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Rural Credit Constraint and Informal Rural Credit Accessibility in China

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Abstract: This paper investigates the effects of rural households' demographic characteristics on formal credit constraint, and explores the relationship between informal and formal lending in rural China. Using 2013 China's Household Finance survey data, the authors apply probit regression models to investigate the effects of demographic factors on formal credit constraint and the household's decision to borrow from informal credit sources. In addition, the endogenous switching regression model is applied to evaluate the impact of credit constraint on the welfare of rural farm households. The empirical evidence confirms that age, family size, annual household nonagricultural income, level of education, and history of informal borrowing have significant influence over credit constraint. Moreover, annual household nonagricultural income, the presence of children, borrowing from social networks and monthly communication expenses significantly impact rural households' decision to utilise informal borrowing. Results from the endogenous switching regression model suggest that credit constraint by formal credit sources has no impact on household consumption.

Keywords: China; rural households; credit constraint; informal borrowing; welfare

1. Introduction

By the end of 2014, 45.23 percent (0.62 billion people) of China's population lived in rural areas [1]. Most of the rural population continues to rely on agriculture and around 20 percent of the rural population lives below the poverty line. China's official poverty line was an annual income of 2300RMB per capita. The number of poor in the population reached 128 million in 2010, which is about 20 percent of the rural population [2,3]. For farmers in rural China, putting aside money is difficult, and acquiring insurance to help them cope with the wide variety of economic shocks they frequently confront, such as extreme weather, is limited.

Access to rural credit is essential for improving production and for making investment and consumption decisions [4,5]. Credit access can significantly increase the rural farmers' ability to meet their financial needs, allowing them to afford agricultural inputs and to make other productive investments. Those farmers who lack collateral experience credit constraint are limited in their participation in a range of income-generating activities. Credit constraint is not necessarily a trap for those in poverty, but it does reinforce it [6,7].

Recognizing the importance of credit access to rural farmers, the Chinese government intervenes heavily in the credit markets whilst suppressing informal credit institutions. Such institutions are not regulated by the China Banking and Regulatory Commission (CBRC) and do not have legal mandate to supply credit to the agriculture sector [8,9]. In addition, all formal rural credit institutions are state-owned. The limited numbers of formal financial institutions currently providing rural credit in China include the Rural Credit Cooperatives (RCCs), the main credit providers to farmers. The three other major institutions that provide assistance to rural populations are the Agricultural Bank of China (ABC), the Agricultural Development Bank of China (ADBC), and the Rural Postal Savings Bank of China (RPSBC) [7,10]. The RPSBC charges higher interest rates than RCCs and the ABC, which is more likely to attract borrowers who cannot meet the guarantee policy of RCCs or ABC [9]. Collectively, the RCCs are the largest rural financial institution with the largest rural loan total. However, they do not provide adequate financial services to those living in rural areas [11]. In 2005, deposits in RCCs totalled 30,694 million RMB, while the loans granted by them totalled only 21,968 million RMB, a difference of 8726 million RMB [4].

Government control of the credit market results in a severe scarcity of formal credit resources in the rural sector [12]. The majority of rural farmers do not have access to formal credit sources or do not borrow from them. In 2005, rural borrowers were granted only 10.9 percent of the loans issued by formal institutions. He and Li [13] surveyed 502 rural households in Tongren Prefecture of Guizhou province and found 88 percent of surveyed framers wanted to borrow, yet only 57 percent were able to access a formal loan. Dong, Lu [11] reported only 33 percent of rural households had access to formal credit in Xinglonggang County, Heilongjiang Province, in 2007. More than 40 percent of the farmers who had financial need could not get sufficient financial support via formal credit channels; credit appears to be rationed even when formal credit is available. He and Li [13] revealed that more than half (56 percent) of the farmers who received loans reported that the sums they obtained did not meet their needs. Credit constraints affect rural farming communities, compromising their productivity, and are thus a major obstacle to China's agricultural development.

