Full Length Research paper

Commercial Rice Growers in Guangxi, China, Provide Evidence of Farm Expansion with Finance Constraints

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In China, financial constraints typically influence agricultural production decisions, and a shortage of finance frequently precludes beneficial investments like farm development that create economies of scale. Nonetheless, China continues to see a rise in farm expansion, with more smallholders moving their operations to a moderate scale, particularly in the rice industry. This study uses a representative household survey of rice farmers in Guangxi Province, China, to precisely evaluate the influence of financing constraints on farm expansion decisions in order to explore this contradiction. The propensity to expand in the near future, which is predicted by a number of parameters where the potential endogeneity of credit constraint is taken into account using instrumental variable methodologies, and the actual expansion in the last five years are both empirically measured. Credit constraints have been demonstrated to have a negative and severe impact on farm expansion. This effect varies and is most pronounced among holders of intermediate scale. Our results demonstrate how crucial it is to provide financial services to comparatively small-scale commercial farmers in emerging nations in order to alleviate their credit constraints.

Key words: Credit constrains, Farm size, Farm expand, Rice farmer, China

INTRODUCTION

In China, where feeding a population of 1.38 billion has continuously been given top priority in agricultural policy designs, food security is one of the most significant agricultural concerns (Godfray et al., 2010). Although economies of scale typically boost agricultural productivity and raise farmers' incomes, for decades Chinese farm households (henceforth referred to as farmers) have been able to operate on a landholding of less than half a hectare due to the mismatch between a relatively large rural population and limited arable land (Cao and Birchenall, 2013). According to Khataza et al. (2019), the adoption of contemporary agricultural technologies and the expansion of farmers' income have been impeded by farming on an excessively small scale. However, the growing number of off-farm jobs brought about by urbanization and the rising cost of farming labor have further deterred agricultural production, particularly for smallholders. Land desertion is so common, and the remaining land is progressively being converted from staple to cash crops (Zhang et al., 2016). This poses

significant obstacles to the sustainable growth of agriculture and the possible improvement of food security. A key element of China's agricultural policies in recent years, farm development has been encouraged by the Chinese government through land transfer (of user rights)1 to engage in moderate-scale grain cultivation in response to this shift (Huang et al., 2017). China's moderate-scale grain growing has been boosted by government encouragement and the use of contemporary agricultural equipment (Huang and Ding, 2016). The acreage under cultivation by moderate-scale farmers and commercial entities3 accounted for 28.6% of China's total cultivated area in 2016, according to the country's decennial Agricultural Census2. Approximately 35% of all farmland was transferred out, a significant rise from just 4.5% in 2006.

Increased productive investment, particularly in land and machinery, is necessary to realize economies of scale (Wang et al., 2016). However, because of long-term, generally small-scale farming and undeveloped rural financial systems, farmers in developing nations are

frequently limited by low income and credit (Conning and Udry, 2007). Due to its significance, a great deal of research is done on production decisions within credit constraints (Barham et al., 1996; Boucher et al., 2008, 2009; Diagne et al., 2000; Jappelli, 1990). Agricultural productivity (Guirkinger and Boucher, 2008; McIntosh et al., 2013), income (Boucher et al., 2008; Li and Xi, 2010; Tran et al., 2016), technology adoption/investment (Berlinschi et al., 2014; Kumar et al., 2013; Okpukpara, 2010; Petrick, 2004; Porgo et al., 2018; Rao et al., 2014), and off-farm labor allocation (Porgo et al., 2018; Uchida et al., 2009) are all significantly impacted by credit constraints, according to an expanding body of empirical research. Few studies have looked into the potential connection between credit constraints and farm expansion, despite the fact that researchers are frequently concerned with the inverse relationship between smallholders' farm size and productivity (Barrett, 1996; Fan and Chan-Kang, 2005; Feder, 1985; Helfand and Levine, 2004; Henderson, 2015). However, in order to support future policy interventions that seek to boost the agricultural sector and contribute to improved national food security through more lucrative farming, it is crucial to quantify the effects of credit constraints. Financial markets are often unfinished in rural China, and smallholders frequently face credit constraints (Feder et al., 1990; Kumar et al., 2013; Li and Xi, 2010). Therefore, the disparity between the pervasive credit constraint and the discernible agricultural expansion during the last ten years becomes a conundrum that needs to be examined in the current study. This research specifically uses a recent rice farm household survey in Guangxi province, China, to thoroughly examine the relationship between credit constraints and farm expansion in rural China. Past farm expansion decisions and future growth intentions are examined side by side to give a complete picture. In order to obtain consistent estimates, instrumental variable techniques are used to address the potential endogeneity of the expansion choice. The study's conclusions will support China's policies for food security, management of production scale, and rural financial reform. They will also offer other emerging nations policy lessons.

