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Effects of Credit Constraints on Productivity and Rural Household Income in China

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Keywords
credit constraint, household income, productivity, rural China

Disciplines
Agricultural and Resource Economics | Agricultural Economics | Finance | Growth and Development

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Abstract

Agricultural production is strongly conditioned by the fact that inputs are transformed into outputs with considerable time lags, causing the rural household to balance its budget during the season when there are high expenditures for input purchases and consumption and few revenues. With limited access to credit, the budget balance within the year can become a constraint to agricultural production. As is the case in many developing countries, Chinese rural households have been suffering from a lack of access to capital. While China is one of the biggest countries in terms of rural areas and agricultural production, few studies have focused on the impact of credit on agriculture in China. Using survey data, this study aims to examine how credit constraints currently affect agricultural productivity and rural household income in China. The study findings suggest that under credit constraints, production inputs, along with farmers' capabilities and education, cannot be fully employed. By removing credit constraints, agricultural productivity and rural household income can be improved.

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Effects of Credit Constraints on Productivity and Rural Household Income in China

Introduction

China has been undertaking economic reforms since 1978. While urban residents' income increased from 343 yuan in 1978 to 17,175 yuan in 2009, farmers' income continued to lag behind, from 134 yuan in 1978 to 5,153 yuan in 2009. Because a widening income gap may jeopardize social stability, increasing agricultural productivity and farmers' income are always important considerations for the Chinese government. It is both socially and economically crucial to investigate elements affecting productivity and find ways to improve rural household income.

Agricultural production is strongly conditioned by the fact that inputs are transformed into outputs with considerable time lags (Conning and Udry, 2005), causing the rural household to balance its budget during the season when there are high expenditures for input purchases and consumption and few revenues. With limited access to credit, the budget balance within the year can become a constraint to agricultural production. When liquidity is a binding constraint, the amounts and combinations of inputs used by a farmer may deviate from optimal levels that in turn limit the optimum production or consumption choices. The marginal contribution of credit therefore brings input levels closer to the optimal levels, thereby increasing yield and output (Feder et al., 1990). Some empirical literature has found that in rural areas of developing countries, credit constraints have significant adverse effects on farm output (Feder et al., 1990; Sial and Carter, 1996), farm investment (Carter and Olinto, 2003), and farm profit (Carter, 1989).

As is the case in many developing countries, Chinese rural households have been suffering from a lack of access to capital (International Fund for Agricultural Development, 2001;

Luo, 2003; Dong and Featherstone, 2006; and Yu, 2008). Rural credit markets can be separated into formal and informal markets. Informal rural credit grew very fast in last few decades and became an important part of Chinese rural credit. Informal rural credit can take various forms. Interpersonal lending, which includes loans extended among friends, relatives, neighbors, or colleagues, is among the most basic strategies that farmers use to deal with liquidity requirements. Other forms include lending from moneylenders, pawnshops, and private money houses, some of which are illegal (Tsai, 2004). While informal credit markets are usually flexible in operation and play an essential financial intermediation function, they are also subject to various limitations (Tang, 1995). Generally, the informal rural credit markets are highly segmented, with participants limited to only those with personal relationships, and the cost of accessing informal credit varies depending on the lenders being friends and family or private moneylenders and money houses. Without legal protection, participants can be vulnerable to potential losses and abuses (Tang, 1995). In addition, informal loans are small and short-term. Most of the informal credit is reportedly obtained for purposes other than production, with construction, social expenditures (wedding, funeral, education, house construction, medical expenses, etc.), and consumption being dominant. Therefore, informal credit is not a good substitute for formal credit (Feder et al., 1990; Chen, 2003).