This restricted access to funds has a substantial social impact. Studies have confirmed that rural farmers prefer to borrow from their social networks such as friends and relatives, and that this credit strategy dominates the informal rural credit market [4,7]. However, the informal rural credit market is highly segmented, with the bulk of borrowers limited to loans from those with whom they have personal relationships. In addition, the cost of accessing informal credit varies. Without legal protection, borrowers can be vulnerable to abuses by informal lenders [11,14]. In addition, previous studies have found that informal loans were generally small and for short terms. These tended to be obtained for personal consumption and social expenditures, such as education, weddings, medical expenses, and the like, rather than for agricultural production [11,15,16]. Therefore, it is important to understand the characteristics of credit constrained farmers, and identify whether informal credit is a good substitute for formal lending, given the credit constraints in the rural sector.

The present study aims to examine the determinants of rural households' credit constraint, with a particular interest in the borrower's characteristics. Given the limited access to formal credit and the popularity of informal lending in rural China, this study also investigates how credit constraint affects households' decisions to borrow via informal channels. Finally, the study assesses how credit constraints affect Chinese rural households' welfare.

Our study contributes to the rural microcredit literature in several ways. First, the issue of credit constraint in rural China is frequently assessed by examining its impact on farm households (for example, see Dong, Lu [11], Feder, Lau [15], Kumar, Turvey [17], Rui and Xi [18]. There are few studies that have empirically evaluated its determinants. Although Tang and Guo [19] examined this, their study focussed primarily on borrowers' decisions between formal and informal lending. Further, we recognize the inter-relationship between credit constraint and informal lending in studying the factors affecting rural households' credit constraint. Even though it has been raised in the literature, the nature of the substitution role of informal lending for formal lending remains ambiguous. For example,

Turvey, Kong [20] study in Heilongjiang province, China in 2007 to 2008 revealed that the decision to rely on informal lending was unaffected by whether the borrowers had loan applications that had been denied. Jia, Heidhues [7] studies in the North China Plain during the period 2001 to 2004, on the other hand, supported a dependent relationship. In addition, while this relationship is often included in studies of informal lending, it is usually ignored in credit constraint research. Finally, our study utilizes the 2013 China's Household Finance survey data, which was collected from 28,228 rural households in 29 (out of 32) provinces in China. Such wide geographic coverage, coupled with the large sample size, is likely to provide robust representation of the population under study, allowing better generalisation to the country as a whole when compared to previous studies with surveys conducted on individual or smaller numbers of provinces in China. The most inclusive study to date was by Rui and Xi [18], who studied ten Chinese provinces..

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the research methodology. Section 4 exhibits the data obtained from the 2013 China Household survey. Empirical results are presented in Section 5, whilst Section 6 concludes the study and provides policy implications.

2. Literature Review

2.1. Factors Affecting Credit Constraint from Formal Credit Sources

Credit constraint arises when there is a mismatch between the household's credit demand and access to credit. A household is considered to be credit constrained if their loan demand is partially or completely rejected by the lender [21], or if they have been discouraged by their perception of no chance of gaining credit. The first case is referred to as credit rationing due to information asymmetry between lenders and borrowers, whilst the latter case represents self-imposed risk rationing by the borrowers [22,23].

The literature suggests that credit constraints are likely to be affected by the rural household characteristics such as gender, age, size, marital status, income, education, and number of dependents. A household headed by females, for example, is perceived as less credit-worthy by lenders and has a lower probability of gaining a loan than one headed by males [24]. It appears that lenders perceive females as having less control over their household economic resources and that they are less likely to be involved in economic activities [25]. Women also face other types of discrimination which restricts their access to formal credit [26]. Such an effect was confirmed by Mohamed [27], who found empirical evidence in a study of smallholder farmers and artisanal fishermen in Zanzibar. This discrimination, however, does not appear to be applicable to decisions about loans to rural households in Madagascar [21].

