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1 August 2012

Credit Constraints, Quality, and Export Prices: Theory and Evidence from China*

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First Draft: February 2012
This Version: August 2012

Abstract

This paper examines (i) the relationship between the credit constraints faced by a firm and the unit value prices of its exports, as well as (ii) the relationship between the export prices of a firm and its productivity. The paper extends Melitz's (2003) model of trade with heterogeneous firms by introducing endogenous quality, credit constraints and marketing costs. There are three key findings. First, there exists a positive relationship between firm productivity and export prices because the choice of higher-quality inputs is associated with higher productivity. Second, tighter credit constraints faced by a firm reduces its optimal prices as its choice of lower-quality inputs dominates the price distortion effect resulting from credit constraints. Third, if one adopts the alternative assumption that quality is exogenous across firms, then completely opposite results would be expected: there would be a negative relationship between prices and productivity; prices increase as firms face tighter credit constraints. An empirical analysis using Chinese bank loans data, Chinese firm-level data from the National Bureau of Statistics of China (NBSC), and Chinese customs data strongly supports the predictions of the endogenous-quality model, and confirms the existence of the quality adjustment effect: firms optimally choose lower quality when facing tighter credit constraints. Our finding of a significant impact of credit constraints on export prices indicates the prevalence of heterogeneity of product quality across firms.

JEL: F1, F3, D2, G2, L1

Keywords: credit constraints, credit access, credit needs, endogenous quality, export prices, quality, heterogeneous firms, productivity

*We thank Gene Grossman, Shang-Jin Wei, Stephen Yeaple, Mark Roberts, Norman Loayza, Davin Chor, Jonathan Vogel, Jim MacGee, Heiwai Tang, Loretta Fung, Yi Lu, Kenneth Corts, Pengfei Wang, David Cook, Albert Park, Xi Li, Nelson Mark, Zhigang Tao, Wen Zhou, Zhanar Akhmetova, Wei Liao, Peng Wang, the participants of the Midwest International Trade Conference (Indiana University Bloomington, May 2012), the Asia Pacific Trade Seminars Annual Meeting (Singapore Management University, July 2012), the Workshop on Emerging Economies (University of New South Wales, August 2012), the 2nd China Trade Research Group Annual Conference (Shandong University, China, May 2012), and of seminars held at HKUST, University of Hong Kong, University of Western Ontario, Hong Kong Institute for Monetary Research, Shanghai University of Finance and Economics, Fudan University, Shanghai Jiaotong University, and Zhejiang University for helpful discussions. An earlier version of this paper was circulated with the title "Credit Constraints and Export Prices: Theory and Evidence from China". All remaining errors are our own.

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1. Introduction

There is a growing body of literature on the effects of credit constraints on international trade, especially after the financial crisis of 2008. Most prior studies have focused on either explaining the mechanism of why exporters need more credit than domestic producers (e.g., Amiti and Weinstein, 2009; Feenstra, Li, and Yu, 2011), or the consequences of different credit conditions on exporting behavior, multinational activities, or aggregate trade volumes (Manova, 2011; Manova, Wei, and Zhang, 2011; Chor and Manova, 2012; Minetti and Zhu, 2011, among others). However, to the best of our knowledge, the impacts of credit constraints on a firm's choice of optimal prices have not been explored. This paper fills a gap in the literature by linking credit constraints to firm attributes and action such as its productivity and its choice of product quality and optimal prices.

Understanding the mechanism through which credit constraints affect export prices helps us better understand how they affect a firm's exporting behavior. In particular, it helps to explain the differential impacts of credit constraints on the intensive margin of trade across products through their effects on the unit value prices of different products. As the intensive margin of a product is measured by the total value of export, the change in the intensive margin is affected by two factors: the change in the quantity exported, and the change in the unit value price of the exported good. Therefore, a thorough analysis on the effect of credit constraints on unit value prices can help us better understand their effect on the intensive margin of trade. Moreover, credit constraints affect bank loans to firms, which are used to cover upfront costs. Tighter credit constraints would affect upfront costs and therefore distort a firm's choice of optimal price more. As noted in the literature on financial distress, binding credit constraints may cause firms to act in ways that would be sub-optimal in normal times, which may lead them to produce lower-quality products, which in turn lowers the unit value price of the product (Phillips and Sertsios, 2011). However, how and why credit constraints affect the export prices of different products differently has not been studied thoroughly. Our paper tries to fill this gap in the literature.

To study the impacts of credit constraints on export prices, we modify Melitz's (2003) model of trade with heterogeneous firms by introducing endogenous quality and credit constraints. Like Arkolakis (2010), we introduce costs of marketing through advertisement. However, there are two main differences between our model and Arkolakis's. First, we introduce endogenous input quality. According to the quality-and-trade literature, more productive firms tend to choose higher-quality inputs, which yield higher export prices.[1] The observed relationship between prices and productivity depends on two opposing forces: the quality effect (via higher input-quality associated with higher productivity) and the productivity effect (via lower marginal cost associated with higher productivity). Given certain plausible parametric values (for example, a high elasticity of substitution between varieties, a high degree of effectiveness of fixed costs in raising quality, and

[1] See Verhoogen (2008), Kugler and Verhoogen (forthcoming), Hallak (2010), Hallak and Sivadasan (2011), Gervais (2009), Johnson (2012), Manova and Zhang (forthcoming), among others.

a high degree of effectiveness in market penetration), the quality effect dominates, and a firm's optimal price is positively correlated with its productivity.

We then introduce credit constraints, which act through two channels. First, we assume that firms must externally finance a certain fraction of its total costs, including variable costs and fixed costs, in order to produce as well as to enter foreign markets. This fraction captures the *credit needs* of the firm. The higher is this fraction, the more likely the firm faces binding credit constraints. Second, we assume that due to frictions in the financial markets, a firm cannot borrow more than a certain fraction of its expected cash flow. This fraction of a firm's expected cash flow capture the firm's *credit access*. To sum up, a firm is more likely to have tighter credit constraints if it has a higher level of "*credit needs*" or faces a lower level of "*credit access*".

The theory indicates that the impacts of credit constraints on prices depend on two opposing forces: (i) *the quality adjustment effect*, which lowers input quality and therefore reduces prices when credit constraints are more stringent; (ii) *the price distortion effect*, which increases price when credit constraints are tighter. It should be noted that the price distortion effect is independent of the assumption of endogenous quality. The intuition behind the price distortion effect is as follows. Given product quality, a firm facing tighter credit constraints will reduce its output, leading to excess demand for its product at the initial price level, which in turn pushes up its price. We call this effect the price distortion effect. However, when product quality is endogenously chosen by a firm, the quality adjustment effect dominates the price distortion effect, and therefore optimal prices **fall** when firms face tighter credit constraints. The economic intuition is that firms can optimally choose lower-quality inputs to mitigate the price distortion caused by tighter credit constraints. On the contrary, if product quality is exogenously fixed across firms, we show that the outcome would be exactly opposite: the existence of more stringent credit constraints would **raise** optimal prices due to the price distortion effect resulting from credit constraints.

Next, we test our model using a matched Chinese firm-product level dataset, based on Chinese firm-level production data from the National Bureau of Statistics of China (NBSC) and Chinese customs data at the transaction-product level. The unique advantage of this matched database is that it contains information on unit value prices of both imports and exports at the product-firm level as well as the information needed to measure credit constraints. We use the augmented Olley-Pakes (1996) approach, which alleviates simultaneity bias and selection bias, to estimate a firm's total factor productivity. In the robustness checks, we also report results based on labor productivity measured by the value added per employee. To measure the severity of credit constraints via *credit needs* faced by firms, we first follow Manova et al. (2011) to employ four different measures at the industry level: external finance dependence, R&D intensity, inventory-to-sales ratio, and asset tangibility. We use US data for those measures as they are widely used in cross-country studies in the literature. For robustness, we also follow Rajan and Zingales (1998) and Manova (2011) to calculate external finance dependence using Chinese firm-level data.[2] To proxy for credit access, we collect balances of bank credits, long-term bank loans and short-term bank loans by province (normalized by province GDP) in China to reflect the credit access by firms located in different regions. In addition, we compare different types of firm ownership in China as each type is expected to be associated with a different level of credit access. Finally, to proxy for input quality, we use three different measures: the unit value price of imported inputs, the average wage of a worker, and the ratio of college workers to total employees.

We test the empirical implications of our model using a model-based estimation equation. All empirical results strongly support the theoretical predictions of the endogenous-quality model instead of the exogenous-quality model: First, there exists a significant, robust and positive relationship between export prices and firm productivity. Second, tighter credit constraints (i.e., either a higher level of credit needs or a lower level of credit access) significantly reduce the optimal price charged by the firm. Third, when a firm faces more stringent credit constraints, it optimally chooses lower quality.

We also test the quality-adjustment mechanism by comparing the effects of productivity, credit needs, and credit access on prices under three different scenarios: (i) without controlling for input quality, (ii) controlling for input quality using average wage, and (iii) controlling for more dimensions of input quality such as unit value prices of imported inputs and the share of workers with college degrees in total employees. The test results confirm the mechanism of quality adjustment proposed by the theory. In addition, we compute the variation in the unit value price of the same product across firms to proxy for the heterogeneity of product quality across firms. Then we test the propositions of our model in a subsample of the products exhibiting more heterogeneity of quality (i.e., the top 50 percentile of products ranked by the variation in their unit value prices) and compare the results with those from our baseline regression. We find that for products exhibiting more heterogeneity of quality, the magnitudes of the predicted effects are larger, thus validating the endogenous-quality model. Overall, our empirical results demonstrate that the endogenous-quality model prevails over the exogenous-quality model, and the mechanism of quality adjustment is the key to a full understanding of the impacts of credit constraints on a firm's optimal choice of export prices.

The main contribution of this paper is that it offers both a theory and the empirical evidence on the impacts of credit constraints (via credit needs and credit access) on export prices, adding to the emerging literature on the role of financial constraints in international trade. To the best of our knowledge, this paper provides the first compelling analysis of the impacts of credit constraints on export prices under a heterogeneous-firm framework.

This paper also complements the large quality-and-trade literature in confirming the prevalence of product quality heterogeneity at the firm level and explaining the mechanism of quality

[2] External finance dependence is the fraction of capital expenditures not financed with cash flow from operations.

adjustment in the presence of credit constraints. Our finding of a positive relationship between firm productivity and export prices is consistent with the findings of the literature on product quality (e.g., Verhoogen, 2008; Kugler and Verhoogen, forthcoming; Hallak, 2010; Johnson, 2012; and Hallak and Sivadasan, 2011). What distinguishes our paper from the literature, however, is that we emphasize that the impacts of credit constraints on optimal prices act through the optimal adjustment of product quality by the firm.

Finally, this paper contributes to the empirical literature by affirming the existence of a positive relationship between a firm's input quality and its export prices. Our empirical analysis makes use of a unique, detailed product-firm level dataset that results from merging the database of the annual survey of Chinese manufacturing firms and the Chinese customs database. Our results provide direct evidence that the quality of inputs (e.g., imported intermediated inputs or highly skilled labor inputs) is strongly and positively associated with unit value prices of exports. This complements the existing studies on the role of imported inputs in the exporting behavior of firms. For example, Goldberg et al. (2010) find that the use of imported inputs increases product scope for Indian firms.

The remainder of the paper is organized as follows. Section 2 presents a trade model with heterogeneous firms, featuring endogenous product quality, market penetration costs, and credit constraints to illustrate the relationship between export prices and firm productivity, as well as the impact of credit constraints on the optimal prices of exports. Section 3 describes the data for the empirical study and introduces the strategy of the empirical analysis. Section 4 presents the empirical results and Section 5 provides some robustness checks. Section 6 concludes.