Formal credit is mostly used for the financing of agricultural production (Feder et al., 1990). The formal financial institutions currently serving rural China include the Agricultural Bank of China (ABC), Agricultural Development Bank of China (ADBC), Rural Credit Cooperatives (RCCs), and Rural Postal Savings (RPSs). Because of high operational costs (such as those related to screening, monitoring, and enforcement), high financial risk (such as risks due

to moral hazard, few assets for collateral,[1] and client's income stability), and low returns (because of interest ceilings set by the government) (Dong and Featherstone, 2006), formal financial institutions have strict requirements for rural loans and limit lending. ABC reduced its service to rural areas when it was transformed into a commercial bank in the mid-1990s. Although a majority of its deposits are from rural areas, ABC's support to agriculture has been decreasing. Although the total loans of ABC increased from about 1.37 trillion yuan in 1998 to over 1.86 trillion yuan in 2002, its agricultural loans decreased from 178 billion yuan to 124 billion yuan during this period. In addition, during the 1998-2001 period, ABC reduced its county-level branches and offices from around 60,000 to 44,000 (OSSC-MOA, 2005). These changes reduced the availability of rural credit that is essential to the development of the rural economy. Moreover, ABC generally extends agricultural loans to agricultural enterprises and seldom to rural households. ADBC is a policy bank. It offers loans for the procurement, reserve, and marketing of grain, edible oil, and cotton; loans for the construction of agricultural infrastructure; and loans for integrated agricultural development. ADBC does not provide loans to individual rural households. As saving-only financial institutions, RPSs had been channeling funds from rural to urban areas. Just since June 2007 have RPSs started to offer micro-credit business in some areas on an experimental basis. Currently, RCCs are major suppliers in rural lending markets (Dong and Featherstone, 2006). By the end of 2008, there were 4,965 RCCs in China. They have the largest area of coverage and rural loan amounts. In 2008, RCCs extended 1.7 trillion yuan in agricultural loans.

To reduce capital shortages in rural China, the China Banking Regulatory Commission (CBRC) relaxed the conditions of entry for financial institutions in rural areas at the end of 2006, allowing investors to set up new types of rural financial institutions such as township and village

[1] Land is owned by the state, and farmers cannot use land as collateral.

banks and rural mutual cooperatives. At the end of 2008, 107 new types of rural financial institutions had obtained licenses including 91 township and village banks, 6 loan companies and 10 rural mutual cooperatives. Their total loan balance to agriculture in 2007 reached 6.09 trillion yuan, of which direct agricultural loans amounted to 1.57 trillion yuan (Cao, 2009). In addition, to enhance micro-credit in rural areas, the CBRC also expanded the list of qualified micro-credit lenders from rural credit unions to all banking institutions. The size of allowable credit lines was raised from a range of 3,000 to 5,000 yuan to a range of 10,000 yuan to as much as 3 million yuan. The loan terms extend from less than one year to as long as three years. However, the proportion of rural households having access to bank loans is only 33% (Cao, 2009). Therefore, rural financial institutions still need to expand their coverage from pilot areas to remote areas to alleviate the capital needs of credit-constrained farmers nationwide.

Previous Studies

There have been many studies on the impacts of credit constraints on agricultural production and rural income, because access to credit is often found to be a key factor for improving productivity and rural living standards in less developed countries. Carter (1989) found that credit had a positive impact on production and can be expected to reduce the pattern of structurally unbalanced growth in Nicaraguan agriculture. Zeller, Diagne, and Mataya (1998) concluded that participation in an agricultural credit program was able to raise the cropping share for hybrid maize and tobacco, and membership in credit programs had a sizable effect on crop income in Malawi. This implies that expansion of credit access can have beneficial effects on agricultural production and rural incomes. Similarly, other studies have found negative effects of lack of access to credit on agricultural production or profitability in developing countries, for example, Duong and Izumida (2002) in Vietnam; Freeman, Ehui, and Jabbar (1998) in Ethiopia

and Kenya; Sial and Carter (1996) in Pakistani Punjab; Foltz (2004) in Tunisia; Kochar (1997) in India; and Guirkinger and Boucher (2008) in Peru.

While China is one of the biggest countries in terms of rural areas and agricultural production, few studies have focused on the impact of credit on agriculture in China. The exception is Feder et al. (1990), who examined the impact of credit on productivity in Chinese agriculture using data collected in 1987 in Gongzhuling, Jilin province. However, at that time, the household responsibility system had just started. After more than 20 years of development, dramatic changes have occurred, such as grain market reforms, rural financial reforms, and the exemption of the agricultural tax.[2] To understand the potential for broad-based economic growth, a current understanding of agricultural credit constraints on agricultural productivity and rural household income is essential. Therefore, it is necessary to reexamine how credit constraints currently affect agricultural productivity and rural household income in China.