The structure of this article is as follows. An analytical process is presented in Section 2. Data and summary statistics are discussed in Section 3. The empirical findings are reported and discussed in Section 4. Finally, section five wraps up with policy implications.

Analytical procedure

The existence of credit limits among farmers must be investigated before studying the household farm expansion decision under credit constraint. In accordance with Diagne et al. (2000), Giné and Townsend (2004), and Boucher et al. (2008, 2009), the direct elicitation approach is used to evaluate the credit limitations. Using self-reported credit demand in manufacturing activities, it rigorously distinguishes households with and without credit constraints. Farmers were questioned in the survey regarding their specific loan requirements, the reason or reasons for applying for a loan, the quantity of credit they had received, and the reason or reasons why they had not received enough credit. Each farmer was questioned if they

had a loan demand in order to determine whether or not there was a credit limitation. Farmers who either had no credit demand or had one but were able to obtain the required amount are then classified as credit-unconstrained. Furthermore, farmers who cited high interest rates or repayment worries as justifications for not requesting for credit are categorized as unconstrained because their demand was deemed incorrect (Boucher et al., 2009; Reyes and Lensink, 2011). Credit-constrained farmers fall into one of three categories, according to Boucher et al. (2008): (1) quantity-rationed (those who applied but were unable to obtain the desired loan amount); (2) transaction-cost rationed (those who needed credit but did not apply because of complicated procedures, limited bank access, a lack of social connections, or a lack of experience with loan applications); and (3) risk-rationed (those who did not apply because they were afraid of losing collateral). After farmers' credit constraints have been appropriately identified, the next stage is to evaluate how these constraints affect their decision-making about farm expansion. It appears that in addition to credit constraints, socioeconomic factors and household production and consumption characteristics also play a role in this decision. Since the existence of credit constraints may be linked to unobserved qualities (such as skills, experiences, entrepreneurial talents, risk attitudes, and social networks), simple multiple regression models may suffer from potential endogeneity even though they can aid in establishing the connections. Regression estimation results may be skewed and inconsistent due to the possibility of links between the factors influencing credit status and scale farm operating decisions (Evans and Jovanovic, 1989; Giné and Townsend, 2004; Jappelli, 1990; Porgo et al., 2018). Instrumental variable (IV) regressions are used to account for this. At the farm household level, the conceptual model can be written as:

$$E = \alpha + \beta C + \gamma X + \delta M + \theta L + \varepsilon$$

A binary indicator of farm growth, E in Equation 1, takes the value of one if the farmer chooses to expand and zero otherwise. As a robustness exercise, we also examine the effect of credit constraints on rice lands that were extended between 2013 and 2017. The auxiliary regression estimates are presented in the supplementary material. Two different methods are used in empirical estimate to quantify E: whether the farmer has really increased the size of their farm in the last five years or if they plan to do so soon.

