(\frac{1}{w^*}\right)^{1-\sigma}h^{1-\sigma}(C_d^*) + \left(\frac{1}{\lambda(\overline{x}_{CE})}-1\right)w^{2-\sigma}C_d\left(\frac{1}{w}\right)^{1-\sigma}h^{1-\sigma}(C_d)\right)^{\frac{1}{1-\sigma}} \\
&= \left(\frac{(1-\delta_i+\lambda(\overline{x}_{CE})\delta_i)\,\frac{w^*}{w}C_E-(1-\lambda(\overline{x}_{CE}))\,(A-C_d)}{\lambda(\overline{x}_{CE})\tau^{1-\sigma}\left(\frac{w^*}{w}\right)^{\sigma}C_d^*h^{1-\sigma}(C_d^*)+(1-\lambda(\overline{x}_{CE}))\,C_dh^{1-\sigma}(C_d)}\right)^{\frac{1}{\sigma-1}}
\end{aligned}$$