Research Methodology

A household is credit constrained if the household requested more loans than were supplied, or if it required loans but was unable to borrow. When estimating the impact of credit constraints on productivity, two issues come up. The first is heterogeneity between credit-constrained and non-constrained households. All credit-constrained and non-constrained households are not homogenous with respect to their credit demand (Feder et al., 1990). For example, many non-borrowers do not borrow because they have sufficient liquidity and do not need to, while some do not borrow because they cannot borrow because of credit constraints. In addition, the effect on agricultural productivity may not be independent of credit status. Under credit constraints, factors of production may have differential effects on agricultural productivity than is the case

[2] The agricultural tax was a lump-sum fee paid by farmers based on the amount of cultivated land and number of family members. It was abolished in 2006.

under unconstrained credit. Therefore, estimation methods that pool all sampled observations to estimate production/output functions with credit as an input or a determinant may not be appropriate. Separate functions for credit-constrained and non-constrained households should be examined. The second issue is endogeneity. Households that are not credit constrained can separate consumption decisions from farm production decisions and choose production inputs optimally for the production process (Foltz, 2004). In contrast, credit-constrained households may deviate from input-optimal levels to allocate limited available resources between consumption and production and thus may have lower productivity. Therefore, possible sample selection bias may arise. Thus, the econometric problem involves both heterogeneity and sample selection. This motivates the use of an endogenous switching regression model (Maddala, 1983), which consists of a joint estimation of the probability of being credit constrained and the productivity level.

First, a probit model is applied in the first stage to determine the relationship between a household's credit condition and a number of socio-economic and credit variables (Feder et al., 1990; Sial and Carter, 1996; and Freeman et al., 1998). The credit condition of the *i*th household is described by an excess credit demand function, I^*, that is a function of a vector of explanatory variables:

$$I_i^* = \gamma Z_i + u_i \tag{1}$$

where Z is a vector of exogenous variables, γ is a vector of parameters, and u_i is a random disturbance. Households are credit constrained if the excess demand is greater than zero. The function that indicates the household's credit status can be specified as

$$\begin{aligned} I_i &= 1, \text{ iff } \gamma Z_i + u_i > 0 \\ I_i &= 0, \text{ iff } \gamma Z_i + u_i \geq 0. \end{aligned} \tag{2}$$

In the second stage, separate regression equations are used to model the productivity of the household conditional on a specified credit status. The production function of the two groups of households is modeled by

$$\begin{aligned} y_{1i} &= X_{1i}\beta_1 + \varepsilon_{1i} \quad \text{iff } I_i=1 \\ y_{2i} &= X_{2i}\beta_2 + \varepsilon_{2i} \quad \text{iff } I_i=0 \end{aligned} \tag{3}$$

where y_{1i} and y_{2i} are the productivity for credit-constrained and credit-unconstrained households, respectively; X_{1i} and X_{2i} are vectors of exogenous variables; β_1 and β_2 are vectors of parameters; and ε_{1i} and ε_{2i} are random disturbance terms. Here, u_i, ε_{1i}, and ε_{2i} are assumed to have a tri-variate normal distribution with mean vector zero and covariance matrix

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1u} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2u} \\ \sigma_{1u} & \sigma_{2u} & \sigma_u^2 \end{bmatrix} \tag{4}$$

where σ_1^2 and σ_2^2 are variances of the error terms, ε_{1i} and ε_{2i}, in equation (3); σ_u^2 is the variance of the error term, u_i, in equation (2); and σ_{12}, σ_{1u}, and σ_{2u} are the covariance of ε_{1i} and ε_{2i}, ε_{1i} and u_i, and ε_{2i} and u_i, respectively. The term σ_u^2 is assumed to be 1 because γ is estimable only up to a scale factor (Maddala, 1983).