2. A Model of Credit Constraints, Product Quality, and Export Prices

In this section we present a partial equilibrium model to study unit value export prices across firms that compete for the same product-destination market. The model is based on the monopolistic competition framework proposed by Melitz (2003) and now incorporates endogenous quality, credit constraints, and marketing costs. Goods are differentiated, and each good is produced by one firm. The main departure from the existing literature is that firms are heterogeneous in both their productivity and the degree of credit constraints they face. Firms choose not only the optimal price but also the optimal product quality as well as the optimal volume of advertisement.

2.1. Preferences and the Market Structure

We denote the source country by i and the destination country by j, where $i, j \in 1, \ldots, N$. Country j is populated by a continuum of consumers of measure L_j. Consumers in country j have access to a set of goods Ω_j, which is potentially different across countries. In each source country i, there is a continuum of firms that ex ante differ in their productivity level, ϕ, the degree of credit access,

θ, and the credit needs, d. A firm facing higher θ has more credit access; a firm with higher d has more financial needs. A lower level of θ or a higher level of d implies tighter credit constraints for this firm (see Section 2.2. for more detail). We assume that a representative consumer in country j faces a constant-elasticity-of-substitution (CES) utility function when she consumes a variety ω in the product set Ω_j:

$$U_j = \left[\int_{\omega \in \Omega_j} \left(h_{ij} \left(q_{ij}(\omega), a_{ij}(\omega) \right) x_{ij} \left(\omega \right) \right)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

where $h_{ij} \left(q_{ij}, a_{ij} \right)$ is a demand shifter which we assume to be equal to $q_{ij} \left(\omega \right) a_{ij} \left(\omega \right)$, with $q_{ij} \left(\omega \right)$ being the component in the demand shifter attributed to the quality of variety ω from country i and $a_{ij} \left(\omega \right)$ being the component in demand shifter attributed to the amount of advertisement; $x_{ij} \left(\omega \right)$ is country j's quantity demanded of variety ω originated from country i; and $\sigma > 1$ is the elasticity of substitution between varieties.[3] Therefore, consumer optimization yields the following demand for variety ω:

$$x_{ij} \left(\omega \right) = \left(q_{ij}(\omega) a_{ij}(\omega) \right)^{\sigma-1} \frac{\left(p_{ij} \left(\omega \right) \right)^{-\sigma}}{P_j^{1-\sigma}} Y_j$$

where $p_{ij} \left(\omega \right)$ is the price of variety ω, $P_j = \left[\int_{\omega \in \Omega_j} \left(p_{ij} \left(\omega \right) / \left(q_{ij}(\omega) a_{ij}(\omega) \right) \right)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$ is an aggregate price index (adjusted by the demand shifter), and Y_j represents the total expenditure of country j. Given the same price, higher-quality products and more heavily-advertised products generate a larger demand.

2.2. The Firm's Problem

A firm's technology is captured by a cost function that features a constant marginal cost (if no quality upgrading) with a fixed overhead cost. Labor is the only factor of production. Following convention, we assume that there is an iceberg trade cost such that $\tau_{ij} \geq 1$ units of good must be shipped from country i in order for one unit to arrive in j.[4] To simplify notation, the subscripts for products and destinations are suppressed hereafter. In addition, the wage rate is normalized to one.

Following the recent quality-and-trade literature, we assume that there is a positive relationship between quality and marginal cost of production. The rationale is that a higher marginal cost is required to produce a higher-quality product.[5] The marginal cost of production is assumed to be q^{α}/ϕ, where $\alpha \in [0, 1]$. Hence, the marginal cost increases in quality, and α captures the elasticity of marginal cost with respect to quality.

[3] Following convention, $h_{ij} \left(\omega \right) x_{ij} \left(\omega \right)$ captures the "implicitly measured quantity" of each variety consumed, which is implicitly measured in units of utility.

[4] Firms face no trade costs in selling in its home market, i.e., $\tau_{ii} = 1$.

[5] The positive relationship between quality and marginal cost is common to the recent quality-and-trade literature, including Baldwin and Harrigan (2009), Verhoogen (2008), and Johnson (2012).

Firms face two types of fixed costs: the fixed cost of marketing and the fixed costs of production. The fixed cost of marketing, denoted by $f(a)$, is assumed to be equal to $f_x \frac{a^{1+\epsilon}}{1+\epsilon}$, where $a \in [0, +\infty)$, $\epsilon > 0$, and f_x is constant.[6] The modeling of advertising technology draws upon the work of Butters (1977), Grossman and Shapiro (1984), Stegeman (1991), and Dinlersoz and Yorukoglu (2008). The advertising technology, $f(a)$, is exogenously given and common to all firms. The formula of the advertising technology captures the fact, established by Sutton (2007), that the effectiveness of advertising is subject to diminishing returns. The fixed cost of production, which represents fixed investments in improving the quality (e.g., R&D expenditures or costs of employing higher-quality inputs), is assumed to be equal to $f_d q^\beta$ ($\beta > 0$), where f_d denotes the fixed production cost in domestic market without quality improvement and $1/\beta$ measures the effectiveness of fixed expenditures in raising quality.

We posit that all firms are subject to possible liquidity constraints in paying all types of costs. Like the extended model in Manova (2011), we assume that exporters need to raise outside capital for a fraction $d \in (0, 1)$ of all costs associated with foreign sales, including variable costs and the two types of fixed costs mentioned above.[7] This fraction d represents the *financial needs* of a firm. The higher the financial needs, the higher is d, and we call this fraction d the "*credit needs*" parameter. We also assume that, constrained by the level of financial development, firms cannot borrow more than a fraction θ of the expected cash flow from exporting. If θ is higher, firms can borrow more from external finance (mainly through bank loans). Therefore, θ is referred to as the *credit access* by firms. A higher level of *credit needs* d or a lower level of *credit access* θ implies that firms are more likely to face tighter credit constraints. It follows that the optimization problem of a firm with productivity ϕ, credit access θ, and credit needs d becomes:[8]

$$\max_{p,q,a} \left(p - \frac{\tau q^\alpha}{\phi}\right)(qa)^{\sigma-1} \frac{p^{-\sigma}}{P^{1-\sigma}} Y - f_x \frac{a^{1+\epsilon}}{1+\epsilon} - f_d q^\beta \tag{1}$$

$$\text{s.t. } \theta \left(\left(p - (1-d)\frac{\tau q^\alpha}{\phi}\right)(qa)^{\sigma-1} \frac{p^{-\sigma}}{P^{1-\sigma}} Y - (1-d)\left(f_x \frac{a^{1+\varepsilon}}{1+\varepsilon} + f_d q^\beta\right)\right) \tag{2}$$

$$\geq d \left(\frac{\tau q^\alpha}{\phi}(qa)^{\sigma-1} \frac{p^{-\sigma}}{P^{1-\sigma}} Y + f_x \frac{a^{1+\varepsilon}}{1+\varepsilon} + f_d q^\beta\right)$$

where budget constraint (2) can be viewed as the "cash flow constraint" condition, in the same spirit as Manova (2011) and Feenstra et al. (2011). Solving this optimization problem by choosing

[6] Here advertising is merely a representative channel of marketing. Any other form of fixed marketing cost is also included in $f(a)$, which we view as penetration costs to enter foreign markets.

[7] We also consider the case that firms only need to raise outside capital for fixed costs in Proposition 6 and the proof is in Appendix.

[8] For simplicity of notation, we suppress variety ω and subscripts of country (i, j). It should be also pointed out that we do not consider the intertemporal structure of costs of borrowing from banks as the current model is a static, one-period model.

price p, quality q, and advertisement a yields

$$p = \frac{\sigma}{\sigma - 1}\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)\frac{\tau q^{\alpha}}{\phi} \tag{3}$$

$$(qa)^{\sigma-1}\frac{p^{1-\sigma}}{P^{1-\sigma}}Y = \frac{\sigma\beta}{(1-\alpha)(\sigma-1)}\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_d q^{\beta} \tag{4}$$

$$(qa)^{\sigma-1}\frac{p^{1-\sigma}}{P^{1-\sigma}}Y = \frac{\sigma}{\sigma-1}\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_x a^{1+\epsilon} \tag{5}$$

where λ is the Lagrangian multiplier associated with the budget constraint condition (2).

Equation (4), together with (5), yield the relation between optimal quality q and optimal advertisement a:

$$\frac{\beta}{1-\alpha}f_d q^{\beta} = f_x a^{1+\epsilon} \tag{6}$$

This expression, together with the budget constraint (2) and conditions (3) and (4), yield:

$$\frac{\sigma\beta}{(1-\alpha)(\sigma-1)}\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right) \geq \left(1 - d + \frac{d}{\theta}\right)\left(\frac{\beta}{1-\alpha} + \frac{\beta}{(1+\varepsilon)(1-\alpha)} + 1\right) \tag{7}$$

Let $\frac{\beta}{(1-\alpha)(\sigma-1)} \equiv \Lambda$ and $\frac{1+\epsilon}{\sigma-1} \equiv 1+\Theta$. Given credit needs d, there exists a cutoff level of credit access θ_h such that budget constraint (2) is binding if and only if $\theta < \theta_h$. Likewise, given credit access θ, there exists a cutoff level of credit needs above which the budget constraint (2) is binding.[9] Next, we analyze two cases according to whether budget constraint (2) is binding.

Case 1: The budget constraint (2) is binding, i.e., $\theta < \theta_h$.

Here, equation (7) yields:

$$\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right) = \left(1 - d + \frac{d}{\theta}\right)\left(\frac{\sigma + \sigma\Theta - \Theta}{\sigma + \sigma\Theta} + \frac{1}{\sigma\Lambda}\right)$$

Let $\left(1 + d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right) \equiv \Delta$, which reflects the price distortion. We call this effect the *price distortion effect*. It should be noted that the price distortion effect is independent of the assumption of endogenous quality.[10] It is obvious that the extent to which price is distorted is related to credit access θ and credit needs d. Lower credit access θ or higher credit needs d increases the price distortion caused by the binding budget constraint. The intuition behind the price distortion effect is as follows. Given product quality, a firm facing tighter credit constraints will reduce its output, leading to excess demand for its product at the initial price level, which in turn pushes up its price.

Now, equation (2), together with (3) and (6), imply that the optimal quality chosen by firms

[9] Equation (7) implies that budget constraint (2) is binding if and only if $\theta < \theta_h$, where $\theta_h = \frac{d(\Lambda(\sigma+\sigma\Theta-\Theta)+1+\Theta)}{\sigma\Lambda(1+\Theta)-(1-d)(\Lambda(\sigma+\sigma\Theta-\Theta)+1+\Theta)}$.

[10] See Appendix A for the proof of the case when quality is exogenous.

satisfies the following condition:

$$q^{\frac{\Theta\beta}{1+\Theta}-(1-\alpha)(\sigma-1)} = \frac{\Delta^{-\sigma}}{\sigma\Lambda f_d}\left(\frac{\Lambda(\sigma-1)f_d}{f_x}\right)^{\frac{1}{1+\Theta}}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma}\frac{Y}{P^{1-\sigma}} \tag{8}$$

Under the condition (i), given by $\Theta\beta > (1-\alpha)(\sigma-1)(1+\Theta)$, there is a positive correlation between firm productivity ϕ and quality q, given credit access θ and credit needs d. This suggests that more productive firms choose higher quality, which is consistent with the findings of the quality-and-trade literature. Given productivity, an increase in θ or a reduction in d (i.e., more credit access or lower credit needs) leads to a higher optimal quality q chosen by the firm, which in turn leads to a higher price. We call this mechanism the *quality adjustment effect*. Given firm productivity, the condition (i) also ensures that a firm with more credit access or less needs to borrow chooses higher quality. An increase in credit access or a reduction in credit needs relaxes its credit constraints, which mitigates the pressure on the optimal quality chosen by the firm.