Age of the household head is related to credit demands and the lender's perception of a borrower's trustworthiness. However, the effect of age on the likelihood of credit constraints is ambiguous. Xuan, Bauer [28], for example, found that a one percent increase in the household-head's age decreases a rural household's probability of accessing formal credit by 0.154 percent. Perhaps it is assumed that younger households are more active in obtaining information about advances in farming technologies and credit sources and are thereby more likely to reduce potential constraints on borrowing. Conversely, compared with younger households, older rural households are seen as more settled and are probably less likely to take on new and capital-demanding projects [29]. However, old age also means a lessened ability to earn money, and is associated with a lower willingness to take on risk and incur more expenses. Thus, increasing age can increase the likelihood of being credit constrained [30,31].

Household size is an indicator of human capital which generally contributes the labour necessary to increase farm production [11]. However, families with more household members are also expected to have higher consumption-related expenditures, such as for food and clothing. These costs increase the household's dependence on credit and decrease the capital available for production [32]. The final impact of household size on credit constraint, therefore, depends on the balance between

farm production and consumption expenditure. In particular, if the household has more children, credit constraint will be more likely because of the assumption that expenditure will increase whilst production will decrease [33,34].

Though not frequently considered in research, the marital status of the household head has been hypothesised as having a negative impact on the probability of credit constraint. Married borrowers are generally seen as more stable and trustworthy to lenders, compared to single borrowers. Thus, they are less likely to be credit constrained [33].

Income is commonly used as a proxy for the individual's financial wealth and the ability to repay a loan [35]. Families with higher incomes are less likely to borrow. They also exhibit greater repayment capability and thus are less likely to be credit constrained [31]. A negative relationship between household income and credit constraints was supported by Tran, Gan [32] in the study on agricultural households in the North Central Coast region of Vietnam.

More highly educated rural households generally have a greater ability to create wealth [12,31]. It is also assumed that they allocate credit more efficiently [7,36]. Thus, rural households with higher levels of education are less likely to suffer from credit constraints. This negative impact of education level on the probability of credit constraint was also found by Akram and Hussain [37] in their study of rural households in 16 districts of Pakistan and by Ali, Deininger [36] in Rwanda.

The relationship between formal credit constraint and informal credit borrowing is ambiguous. Jia, Heidhues [7] utilised probit and bivariate probit models to determine the factors that influence credit rationing in both formal and informal sectors. In a 2005 survey of 337 rural households, they found weak substitutability between formal and informal lending. Their result contradicts Kochar's finding Kochar [38], which showed that the informal credit sector subsidized the formal credit sector in rural India. This effect can be explained by noting that reservation costs are generally lower with informal credit. The probability of a household being credit constrained in the formal credit sector has a positive impact on the household's access to informal credit. This can be construed as an indication that the informal credit sector provides a substitute for formal credit [39,40].

Han and Hare [41] study suggests a different point of view. They examined how the credit market influences households' entrepreneurial choices, and observed a complementary relationship between formal and informal credit sectors. The expansion of the formal credit sector may reduce the total volume of lending in the informal credit sector. Qin, Xu [42] studied monthly survey data from Wenzhou, China and employed a Vector Error Correction model to investigate how formal bank credits and market rates affected informal lending over the 2003 to 2011 period. The study revealed a substitutive effect for short-run loans, where the informal sector replaced a portion of loans that would otherwise have relied on formal credit sources. Their analysis also revealed a complementary relationship between informal credit and formal credit in the long run. Turvey and Kong [43] tested whether denying a formal loan to a farmer affects the decision to borrow from informal sources. They documented that those denied a formal loan are more likely to attempt borrowing in the informal sector, rather than approach banks or Rural Credit Cooperatives. Aliou and Zeller [44] found the informal credit sector serves as more than just a substitute for the formal credit sector, arguing that loans from these sources are often put to different purposes. They suggest, for example, that informal credit is used for "consumption smoothing purposes" (p. 124). There is no consensus on the question of whether formal and informal credit sectors are substitutes. The preference for informal borrowing can thus be taken as something more than simply evidence of rationing in the formal sector. Turvey and Kong [43] suggested that a preference for informal borrowing is likely to be an artefact of something other than credit rationing, as informal borrowing does not appear to be a perfect substitute for formal borrowing.

