The Impact of Credit Constraints on the Performance of Chinese Agricultural Wholesalers

Lifang Hu*

School of Agricultural and Rural Development
Renmin University of China

Rigoberto A. Lopez

Department of Agricultural and Resource Economics
University of Connecticut

Yinchu Zeng

School of Agricultural and Rural Development
Renmin University of China

*contact author: lilyruc@126.com

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Abstract: Following market reforms and economic growth since the late 1970s, agricultural wholesale markets in China have developed substantially and become increasingly important in food distribution. This paper investigates the impact of credit constraints on the performance of agricultural wholesalers via a stochastic frontier approach (SFA) and a sample of 1,332 wholesalers nationwide. Empirical results show that relaxing credit constraints imposed by formal institutions results in an approximately 20-30 percent increase in the annual sales of agricultural wholesalers who are credit-constrained (40 percent of the sample). Credit constraints disproportionally impact the performance of micro and small wholesalers. Thus, policies aimed at providing credit access for these wholesalers would significantly boost the performance of smaller agricultural wholesalers while improving the functioning of these markets in China.

Keywords: credit, credit access, agriculture, wholesalers, stochastic frontier, China

JEL: Q14, Q13, O13

1. Introduction

Previous work indicates that small and medium-sized businesses in developing countries are generally undercapitalized and that lack of access to formal credit increases risk aversion and is a significant obstacle to capital accumulation, technology adoption, and productivity (Akoten et al., 2006; Briggeman et al., 2009; Absanto and Aikaruwa, 2013; Essien and Arene, 2014).[1] While many studies of access to credit have looked at the existence and determinants of credit constraints among small and medium enterprises (SMEs) and farm households, there is a lack of studies on how access to credit impacts their business performance (Bigsten, et al., 2003). Petrick (2004) and Briggeman et al. (2009) demonstrate that being credit-constrained lowered production. They assume that credit constraints can be part of budget constraints and that, by relaxing budget constraints, credit access ultimately increases the level of optimal production. On the other hand, some studies conclude that credit does not affect performance. Akoten et al. (2006) use profitability and the employment growth rate to measure the performance of garment firms and conclude that credit access is not a decisive factor influencing firm performance.

Chinese agricultural wholesalers, an economically important component of the food supply chain, provide a useful case study for analysis of the impact of credit access. As in many developing countries, most Chinese agricultural wholesalers are small and medium-sized businesses that play an important role in stimulating vertical market transactions and improving farmers' income and consumer welfare, as well as ensuring

[1]In this paper, "credit constraints" refers to formal limits imposed by commercial banks, micro-finance institutions, and other formal financial institutions, not to loans from relatives, friends, and other non-formal sources.

the food supply (Yu et al., 2009; Ma, 2014).[2] More than 70 percent of fresh produce now passes through wholesale markets before reaching the Chinese consumer (Ma, 2014). As illustrated in Figure 1, primary produce wholesalers are vital to downstream businesses that retail food to Chinese consumers. In addition, wholesale markets are broadly important in the Chinese economy. According to the Ministry of Commerce of China (2014), at the end of 2013 there were 4,476 agricultural wholesale markets in China with total annual sales of 3.74 trillion yuan (approximately 614 billion U.S. dollars), employing 2.14 million agricultural wholesalers and 6.5 million additional employees. It is worth noting that the People's Republic of China is the world's largest importer, producer, and consumer of agricultural products. Therefore, the performance of Chinese agricultural wholesale markets can also have implications for other countries.

This article makes two contributions to the existing literature on credit access and production outcomes: (1) it provides quantitative evidence on the impact of access to credit by wholesalers in Chinese agricultural markets in contrast to small and medium-sized non-agricultural enterprises or farm households, which are well-explored in the existing literature; and (2) rather than using the standard linear model, it employs a stochastic frontier approach (SFA) to estimate the impacts of credit constraints on the volume of output through both intermediate inputs and managerial ability. Unlike Petrick (2004) and Briggeman et al. (2009), this approach allows for deviations from the frontier caused by inefficiency in, for example, managerial factors in addition to random errors. To fully account for credit constraints requires using an integrated

[2]Agricultural wholesalers play an active role in connecting smallholders with processors, retailers, and consumers in developing countries (Gabre-Madhin, 2001; Fafchamps et al., 2003).

framework that not only considers the effects of credit access on the ability to buy intermediate inputs but also on managerial ability, given the levels of capital and labor.