Hence, the optimal pricing rule (3), together with (8), yield:

$$p = \Delta^{1-\sigma\Psi}\left(\frac{1}{\sigma\Lambda f_d}\right)^{\Psi}\left(\frac{\Lambda(\sigma-1)f_d}{f_x}\right)^{\frac{\Psi}{1+\Theta}}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1+(1-\sigma)\Psi}\left(\frac{Y}{P^{1-\sigma}}\right)^{\Psi} \tag{9}$$

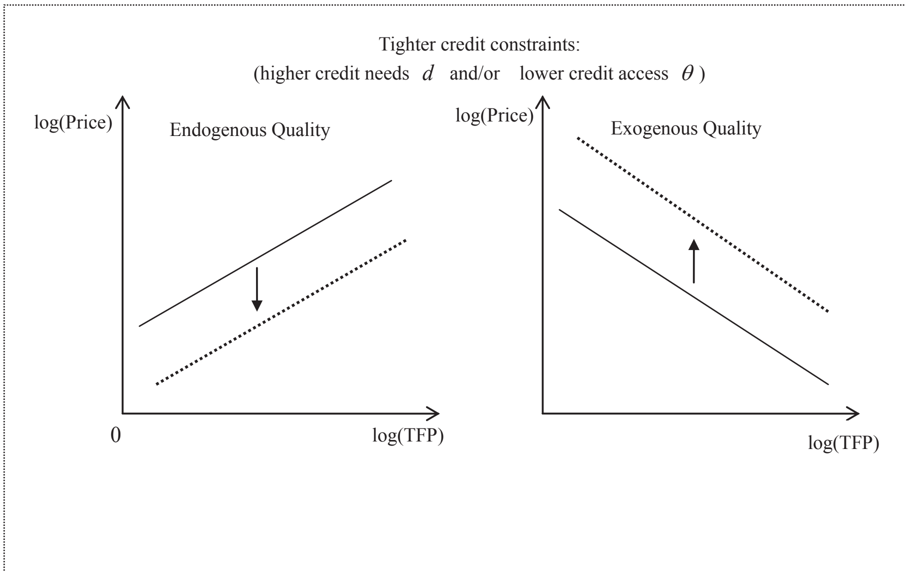
where $\Psi = \frac{\alpha(1+\Theta)}{\Theta\beta-(1-\alpha)(\sigma-1)(1+\Theta)} > 0$. If the condition (ii), given by $(\sigma-1)(1+\Theta) > \Theta\beta$, also holds, then a firm's optimal price is positively correlated with firm productivity.[11] Condition (i) and (ii) combined is equivalent to the condition (A), given by $\frac{1}{\beta} > \frac{1}{\sigma-1} - \frac{1}{1+\epsilon} > \frac{1-\alpha}{\beta}$.[12] If condition (A) holds, a firm with higher productivity charges higher optimal prices. The mechanism behind this positive correlation between firm productivity and export prices is due to two opposing effects of credit constraints on the optimal price. One is caused by the price distortion Δ induced by credit constraints. The other is caused by the optimal quality chosen by the firm. The former effect tends to increase the optimal price when a firm faces higher credit needs d and lower credit access θ (i.e., when d increases or θ decreases, the price distortion Δ increases and therefore price increases). However, the latter effect tends to reduce the optimal price. Therefore, the net effect of productivity on price depends on which effect dominates.

Under condition (A), the condition $1-\sigma\Psi < 0$ is also satisfied. Then, according to equation (9), the price distortion Δ is negatively correlated with the optimal price. As tighter credit constraints (via either higher credit needs d or lower credit access θ) eventually reduce the optimal price, it implies that the quality adjustment effect dominates the price distortion effect. The graph in the left panel of Figure 1 illustrates the relationship between prices, productivity, and credit constraints when condition (A) holds: the solid line corresponds to more relaxed credit constraint (i.e., a higher θ and a lower d), and the dashed line captures the tighter credit constraint situation

[11] Condition (i) and (ii) implies $1+(1-\sigma)\Psi < 0$.

[12] If β is small, α is sufficiently close to one, or σ and ϵ are both large or both small, then the condition (A) holds.

Figure 1: The relationship between prices, TFP, and credit constraints



(i.e., a lower θ and a higher d).

Case 2: The budget constraint (2) is nonbinding, i.e., $\theta > \theta_h$.

Equation (4), together with (3) and (6), imply:

$$q^{\frac{\Theta\beta}{1+\Theta}-(1-\alpha)(\sigma-1)} = \frac{1}{\sigma\Lambda f_d}\left(\frac{(\sigma-1)\Lambda f_d}{f_x}\right)^{\frac{1}{1+\Theta}}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma}\frac{Y}{P^{1-\sigma}} \tag{10}$$

Under the condition (i) $\Theta\beta > (1-\alpha)(\sigma-1)(1+\Theta)$, the firm with higher productivity will choose higher quality. Then, equation (10), together with (3), imply that the optimal pricing rule is given by

$$p = (\sigma\Lambda f_d)^{-\Psi}\left(\frac{(\sigma-1)\Lambda f_d}{f_x}\right)^{\Psi/(1+\Theta)}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1+(1-\sigma)\Psi}\left(\frac{Y}{P^{1-\sigma}}\right)^{\Psi} \tag{11}$$

If condition (A) holds, then $1+(1-\sigma)\Psi < 0$, and so (11) implies that there is a positive relationship between price and productivity. Therefore, the solid line in Figure 1 still describes the relationship between price and log(TFP). However, the optimal prices are not affected by credit access θ or credit needs d anymore, as firms have sufficient credit access compared to its credit needs (i.e., $\theta > \theta_h$). Therefore, the solid line in the left panel of Figure 1 does not shift as θ or d changes.

Therefore, given that condition (A) and $\theta < \theta_h$ are satisfied, we have the following four testable propositions based on the endogenous-quality model:

Proposition 1 *When firms can choose endogenous product quality, the more productive firms choose higher product quality and set higher prices.*

Proposition 2 *Given the credit needs d, lower level of credit access (i.e., a lower θ) reduces the optimal price set by a firm.*

Proposition 3 *Given the credit access θ, tighter credit constraints resulting from higher credit needs (i.e., a higher d) reduce the optimal price set by a firm.*

Proposition 4 *(Quality Adjustment Effect): Given productivity and the credit needs d, lower level of credit access reduces the optimal quality chosen by a firm. Moreover, given productivity and credit access θ, higher credit needs d lowers the optimal quality chosen by a firm.*

The above analysis is based on the assumption that quality is endogenously chosen by firms and therefore there could be heterogeneity of product quality across firms. For comparison purpose, we carry out analyses based on the original Melitz-type model, in which quality is exogenously fixed across firms. In this case, quality adjustment effect does not exist and productivity only affects marginal cost, leading to the optimal price decreasing in productivity. The intuition for this case is straightforward: more productive firms face lower marginal cost of production and hence charge lower prices to outperform the market. Obviously, the quality adjustment effect does not exist. Hence, tighter credit constraints (i.e., a higher d or a lower θ) increase the optimal prices charged by firms in the exogenous-quality Melitz-type model. See the graph in the right panel of Figure 1 for illustration. We summarize the properties for the exogenous-quality model in the following proposition (see Appendix A for the proof of Proposition 5).

Proposition 5 *When there is no quality choice by firms, a more productive firm sets a lower price. In this case, given the credit needs d, a lower level of credit access (i.e., a lower θ) increases the optimal price set by a firm. Moreover, given the credit access θ, higher credit needs (i.e., a higher d) increases the optimal price set by a firm.*

In the earlier discussion, we assume that all firms are subject to credit constraints in paying all costs. Therefore, both the variable costs and fixed costs cannot be totally financed internally and firms need to raise outside capital for a fraction $d \in (0, 1)$ of the variable costs and the fixed costs including the fixed marketing cost and the fixed investment cost. However, if the firms only need to raise outside capital for a fraction $d \in (0, 1)$ of fixed costs, price distortion induced by credit constraints does not exist. As a result, the optimal price is unrelated to credit constraint when quality is exogenous. We summarize this case in the following proposition (see Appendix B for the proof of Proposition 6).

Proposition 6 *When only fixed costs are financed by outside capital and variable costs can be totally financed internally, tighter credit constraints (i.e., a higher d or a lower θ) reduce the optimal price if quality is endogenous. In this case, prices increase in productivity, ceteris paribus. However, when quality is exogenous, the optimal price is unrelated to credit constraints. In this case, prices decrease in productivity, ceteris paribus.*

The discussion in this section suggests that there are two competing theories to explain the relationship between firm productivity and export prices as well as the effect of credit constraints on the optimal price. As illustrated in Figure 1, the model that assumes that quality is endogenous yields a positive relationship between productivity and export prices, and we should expect tighter credit constraints to lower the optimal prices set by the firm as the quality adjustment effect dominates. On the other hand, the model that assumes that quality is exogenous yields a negative relationship between productivity and export prices, and we should expect that tighter credit constraints increase the optimal prices as the only effect that exists is the price distortion effect. In the next section we use data from China to test the relationship between productivity and prices as well as the impact of credit constraints on export prices. It will be seen that our results support the endogenous-quality model.

3. Empirical Specification, Data and Measurement

3.1. Empirical Specification

The propositions in Section 2 imply that export prices are a function of firm productivity and can be affected by credit access or credit needs. We test the proposed propositions with the following reduced form estimating equation:

$$\log price_{fpct} = b_0+b_1\log(TFP_{ft})+\gamma X_{ft}+\chi_1 FinDev_r+\chi_2 ExtFin_i+\mu\Gamma_{ft}+\varphi_p+\varphi_c+\varphi_t+\epsilon_{fpct} \quad (12)$$

where $price_{fpct}$ represents the unit value export price of product p (disaggregated at HS 8-digit level) exported by firm f located in province r to destination country c in year t; TFP_{ft} denotes a firm f's productivity in year t; X_{ft} is a vector of time-varying firm attributes of firm f in year t; $FinDev_r$ captures the credit access in province r; $ExtFin_i$ reflects the credit needs at industry i and external finance dependence is one of those credit needs measures; Γ_{ft} is a vector of input quality by firm f at year t; φ_p, φ_c, and φ_t are fixed effect terms of product, destination country, and year, respectively;[13] ϵ_{fpct} is the error term that includes all unobserved factors that may affect the export prices. The vector of time-varying firm attributes X_{ft} includes firm size and capital intensity: employment is used to stand for firm size and to control for the economies of scale; capital-labor ratio, K/L, is used to control for production technique, which may not be captured by the technology level of a firm. The input quality Γ_{ft} is measured by average payments for each worker, the ratio of college workers to total employee, and the unit value price of imported inputs.

[13] We do not include the province fixed effects because province fixed effect terms absorb the effects of our credit access measures and make the effects of these measures less significant. However, including province fixed effects does not change the sign of their coefficients.

3.2. Firm-level and Product-level Data

To investigate the relationship between firms' productivity and their export prices as well as the role of credit constraints, we merge the following two highly disaggregated large panel data sets: (1) the firm-level production data, and (2) the product-level trade data. The sample period is between 2000 and 2006.

The data source for the firm-level production data is the annual surveys of Chinese manufacturing firms, which was conducted by the National Bureau of Statistics of China (NBSC). The database covers all state-owned enterprises (SOEs), and non-state-owned enterprises with annual sales of at least 5 million RMB (Chinese currency).[14] Between 2000 and 2006, the approximate number of firms covered by the NBSC database varied from 163,000 to 302,000. This database has been widely used by previous studies of Chinese economy and other economic questions based on evidence from Chinese data (e.g., Cai and Liu, 2009; Lu et al., 2010; Feenstra et al., 2011; Brandt et al. 2012; among others) as it contains detailed firm-level information of manufacturing enterprises in China, such as ownership structure, employment, capital stock, gross output, value added, firm identification (e.g., company name, telephone number, zip code, contact person, etc.), and complete information on the three major accounting statements (i.e., balance sheets, profit & loss accounts, and cash flow statements). Among all the information contained in the NBSC Database, we are mostly interested in the variables related to measuring firm total factor productivity and credit constraints. In order to merge the NBSC Database with the product-level trade data so as to obtain the import and export prices for each firm, we also use firm identification information.