2.2. Factors Affecting Credit from Informal Credit Sources

Active informal financial markets operate alongside formal financial institutions in most developing countries. In these economies, informal credit sources may be the institutions of choice

in many cases, particularly for small loans [41]. As economic reforms in China progressed from rural to urban areas, reform was mostly defined by the transformation of the labour force from agriculture-focused to nonagricultural [45]. Off-farm employment plays a large and important role in agricultural transformation, which has promoted farmer entrepreneurship and enhanced self-employment in rural China [46]. The formal financial sector does not satisfy the growing demand for rural credit, and many rural households turn to borrowing from informal sources such as relatives, friends, and private moneylenders to meet their production and consumption needs [41,47]. An informal loan is likely to be more flexible and has a no (or little) collateral advantage over formal loans. In the Jia, Heidhues [7] study noted above, 67 percent of households were rationed by formal credit institutions, compared with only 30 percent of the households that were rationed by informal creditors.

The key determinant that affects the rural households' access to informal credits is social network [48,49]. Relationship plays an important role in informal lending in China, and other variables such as gender, education, annual income and marital status become less important in the informal credit sector [18]. In China, most informal borrowing is carried out between friends and relatives or those in their social network [43,49–51]. Income indicates household's wealth and it is another important factor that affects the likelihood of informal credit constraints, because the household with lower wealth has no other financial means to invest in social capital, such as sustained relationships with others. For example, Shoji, Aoyagi [51] and Yuan and Xu [49] found that households with lower levels of wealth are less likely to enter the informal credit market.

2.3. Impact of Credit Constraint on the Household's Welfare

The household's consumption has an indirect effect on its investment and growth. The life cycle model suggests that the households choose the level of consumption, investment and savings/borrowings in each period of their lifetime. However, these choices are constrained by the investment, production and borrowing opportunities available to them [52]. Deviating from the imperfection of the markets, credit constraints have been identified as a factor contributing to the reduction in rural productivity, and slow economic development [53]. Access to rural credit is essential for farmers in making investment and consumption decisions [4,5]. Credit access can significantly increase the rural farmers' ability to meet their financial needs, and allow them to afford agricultural inputs and make productive investments. Those farmers who experience credit constraints, are excluded from participation in a range of income-generating activities. Credit constraint is not necessarily a trap for those in poverty, but it does appear to reinforce it [6,7].

Rural credit constraint has been found to have adverse impacts on the household's welfare. The study of Baiyegunhi, Fraser [24] on households in the Eastern Cape Province in South Africa suggests that households with no credit constraint had higher monthly expenditure than constrained counterparts. In a study of six provinces in Vietnam, Tran, Gan [32] added that credit constrained households had lower consumption expenditure than randomly selected households. Similarly, Briggeman, Towe [54] showed that the average consumption of both farm and nonfarm households in the US facing credit constraints was $18,377 lower than that of those households without constraints.

In China, the impact of credit constraints has been examined on the household's expenditure and income. Employing the average treatment effect model (ATE), Li, Li [12] compared the welfare losses between constrained and nonconstrained households located in ten provinces in China in 2003. The study revealed that households with credit constraints experienced a loss in rural income by 13.2 percent and consumption expenditure by 15.8 percent. These losses were quite similar to the welfare losses of all households, of which 71 percent faced credit constraints. They concluded that another consequence of credit constraint was a transfer of welfare losses. In addition, these losses were greater if the household's credit demand was completely rejected. Focusing on the income effect, Dong, Lu's study Dong, Lu [11] of rural households in Heilongjiang province in 2008 showed a much greater effect of credit constraints; without constraints, household income could be improved by 23.2 percent.