Using national survey data on 1,332 Chinese agricultural wholesalers in 18 markets, we find that approximately 40 percent of wholesalers are credit-constrained. Our empirical results indicate that being credit-constrained is negatively associated with wholesalers' sales performance. Relaxing credit constraints can increase credit-constrained wholesalers' sales between 21 and 32 percent. Thus, the credit constraints that agricultural wholesalers face have implications particularly for the smooth functioning of Chinese agricultural wholesale markets.

2. The Impact of Credit Constraints

Credit constraints arise from asymmetric information between lenders and borrowers. The potential for adverse selection and breaches of contracts discourages lenders from using the interest rate as a way to ration excess credit demand (Stiglitz and Weiss, 1981). As a result, some borrowers may receive credit, while others with similar financial characteristics may not (Briggeman et al., 2009). Credit constraints are strong enough to push small and medium-sized businesses out of credit markets (Akoten et al., 2006), thus impacting performance.

The impact of credit constraints, if any, is conditional on several variables and on whether firms are credit-constrained in the first place. Thus, numerous studies try to examine the existence and determinants of credit constraints that SMEs and farm households face. Jappelli (1990), Crook (1996), and Petrick (2004) identify a household

as credit-constrained if its demand for credit exceeds the supply of credit. Briggeman et al. (2009) point out that potential borrowers who do not need credit should not be classified as credit-constrained. Kon and Storey (2003) find that high application costs and banks' erroneous screening due to a lack of information could discourage applicants, and that "discouraged borrowers" should be treated as credit-constrained. Akoten et al. (2006) find that older firms that are relatively large and whose owners have more relatives in the same line of business (i.e., are socially networked) have better access to subsidized bank loans. Briggeman et al. (2009) find that farms with greater net worth, with college educated owners, and that have been in the business longer have a lower probability of being credit-constrained.

Credit constraints can affect wholesalers' performance in at least two ways: (1) consistent with Briggeman et al. (2009)'s assumption, access to credit relaxes agricultural wholesalers' budget constraints, enabling them to buy intermediate inputs like raw agricultural products and packaging and labor in the short run, and fixed assets in the long run; and (2) wholesalers' access to credit can improve their managerial ability as they are more likely to buy and sell products at the time of better prices since they do not face liquidity constraints.

To illustrate the impact of credit constraints on the volume of output handled by agricultural wholesalers, consider two possible cases: (1) credit access affects the purchase of intermediate inputs (i.e., raw agricultural commodities) through a budget constraint; and/or (2) credit access affects the efficiency of the use of other inputs (capital and labor). To illustrate, in Figure 2, let Q denote the level of outputand X the

level of the sole variable input. Case 1 illustrates where a credit constrained firm can buy $X_c - X_a$ on credit, thus increasing output from y_b to y_c due to credit access. Case 2 illustrates whether the firm is also inefficient. Accordingly, an increase in output from y_a to y_b with the same variable input X_a is possible by improving managerial abilities. Note that if credit access affects managerial ability, it is possible to increase sales without purchasing additional inputs.

3. Empirical Model

This article draws its empirical framework from the stochastic frontier approach proposed by Aigner et al. (1977) and O'Donnell (2016). Following their approach, we propose a stochastic frontier production function model：

$$y_i = f\left(x_{ij}; z_{ik}; \beta_j; \delta_k\right) exp(v_i - u_i), \qquad (1)$$

where subscripts i, j and k denote an individual wholesaler i using input j with productive and environmental characteristics k. y_i is a log measure of output for wholesaler i. x_{ij} is a vector of inputs, and β_j is a vector of corresponding coefficients to be estimated for wholesaler i usinginput j. z_{ik} is a vector of production and environmental characteristics, and δ_k is a vector of corresponding coefficients to be estimated for wholesaler i. v_i is the random errorand $v_i \sim N(0, \sigma_v^2)$, and u_i is the deviation from the frontier due to lack of managerial ability.