Because the disturbance terms in equation (3) are conditional on the sample selection criterion and have non-zero expected values, the ordinary least squares (OLS) estimates of β_1 and β_2 will suffer from sample selection bias and are inconsistent (Lee, 1978; Maddala, 1983). Some studies have used a two-stage estimation method to estimate the system of equations (2) and (3) (Lee, 1978; Feder et al., 1990; Freeman et al., 1998) or used weighted least squares to account for the heteroskedastic errors (Freeman, et al., 1998). The use of weighted least squares,

however, is limited to situations in which the exact form of heteroskedasticity is known, which is rarely the case (Alene and Manyong, 2007).

To estimate the endogenous switching regression model more efficiently and with no strict assumptions, we use the full information maximum likelihood (FIML) method (Greene, 2000; Lokshin and Sajaia, 2004). The FIML method simultaneously estimates the probit equation and the regression equations to yield consistent standard errors. The log likelihood function for this model is

$$\ln L(\beta_1,\beta_2,\sigma_1^2,\sigma_2^2,\sigma_{1u},\sigma_{2u}) = \sum_i (I_i[\ln\{F(\frac{(\gamma Z_i + \rho_1\varepsilon_{1i}/\sigma_1)}{\sqrt{(1-\rho_1^{\ 2}}})\} + \ln\{f(\varepsilon_{1i}/\sigma_1)/\sigma_1\}] + (1-I_i)[\ln\{1-F(\frac{(\gamma Z_i + \rho_2\varepsilon_{2i}/\sigma_2)}{\sqrt{(1-\rho_2^{\ 2}}})\} + \ln\{f(\varepsilon_{2i}/\sigma_2)/\sigma_2\}]) \quad (5)$$

where F is a cumulative normal distribution function, f is a normal density distribution function, $\rho_1 = \sigma_{1u}/\sigma_u\sigma_1$ is the correlation coefficient between ε_{1i} and u_i, and $\rho_2 = \sigma_{2u}/\sigma_u\sigma_2$ is the correlation coefficient between ε_{2i} and u_i. Only one value of y, y_{1i} or y_{2i}, is actually observed for any given household, depending upon which regime that particular household is in, credit constrained or unconstrained. Therefore, σ_{12} does not occur in the likelihood function and is not estimable.

Data

The data used in this study came from a rural financial survey conducted in Xinglonggang County, Heilongjiang province in Northeast China, in 2008. The county has 2,794 rural households, which produce mainly soybeans, corn, wheat, rice, and sweet beets. Raising cattle or sheep is also an important part of agricultural production. After deleting all households with missing values, the sample consisted of 511 rural households that accounted for 18.3% of the total rural households in Xinglonggang County. The survey asked demographic questions,

including age and education of the household head, household size, household labor, dependents or college students in the household, and how many members had chronic disease. The survey also asked financial and operational questions such as value of real estate (house), saving, income, production inputs and outputs, whether the farmer had a loan, the amount of the loan, the use of the loan, if the loan needed collateral or pledge, if a loan was received before, and whether the loan was repaid on time. In addition, the survey also asked the borrowing households if at the going rates of interest they would have liked more credit than the amount they were actually granted. Households that did not borrow were asked reasons for not borrowing. The borrowers who indicated a desire for more credit and the non-borrowers who responded that they could not obtain credit are classified as credit-constrained.

The summary statistics of the data are listed in table 1. The dependent variable in the criterion equation (equation (2)) is the household's credit status (*Constraint*). This variable (*Constraint*) takes a value of 1 if the household is credit constrained and 0 otherwise. About 17% of households were credit constrained in the sample. The proportion of credit-constrained households in the sample data is lower compared to those used in some other studies, such as Feder et al. (1990).