This suggests that the effect of credit constraints on income has grown larger over time. However, an increase in the magnitude of the effect may be specific to Heilongjiang province. Kumar, Turvey [17] conducted a comparative study of the effects of credit constraints on the rural livelihood between China and India. The study's survey revealed that credit constraints caused a reduction in agricultural inputs and human investment in education and health. About 74 percent of households in China and 78 percent of households in India would use less input than required to maximize their farm income. More than 90 percent of the respondents suggested that they would turn to off-farm employment as a result of lower productivity. Using a 2011 China Household Finance survey data, Cai, Song [55] adds that credit constraint negatively affects the entrepreneurship in China. It reduces the likelihood of farmers' start-ups by around 3 percent.

3. Conceptual Framework and Research Methods

3.1. Conceptual Framework and Analytic Strategy

The literature suggests that credit constraint is affected by borrower characteristics such as gender, age, family size, number of dependents, marital status, household income, and education level. In addition, lending via informal channels can have a causal relationship with formal credit constraint. Consequently, constraint will affect the household's welfare by limiting their inputs, human capital accumulation and reduced productivity (see Figure 1).

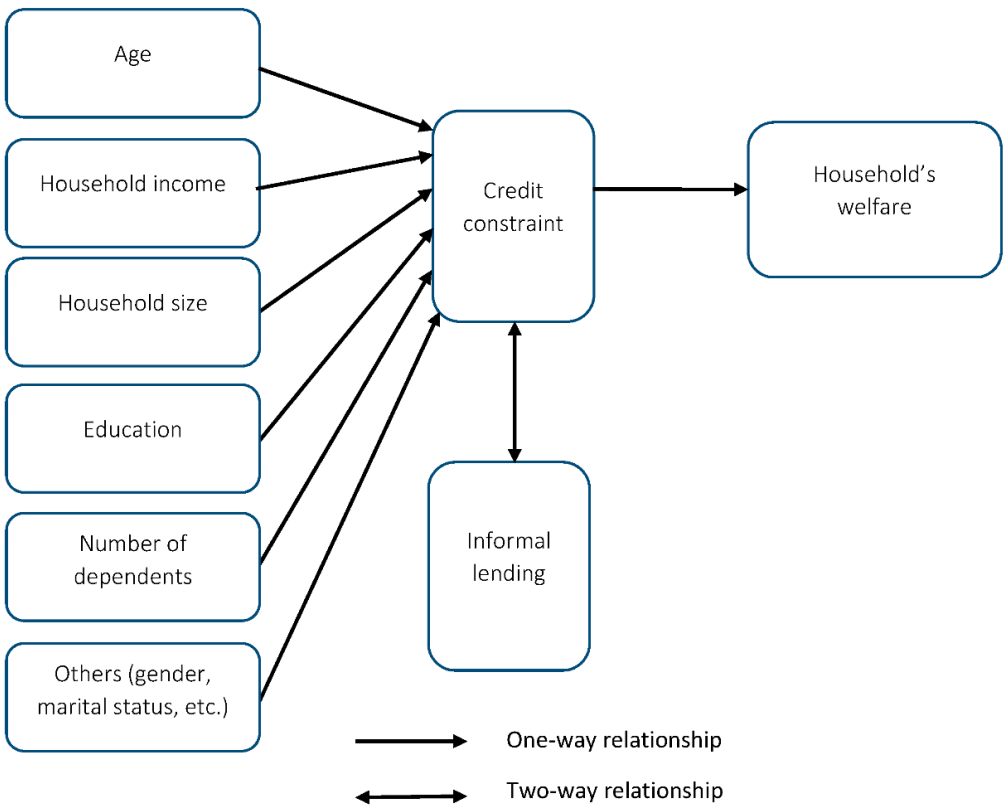

Figure 1. Conceptual framework.