C is a binary measure of credit restriction that is one for farmers who have credit constraints and zero for those who do not. It is one of the independent variables. X is a collection of socioeconomic and demographic traits that may influence decisions about farm growth. M is a vector of indices of the state of the local market, such as the number of nearby rice processing businesses and the distance to the closest grain wholesale market (which measures the ease of marketing crops). L is also a landscape measure of the farm's location, which might be either plain or hilly and mountainous. The random disturbance is denoted by ˚, whereas the coefficients α, β, γ, δ, and θ describe the marginal effects of these factors on the decision to expand a farm.

To account for the possible endogeneity of credit constraint, IV regression is performed, where the first-stage regression model is specified as:

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$$C = a + bD + cN + dX + fM + gL + u$$

Two IVs are used to estimate Equation 2: the number of local financial institutions within 30 kilometers of the respondent's home (N) and the distance to the closest financial institution (D). The above describes additional covariates. The disturbance is denoted by u, and the coefficients to be evaluated are a, b, c, d, f, and g. It makes intuitive sense that both IVs should be associated with the presence of credit constraints, but they shouldn't have a direct influence on the decision to expand a farm aside from their effect on the credit standing of the farmer. The terrain of a large portion of Guangxi is karst, with flat regions in between cone-shaped mountains. The majority of these mountains are too steep to build rice terraces, in contrast to several other parts of China. As a result, township centers are typically found in flat areas with a high concentration of rice agriculture. Farmers' land plots in those level areas are typically connected by comparable agroecological and land quality parameters. As a result, not many townships are too far away to obtain banking services. However, in an effort to alleviate credit limits among the most vulnerable residents of rural areas, the Chinese government has been working to grant credit access to every township. Therefore, each township center often has two or three financial institutions (primarily Postal Savings Bank of China, Agricultural Bank of China, and Rural Credit Cooperatives). The number of financial institutions varies based on the size of the population and the level of economic development. However, no township is too far away to obtain financing because even from neighboring townships, a 30-kilometer distance is sufficient. As a result, doubts regarding the reliability of the distance-based IVs for credit limitation ought to be reduced. As will be covered in more depth below, empirical tests also show that these IVs are suitable for detecting the proposed link.

Data and descriptive statistics

Data

With a long history of rice cultivation and the cradle of human rice culture, Guangxi is one of China's most important double-season rice planting regions (Huang et al., 2012). The current study is made possible by a recent survey of rural households that was carried out by Guangxi University graduate students and faculty between July 2016 and April 2017. Six regions—Nanning, Guilin, Liuzhou, Guigang, Yulin, and Qinzhou—that collectively account for almost 70% of the province's rice production were included in the survey. The survey employed a stratified sampling technique. Fifteen counties were initially chosen from these six regions based on the total area under rice cultivation during the previous four years (2013-2016). Twelve rice farmers were then chosen at random from each of the three townships that were chosen at random in each county. The questioned homes chosen for these samples have satisfied the following requirements, as the survey focuses on the size and scale of rice farms: (1) rice is grown for commercial markets rather than for personal use; and (2) rice cultivation is one of the primary sources of household income. In rural Guangxi, there were still relatively few farmers who planted rice on a somewhat big scale, particularly those who planted more than 50 mu (3.33 ha) of land. The sampled farmers' farms are relatively modest when compared to industrialized nations, but the sampled households' farms are larger when compared to subsistence farmers. In 45 townships, 540 rice households were chosen at random; 462 (85.6%) of these were present at the time of the survey, and all of them took part. We called 48 of the 78 people who were not there and spoke with them later. With no statistical significance at the 5% level using pairwise t-tests, the observed characteristics—that is, the values of the variables included in the analysis that follows—were strikingly similar to those of respondents who were interviewed in person. Thus, sample selection concerns are reduced.

Descriptive statistics

Table 1 shows the distribution of credit constraints among Guangxi farmers polled. There was a comparatively substantial data variance, with 42.86% of the farmers having credit constraints and 57.14% not having any. Less than one fifth of farmers who require credit have been able to obtain the required amount, although almost half of farmers who are not under any constraints show an invalid demand for credit. Due to quantity rationing, the majority of credit-constrained farmers are unable to acquire the required amount.