As there are some reporting errors in the NBSC database, to clean the NBSC sample, we follow Feenstra et al. (2011), Cai and Liu (2009), and the General Accepted Accounting Principles to rule out observations if any of the following criteria is violated: (1) the key financial variables (such as total assets, net value of fixed assets, sales, gross value of industrial output) cannot be missing; (2) the number of employees hired by a firm must not be less than 10; (3) the total assets must be higher than the liquid assets; (4) the total assets must be larger than the total fixed assets; (5) the total assets must be larger than the net value of the fixed assets; (6) a firm's identification number cannot be missing and must be unique; and (7) the established time must be valid (e.g., the opening month cannot be later than December or earlier than January).

The second database we use is the Chinese trade data at HS 8-digit level, provided by China's General Administration of Customs. This Chinese Customs Database covers the universe of all Chinese exporters and importers in 2000-2006. It records detailed information of each trade transactions, including import and export values, quantities, quantity units, products, source or destination countries, contact information of the firm (e.g., company name, telephone, zip code, contact

[14] It equals to US$640,000 approximately, according to the official end-of-period exchange rate in 2006, reported by the central bank of China.

person), type of enterprises (e.g. state owned, domestic private firms, foreign invested, and joint ventures), and customs regime (e.g. "Processing and Assembling" and "Processing with Imported Materials"). Among all the information in the customs database, import and export values and quantities are of special interest to this study as they yield unit value price of imported input and export.

In order to merge the above two databases, we match the product-level trade data contained in the Chinese Customs Database to data on manufacturing firms contained in the NBSC Database, according to the contact information of firms, because there is no consistent coding system of firm identity between these two databases.[15] Our matching procedure is done in three steps. First, the vast majority of firms (89.3%) are matched by company names exactly. Second, an additional 10.1% are matched by telephone number and zip code exactly. Finally, the remaining 0.6% of firms are matched by telephone number and contact person name exactly.[16] Compared with the manufacturing exporting firms in the NBSC Database, the matching rate of our sample (in terms of the number of firms) varies from 52% to 63% between 2000 and 2006, which covers 56% to 63% of total export value reported by the NBSC Database between 2000 and 2006. In total, the matched sample covers more than 60% of total value of firm exports in the manufacturing sector reported by the NBSC Database and more than 40% of total value of firm exports reported by the Customs Database.

3.3. Measurement

3.3.1. Measures of Productivity

To capture firms' productivity, we compute both total factor productivity (TFP) in main estimation results and labor productivity (measured by value added per worker) in robustness checks.

For TFP we use a Cobb-Douglas production function as estimation specification:[17]

$$Y_{ft} = A_{ft} L_{ft}^{\beta_l} K_{ft}^{\beta_k} \tag{13}$$

where production output of firm f at year t, Y_{ft}, is a function of labor, L_{ft}, and capital, K_{ft}; A_{ft} captures firm f's TFP in year t. We use deflated firm's value-added to measure production output. We do not include intermediate inputs (materials) as one of the input factors in our main results because the prices of imported intermediate inputs are different from those of domestic

[15] In the NBSC Database, firms are identified by their corporate representative codes and contact information. While in the Customs Database, firms are identified by their corporate custom codes and contact information. These two coding systems are neither consistent, nor transferable with each other.

[16] In order to obtain more precise matching, we do not use contact person and zip code to match trade transactions to manufacturing firms since there are many different companies, which have the same contact person name in the same zip-code region.

[17] An alternative specification would be to use a trans-log production function, which also leads to similar estimation results.

intermediate inputs. As processing trade in China accounts for a substantial proportion of its total trade since 1995, using China's domestic deflator to measure its imported intermediate input would raise another unnecessary estimation bias (Feenstra et al., 2011). However, for robustness check, we also estimated TFP based on the formula, treating material as an intermediate input. It turns out that including intermediate inputs (materials) in the estimation of TFP does not alter our empirical results of testing the theoretical predictions.

As the traditional OLS estimation method suffers from simultaneity bias and selection bias, we employ the augmented Olley-Pakes (1996) approach to estimate firms' total factor productivity to deal with both the simultaneity bias and selection bias in measured TFP. Our approach is based on the recent development in the application of the Olley-Pakes method, for example, Amiti and Konings (2007), Feenstra et al. (2011), and Yu (2011), among others.

First, to measure a firm's inputs (labor and capital) and output in real term, we use different input price deflators and output price deflators, drawing the data directly from Brandt et al. (2012).[18] In Brandt et al. (2012), the output deflators are constructed using "reference price" information from China's Statistical Yearbooks and the input deflators are constructed based on output deflators and China's national input-output table (2002).

Second, we construct the real investment variable by adopting the perpetual inventory method to investigate the law of motion for real capital and real investment. To capture the depreciation rate, we use each firm's real depreciation rate provided by the Chinese firm-level data.

Furthermore, to take into account firm's trade status in the TFP realization, following Amiti and Konings (2007) we include two trade-status dummy variables–an export dummy (equal to one for exports and zero otherwise) and an import dummy (equal to one for imports and zero otherwise). In addition, as we are dealing with Chinese data and our sample period is between 2000 and 2006, we include a WTO dummy (i.e., one for a year after 2001 and zero for before) in the Olley-Pakes estimation, as have been done by Feenstra et al. (2011) and Yu (2011). The WTO dummy can capture the effect of China joining WTO on the realization of the TFP because the WTO accession in 2001 was a positive demand shock for China's exports. Our estimates of TFP coefficients at the 2-digit industry level are reported in Table 1 and the magnitudes of our estimates are similar to those reported by Feenstra et al. (2011).

3.3.2. Measures of Credit Access

In order to measure credit access, we collect data on the balances of total bank credits, long-term bank loans, and short-term bank loans and calculate the bank loans to GDP ratio at the provincial level. As regional heterogeneity is huge in China, we believe that bank loans by province serve as a good proxy for credit access, which reflects regional financial development. Our sample includes 31 provincial-level regions (including 22 provinces, 4 municipalities, and 5 autonomous regions).

[18] The data can be accessed via http://www.econ.kuleuven.be/public/N07057/CHINA/appendix/.

The data source is Almanac of China's Finance and Banking (2000-2007). If the level of financial development is higher, then there is more credit access by firms and so we expect to see increases in optimal prices under the endogenous-quality model.

Another measure we use to proxy for credit access is firm ownership. We compare state-owned enterprises (SOE) with domestic private enterprises (DPE) and multinational corporation (MNC) with joint venture (JV). We compare different types of firms in China because the literature clearly suggests that given the underdevelopment of Chinese financial markets, the Chinese DPE face less credit access than SOE do, because SOE can finance a larger share of their investments through external financing from bank loans provided by state-owned banks. For example, Boyreau-Debray and Wei (2005) point out that the Chinese banks–mostly state owned–tend to offer easier credit to SOE. Dollar and Wei (2007) and Riedel, Jin, and Gao (2007) report that private firms rely significantly less on bank loans and significantly more on retained earnings as well as family and friends to finance investments. Song, Storesletten, and Zilibotti (2011) also show that SOE finance more than 30 percent of their investments through bank loans compared to less than 10 percent for domestic private firms, and other forms of official market financing (through bank loans) are marginal for private firms in China as private firms rely more on internal or informal financing. Therefore, it is safe to conclude that SOE in China face more credit access, compared to DPE. Analogously, the literature also indicates that multinational companies have better credit access than joint ventures as multinational companies are able to reallocate resources on a global scale and finance their subsidiaries from headquarters or other affiliates. Therefore, according to the previous theoretical discussion, if the endogenous-quality model prevails over the exogenous-quality model, we expect the optimal prices set by SOE to be higher than those by DPE and the optimal prices set by MNC higher than those by JV, respectively.

3.3.3. Measures of Credit Needs

Following Manova et al. (2011), we employ four different measures of an industry's financial vulnerability at the 2-digit industry level to proxy for credit needs at the industry level. The idea is that if an industry is more financially vulnerable, it is more likely to face binding credit constraint. These measures have been widely used in the literature on the role of credit constraints in international trade and growth. It should be noted that these measures are meant to reflect technologically determined characteristics of each industry that are beyond the control of individual firms. Therefore, these measures of industrial financial vulnerability are inherent to the nature of the industry, which should be viewed as exogenously given for each individual firm.

These four measures are external finance dependence, R&D intensity, inventory-to-sales ratio, and asset tangibility. An industry's external finance dependence ($ExtFin_i$) is defined as the share of capital expenditure not financed with cash flows from operations. If external finance dependence is high, the industry is more financially vulnerable and have higher credit needs.

R&D intensity is defined as R&D spending to total sales ratio (RD_i), which can also reflect the industry's financial vulnerability, because research and development activities are capital-intensive. Typically, R&D expenditures, as the impetus for production, occur before products can be manufactured and successfully marketed and thus require large financial resource input. Third, we use inventory-to-sales ratio ($Invent_i$) as it captures the duration of the manufacturing process and the working capital that a firm requires in order to maintain inventory so as to meet demand. Last but not least, a measure of asset tangibility ($Tang_i$) can also capture the liquidity situation of an industry and it is defined as the share of net value of fixed assets (such as plants, properties and equipments) in total book value assets. Among these four measures, higher external finance dependence, R&D intensity, and inventory-to-sales ratio imply tighter credit constraint (i.e., a higher d), while higher asset tangibility implies lower credit needs as tangible assets can serve as collateral for borrowing and help to alleviate credit constraints.

In the main tests, we employ these four measures of industrial financial vulnerability constructed by Kroszner, Laeven and Klingebiel (2007), based on data on all publicly traded U.S.-based companies from Compustat's annual industrial files. These measures have also been used by Manova et al. (2011). They are constructed following the methodology of Rajan and Zingales (1998) and Claessens and Laeven (2003). They are averaged over the 1980-1999 period for the median U.S. firm in each sector, and appear to be very stable over time. The four indicators of industries' financial vulnerability are available for 29 sectors in the ISIC 3-digit classification system. We match Chinese HS 8-digit product codes to these ISIC 3-digit sector categories in our empirical analysis.

The application of these measures calculated based on US data to countries other than the US is quite common in the literature (e.g., Rajan and Zingales, 1998; Kroszner et al., 2007, Manova et al., 2011). The rationale is that these measures in an industry of financial needs are determined by the nature of the industry, which is supported to be the same across countries. As argued by Rajan and Zingales (1998), Kroszner et al. (2007), and Claessens and Laeven (2003), among others, there is a technological reason why some industries depend more on external finance than others and these technological differences persist across countries. Manova et al. (2011) also argue that the ranking of industries in terms of their financial vulnerability remains relatively stable across countries. In fact, Rajan and Zingales (1998) explicitly indicate that "most of the determinants of ratio of cash flow to capital are likely to be similar worldwide: the level of demand for a certain product, its stage in the life cycle, and its cash harvest period". This implies that, in principle, the measures calculated by data from any country with well-functioning capital markets should be applicable to our study. Therefore, we use an industry's financial vulnerability calculated based on US data as measures of its credit needs in our main tests. Credit need measures calculated based on Chinese data are not used in the main tests because we suspect that Chinese financial markets are not mature and hence these measures cannot completely reflect the *real* financial needs by firms.

However, for robustness, we also construct the measure of external finance dependence calculated at the 2-digit Chinese Industrial Classification (CIC) level using Chinese firm-level data and report our results in Table 2 (in ascending order of credit needs) so as to compare with the results from the measures based on US data.[19] Due to the immaturity of Chinese financial markets, capital expenditures by Chinese firms are more likely to be financed internally. As a result, the mean external finance dependence in China is lower.[20] Consistent with the finding in prior studies that the external finance dependence of U.S. firms is a good proxy for other countries, we find that the rankings of industries in China and US are similar to each other, with reasonable difference across industries as the two countries use different industrial classification system. For example, tobacco industry is always at the top of the ranking list and is less credit-constrained, while petroleum products industry and professional and scientific equipment industry are at the bottom of the ranking list as they are usually more technology-intensive and need more external capital.