Let the production function be a Cobb-Douglas type, where output and inputs are in logarithms. The empirical model in equation (1) can thus be expressed as follows:

$$y_{ij} = \beta_0 + \sum_j \beta_j x_{ij} + \sum_k \delta_k z_{ik} + v_i - u_i. \qquad (2)$$

We assume that output is determined by the level of input (x_{ij}) used, other productive and environmental characteristics (z_{ik}) such as technology, and the deviations from the production frontier: an unobserved random error v_i and an efficiencydeviation u_i for wholesalers below the frontier due to lack of managerial ability. As discussed above, credit constraints can enter the SF production function either as a proxy for intermediate inputs (assuming the wholesaler is otherwise efficient) or embedded in u_i to reflect how they impact managerial ability.

According to Farrell (1957) and Fried et al. (2008), technical efficiency is defined by$exp(-u_i)$. A higher value of $exp(-u_i)$ indicates a smaller deviation from the stochastic frontierand being closer to a technically efficient output in the cases where credit constraints impact managerial ability. The null hypothesis of zero variance of $u_i$is tested in the estimation model, and the results of the stochastic frontier model will be employed if the null hypothesis is rejected; if not, the model will become a standard linear model.

4. Data and Estimation

The data to estimate equation (2) came from a national survey administered in 18 agricultural wholesale markets in 13 provinces in China from October through December 2014, by the School of Agricultural Economics and Rural Development at Renmin University of China. The survey sample is comprised of 1,601 agricultural wholesalers, but after eliminating observations missing critical information (e.g., whether or not the wholesaler was credit-constrained, sales, or input levels), the

estimating sample consisted of 1,332 wholesalers. The data collected provide comprehensive information on wholesalers' access to and use of different sources of credit as well as characteristics of the wholesale businesses and their owners.[3]

The stochastic frontier production model was specified as follows. Output (y_i) of wholesalers is measured by their level of sales, given the diversity of commodities they specialize in.[4]Variable inputs (x_{ij}) used by each wholesaler include hired labor and the value of fixed assets (buildings, equipment). No data were available on the quantity of intermediate inputs, such as packaging and agricultural materials acquired from farmers. Instead, for wholesalers who were credit-constrained, a credit-constrained variable (explained below) was included in the model. Other production shifters include the state of technology (internet use and product packaging), commodity, and regional fixed effects to capture unobserved commodity and regional characteristics. In addition, we treat wholesalers' characteristics and owners' human capital characteristics as proxies for managerial ability and, thus, determinants of deviations below the production frontier.

The determinants of deviations from the frontier (v_i) include factors that influence managerial ability, including a variable for credit constraints. Other factors include owner characteristics (education, gender, and age), years in business as a proxy for

[3]The data are representative of the characteristics of wholesalers in Chinese agricultural markets. First, we selected 13 key provinces based on Chinese agro-distribution. Second, 18 wholesale markets were selected, based on trading volume, annual turnover, geographical location, and other essential business information from the Ministry of Commerce of China (Ministry of Commerce of China, 2014). Third, 10 to 40 wholesalers were randomly selected from sub-markets for fruits, vegetables, meat, fish, grain, eggs, and other agricultural commodities. Finally, we distributed questionnaires and conducted in-person interviews.

[4]Results using physical output units, such as tonnage, did not produce better results and, in fact, distorted performance as commodities differ greatly in value. In addition, given the competitive conditions on the output buyer side, sales are a simple monotonic transformation of output since output prices are fixed and exogenous at the wholesale level and sales are the product of output and output price.

experience, and whether or not the wholesaler belongs to an industry association.

Next, we turn our attention to how to measure whether or not a wholesaler was credit-constrained. Our structured questionnaire outcomes allow us to adopt the direct approach of Jappelli (1990) to identify credit constraints. However, Briggeman et al. (2009) pointed out that there is a contamination in Jappelli's (1990) classification of credit constraints. They demonstrate that there is a bias when potential borrowers who do not need credit are classified in the control group. We therefore classify a wholesaler's status of credit constraint as conditioned on seeking or needing credit, eliminating the contamination of those who do not need credit being in the control group.[5]

Thus, among those seeking credit, credit-constrained status is designated when one of the following conditions is met: (1) the wholesaler was rejected by a bank in the last two years; (2) the loan amount granted was less than requested; (3) the wholesaler did not apply for credit in the last two years because he or she was a discouraged borrower. However, the status of being credit-constrained may potentially be an endogenous variable in the stochastic frontier model. Banks generally base loan decisions on