The dependent variable in the switching regression model (equation (3)) is productivity (*Prod*). Because farmers engaged in several different crops and/or cattle/sheep production, monetary values were used instead of quantities to measure production to make it comparable across households. Productivity was measured as net revenue (production output value - input value) per household labor. The explanatory variables in the switching regression models for labor productivity include age, education level, number of dependents, real estate value, household saving, number of college students, and number of household members with chronic

disease. The variable age^2 is included, as the effect of age may not be linear. Education is categorized into three levels: elementary school (*edu1*), junior high school (*edu2*), and high school (*edu3*). The variable *edu1* is used as the base and deleted from the regression to avoid singularity. Besides all variables included in the switching regression model, variables about whether a loan had been received before (*preloan*) and whether the loan needed collateral (*collateral*) were also included as instrumental variables in the criterion model. Because all surveyed households that received loans before paid their loans on time, we excluded the variable whether the loan was repaid on time from the credit equation.

Estimation Results

Impacts of Credit Constraints on Productivity

The maximum likelihood estimates of the endogenous switching regression model are shown in table 2. For the criterion equation of the credit status, *Age* increased the odds of being credit constrained and the effect was not linear, as the coefficient of *age2* is statistically significant, too. Education, the number of household member with chronic disease, and the number of college students in the household had no statistically significant effect on the probability of being credit constrained. If a household had more saving, its odds of being credit constrained decreased. This result is similar to that of Feder et al. (1990). In addition, if a household had more dependents, it was less likely to be credit constrained. In contrast, if a household had a higher real estate value, its odds of being credit constrained were higher. This may reflect the fact that house construction is a large expense for a rural household. It may use up the capital resources of the household and thus increase the odds of being credit constrained. The criterion model also shows that if the household had previous loans, it was more likely to get a loan, which showed the role that good credit played in borrowing. But collateral did not

significantly affect the odds of getting a loan. Farmers in China do not have ownership of land, and land cannot be used as collateral. A few assets such as residential housing or machinery can be used as collateral, but they are generally difficult to acquire by the financial institution as they are necessities for farmers or for resale, which makes most lenders reticent to rely on collateral for loans.

The estimates from the productivity function show that for credit-constrained households, only savings helped to increase productivity. This indicates that liquidity was important for improving productivity. In contrast, many factors affected productivity if the household was not credit constrained. An important implication is that if a household was credit constrained, most resources could not be brought into full play. For example, age did not affect productivity if the household was credit constrained. With no credit constraints, age had a significant negative effect on labor productivity, or, in other words, younger farmers had higher productivity. Generally, farm work is labor intensive. Only without credit constraints can younger farmers make full use of their physical advantage. Similarly, education did not affect productivity if the household was credit constrained. However, education improved productivity if the household was not credit constrained. A farmer with a high school education (*edu3*) had higher productivity compared to a farmer with just an elementary school education (*edu1*). This result has other important implications. China has been making great efforts to improve the level of education in rural areas. If the rural financing conditions are not improved and farmers are credit constrained, the benefits of additional education would not be as supportive for rural productivity as it could be. Therefore, for education to improve rural productivity, the problem of rural credit constraints needs to be solved. The result of education in this analysis is similar to that in Feder et al. (1990).

The effect of having a junior high school education was not statistically significantly different compared to that of having just an elementary school education.

The number of dependents in the household positively affected labor productivity in credit-unconstrained households. This reflects the fact that kids generally help with household farm work, although they are not counted as labor. The number of household members with chronic disease had a significant negative effect on household labor productivity. This might be because other household members spend time taking care of the member with chronic disease and consequently this reduces their productivity. In the credit-constrained household, there is no statistical effect for the number of dependents and the number of members with chronic disease in the household. This suggests that under credit constraints, increasing or decreasing labor does not affect productivity, reaffirming that input factors may be underutilized because of credit constraints. *Saving* had significant positive effects for credit-unconstrained households. This result is unexpected because if the household were not credit constrained, saving should not matter to its productivity. This result implies that even without credit constraints, more liquidity in the household can still improve productivity perhaps through a self-insurance mechanism. Interestingly, real estate value (*revalue*) had a negative statistically significant effect on the productivity in credit-unconstrained households, although the impact was small compared to that of other factors. This might be because having a quality house is a big achievement and a goal for most Chinese farmers. After realizing the dream, farmers may have less motivation to work harder. The number of college students in the household did not have a significant effect on labor productivity.