4. Results

In this section, we report our empirical results, which are found to support the theoretical predictions based on the endogenous-quality model.

4.1. Prices and TFP

From the previous theoretical discussion, if the exogenous-quality model prevails, we should expect to see a negative relationship between firm productivity and export prices. On the contrary, if the endogenous-quality model is correct, we should expect that prices increase in productivity, as stated in Proposition 1. The reason is that now firm productivity affects product prices through two channels. On the one hand, higher-productivity firms have lower marginal costs, leading to lower product prices. On the other hand, more productive firms use more expensive inputs to produce goods of higher quality, leading to higher product prices. As the quality effect dominates, the total effect is that prices increase in productivity. In Tables 3-6, when we run regressions of log(price) on log(TFP) according to the estimating equation (12), we find that the coefficients on TFP in all specifications are always positive and significant at 0.001 level. This indicates that there exists a positive relationship between productivity and prices, which supports the endogenous-quality model.

[19] Data available in year 2004-2006 in the NBSC Database. We calculate the aggregate rather than the median external finance dependence at 2-digit industry level, because the median firm in Chinese database often has no capital expenditure. In our sample, approximately 68.1% firms have zero capital expenditure. Hence, we cannot use median firm approach to calculate external finance dependence.

[20] According to our calculation, the mean external finance dependence in China is approximately -0.57 while the mean external finance dependence from the US data is about -0.16.

4.2. Effects of Credit Constraints

4.2.1. Effects of Credit Access and Credit Needs on Price

We are interested in examining the impacts of credit access and credit needs on export prices. According to Proposition 2-3, if the endogenous-quality model is correct, we should expect that lower credit access or higher credit needs lowers the optimal price set by the firm. Otherwise, if the exogenous-quality model is correct, we should expect the opposite effects of credit access and credit needs on export prices.

We report our main results in four tables (Table 3-6) and our results indicate that the predictions of the endogenous-quality model are more consistent with reality. In each of the four tables, we use three types of bank loans to GDP ratio and the different types of firm ownership to control for credit access, and employ one of the four measures of financial vulnerability (i.e., external finance dependence, R&D intensity, inventory-to-sales ratio, and asset tangibility) to proxy for credit needs.

In Table 3-6, specifications (1)-(3) show the regression results under three different measures of credit access using bank loans. Specifications (4) and (5) include two firm-type dummy variables, SOE, which is equal to 1 if the firm belongs to state-owned enterprises (SOE) and 0 if it belongs to domestic private enterprises (DPE); and MNC, which is equal to 1 if the firm is a multinational corporation (MNC) and 0 if it belongs to a joint venture (JV). According to Proposition 2 and further discussion in Section 3.3.2., we expect the coefficients on three types of bank loans as well as SOE and MNC to be positive, if the endogenous-quality model is correct. We find that the coefficients on all measures of credit access are positive and significant at 0.001 level, implying that firms with more access to bank loans set higher prices, and the prices set by SOE and MNC are higher than the prices set by DPE and JV, respectively. These results support Proposition 2.

Analogously, if the endogenous-quality model is correct, according to Proposition 3 and the further discussion in Section 3.3.3., we should expect the coefficients on external finance dependence, R&D intensity, and inventory-to-sales ratio to be negative while the coefficients on asset tangibility to be positive because firms in industries with higher external finance dependence, R&D ratio, and inventory-to-sales ratio face tighter credit constraints whereas those with more tangible assets have more relaxed credit constraints. Again, the results presented in Table 3-6 confirm the endogenous-quality model: given the level of credit access, higher credit needs lowers the optimal prices with statistical significance.

4.2.2. Effects of Credit Access and Credit Needs on Quality

We test Proposition 4 in Table 7 to examine the impacts of credit access and credit needs on the choice of quality. We report our results based on two measures of input quality: unit value price of imported intermediate inputs (specifications (1)-(3)) and (log) average wage per employee (specifications (4)-(6)).[21] The coefficients on productivity are positive and significant in all specifications, implying that more productive firms indeed choose higher quality inputs (either higher-quality imported intermediate inputs or higher-quality labor inputs), consistent with the quality-and-trade literature. Given productivity, we are more interested in the effects of credit access θ and credit needs d on choice of input quality. As predicted by Proposition 4, we observe positive coefficients on credit access measures and negative coefficients on credit needs measures (e.g., external finance dependence). Intuitively speaking, when firms face tighter credit constraints (i.e., a higher d or a lower θ), they tend to choose lower quality inputs to mitigate the impacts of financial distress. Therefore, the results shown in Table 7 validate the *quality adjustment effect* exhibited in Proposition 4.

4.3. Mechanism of Quality Adjustment

The previous results confirm the predictions from the endogenous-quality model. This model works through the mechanism of quality adjustment if firms choose optimal quality according to their productivity and credit constraints. First, optimal prices increase in firm productivity because the quality effect dominates the marginal cost effect. Second, optimal prices decrease in credit needs but increase in credit access because the quality adjustment effect dominates the price distortion induced by credit constraints.

In this section, we further test the mechanism of quality adjustment and show why quality is a valid mechanism in our model. Our earlier theoretical discussions suggest that in the endogenous-quality model, the choice of input quality is the key element through which optimal prices increase in productivity and decrease (or increase) in credit needs (or credit access). Otherwise, if quality is exogenous across firms, the exact opposite effects would hold.

4.3.1. Controlling for the Different Dimensions of Quality

If input quality adjustment is indeed a true and important mechanism, we should expect that without controlling for input quality the effects of productivity, credit needs, and credit access on prices would have been amplified. We thus run the same regressions as in Table 3-6 but do not control for input quality measured by log wage (i.e., we compare the regressions without wage as control variables of input quality with those with wage). In Table 8 we present the regression results using external finance dependence and R&D intensity to represent credit needs and in Table 9 we report results based on inventory-to-sales ratio and asset tangibility as credit needs measures. Comparing Table 8 with Table 3 and 4, we find that without controlling for input quality, the coefficients on TFP almost double and the effects of credit constraints on prices are also substantially increased. Similar patterns exist when we compare Table 9 with Table 5 and 6.

[21] Another measure of input quality, the share of college workers in total employee, yields similar pattern as shown in Table 7. We do not report it in Table 7 to save the space.

We then conduct another test to show that if input quality is controlled for in the regressions, there is substantial reduction in the effects of productivity, credit needs, and credit access on optimal prices. In specifications (1)-(3) in Table 10, we use three different measures of input quality: the unit value price of imported inputs, average payments for each worker, and the fraction of college workers in total employment. The rationale is that firms employing imported intermediate inputs that are more expensive and those hiring more skilled workers do sell their products at higher prices. In general, the average unit value price represents the quality of the good. Hence, the fact that usage of imported inputs is associated with higher unit value prices reflects that when higher-quality inputs are used, firms can charge higher prices. As for the skilled workers, the database from NBSC provides the average wage paid by each firm. In addition, information on workers' education is available for the year of 2004. In specifications (4)-(6) in Table 10 we run regressions using wage as the only indicator of input quality, in comparison with specifications (1)-(3) using three different indicators of input quality. We find that once we control more for input quality (specifications (1)-(3)), the magnitude of the coefficients on productivity, credit needs, and credit access reduces substantially. Therefore, the results in Table 10 further confirm the mechanism of quality adjustment in our model: the impacts of productivity, credit needs, and credit access on prices act through input-quality adjustment by firms.

It should be noted that our results only confirm quality adjustment as a true and important mechanism through which those variables of interest (i.e., productivity, credit needs, and credit access) impact prices, but quality adjustment may not serve as the sole mechanism. Hence, it is not surprising to observe persistent effects of productivity and credit constraints on prices even after controlling for these three different dimensions of input quality. Moreover, it is very unlikely that one can perfectly control for input quality in the empirical investigation.

4.3.2. Effects of Quality-Heterogeneity across Firms

Our empirical results above show that predictions from the endogenous-quality model are supported by the data. To further compare the two competing theories based on exogenous- and endogenous-quality models, we ask: compared with the benchmark estimation results (see Table 3), what if quality presents more heterogeneity across firms? If the endogenous-quality model indeed prevails over the exogenous-quality model, we should expect to observe that the impacts of credit constraints and productivity on prices are larger for industries with more heterogeneity of quality across firms.

We use the variance of unit value export price charged by different firms for the same product to proxy for the heterogeneity of product quality. Then we rank sectors according to the variance of their unit value prices (i.e., quality heterogeneity) and keep those highly heterogeneous sectors at the top 50 percentile as a subsample to test our main prediction.[22] The estimation results are

[22]To rule out some outliers, we winsorize the extreme 5% of total observations.

presented in Table 11. Comparing Table 11 with the baseline regression in Table 3, we find that in all five specifications, the magnitude of the effects of credit constraints (measured by external finance dependence) becomes larger for more quality-heterogeneous sectors as shown in Table 11. Similarly, the effects of credit access (measured by bank loans to GDP ratio and different ownership type) become more pronounced in those sectors.[23] Finally, the impacts of productivity on export prices also become larger. Therefore, this exercise further supports the endogenous-quality model.

5. Robustness

In addition to the estimation results in previous tables, we test a number of other specifications that yield the same patterns of positive relationship between productivity and export prices as well as positive impact of credit access and negative impact of credit needs on prices. The results in Tables 12-16 are not intended for publication, but are just for the perusal of the referees.

First, in the main tables we report the results based on the measures of credit needs calculated based on US firm data. In the robustness checks, we construct the key measurement of credit needs–external finance dependence–using Chinese firm data and report regression results in Table 12. As discussed in Section 3.3.3., the ranking of industries based on Chinese data is quite similar to the one based on US data. Thus, we expect that the results based on the external finance dependence from Chinese data are also consistent with the predictions of the endogenous-quality model: the coefficients on productivity and credit access are significantly positive; while the coefficients on credit needs are significantly negative. The results in Table 12 indeed confirm those predictions.

Second, the results reported in the main tables are estimated using ordinary trade data as we believe firms doing processing trade behave differently from other firms in their exporting behavior. In our sample, ordinary trade accounts for more than 73% of total transactions. Thus the results based on ordinary trade in fact reflect the general situation in our sample. In another robustness check, we include processing trade data and find that all predictions from the endogenous-quality model remain valid except that the sign of the coefficient on the firm-ownership dummy variable MNC now becomes negative (see Table 13). This is because many Hong Kong-or Taiwan-invested firms are viewed as multinational companies but they are in fact doing processing trade and thus behave differently compared with other multinational companies, say from OECD countries.

Third, we tried different measures of productivity. In the O-P method, except for the main results we report, we also include material as an input factor when computing TFP and use the

[23] There is an exception for the comparison between MNC and JV, where the coefficient on MNC becomes negative and less significant.

trans-log production function to estimate TFP as robustness checks. In addition, we use labor productivity measured by value added per employee and report the estimation results based on labor productivity in Table 14. We find that all the main results are preserved. Furthermore, as productivity serves only as a control variable when we test the effects of credit constraints on export prices, we also estimate the baseline regression, Equation (12), without controlling for productivity (see Table 15). By dropping productivity, we can directly observe the overall impact of credit needs and credit access on prices. Again, the results presented in Table 15 support the predictions from the endogenous-quality model: tighter credit constraints lead to lower export prices.