We utilised the bivariate probit model for our analysis. This model is well-suited to estimating simultaneous equation models in which the dependent variables are dummy and endogenous [56]. The method has gained popularity in applied econometric research that focusses on consumer behaviour [57], such as examining the impacts of consumer variables on decision making. Li, Poskitt [58] demonstrated that bivariate probit model results can be interpreted from a partial identification perspective, with estimations that are in line with the average treatment effects of the

true data generating process. Therefore, it is a resilient empirical tool that deals with the endogenous influences problem for binary variables.

3.2. Empirical Models

3.2.1. Determinants of the Household's Credit Constraint

The empirical framework was developed from the qualitative choice analysis perspective, which is widely used in describing decision-makers' choices by researchers studying many commodities and services markets [59,60]. Models for determining discrete choice such as whether to participate or not in state or local government programs, and to favour or not favour a particular political party are known as qualitative choice models. Such models seek to determine the likelihood that a decision-maker with a given set of attributes will make a particular choice rather than its alternative [61]. Therefore, the determination of being credit constrained or unconstrained falls into the qualitative choice model.

Whether the ith rural household is credit constrained or not is determined as follows:

$$\begin{cases} Y_{credit_constrained_i} = 1 \; if \; Y_{credit_constrained_i} = \alpha_0 + \sum \beta_j X_{ij} + \varepsilon_i > 0 \\ Y_{credit_constrained_i} = 0, \; otherwise \end{cases} \tag{1}$$

where $Y_{credit_constrained}$ is a dummy variable, equals "1" when the household is credit constrained and "0", otherwise; α_0 is the intercept and β_j are the parameter coefficients of jth explanatory variables X, respectively; ε_i is the error term.

The probability that a household is credit constrained can be written as:

$$P(Y_{credit_constrained_i} = 1) = f(X) = \frac{1}{1 + e^{-(\alpha_0 + \sum \beta_j X_{ij})}} \tag{2}$$

Credit constraint is a qualitative variable and is difficult to observe directly. A widely adopted method for measurement of credit constraint is the direct elicitation method (DEM), which is directly based on the survey questions to separate the households with credit constraint from those without constraints (for example, see Boucher, Guirkinger [62] and Jia, Heidhues [7]). To apply this method in our study, we asked households whether they currently have any bank loans for all their agricultural activities. If they answered "yes", this documents that they are not credit constrained. For households who do not have any bank loans, the survey further asked why they do not. Households whose answers included "no need" or "had a loan but paid it off" were categorised as not credit constrained. Households were considered credit constrained if their answers were "need loans, but have never applied" or "applied for loans but was denied". Households who need loans but have never applied because they do not know how to, do not have confidence that the loan would be granted or if they thought the application process too troublesome were seen as credit constrained because of self-imposed rationing. In this study, we did not separate complete constraint from partial constraint for two reasons. First, our survey data comes from the China Household Finance Survey (CHFS) conducted by the Southwestern University of Finance and Economics in 2013, which presented a fixed set of questions that did not provide a mechanism to distinguish between degrees of constraint. We thus reasoned that partial constraint is, nevertheless, still constraint. Second, Rui and Xi [18] noted that partially constrained households accounted for a relatively small proportion as compared to completely constrained households (15 percent versus 55 percent). In addition, the consumption loss of partially constrained households is not much different from that of completely constrained households (1244 yuan and 1358 yuan, respectively) while their income loss is not significantly different from nonconstrained households. The two constraint conditions, in other words, do not differ in a meaningful way and therefore can be collapsed into a single category.

Explanatory variables for credit constraint (X) are the borrowers' characteristics as suggested by the literature. They include gender, age, family size, children, marital status, household no-agricultural

income, and education level. This list also includes informal borrowing, based on the assumption that formal credit is systematic and mandated in the credit market where loans are restricted to bank lending procedures. In contrast, informal credit is discrete and prevalent at the local level. Therefore, borrowers are likely to borrow from informal credit before they borrow from the formal credit sector.

While borrowing money from informal sources helps alleviate rural households' credit constraint, those households with formal credit constraint may be encouraged to borrow from informal credit sources, given their greater flexibility and easier access. This reverse effect could lead to an endogeneity problem in the formal credit constrained model. Since "credit constraint" and "informal borrowing" are binary variables, with the bivariate probit model applied to estimate Equation (1).