The correlation coefficients ρ_1 and ρ_2 are both significant. Since ρ_1 is positive and ρ_2 is negative, the model indicates that individuals that were credit constrained had lower

productivity than a random individual from the sample would have, and those who were not credit constrained had higher productivity than a random individual from the sample would have. The likelihood-ratio test for joint independence of the three equations reported in the last row of table 2 showed that these three models are not jointly independent and should not be estimated separately.

To further evaluate the impact of credit constraints on the productivity of Chinese farmers, the magnitude of this impact on productivity is estimated to determine how much the productivity of credit-constrained labor would increase if the constraints were removed. Following Guirkinger and Boucher (2008), the predicted impact for productivity in each constrained household is computed as

$$\hat{\Delta}_{it} = X_{it}(\hat{\beta}^{U} - \hat{\beta}^{C}) \tag{6}$$

where $\hat{\beta}^{U}$ and $\hat{\beta}^{C}$ are the parameter estimates for credit-unconstrained and credit-constrained households that are reported in table 2. The results indicate that productivity would increase from 9,883 yuan to 13,008 yuan if the household were not credit constrained, a 31.6% increase.

Impacts of Credit Constraints on Household Income

The same type of analysis was also conducted on household income. All variables included in the income equation were the same as those in the equation of productivity except that the number of dependents (*depnum*) was replaced by the amount of labor in the household (*lbnum*) and household saving (*saving*) was excluded. The amount of labor in the household was found to directly affect the total income of the household. The reason for excluding *saving* from the income equation is that income more likely affects saving instead of vice versa. The results are shown in table 3.

Under credit constraints, no variables had significant effects on household income. Without a credit constraint, households with older household heads had lower household income than those with younger household heads. More household labor increased household income. The number of members with chronic disease and the education level of household heads had no effect on household income. Households with more college students had higher household income. This may indicate that college students worked while they were studying in the college to help earn income for their households. Generally, universities in China are located in urban areas where wages are higher than in rural areas.

The coefficients ρ_2 for the correlation between the criterion equation and the income equation for credit unconstrained is statistically significant and negative while ρ_1 for the correlation between the criterion equation and the income equation for credit constraints is not statistically significant from zero. This result suggests that individuals who were credit unconstrained had more household income than a random individual from the sample would have had, and those who were credit constrained did not have higher or lower household income than a random individual. The likelihood-ratio test for joint independence of the three equations reported in the last row of table 3 showed that these three models are not jointly independent and cannot be estimated separately.

Similarly, we also estimate the magnitude of how much income would increase if the credit constraints were removed. The calculation of the predicted impact for household income using equation (6) showed that if the credit constraints were removed, household income could be improved by 12,460 yuan, which is about a 23.2% increase.

Conclusions

In this paper, we use an endogenous switching regression model that accounts for both heterogeneity and sample selection issues to examine the impacts of credit constraints on agricultural productivity and rural household income in China. The results show that factors have different marginal contributions to productivity and income among credit-constrained and unconstrained households. The productivity-enhancing effects of schooling only occur in credit-unconstrained households. Young farmers may not be able to leverage their comparative advantage for physically intensive farm work under credit constraints. In addition, increasing or decreasing household labor does not improve productivity. These results imply that under credit constraints, production inputs, along with farmers' capabilities and education, cannot be fully employed. Agricultural productivity and rural household income are estimated to improve by 31.6% and 23.2%, respectively, with the removal of credit constraints. Moreover, the study suggests that individuals who were credit constrained had lower productivity than a random individual from the sample, and those who were not credit constrained had higher productivity than a random individual from the sample would have had. In terms of income, individuals who were credit unconstrained had more household income than did a random individual from the sample, and those who were credit constrained did not have higher or lower household income than a random individual.

An important issue in the context of agricultural credit policy is the magnitude of the expected productivity gain. If the marginal productivity effect of credit is small, then the resources may be more beneficially deployed elsewhere. This study provides important evidence of the effects of credit constraints on agricultural productivity and rural household income. Policymakers who aim to improve agricultural productivity and living standards of rural

households may need to first reduce credit constraints in rural areas to have production factors function to their fullest potential. With credit constraints, most production inputs may not be used efficiently.