[5]We estimate those who did and did not apply for loans in the last two years. First, among those who applied for credit in the last two years, wholesalers who reported that they applied through commercial banks or micro-finance institutions but were rejected or only got part of what they applied for are classified as credit-constrained; those who applied for loans and obtained the total amount they applied for are classified as unconstrained. Second, from those who did not apply for credit during the last two years, we elicited self-reported reasons, such as: "the loan application procedure is too complicated," "it takes a long time to process the application," "lack of collateral," "the loan I want to obtain is short-term," "the loan amount is less than required," "high interest rate," "fear of denial," "not familiar with bankers," "I fear that I have no chance of success in business and can't make repayment," and "I am not a local citizen and am afraid of being rejected." These situations arise from credit rationing by financial institutions as well as potential borrowers' self-rationing behavior. We classify wholesalers who gave the above answers as credit-constrained.

observable characteristics of borrower, and such decisions are not random.[6]

Li et al. (2016) point out that to estimate the impact of credit on firm performance, one needs to use appropriate instrumental variables to avoid bias.[7] We use four instrumental variables to estimate a probit model of the determinants of credit-constrained status: firm size (as in Li et al., 2016), firm's age (as in Akoten et al., 2006 and Briggeman et al., 2009), prior satisfaction with formal financial services, and ownership of an apartment or house as a proxy for collateral. Due to long-existing credit rationing in Chinese financial markets, financial institutions have a relatively high probability of imperfect screening, which may result in either pushing some of the qualified borrowers out of the credit market or potential borrowers' becoming discouraged (Kon and Storey, 2003).[8] Such "discouraged borrowers" made up as much as 23.13 percent of the group seeking loans. Last, since financial institutions always require collateral, such as owners' houses, when making loan decisions (Berkowitz and White, 2004), firms having a higher value of collateral are more likely to have access to credit. We use ownership of an apartment or house as an instrument.[9]

Table 1 shows the summary statistics of the variables used for estimation of the SF model.[10] Model estimation was done in two stages: (1) we estimate the probit model

[6]Peterson and Rajan (1997) find that credit could simply go to better-performing firms.

[7]However, they empirically find that credit access is not correlated with performance (firm size, labor productivity, and returns to assets) for Chinese manufacturing firms.

[8]With a better environment for financing in the wholesale markets, banks are more likely to obtain more detailed information about borrowers' operations, and wholesalers are more likely to be familiar with the loan application process, which can result in reduced information asymmetry and better screening mechanisms by banks.

[9]Even though agricultural wholesalers may use fixed facilities like packing machines and cold storage warehouses, these facilities are usually rented from the wholesale markets. Therefore, ownership of real estate is decisive of credit access in practice.

[10]After deleting observations with missing data, the usable sample contained data for 1,332 agricultural wholesalers.

of the determinants of being credit-constrained, and (2) we estimate two alternative models of the stochastic frontier function, placing the predicted credit constraint status (condition of needing credit) either directly in the production function as a proxy for intermediate inputs or in the managerial efficiency deviation. Unfortunately, a comprehensive model that includes both potential impacts was not estimable, but we do compare the performance of the alternative models. Furthermore, the null hypothesis of the variance of inefficiency component of the SF models being equal to zero is rejected, and the results of the stochastic frontier models are employed instead of a standard linear model. Stata12.0 is employed to complete data processing and the regression analysis. The empirical results are presented below.

5. Empirical Results

The results for the probit model for instrumentalizing credit constraint status are presented in Table 3. These results conform to expectations in terms of prior results on the determinants of credit access and the signs of the coefficients (Akoten et al., 2006; Briggeman et al., 2009). Thus, the predicted values of the probit model were deemed appropriate to use in the SF model. To this end, the predicted values of the credit constraint variable were interacted with a dummy variable for those wholesalers who needed credit in the SF models, rendering a value of zero for credit constraint of those who did not need credit in the first place.