Table 2 details variations in farm size from 2013 to 2017. Over the course of the five years, 61.04% of households grew the size of their rice farms, while 7.57% decreased it, while 31.38% of all households stayed the same. While 69.69% of credit-unconstrained households increased their farm size, over half of credit-constrained households did the opposite. However, throughout the course of the five years, only 1.89% of households without credit saw a drop in the size of their rice farms, compared to 15.15% of households with credit constraints.

The outcome variables and covariates are described in Table 3. Half of the farmers expressed a desire to increase the size of their rice farm in the near future, while 61% of households increased their farm size in the previous five years. The low average age of education (7.67 years) and the significance of on-farm revenue creation (82% of family income) are two further observations. Furthermore, 39% of the farmers polled had acquired credit from unofficial sources, such as friends, family, or suppliers of inputs.

Results and discussions

This is how the empirical analysis goes. The influence of credit constraints on decisions to expand over the last five years is calculated first, followed by the impact on the willingness to expand farms in the near future, using two alternative metrics of farm expansion. We further differentiate and evaluate the potential effects on smaller holdings (<3.33 ha) and bigger holders (≥3.33 ha).

First, a probit model is estimated because the outcome variable is binary. Additionally, an IV-probit model is calculated to handle potential endogeneity of the credit limitation. Two-stage least squares (2SLS) are used to further estimate the same regression model. Compared to discrete choice models, 2SLS typically yields very near marginal impact estimates and is resilient to first-stage misspecifications, making it appropriate (Angrist, 2001; Angrist and Pischke, 2008). As a result, it functions as a trustworthy robustness check. Instrument weakness is ruled out by the 2SLS estimation first-stage findings, which are displayed in Supplementary Table S1. Furthermore, credit constraints are more common among farmers who live further away from financial institutions and have fewer access points to financial institutions; nevertheless, the impact of these factors on farm size is minimal. These results repeatedly point to the IVs' suitability. Township-level standard errors are grouped in the estimation.

Credit constraints' effects on farmers' agricultural expansion over the previous five years

The estimation findings, where farm expansion is quantified in such decisions taken over the last five years, are shown in Table 4. The impact estimates are supported by the reassuring similarity between the computed marginal effects from the IV-probit and coefficient estimations from the 2SLS methods. Credit constraints are revealed to have a highly significant negative impact on the decision to expand a farm across all models. In particular, the likelihood of expanding the size of a rice farm is reduced by 37.3–40.4 percentage points when financial constraints are present. Therefore, it is inferred that if the financing constraint is lifted and these rice farmers are better able to enjoy economies of scale, farm growth will be promoted. However, it is also discovered that the initial area used for rice cultivation within the last five years (as of 2013) has a negative impact on farm expansion, as larger farms are less likely to grow. Even though this effect is minimal, it suggests that there might be a systematic relationship between farm size and the decision to expand.

Despite the fact that financing constraints deter farm expansion, China's farm sizes are generally continuing to increase. Therefore, in order to comprehend the dilemma, it is necessary to interpret the potential roles that other circumstances may play. Among the variables, farmers who are wealthier, have more dependents, and live in flat areas are more likely to expand their farms. Farm expansion is linked to the use of informal financing and specialist mechanical services in production techniques. However, these individual effects pale in comparison to the size of credit limitation.

Regression results with actual farm expansion from 2013 to 2017 as the outcome variable are further reported in Supplementary Table S2. With greater credit limitation impact magnitudes, these estimates seem to be rather comparable to our primary findings above. Thus, the aforementioned conclusions are strongly supported.