The bivariate probit selection framework is a modification of Heckman's two step estimator that accommodates two sequential bivariate probit equations to estimate the two equation system [57]. The bivariate probit model applied in our study assumes the error terms between the equations are correlated. A specification for informal borrowing is necessary for the bivariate probit regression. Following Turvey, He [9], Tang and Guo [19], Barslund and Tarp [29], informal borrowing is determined as a function of gender, marital status, annual household income, children, social networks and communication expenses (Z) as follows:

$$\begin{cases} Y_{informal_borrowing_i} = 1 \; if \; Y_{informal_borrowing_i} = \gamma_0 + \sum \delta_j Z_{ij} + \nu_i \\ Y_{informal_borrowing_i} = 0, \; otherwise \end{cases} \tag{3}$$

$Y_{informal_borrowing_i}$ is a dummy variable, which equals "1" if the household borrows from informal sources, and "0" otherwise. γ_0 is the intercept and δ_j are the parameter coefficients of jth explanatory variables Z, respectively; ν_i is the error term.

The probability that a household will borrow from informal sources is therefore:

$$P(Y_{informal_borrowing_i} = 1) = f(Z) = \frac{1}{1 + e^{-(\gamma_0 + \sum \delta_j Z_{ij})}} \tag{4}$$

3.2.2. Test for Robustness

Another factor underlying the estimation of whether the respondents are credit constrained is selection bias. People who are employed full time, for example, those working in government agencies, SOEs or institutions supported by government, are less likely to be credit constrained. Thus, the respondent who has a full-time job is less likely to borrow from informal sources. In contrast, people who are self-employed, such as those growing crops or raising livestock, and those who are unemployed, are not likely to have the opportunity to borrow from formal sources, even though formal borrowing would ultimately be less costly than informal borrowing. These conditions suggest that borrowing from informal sources is not randomly distributed in our sample and is indicate of selection bias in the credit market.

The bivariate probit model was applied as a correction for the sample selection bias in Equation (3) (informal borrowing model), which results in the transformation of residuals from the Equation (2) (credit constraint model) into an additional variable to adjust for the correlation of the errors between formal credit constraint and informal borrowing in the second equation. In this study, the formal credit constraint equation includes the independent variables of gender, age (middle), family size, marital status, annual household income, educational level, whether has children and whether borrowed from informal sources. Informal credit borrowing model is a function of gender, marital status, annual household income, whether has children, social networks and communication expenses.

3.2.3. Evaluation of the Impact of Credit Constraints on Rural Farm Households' Welfare

In evaluating the impact of credit constraints on rural farm households' welfare, two issues need to be controlled. These are the heterogeneity of credit constraint and the endogeneity caused by the credit

constraint on households' welfare. In term of credit constraint heterogeneity, credit constrained and nonconstrained households may have different credit demand [15]. At the same time, the households' welfare cannot be independent of its credit status. Thus, it is expected that the households' welfare will be different across households with and without credit constraints [11]. In addition, the credit constrained households may not have enough resources for production and thus, have lower welfares. In contrast, nonconstrained households do not face such a restriction. They can choose their optimal input production and create higher welfare. Therefore, the sample might suffer from selection bias. For this reason, our study applies the endogenous switching regression model (ESR) to address these problems [63].