The null hypothesis of zero variance of u_i equal to zero is rejected in both SF models estimated, leading us to use a SF model rather than a standard linear model used in the

credit literature. Since SF models 1 (credit constraints as a proxy for intermediate inputs) and 2 (credit constraints as affecting managerial ability) are non-nested models, the Akaike Information Criterion (AIC) was used to select the preferred model, that is, one with a lower AIC value being preferred. The log likelihood values are similar for the two models; nearly all parameters for the two models are similar, except for credit constraints. In addition, the coefficient for credit constraints is statistically more significant for Model 1 than for Model 2. Therefore, based on AIC and the t-tests for credit constraints, Model 1is preferred but Model 2 cannot be excluded.[11]

Table 4 shows that nearly all parameters for the production frontier and efficiency are statistically significant at the 5 percent level. The coefficients of the variables of the value of fixed assets, number of workers, credit constraints, internet use, packaged products, years in business, membership in a business association, and age and gender of the owner are all statistically significant and their signs are in line with expectations.

Impact of Credit Constraints on Sales

The empirical results in Table 4 indicate that being credit-constrained is negatively associated with total sales at significance levels of 5 and 10 percent for Models 1 and 2, respectively. Thus, the composite effect of credit constraints is to significantly reduce production of wholesalers in Chinese agricultural wholesale markets. The estimated effect of credit constraints is robust.

[11]We use Model 2 to compute Farrell's (1957) technical efficiency via a t-test and find that the mean of technical efficiency of credit-constrained wholesalers is statistically smaller (at the 1 percent significance level) than that of non-credit-constrained wholesalers.

To analyze the impact of eliminating credit constraints on wholesalers, sales are simulated by setting the credit-constraint value to zero and comparing sales of wholesalers with and without credit constraints. The simulation result for Model 1 reveals that for those who are credit-constrained, eliminating credit constraints will result in a 21.41 percent increase in production or sales. This is consistent with the findings of Briggeman et al. (2009)that being credit-constrained decreases output value significantly, resulting in a loss of 3 and 13 percent of the value of production for farm and non-farm proprietorships respectively.

We further compare the impact of credit constraints on sales by different wholesaler sizes, using the Ministry of Commerce (2014) classification system for enterprise sizes.[12] The results reveal that for micro, small, medium, and large firms, eliminating credit constraints can increase sales among those that are credit-constrained by 23.11, 21.56, 18.39, and 2.73 percent, respectively. The finding that eliminating credit constraints would disproportionately increase the percentage of sales of smaller rather than large wholesalers merits additional explanation. Smaller wholesalers tend to rely more on credit for the purchase of raw products and materials. Therefore, it is more difficult for them to maintain business volumes if they are credit-constrained. That is, large wholesalers are less affected by credit constraints.

The simulation result for Model 2 reveals that eliminating credit constraints will result in a 31.72 percent increase in sales if we regard credit constraints as affecting

[12]According to firm size classification of the agricultural industry issued by the Ministry of Commerce of China, an agricultural firm with annual sales lower than 0.5 million yuan a year is a micro-firm; those with annual sales between 0.5 million and 5 million yuan are small firms; those with sales between 5 million and 200 million yuan are medium-sized firms; and those with sales more than 200 million yuan are designated as large firms.

managerial ability. For micro, small, medium, and large firms, eliminating credit constraints can increase sales among those that are credit-constrained by 34.34, 31.96, 27.12, and 3.90 percent, respectively. These results are consistent with the results for Model 1 on various sizes of wholesalers. The results for Models 1 and 2 differ from those of Akoten et al. (2006) and Li et al. (2016), who find that larger wholesalers are disproportionately affected by credit constraints.

The correlation between the removal of credit constraints and an increase in sales performance also merits additional explanation, as the production methods and behavior of wholesalers need to be taken into account. First, access to credit is an indicator of cash flow, and the amount of loans is part of the budget constraint. As we have put labor and fixed assets into the model, a production increase is associated with the fact that wholesalers with access to credit can buy more intermediate materials, such as packing bags, and intermediate inputs that will add value to their products from the point of view of buyers. Moreover, with relaxed budget constraints, wholesalers in agricultural wholesale markets can buy more agricultural produce from farmers or upstream dealers, thus enlarging their business scale.[13] This advantage is generally based on oral or written contracts in Chinese agricultural markets (Yu et al., 2009). In this case, wholesalers with access to credit can obtain expected amounts from upstream produce sources and make advance payment to enforce these contracts. Last, access to credit influences wholesalers' timing to improve performance. Since prices of

[13]For instance, nearly 70 percent of wholesalers in our sample buy agricultural produce from relatively fixed upstream sellers to get an expected amount of produce and avoid food insecurity problems. Cash flow is an essential factor in building this source advantage.

agricultural products go up and down even daily, a wholesaler with abundant cash can wait for the best trade timing to buy at a lower price or sell at a higher price. Thus, access to credit could increase outcome performance by relaxing cash flows for intermediate materials, enlarging business scale and timelines of trade.