Effects of loan limitations on farmers' readiness to expand their farms

Table 5 further estimates the effect of financial constraints on farmers' willingness to expand their farms. Additionally, the size and 1% significance of the impact estimations from IV-probit and 2SLS are fairly comparable. In particular, farm expansion willingness is adversely affected by credit constraints. The impact is greater than the observed farm expansion over the previous five years, ranging from 56.7 to 65.9 percentage points. The area now used for rice cultivation is once more having a detrimental impact on farm growth intentions.

Age and gender are statistically significant among the covariate coefficients, which contrasts the aforementioned results with the actual farm expansion measure. Although there are no such trends among farmers who have actually extended their farms in the last five years, it seems intuitive that older and female farmers are less inclined to do so. Additionally, a higher off-farm income contribution deters farm expansion, but participation in a farmer cooperative promotes it, maybe as a result of improved access to resources for production, risk mitigation, and/or marketing (Liu et al., 2019). Once more, the effects of family size (number of dependents) and education are validated. Although the coefficient is statistically insignificant in the 2SLS estimation, the role of informal financing is not well supported. This is because farmers who are just eager to expand their farms may not use these resources, thus the influence has not been apparent. There is also a disparity in the use of mechanical services, which has little bearing on farmers' readiness to expand their operations. This may be explained by the possibility that as farm sizes increase, a considerable number of farmers may find third-party mechanical services to be unaffordable.

Robust checks

According to the aforementioned analysis, farmers' decisions to expand their farms may have an impact on family income and the use of mechanical services, which could lead to a problem with reverse causality. Additionally, the area used for rice cultivation may have non-linear impacts. We apply robustness checks by changing the explanatory variables in order to specifically address these issues. Table 6 presents the findings.

Following the removal of the family income variable from the model, the regression result is displayed in the first column of Table 6. Following the removal of the mechanical service variable, the regression result is shown in the second column. Following the addition of the square of the rice cultivation area, the regression result is shown in the third column. The projected marginal effects of credit constraint on the actual decision to expand a farm and the willingness to expand in the future do not differ significantly, according to computed marginal effects from the IV-probit and coefficient estimates from the 2SLS methods. The credit constraint is negative and very significant in all models, and changes in the control variables in the estimations have little effect on the estimated outcomes. These estimates are strong and support our primary findings for the impact of credit limits.

Effects of loan restrictions on the growth of comparatively smaller and larger farms

Relatively smaller (<3.33 ha) and bigger (≥3.33 ha) commercial

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farmers may have different effects from credit constraints, according to the results of both measurements (actual decision and willingness of farm expansion). Therefore, using two subsample analyses to dissect the potential heterogeneity is simple. Policymakers will find this significant since it highlights the need to tailor interventions by landholding in order to optimize the intended outcome. Table 7 presents the findings.

The estimated marginal effects of credit constraint on the decision to expand a farm and the willingness to expand a farm in the future differ considerably, as shown in Table 7. In particular, the coefficient estimates in 2SLS models and the marginal effects in IV-probit models seem to be larger for large holders (i.e., the impact is stronger for large holders). Therefore, householders will be more susceptible to credit limits and it will be considerably more challenging to expand farm size/scale when the smaller holders grow into moderate farmers with a size of 50 mu (3.33 ha) or more. Therefore, policy measures that seek to maximize production scale and enhance credit market conditions may give special consideration to moderate farmers.

The aforementioned results typically imply that credit limitations prevent farms from expanding. However, the positive contributions of other factors may have completely counterbalanced the unfavorable effects, which is why agricultural growth is still frequently seen. This shows that removing credit limits can further encourage farm expansion and helps explain the conundrum where credit constraints and farm expansion are widely observed.