Lastly, to further confirm the robustness of our main results in Table 3, we compute the cluster-robust standard error estimator, clustering at firm level. This takes into account the potential correlation in error terms within each firm as the same firm may react to credit constraints in a similar way to price its products. We report the results in Table 16. All major results regarding the effects of credit access and external finance dependence remain their significance levels, with the only exception that the MNC variable now becomes insignificant. It indicates that the multinational companies may not charge higher prices due to better credit access than joint ventures, after controlling for the potential correlation of unobserved error terms within each firm. The positive relation between TFP and export prices also remains its significance levels in all specifications except for the specification (4), suggesting a weaker relationship between productivity and prices for SOE and DPE in China.

6. Conclusion

In this paper we build a tractable trade model with heterogeneous firms to investigate the relationship between firm productivity and unit value export prices, as well as the impacts of credit constraints (via credit needs and credit access) on optimal export prices. Our model departs from Melitz's (2003) in its incorporation of market penetration costs, endogenous product quality, and credit constraints. The last two features distinguish our model from Arkolakis's (2010). The endogenous determination of product quality is key to our model. As firms endogenously choose input quality to produce goods according to the productivity and the credit constraints they face, the more productive firms tend to choose higher-quality inputs. We call this the *quality adjustment effect*. The quality adjustment effect dominates the marginal cost effect (i.e., higher-productivity firms bear lower marginal costs for the same product quality) and therefore more productive firms charge higher export prices. Furthermore, in our model, the quality adjustment effect dominates the price distortion effect induced by credit constraints. Therefore, optimal prices increase in the level of credit access and decrease in the degree of credit needs, i.e., firms charge lower prices when facing tighter credit constraints. On the contrary, if quality is exogenous across firms, the exact opposite effects would hold, i.e., the optimal prices would decrease in productivity and credit access while firms would charge higher prices when facing higher credit needs. These contrasting empirical implications enable us to test empirically the endogenous-quality model against the exogenous-quality model.

To test the endogenous-quality model against the exogenous-quality model, we use different types of bank loans and firm ownership to proxy for different levels of credit access and employ external finance dependence, R&D intensity, inventory-to-sales ratio, and asset tangibility to proxy for credit needs. Our empirical results show that all predictions from the endogenous-quality model are confirmed at 0.001 significance level, implying that the endogenous-quality model prevails.

The main contribution of this paper is to offer both a theory and the empirical evidence concerning the impacts of credit constraints on export prices set by firms. Our paper contributes to the emerging literature on credit constraints and trade by linking credit constraints with firm attributes and actions such as productivity, quality choice, and optimal export prices. Our paper also contributes to the vast quality-and-trade literature in providing empirical evidence in support of the endogenous-quality model against the exogenous-quality model.

There are undoubtedly some limitations to our present study. One concern is that, like the previous studies of credit constraints, we aggregate credit needs measures at the 2-digit industry level, without taking into account the distribution effects of credit constraints within an industry. As Chaney (2005) indicates, intra-industry distribution of liquidity constraints may impact exporting behavior. It is reasonable to suspect that there are significant impacts of the distribution of credit constraints on export prices as well as on the relationship between productivity and export prices. A thorough analysis of this issue would be fruitful and is left to future research. Another limitation is that our empirical findings and the theoretical propositions both build upon exogenous credit constraints. If credit constraints are endogenously determined, some dynamic effects may emerge, and this would affect the exit and entry of firms. In the present paper, our database does not include non-exporting firms because data on domestic prices are not available at the firm-product level. If domestic-price data are available, we should be able to construct a model to analyze the difference in firm dynamics between exporters and non-exporters with respect to the impacts of credit constraints. For this endeavor, it would be useful to acquire and construct firm- and product-level data on prices in domestic markets.

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7. Appendix

A Proof of Proposition 5 (Quality is exogenous)

When quality is exogenous, the optimization problem of a firm with productivity ϕ, credit access θ, and credit needs d becomes:

$$\max_{p,a}\left(p-\frac{\tau}{\phi}\right)\frac{a^{\sigma-1}p^{-\sigma}}{P^{1-\sigma}}Y-f_x\frac{a^{1+\varepsilon}}{1+\varepsilon}-f_d \tag{14}$$

$$\text{s.t. }\theta\left(\left(p-(1-d)\frac{\tau}{\phi}\right)\frac{a^{\sigma-1}p^{-\sigma}}{P^{1-\sigma}}Y-(1-d)\left(f_x\frac{a^{1+\varepsilon}}{1+\varepsilon}+f_d\right)\right) \tag{15}$$
$$\geq d\left(\frac{\tau}{\phi}\frac{a^{\sigma-1}p^{-\sigma}}{P^{1-\sigma}}Y+f_x\frac{a^{1+\varepsilon}}{1+\varepsilon}+f_d\right)$$

Solving this optimization problem with respect to price p, and advertisement a yields:

$$p=\frac{\sigma}{\sigma-1}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)\frac{\tau}{\phi} \tag{16}$$

$$\frac{a^{\sigma-1}p^{1-\sigma}}{P^{1-\sigma}}Y=\frac{\sigma}{\sigma-1}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_x a^{1+\epsilon} \tag{17}$$

where λ is the Lagrangian multiplier associated with budget constraint condition (15). Next, we analyze this optimization problem for two cases.

Case A.1: The budget constraint (15) is binding.

According to the equations (16) and (17), we have:

$$\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma}\frac{Y}{P^{1-\sigma}}=\frac{\sigma}{\sigma-1}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)^{\sigma}a^{(\sigma-1)\Theta} \tag{18}$$

where $1+\Theta\equiv\frac{1+\epsilon}{\sigma-1}$. The budget constraint (15), together with equations (16) and (17), imply:

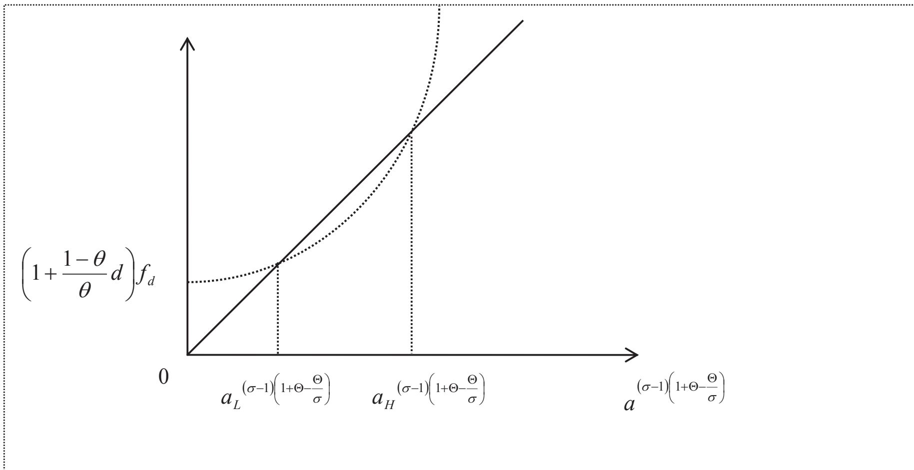
$$\frac{\sigma}{\sigma-1}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_x a^{(\sigma-1)(1+\Theta)}\geq\left(1-d+\frac{d}{\theta}\right)\left(f_x a^{(\sigma-1)(1+\Theta)}+f_x\frac{a^{(\sigma-1)(1+\Theta)}}{(\sigma-1)(1+\Theta)}+f_d\right) \tag{19}$$

Hence, (18) and (19) yield

$$\left(\frac{\tau}{\phi}\right)^{\frac{1-\sigma}{\sigma}}\left(\frac{Y}{P^{1-\sigma}}\right)^{\frac{1}{\sigma}}a^{(\sigma-1)\left(1+\Theta-\frac{\Theta}{\sigma}\right)}\geq\left(1-d+\frac{d}{\theta}\right)\left(\frac{\sigma+\sigma\Theta-\Theta}{(\sigma-1)(1+\Theta)}f_x a^{(\sigma-1)(1+\Theta)}+f_d\right) \tag{20}$$

This equation implies that the budget constraint (15) holds only in the zone $a\in[a_L,a_H]$ as shown in Figure 2. If **the first-best solution** does not belong in this zone, then budget constraint is bind-

Figure 2: When quality is exogenous



ing. Now, the firm's profit satisfies:

$$\left(p-\frac{\tau}{\phi}\right)\frac{a^{\sigma-1}p^{-\sigma}}{P^{1-\sigma}}Y-f_x\frac{a^{1+\varepsilon}}{1+\varepsilon}-f_d=\frac{1-\theta}{\theta}d\left(\frac{\tau}{\phi}\frac{a^{\sigma-1}p^{-\sigma}}{P^{1-\sigma}}Y+f_x\frac{a^{(\sigma-1)(1+\Theta)}}{(\sigma-1)(1+\Theta)}+f_d\right)$$
$$=\frac{1-\theta}{\theta}d\left(f_xa^{(\sigma-1)(1+\Theta)}+f_x\frac{a^{(\sigma-1)(1+\Theta)}}{(\sigma-1)(1+\Theta)}+f_d\right)$$

Then the firm will choose its second-best solution a_H in order to maximize its profit. We use Figure 2 to illustrate: In Figure 2, the horizontal axis denotes $a^{(\sigma-1)\left(1+\Theta-\frac{\Theta}{\sigma}\right)}$ and the vertical axis denotes any multiplicative scale of $a^{(\sigma-1)\left(1+\Theta-\frac{\Theta}{\sigma}\right)}$. The dotted curve represents the right-hand-side of inequality (20) with intercept $\left(1+\frac{1-\theta}{\theta}\right)f_d$. The solid line represents the left-hand-side of inequality (20). As shown in Figure 2, given firm's productivity ϕ, the dotted curve in Figure 2 will shift upward as credit needs d increases or credit access θ decreases. As a result, the optimal demand shifter induced by advertisement will decline. Meanwhile, the optimal price distorted by $1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}$ rises according to equation (18). Therefore, tighter credit constraints (i.e., a higher d or a lower θ) lead to higher prices when quality is exogenous. Given credit access θ and credit needs d, the solid line in Figure 2 will shift upward when productivity ϕ increases. This yields a higher a_H, which implies that the distortion $1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}$ decreases according to equation (19). Hence, the optimal price will decrease in productivity according to the pricing rule (16).

Case A.2: The budget constraint (15) is nonbinding. There is no distortion caused by credit constraint in price setting and the optimal pricing rule is given by $p=\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}$. Hence, the optimal price is unrelated to credit constraint and decreases in productivity. QED.

B Proof of Proposition 6 (Only fixed costs are financed by outside capital)

B1. Under endogenous quality

Now, the optimization problem of a firm with productivity ϕ, credit access θ, and credit needs d becomes:

$$\max_{p,q,a}\left(p-\frac{\tau q^{\alpha}}{\phi}\right)(qa)^{\sigma-1}\frac{p^{-\sigma}}{P^{1-\sigma}}Y-f_x\frac{a^{1+\epsilon}}{1+\epsilon}-f_dq^{\beta} \tag{21}$$

$$\text{s.t. }\theta\left(\left(p-\frac{\tau q^{\alpha}}{\phi}\right)(qa)^{\sigma-1}\frac{p^{-\sigma}}{P^{1-\sigma}}Y-(1-d)\left(f_x\frac{a^{1+\epsilon}}{1+\epsilon}+f_dq^{\beta}\right)\right)\geq d\left(f_x\frac{a^{1+\epsilon}}{1+\epsilon}+f_dq^{\beta}\right) \tag{22}$$

Solving this optimization problem with respect to price p, quality q, and advertisement a yields

$$p=\frac{\sigma}{\sigma-1}\frac{\tau q^{\alpha}}{\phi} \tag{23}$$

$$(qa)^{\sigma-1}\frac{p^{1-\sigma}}{P^{1-\sigma}}Y=\frac{\sigma\beta}{(1-\alpha)(\sigma-1)}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_dq^{\beta} \tag{24}$$

$$(qa)^{\sigma-1}\frac{p^{1-\sigma}}{P^{1-\sigma}}Y=\frac{\sigma}{\sigma-1}\left(1+d\frac{(1-\theta)\lambda}{\theta(1+\lambda)}\right)f_xa^{1+\epsilon} \tag{25}$$

where λ is the Lagrangian multiplier associated with budget constraint (22). Then equations (24) and (25) imply that the optimal volume of advertisement, a, is positively correlated with product quality, q.

$$q^{\beta}=\frac{1-\alpha}{\beta f_d}f_xa^{1+\epsilon} \tag{26}$$

This expression, together with budget constraint (22) and conditions (23) and (24), imply

$$\Lambda\left(1+d\frac{(1-\theta)\lambda}{1+\theta\lambda}\right)\geq\left(1-d+\frac{d}{\theta}\right)\left(\frac{\Lambda}{1+\Theta}+1\right)$$

Then we also analyze two cases.