Impact of Other Factors

In terms of other factors affecting the wholesalers' stochastic frontier, the value of fixed assets and number of workers are statistically significant at the 1 percent level and are found to be positively associated with sales. Since their coefficients are elasticities, the results show that a 1 percent increase in the value of fixed assets would result in an approximately 9 percent increase in annual sales. Frequent use of the internet increases sales, as wholesalers improve their information on product prices and market news provided by websites of local market organizers. Internet access also allows them to advertise and use software such as "Wechat" and "QQ." Nowadays, even though more than 90 percent of wholesalers use face-to-face transactions, releasing product and firm information on the internet is prevalent in China. In addition, packaging is positively associated with sales since it adds product value.

Table 4 also shows that wholesalers who handle fruits, vegetables, meat, fish, and grain sales have significantly higher sales than those who sell flowers, tea, eggs, and other miscellaneous sub-markets. The finding that sales are higher in eastern and western wholesale markets relative to central China merits additional explanation. According to our survey data, there is a distribution network connecting north and south

among eastern provinces of China. Thus, agricultural wholesale markets are well established in these provinces, performing better than those in the central provinces. However, wholesale facilities, particularly highways, are highly developed in the central provinces, providing better transportation infrastructure than for eastern and western distribution centers. Therefore, agricultural wholesale markets in central China have potentially better sales performance.

Managerial factors are treated as factors that impact efficiency. The estimated parameters in Table 4 show that years in business, membership in a business association, and male ownership are positively associated with wholesalers' higher sales. Since years in business is a proxy for management experience, older firms are generally believed to be managed more efficiently and to handle risk and labor arrangements better. Membership in a business association improves performance by influencing the owners' ability in management, as many business associations in the wholesale sector organize business training and share experiences and marketing information. Based on our survey data, the main activities, such as providing information, marketing, sharing business experience, analyzing industry developments, human capital training, and business parties, account for 26.74, 11.74, 26.74, 13.48, 8.26, and 13.04 percent, respectively, of total activities. Thus, owners gain managerial efficiency by taking part in these activities.

The impact of age level is nonlinear, as younger owners manage better than their 55+ years-old counterparts. At the same time, male wholesaler owners have significantly higher sales than female owners. Education is positively associated with sales, although

not statistically significantly, perhaps because education levels in our sample are generally low, since most wholesalers only have middle and high school degrees (as shown in Table 2).

6. Conclusions

In Chinese agricultural markets, the majority of wholesalers, who play a critical role in the marketing system for agricultural products, are small and medium-sized businesses and, like other small and medium-sized businesses in China today, many face serious credit constraints. Using national survey data on 1,332 agricultural wholesalers, this study indicates that credit-constrained wholesalers account for approximately 40 percent of those seeking or needing credit.

This article estimates a stochastic frontier model of wholesalers in Chinese agricultural markets and identifies the impact of credit constraints on their performance. It reveals that credit access has an strong impact on agricultural wholesalers' production performance, and simulation results show that eliminating credit constraints will result, on average, in a21.41 to 31.72 percent increase in annual sales, since access to credit can increase outcome performance by relaxing cash flow for intermediate materials, enlarging business scale, and helping capture trade timing. Further results show that credit constraints are disproportionally biased against micro and small-sized wholesalers whose sales levels are the most adversely impacted, whether by limiting their ability to buy intermediate inputs or byimpairing managerial ability.

A key contribution of this article is that it extends the few existing survey-based

quantitative studies on the access to credit of individual wholesalers in the Chinese agricultural markets. Moreover, this article provides policy makers and researchers a framework for estimating the impact of credit access on the level of sales using the stochastic frontier approach. This framework demonstrates that there is loss in efficiency mainly accounted for by managerial factors.

The ensuing increase in performance that could be derived from eliminating credit constraints is significant and, therefore, a worthwhile policy goal, particularly for small and medium-sized wholesalers in Chinese agricultural markets. However, because credit markets in China are imperfect, it is essential to further innovate and improve loan mechanisms to effectively reduce credit constraints faced by small and medium-sized agricultural wholesalers who might otherwise qualify for credit.