Conclusions and policy implications

This study examines the paradox where credit limits and farm expansions coexist by empirically evaluating the effect of credit constraints on farm expansions using a recent survey of commercial rice farmers in Guangxi Province, China. As predicted, the decision to expand a farm is greatly discouraged by credit constraints, as evidenced by both willingness and actual expansion decisions. However, subsample analysis also indicates that moderate farmers are more vulnerable to credit constraint in both their actual decision to expand and their propensity to do so in the future, even though the effects of credit constraint on farm growth are comparable for relatively small. In addition to indicating the need for customized policy considerations (Huber et al., 2015), this study adds to the body of literature on the complex drawbacks of smaller holdings in farm expansion and their effects (Collier and Dercon, 2014; Huang and Ding, 2016; Ostwald and Chen, 2006). Although resources that are otherwise available (such as cooperative membership, third-party mechanical services, and informal credit) counteract the negative effects of credit constraints on farm expansion, credit constraint removal is still necessary for further farm expansion and improved realization of economies of scale.

It should be one of the government's policy considerations to further strengthen the credit market with a focus on providing microfinance to householders, given the expected immediate impact mentioned above. First, the significance of having a range of available credit options to satisfy various credit needs

is amply demonstrated by the role of informal credit access. Therefore, easing farmers' credit limits will benefit from promoting the growth of microfinance organizations and unofficial agricultural financial institutions. Second, credit constraint cannot be entirely eliminated in the near future since smaller holders typically lack collateral. In order to support ongoing income growth and increases in capital investment, interventions should also concentrate on stabilizing rural household income by reducing potential production and/or marketing risks. However, the continuous, incremental reform of the rural land system can also make farmers' land more liquid, which will make it easier to get a land mortgage from a rural banking institution. Third, offering mechanical and associated agricultural services can encourage large-scale operations and reduce farmer investment.

The credit supply side, namely agricultural credit institutions, might then be the subject of policy consequences. Given the significant demand, the fact that nearly half of the farmers questioned (42.86%) had credit constraints implies that the rural finance market has enormous potential as agricultural operations expand up. Therefore, in order to satisfy the needs of farmers, credit institutions should focus on innovations in financial instruments and services. Furthermore, policies aimed at fostering the growth of rural financial institutions could thoroughly examine the viability of extending microcredit to more small farmers and offering more financial services to larger farmers. With the aid of contemporary information technology, rural financial institutions could more effectively evaluate the credit ratings and collateral values of farmers. Finally, as transaction costs are a major factor in farmers' credit constraints, rural financial institutions should increase their marketing efforts and help farmers learn more about the financial products that are offered.

Regarding agricultural and agribusiness management, there are policy ramifications on the credit demand side as well. In order to smooth farm revenue and preserve a positive credit history, farms should first implement the required risk management techniques (such as buying agricultural insurance and diversifying their product portfolio). This will help reduce the concerns of financial providers regarding payback risk. Second, as part of extension packages, farms should try to take part in pertinent financial trainings or market activities.

To lessen information asymmetry, stay in touch with financial institutions. Third, through agricultural cooperatives or associations, smaller farms can collaborate and help one another financially, particularly when it comes to mutual borrowing. Although evaluating these measures' merits is outside the purview of this analysis, they demand policy consideration, which is crucial for improving food security in nations like China.

Additionally, the possible usage of credit for particular farms needs to be improved. It should be mentioned that Chinese farm management techniques could not be the same as those in industrialized nations. Chinese farmers continue to place a strong emphasis on the production process while mainly ignoring marketing and value chain development. To alleviate financial constraints, farmers in smaller-scale farming will buy third-party services in certain production connections (e.g., mechanical services). Farmers that have access to finance may utilize it to purchase machinery and equipment, but they typically neglect to invest in marketing, talent development, and value chain collaboration. The tradition of subsistence farming may be the cause of this perceptual myopia, which needs to be fixed for sustainable farm management. China, which is shifting from a

smallholder rural economy to a commercialized one, needs to pay particular attention to this.

There are limitations to the current investigation. For starters, farming dynamics throughout time cannot be adequately captured by cross-sectional statistics. Another is that the particular geographic focus (one significant rice-growing region) would not accurately reflect circumstances seen in other regions of China or other nations. Together, these drawbacks necessitate additional study and inquiry to support the external validity of our conclusions.

Acknowledgements

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