Case B.1: The budget constraint (22) is binding. Now, equation (22), together with (23) and (26), imply:

$$\left(1-d+\frac{d}{\theta}\right)\left(\frac{\Lambda}{1+\Theta}+1\right)\sigma f_dq^{\frac{\Theta\beta}{1+\Theta}-(1-\alpha)(\sigma-1)}=\left(\frac{(\sigma-1)\Lambda f_d}{f_x}\right)^{\frac{1}{1+\Theta}}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma}\frac{Y}{P^{1-\sigma}} \tag{27}$$

Under the condition (i) $\Theta\beta>(1-\alpha)(\sigma-1)(1+\Theta)$, there is positive correlation between firm productivity ϕ and quality q. Combining the equations (27) and (23), the optimal price in this case is given by:

$$p=\left(\frac{1}{\left(1-d+\frac{d}{\theta}\right)\left(\frac{\Lambda}{1+\Theta}+1\right)\sigma f_d}\right)^{\Psi}\left(\frac{(\sigma-1)\Lambda f_d}{f_x}\right)^{\frac{\Psi}{1+\Theta}}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1+(1-\sigma)\Psi}\left(\frac{Y}{P^{1-\sigma}}\right)^{\Psi}$$

where $\Psi = \frac{\alpha(1+\Theta)}{\Theta\beta-(1-\alpha)(\sigma-1)(1+\Theta)}$. Under the two conditions: (i) $\Theta\beta > (1-\alpha)(\sigma-1)(1+\Theta)$; and (ii) $(\sigma-1)(1+\Theta)-\Theta\beta > 0$, the optimal price increases in productivity. In addition, less credit access (i.e., a lower θ) or higher credit needs (i.e., a higher d) leads to lower prices.

Case B.2: The budget constraint (22) is nonbinding. Based on the same derivation, the optimal pricing rule also satisfies:

$$p = (\sigma\Lambda f_d)^{-\Psi}\left(\frac{(\sigma-1)\Lambda f_d}{f_x}\right)^{\Psi/(1+\Theta)}\left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1+(1-\sigma)\Psi}\left(\frac{Y}{P^{1-\sigma}}\right)^{\Psi}$$

Hence under the conditions (i) $\Theta\beta > (1-\alpha)(\sigma-1)(1+\Theta)$ and (ii) $(\sigma-1)(1+\Theta)-\Theta\beta > 0$, the optimal price increases in productivity. However, the optimal price is unrelated to credit constraints.

B2. Under exogenous quality

Then, the optimal price satisfies:

$$p = \frac{\sigma}{\sigma-1}\frac{\tau}{\phi}$$

Hence, the optimal price decreases in productivity. In addition, the optimal price is independent of credit constraints. QED.

C Tables

Note: Tables 12-16 are not intended for publication but for the perusal of the referees.

Table 1: Total Factor Productivity of Chinese Firms (2000-2006)

Chinese Industrial Classification (2-digit code):	Labor coeff	Capital coeff
Processing of Food from Agricultural Products (13)	0..5136	0.2834
Manufacture of Foods (14)	0.5717	0.3562
Manufacture of Beverages (15)	0.5427	0.4335
Manufacture of Tobacco (16)	0.4559	0.6209
Manufacture of Textile (17)	0.4710	0.2279
Manufacture of Textile Wearing Apparel, Footware, and Caps (18)	0.5505	0.2313
Manufacture of Leather, Fur, Feather and Related Products(19)	0.4801	0.2476
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products (20)	0.5021	0.2893
Manufacture of Furniture (21)	0.5871	0.1442
Manufacture of Paper and Paper Products (22)	0.4960	0.3371
Printing, Reproduction of Recording Media (23)	0.4939	0.2791
Manufacture of Articles For Culture, Education and Sport Activity (24)	0.5036	0.1299
Processing of Petroleum, Coking, Processing of Nuclear Fuel (25)	0.3238	0.4445
Manufacture of Raw Chemical Materials and Chemical Products (26)	0.3799	0.3485
Manufacture of Medicines (27)	0.5082	0.2284
Manufacture of Chemical Fibers(28)	0.5118	0.4046
Manufacture of Rubber (29)	0.4403	0.1651
Manufacture of Plastics (30)	0.4601	0.2859
Manufacture of Non-metallic Mineral Products (31)	0.4173	0.2873
Smelting and Pressing of Ferrous Metals (32)	0.5029	0.3298
Smelting and Pressing of Non-ferrous Metals (33)	0.4349	0.3244
Manufacture of Metal Products (34)	0.4443	0.3000
Manufacture of General Purpose Machinery (35)	0.4686	0.3035
Manufacture of Special Purpose Machinery (36)	0.4949	0.3610
Manufacture of Transport Equipment (37)	0.5488	0.3269
Manufacture of Electrical Machinery and Equipment (39)	0.4873	0.3097
Manufacture of Communication Equipment, Computers and Other Electronic Equipment (40)	0.5327	0.2537
Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work (41)	0.4310	0.2347
Manufacture of Artwork and Other Manufacturing (42)	0.4649	0.2000

Table 2: External Finance Dependence: US vs. China

Industry Name (US)	ISIC	value	value	CIC	Industry Name (CHN)
Tobacco	314	-1.14	-2.59	35	General Purpose Machinery
Leather products	323	-0.95	-1.54	16	Tobacco
Footwear	324	-0.74	-1.34	41	Measuring Instruments and Machinery for Cultural Activity and Office Work
Printing and Publishing	342	-0.42	-1.32	18	Textile Wearing Apparel, Footware, and Caps
Pottery, china, earthenware	361	-0.41	-1.11	19	Leather, Fur, Feather and Related Products
Furniture	332	-0.38	-0.93	34	Metal Products
Paper products	341	-0.35	-0.8	23	Printing, Reproduction of Recording Media
Other chemical products	352	-0.3	-0.72	20	Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products
Non-metallic products	369	-0.29	-0.72	15	Beverages
Fabricated metal products	381	-0.25	-0.72	37	Transport Equipment
Apparel	322	-0.21	-0.65	21	Furniture
Industrial chemicals	3511	-0.19	-0.62	42	Artwork and Other Manufacturing
Food products	311	-0.15	-0.48	17	Textile
Non-ferrous metals	372	-0.12	-0.47	30	Plastics
Transport equipment	384	-0.08	-0.47	13	Processing of Food from Agricultural Products
Machinery, except electrical	382	-0.04	-0.44	27	Medicines
Petroleum refineries	353	-0.02	-0.44	39	Electrical Machinery and Equipment
Plastic products	356	-0.02	-0.41	28	Chemical Fibers
Rubber products	355	-0.02	-0.4	24	Articles For Culture, Education and Sport Activity
Textiles	321	0.01	-0.32	14	Foods
Beverages	313	0.03	-0.29	31	Non-metallic Mineral Products
Synthetic resins	3513	0.03	-0.27	36	Special Purpose Machinery
Glass products	362	0.03	-0.26	29	Rubber
Iron and steel	371	0.05	-0.23	26	Raw Chemical Materials and Chemical Products
Wood products	331	0.05	-0.1	33	Smelting and Pressing of Non-ferrous Metals
Petroleum and coal products	354	0.13	0.02	40	Communication Equipment, Computers and Other Electronic Equipment
Electrical machinery	383	0.24	0.07	22	Paper and Paper Products
Other manufactured products	390	0.28	0.33	32	Smelting and Pressing of Ferrous Metals
Professional and scientific equipment	385	0.72	0.62	25	Processing of Petroleum, Coking, Processing of Nuclear Fuel
	mean	-0.16	-0.57	mean	

Table 3: External Finance Dependence: Export Price vs. Credit Constraints

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.057 ***	0.054 ***	0.056 ***	0.022 ***	0.064 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.025 ***	0.022 ***	0.024 ***	-0.019 ***	0.020 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.044 ***	0.045 ***	0.046 ***	0.019 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.251 ***	0.277 ***	0.244 ***	0.169 ***	0.286 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
ExtFin	-2.985 ***	-3.007 ***	-2.963 ***	-3.008 ***	-3.023 ***
	(0.028)	(0.028)	(0.028)	(0.054)	(0.038)
All Credits to GDP Ratio	0.299***				
	(0.003)				
Short-term Loans to GDP Ratio		0.374***			
		(0.007)			
Long-term Loans to GDP Ratio			0.558***		
			(0.005)		
SOE				0.286***	
				(0.007)	
MNC					0.017***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.538	0.537	0.538	0.586	0.501

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: R&D Intensity: Export Price vs. Credit Constraints

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.056 ***	0.054 ***	0.056 ***	0.021 ***	0.064 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.025 ***	0.022 ***	0.024 ***	-0.019 ***	0.020 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.044 ***	0.045 ***	0.045 ***	0.018 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.251 ***	0.278 ***	0.244 ***	0.169 ***	0.286 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
RD	-25.55 ***	-25.73 ***	-25.40 ***	-25.33 ***	-25.12 ***
	(0.451)	(0.451)	(0.451)	(0.844)	(0.637)
All Credits to GDP Ratio	0.299***				
	(0.003)				
Short-term Loans to GDP Ratio		0.366***			
		(0.007)			
Long-term Loans to GDP Ratio			0.561***		
			(0.005)		
SOE				0.285***	
				(0.007)	
MNC					0.017***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.537	0.535	0.537	0.585	0.500

Notes: Standard errors in parentheses. $^{*}p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 5: Inventory Ratio: Export Price vs. Credit Constraints

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.058 ***	0.055 ***	0.057 ***	0.023 ***	0.064 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.025 ***	0.022 ***	0.024 ***	-0.020 ***	0.020 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.044 ***	0.045 ***	0.045 ***	0.018 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.251 ***	0.277 ***	0.244 ***	0.167 ***	0.285 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
Invent	-15.76 ***	-15.91 ***	-15.69 ***	-20.48 ***	-14.55 ***
	(0.223)	(0.223)	(0.223)	(0.492)	(0.266)
all credits to GDP Ratio	0.298***				
	(0.003)				
Short-term Loans to GDP Ratio		0.368***			
		(0.007)			
Long-term Loans to GDP Ratio			0.560***		
			(0.005)		
SOE				0.288***	
				(0.007)	
MNC					0.016***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.537	0.536	0.537	0.585	0.499

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Asset Tangibility: Export Price vs. Credit Constraints

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.057 ***	0.055 ***	0.056 ***	0.022 ***	0.064 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.025 ***	0.022 ***	0.024 ***	-0.019 ***	0.020 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.044 ***	0.045 ***	0.046 ***	0.019 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.252 ***	0.279 ***	0.245 ***	0.168 ***	0.287 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
Tang	0.600 ***	0.643 ***	0.567 ***	0.253	0.715 ***
	(0.064)	(0.064)	(0.063)	(0.139)	(0.077)
All Credits to GDP Ratio	0.299***				
	(0.003)				
Short-term Loans to GDP Ratio		0.366***			
		(0.007)			
Long-term Loans to GDP Ratio			0.562***		
			(0.005)		
SOE				0.288***	
				(0.007)	
MNC					0.017***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.536	0.535	0.537	0.584	0.498