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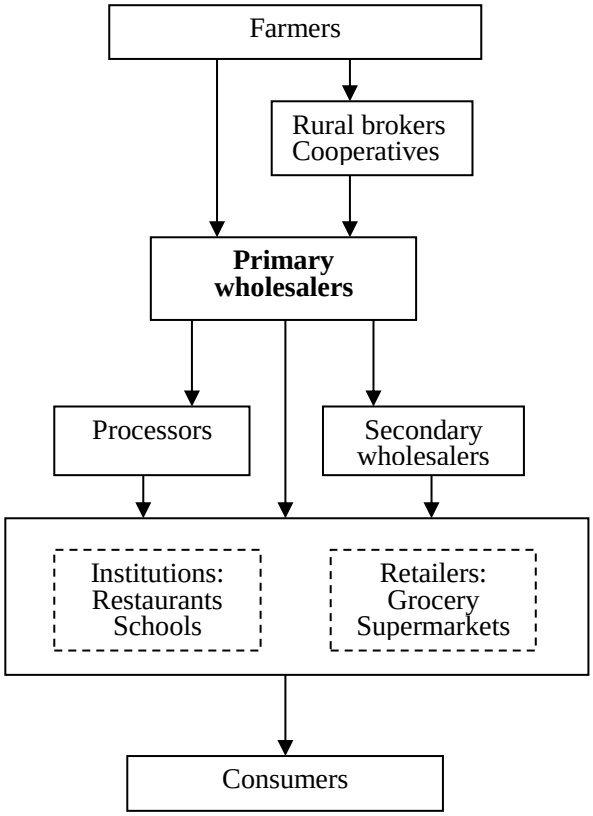

Figure 1. Typical Produce Market Channels in China

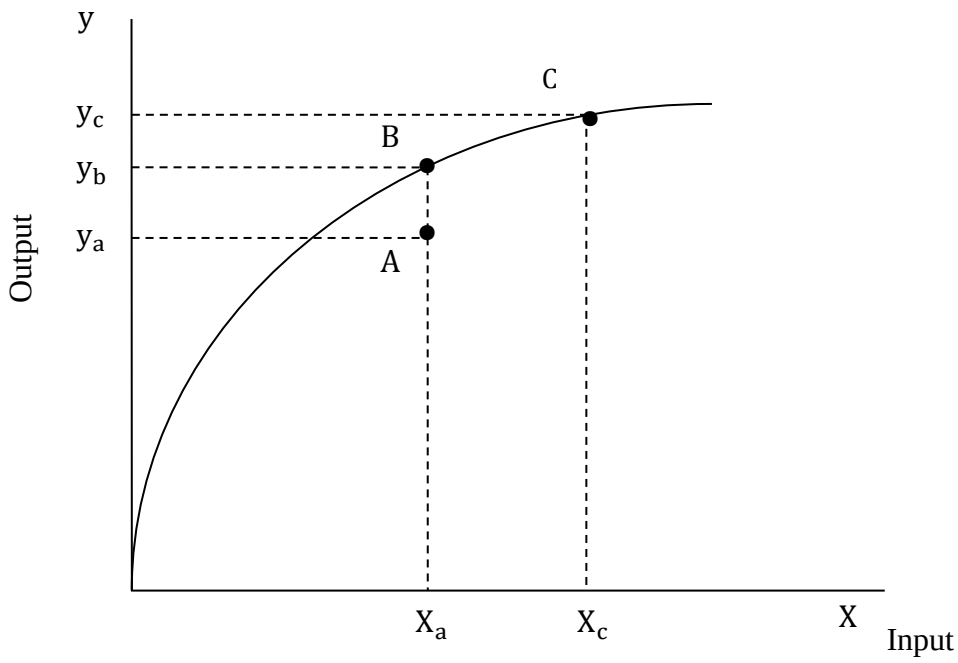

Figure 2. Impact of Credit Constraints on Output

Table 1. Summary Statistics for Variables Used in the Determination of Credit Constraints

Descriptive Statistics		Total		credit_constraint =1		credit_constraint =0	
Variable	Explanation	mean	sd	mean	sd	mean	sd
Sample size		471		179		292	
credit constraint	credit-constrained=1; otherwise=0	0.380	0.486	1.000	0.000	0.000	0.000
financial service	satisfaction with financial serv.	2.892	1.027	2.732	1.003	2.990	1.030
firm size	annual sales (million yuan)	18.11	47.95	11.04	20.55	22.45	58.36
apartment ownership	owning house or apartment=1;otherwise=0	0.384	0.487	0.302	0.460	0.435	0.497
firm's age	years in business	11.59	7.392	11.25	7.375	11.79	7.407

Note: Financial service assessment: very good=5; good=4; fair=3; bad=2; very bad=1.