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Table 1. Descriptive statistics for 511 Chinese households in Xinglonggang County, Heilongjiang Province, China

		N=511	
variable	Description	mean	std
age	Age of household head in years	45.52	10.21
edu1	1 if the farmer has highest formal education of elementary school and 0 otherwise	0.16	0.37
edu2	1 if the farmer has highest formal education of junior high school and 0 otherwise	0.79	0.41
edu3	1 if the farmer has highest formal education of high school and 0 otherwise	0.05	0.21
hhnum	Number of household member	3.43	1.27
lbnum	Number of household labor	2.10	0.82
depnum	Number of dependents	1.34	1.10
revalue	Real estate value in 1,000 yuan	65.95	43.33
saving	Household saving in 1,000 yuan	25.04	21.77
income	Household income in 1,000 yuan	53.71	42.59
chrdisnum	Number of household member with chronic disease	0.10	0.33
colstdnum	Number of college students	0.05	0.24
chrdis	1 if the household has member with chronic disease and 0 otherwise	0.09	0.29
collateral	1 if the loan needs collateral and 0 otherwise	0.44	0.50
preloan	1 if the household got loan before and 0 otherwise	0.75	0.43
constraint	1 if the household applied a loan but did not get it or just got part of it and 0 otherwise	0.17	0.37
prod	Productivity, yuan per household labor	13.59	13.73

Table 2. Maximum likelihood estimates of the endogenous switching regression model for productivity

Variable	**Criteria Equation (Credit constraint)**		**Productivity Equation**			
			Credit Constrained (N=85)		Credit Unconstrained (N=426)	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
age	0.116**	0.041	-0.561	0.649	-1.554**	0.267
age^2	-0.001**	0.000	0.005	0.007	0.018**	0.003
edu2	0.106	0.181	-0.956	2.502	0.880	1.144
edu3	-0.277	0.379	-5.558	6.138	3.894*	2.118
depnum	-0.216**	0.060	1.610	1.049	2.565**	0.383
saving	-0.015**	0.004	0.146**	0.069	0.404**	0.019
revalue	0.005**	0.002	-0.042	0.028	-0.050**	0.009
chrdisnum	0.252	0.192	-2.574	2.956	-3.249**	1.251
colstdnum	-0.359	0.352	8.788	7.485	2.169	1.649
preloan	-1.178	0.287				
collateral	0.402**	0.273				
_cons	-2.549	0.950	12.553	16.554	33.814**	6.441
σ_1			11.440**	1.438		
σ_2					8.474**	0.312
ρ_1			0.888**	0.061		
ρ_1					-0.963**	0.020
LR test for joint Independence of equations			χ^2=37.00			

Note: ** indicates statistically significant at 5%;
* indicates statistically significant at 10%.

Table 3. Maximum likelihood estimates of the endogenous switching regression model for household income

Variable	**Criteria Equation (Credit constraint)**		**Income Equation**			
			Credit Constrained (N=85)		Credit Unconstrained (N=426)	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
age	0.090**	0.045	-1.761	2.745	-7.613**	1.337
age2	-0.001*	0.000	0.006	0.028	0.080**	0.014
edu2	-0.017	0.203	3.703	10.843	0.566	5.842
edu3	-0.035	0.420	-20.118	28.952	2.701	10.688
revalue1	0.005**	0.002	9.650	6.434	11.673**	2.507
chrdisnum	-0.195	0.216	-0.160	0.123	-0.140	0.048
colstdnum	-0.598	0.468	-0.809	11.823	-0.043**	6.268
lbnum	0.034	0.108	20.585	39.151	19.475**	8.211
preloan	-1.017**	0.351				
collateral	-0.593*	0.326				
_cons	-2.397**	1.060	90.734	74.698	203.413**	31.248
σ_1			39.063**	3.669		
σ_2					42.172**	1.545
ρ_1			0.331	0.276		
ρ_1					-0.889**	0.038
LR test for joint Independence of equations			χ^2=43.05			

Note: ** indicates statistically significant at 5%;
* indicates statistically significant at 10%.