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Choice of Quality: Import Price and Wage as Dependent Variables

Regressor:	(1)	(2)	(3)	(4)	(5)	(6)
log(TFP)	0.015 ***	0.015 ***	0.015 ***	0.183 ***	0.187 ***	0.180***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
log(Labor)	0.146 ***	0.147 ***	0.146 ***	-0.032 ***	-0.035 ***	-0.034 ***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
log(Capital/Labor)	0.127 ***	0.127 ***	0.127 ***	0.117 ***	0.120 ***	0.119 ***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
log(Wage)	0.113 ***	0.112 ***	0.113***			
	(0.003)	(0.003)	(0.003)			
ExtFin	-3.205 ***	-3.205 ***	-3.205 ***	-0.103 ***	-0.142 ***	-0.078 ***
	(0.069)	(0.069)	(0.069)	(0.001)	(0.001)	(0.001)
All Credits to GDP Ratio	0.042***			0.38***		
	(0.004)			(0.001)		
Short-term Loans to GDP Ratio		0.189***			0.645***	
		(0.012)			(0.003)	
Long-term Loans to GDP Ratio			0.059***			0.652***
			(0.005)			(0.002)
Year fixed effects	yes	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes	yes
Observations	1568866	1568866	1568866	2670022	2670022	2670022
Adjusted R^2	0.506	0.506	0.506	0.356	0.338	0.359

Notes: Standard errors in parentheses. $^{*}p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 8: Mechanism of Quality Adjustment: Export Price vs. Credit Constraints (w.r.t. ExtFin and RD)

Regressor:	(1)	(2)	(3)	(4)	(5)	(6)
log(TFP)	0.103***	0.106***	0.100***	0.102***	0.106***	0.099***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
log(Labor)	0.017***	0.013***	0.016***	0.017***	0.013***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
log(Capital/Labor)	0.074***	0.079***	0.075***	0.073***	0.078***	0.074***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ExtFin	-3.011***	-3.056***	-2.982***			
	(0.028)	(0.029)	(0.028)			
RD				-26.12***	-26.45***	-25.91***
				(0.452)	(0.453)	(0.452)
All Credits to GDP Ratio	0.393***			0.393***		
	(0.003)			(0.003)		
Short-term Loans to GDP Ratio		0.552***			0.544***	
		(0.007)			(0.007)	
Long-term Loans to GDP Ratio			0.716***			0.719***
			(0.005)			(0.005)
Year fixed effects	yes	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	2670022	2670022	2670022
Adjusted R^2	0.534	0.532	0.535	0.533	0.531	0.534

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Mechanism of Quality Adjustment: Export Price vs. Credit Constraints (w.r.t. Invent and Tang)

Regressor:	(1)	(2)	(3)	(4)	(5)	(6)
log(TFP)	0.103***	0.107***	0.100***	0.103***	0.107***	0.100***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
log(Labor)	0.017***	0.012***	0.016***	0.017***	0.013***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
log(Capital/Labor)	0.073***	0.078***	0.074***	0.073***	0.078***	0.075***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Invent	-16.08***	-16.32***	-15.97***			
	(0.224)	(0.224)	(0.224)			
Tang				0.724***	0.803***	0.678***
				(0.064)	(0.064)	(0.064)
All Credits to GDP Ratio	0.393***			0.394***		
	(0.003)			(0.003)		
Short-term Loans to GDP Ratio		0.546***			0.545***	
		(0.007)			(0.007)	
Long-term Loans to GDP Ratio			0.718***			0.721***
			(0.005)			(0.005)
Year fixed effects	yes	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	2670022	2670022	2670022
Adjusted R^2	0.533	0.531	0.534	0.532	0.530	0.533

Notes: Standard errors in parentheses. $^{*}p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 10: Mechanism of Quality Adjustment: Export Price vs. Credit Constraints (with Imported Inputs)

Regressor:	(1)	(2)	(3)	(4)	(5)	(6)
log(TFP)	0.043***	0.040***	0.043***	0.081***	0.079***	0.080***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
log(Labor)	0.022***	0.020***	0.021***	0.007**	0.010***	0.007**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
log(Capital/Labor)	0.020***	0.019***	0.022***	0.034***	0.034***	0.036***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
log(Wage)	0.211***	0.230***	0.208***	0.295***	0.320***	0.288***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
log(Import Price)	0.055***	0.055***	0.055***			
	(0.001)	(0.001)	(0.001)			
Share of College Workers	1.214***	1.252***	1.194***			
	(0.020)	(0.020)	(0.020)			
ExtFin	-3.234***	-3.249***	-3.223***	-3.376***	-3.394***	-3.360***
	(0.093)	(0.093)	(0.093)	(0.094)	(0.094)	(0.094)
All Credits to GDP Ratio	0.234***			0.265***		
	(0.008)			(0.008)		
Short-term Loans to GDP Ratio		0.368***			0.371***	
		(0.021)			(0.021)	
Long-term Loans to GDP Ratio			0.415***			0.486***
			(0.014)			(0.014)
Year fixed effects	yes	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes	yes
Observations	341939	341939	341939	341939	341939	341939
Adjusted R^2	0.542	0.542	0.542	0.533	0.532	0.534

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Mechanism of Quality Adjustment: with More Heterogeneity of Quality

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.068 ***	0.066 ***	0.066 ***	0.028 ***	0.081 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
log(Labor)	0.034 ***	0.031 ***	0.033 ***	0.0094 ***	0.016 ***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)
log(Capital/Labor)	0.072 ***	0.073 ***	0.074 ***	0.057 ***	0.078 ***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)
log(Wage)	0.274 ***	0.307 ***	0.267 ***	0.192 ***	0.336 ***
	(0.003)	(0.003)	(0.003)	(0.007)	(0.004)
ExtFin	-10.18 ***	-10.21 ***	-10.21***	-8.61***	-13.24 ***
	(0.087)	(0.087)	(0.087)	(0.155)	(0.123)
All Credits to GDP Ratio	0.364***				
	(0.005)				
Short-term Loans to GDP Ratio		0.481***			
		(0.012)			
Long-term Loans to GDP Ratio			0.665***		
			(0.008)		
SOE				0.309***	
				(0.011)	
MNC					-0.009*
					(0.004)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	1193612	1193612	1193612	294942	674438
Adjusted R^2	0.558	0.556	0.558	0.602	0.525

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Robustness: Export Price vs. Credit Constraints (ExtFin Constructed by Chinese Data)

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.058 ***	0.055 ***	0.056 ***	0.022 ***	0.064***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.025***	0.023 ***	0.025 ***	-0.019 ***	0.020 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.044 ***	0.045 ***	0.046 ***	0.019 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.252 ***	0.279 ***	0.245 ***	0.168 ***	0.287 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
ExtFin	-0.028 ***	-0.028 ***	-0.030 ***	-0.030 ***	-0.027***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
All Credits to GDP Ratio	0.299***				
	(0.003)				
Short-term Loans to GDP Ratio		0.362***			
		(0.007)			
Long-term Loans to GDP Ratio			0.562***		
			(0.005)		
SOE				0.290***	
				(0.007)	
MNC					0.017***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.536	0.535	0.537	0.584	0.498

Notes: Standard errors in parentheses. $^{*}p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 13: Robustness: Export Price vs. Credit Constraints (with Processing Trade)

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.082 ***	0.080 ***	0.082 ***	0.026 ***	0.091 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.045 ***	0.046 ***	0.043 ***	-0.012 ***	0.051 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.066 ***	0.066 ***	0.068 ***	0.024 ***	0.090 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.298 ***	0.320 ***	0.294 ***	0.186 ***	0.350 ***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.002)
ExtFin	-2.700 ***	-2.728 ***	-2.683 ***	-2.994 ***	-2.611 ***
	(0.024)	(0.024)	(0.024)	(0.053)	(0.030)
All Credits to GDP Ratio	0.345***				
	(0.003)				
Short-term Loans to GDP Ratio		0.631***			
		(0.006)			
Long-term Loans to GDP Ratio			0.593***		
			(0.004)		
SOE				0.271***	
				(0.006)	
MNC					-0.050***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	3857020	3857020	3857020	712838	2603900
Adjusted R^2	0.530	0.529	0.530	0.594	0.500

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Robustness: Labor Productivity Measured by Value-Added per Employee

Regressor:	(1)	(2)	(3)	(4)	(5)
log(Value-Added per Employee)	0.076 ***	0.073 ***	0.074 ***	0.046 ***	0.081 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Labor)	0.040 ***	0.037 ***	0.039 ***	-0.012 ***	0.037 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.024 ***	0.026 ***	0.026 ***	0.007 ***	0.037 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.239 ***	0.265 ***	0.232 ***	0.156 ***	0.276 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
ExtFin	-2.984 ***	-3.007 ***	-2.962 ***	-3.006 ***	-3.019 ***
	(0.028)	(0.028)	(0.028)	(0.054)	(0.038)
All Credits to GDP Ratio	0.303***				
	(0.003)				
Short-term Loans to GDP Ratio		0.392***			
		(0.007)			
Long-term Loans to GDP Ratio			0.563***		
			(0.005)		
SOE				0.294***	
				(0.007)	
MNC					0.017***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.538	0.537	0.539	0.586	0.501

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Robustness: Export Price vs. Credit Constraints (without controlling for TFP)

Regressor:	(1)	(2)	(3)	(4)	(5)
log(Labor)	0.035 ***	0.032 ***	0.034 ***	-0.015 ***	0.033***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Capital/Labor)	0.043 ***	0.044 ***	0.045 ***	0.018 ***	0.058 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
log(Wage)	0.282 ***	0.307 ***	0.274 ***	0.179 ***	0.320 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
ExtFin	-2.991 ***	-3.012 ***	-2.970 ***	-3.010 ***	-3.027 ***
	(0.028)	(0.028)	(0.028)	(0.054)	(0.038)
All Credits to GDP Ratio	0.287***				
	(0.003)				
Short-term Loans to GDP Ratio		0.339***			
		(0.007)			
Long-term Loans to GDP Ratio			0.544***		
			(0.005)		
SOE				0.278***	
				(0.007)	
MNC					0.011***
					(0.002)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.537	0.536	0.538	0.586	0.500

Notes: Standard errors in parentheses. $^{*}p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: Robustness: Export Price vs. Credit Constraints (Cluster-Robust Errors at Firm Level)

Regressor:	(1)	(2)	(3)	(4)	(5)
log(TFP)	0.057 ***	0.054 ***	0.056 ***	0.022	0.064***
	(0.007)	(0.007)	(0.007)	(0.014)	(0.008)
log(Labor)	0.025 **	0.022 **	0.024 **	-0.019	0.020*
	(0.008)	(0.008)	(0.008)	(0.011)	(0.009)
log(Capital/Labor)	0.044 ***	0.045 ***	0.046 ***	0.019	0.058***
	(0.006)	(0.006)	(0.006)	(0.011)	(0.006)
log(Wage)	0.251 ***	0.277 ***	0.244 ***	0.169 ***	0.286***
	(0.016)	(0.016)	(0.016)	(0.023)	(0.016)
ExtFin	-2.985 ***	-3.007 ***	-2.963 ***	-3.008 ***	-3.023 ***
	(0.265)	(0.265)	(0.265)	(0.449)	(0.307)
All Credits to GDP Ratio	0.299***				
	(0.024)				
Short-term Loans to GDP Ratio		0.374***			
		(0.060)			
Long-term Loans to GDP Ratio			0.558***		
			(0.041)		
SOE				0.286***	
				(0.054)	
MNC					0.017
					(0.017)
Year fixed effects	yes	yes	yes	yes	yes
Destination fixed effects	yes	yes	yes	yes	yes
Product fixed effects	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes
Observations	2670022	2670022	2670022	656343	1532337
Adjusted R^2	0.538	0.537	0.538	0.586	0.501

Notes: Cluster-robust standard errors in parentheses. $^{*}p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$