Table 2. Summary Statistics for Variables Used in the Stochastic Frontier Model

variable	Explanation	mean	sd	min	max
sales	annual sales (million yuan)	15.72	40.77	0.003	648
credit constraint IV	probability of being credit-constrained	0.165	0.201	0	0.573
capital assets	value of fixed assets (million yuan)	0.541	1.762	0.00005	30
hired labor	number of laborers	5.428	5.409	1	51
internet use	use internet frequently=1; otherwise=0	0.553	0.497	0	1
packaging	product with packages=1;otherwise=0	0.748	0.434	0	1
fruit	belongs to fruit market=1;otherwise=0	0.192	0.394	0	1
vegetable	belongs to veg. market=1; otherwise=0	0.384	0.486	0	1
meat	belongs to meat market=1;otherwise=0	0.0766	0.266	0	1
fish	belongs to fish market=1;otherwise=0	0.0706	0.256	0	1
grain	belongs to rice market=1;otherwise=0	0.0773	0.267	0	1
east	located in eastern China	0.606	0.489	0	1
west	located in western China	0.193	0.395	0	1
firm's age	years in business	11.16	7.421	0.500	43
association	membership in a business association	0.145	0.352	0	1
education	owner's education, see note 1	3.530	1.304	1	7
male	male=1; female=0	0.743	0.437	0	1
age18-36	owner's age 18 to 36 yrs.; otherwise=0	0.434	0.496	0	1
age37-55	owner's age 37 to 55 yrs.; otherwise=0	0.532	0.499	0	1

Notes: (1) Education level: bachelor or above=7; junior college=6; middle college=5; high school=4; middle school=3; elementary school=2; no formal education=1

(2) Miscellaneous includes flowers, tea and other markets not included in the Tables. This category was used as a fixed effect benchmark.

(3) The benchmark of regional fixed effects is Central China.

Table 3. Estimation Results for Credit Constraints among Those Who Seek Credit

Variable	Coef.	Std. Err.
financial service	-.155***	.059
firm size	-.00656**	.003
firm size square	.00000453	.00000453
apartment ownership	-.288**	.127
firm's age	.000317	.008
constant	.336	.206
pseudo R2	.0370	
observations	471	

Note: Significance levels are denoted by triple asterisks (***), double asterisks (**), and single asterisks (*) for 1%, 5%, and 10%, respectively.

Table 4. Estimation Results for the Wholesalers' Stochastic Frontier

	Model 1		Model 2	
Variable	Coef.	Std. Err.	Coef.	Std. Err.
ln cap. assets	.0917***	.022	.0921***	.022
ln labor	.550***	.054	0.556***	.054
credit constraint	-.473**	.216		
internet	. 283***	.094	.284***	.094
packaging	.233**	.104	.232**	.104
fruit	.807***	.142	.808***	.142
vegetable	.578***	.134	.577***	.134
meat	.442**	.193	.444**	.193
fish	.842***	.195	.847***	.195
grain	1.069***	.181	1.066***	.181
east	.790***	.124	.802***	.123
west	.504***	.146	.505***	.146
credit constraint			-.670*	.382
firm's age	.0537***	.015	.0567***	.018
association	.431*	.223	.444*	.242
education	.0623	.057	.0681	.061
male	.380**	.152	.393**	.165
age18-36	.769**	.372	.787**	.396
age37-55	.631*	.344	.641*	.366
constant	1.293***	.470	1.078**	.465
sigma2	2.918663		2.978021	
gamma	.5785936		.559777	
sigma_u2	1.68872		1.667028	
sigma_v2	1.229943		1.310993	
log likelihood	-2456.957		-2457.2984	
observations			1332	

Note: Significance levels are denoted by triple asterisks (***), double asterisks (**), and single asterisks (*) for 1%, 5%, and 10%, respectively.