Accordingly, the welfare functions of credit constrained and nonconstrained households are:

$$\begin{cases} Y_{1i} = \zeta_{1j}\mathrm{K}_{1ij} + \epsilon_{1i}\ if\ Y_{credit_constraint_i} = 1 \\ Y_{0i} = \zeta_{0j}\mathrm{K}_{0ij} + \epsilon_{0i}\ if\ Y_{credit_constraint_i} = 0 \end{cases} \tag{5}$$

where Y_1 and Y_0 represent the welfare functions of credit constrained and unconstrained households, respectively. We used the natural logarithm of annual household consumption expenditure as a measure of household welfare. ζ_1 *and* ζ_0 are vectors of parameters to be estimated; ϵ_{1i} and ϵ_{0i} are error terms. $Y_{credit_constraint_i}$ is determined from Equation (1)

K_1 and K_0 are vectors of the explanatory variables. The explanatory variables of household's welfare for nonconstrained households include gender, age, family size, marital status, household income, education level, children, communication expenses, and social networks. For constrained households, the explanatory variables additionally include informal borrowing.

The definitions of all variables used in Equations (1), (3) and (5) are provided in Table 1.

Table 1. Variables and definitions.

Variables	Description
Ln (annual household consumption expenditures)	Ln (Total amount of consumer spending which includes the spending on food, water bill, local transport costs etc.)
Constrained	1 = if household's credit constrained, 0 = unconstrained
Gender	1 = if household is male, 0 = female
Age (middle age group)	1 = if household is between 35–55, 0 = otherwise
Family size	The number of people in the family
Marital Status	1 = single 0 = married
Annual household nonagricultural income (wage, bonus and other nonagricultural activities related income)	1 = less than 20,000RMB, 2 = 20,000–30,000RMB, 3 = 30,000–50,000RMB, 4 = 50,000–100,000RMB, 5 = 100,000–200,000RMB, 6 = more than 200,000RMB
Education level	1 = high school or higher, 0 = less than high school
Respondents with children	1 = have children, 0 = otherwise

Table 1. *Cont.*

Variables	Description
Money borrowed from other informal sources (nonbank loans)	1 = Yes; 0 = No
Social networks	1 = from parents/parents in law, children, siblings, other relatives, friends/colleagues, a person or institute respondent has partnered with before 0 = otherwise
Communication expenses	The average monthly amount family spent on communication expenses such as telephone and internet fees last year
Occupation (farmer)	1 = respondent's occupation is farmer 0 = otherwise

To provide efficient and unbiased estimations of Equations (1) and (5), a full information maximum likelihood method was employed [64,65]. Since estimation of credit constraint is important for estimating its impact on household welfare, we also included a maximum likelihood method estimation using the univariate regression procedure without considering the endogeneity between formal credit constraint and informal borrowing as a robustness check.

4. Data and Descriptive Statistics

The data for this study was taken from the China Household Finance Survey (CHFS) conducted by the Southwestern University of Finance and Economics in 2013. The dataset covered 28,228 households, 1,048 communities, 262 counties and 29 provinces. The provinces included Beijing, Shanghai, Tianjin, Hebei, Shanxi, Liaoning, Heilongjiang, Jiangsu, Zhejiang, Anhui, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu and Qinghai. Thus, the data is likely to be both nationally and provincially representative. However, the poverty rate in China has fallen steadily since the data was collected. This trend might have an impact on credit constraint, though we assume that the relationships amongst the concepts in our models are unlikely to have changed. Data from the 2015 and 2017 versions of the CHFS were not available at the time of our analysis.

Table 2 provides the descriptive statistics of the variables measured for our study, separated into credit constrained and credit unconstrained household subgroups. Gender ratios are consistent with the overall sample; male heads of household constituted 65.05 percent of the credit constrained respondents, compared to 63.75 percent of the unconstrained households. Female household heads are less likely to be credit constrained; only 34.95 percent of these are credit constrained compared to the above noted 65.05 percent for males. The proportion of credit constrained households that obtained high school or higher levels of education is lower than households where the educational level is primary school or less. The results of chi-square testing indicate that age, educational level, sources of loan obtain, occupation type and income have statistically significant relationships with credit constraints at the 1 and 5 percent levels, respectively. Table 2 also reveals that there are statistically significant differences between credit constrained and unconstrained household groups in terms of household size, number of children and consumption per capita.

Table 2. Profile of credit constrained survey respondents.

Characteristics	Credit Constrained Household		Credit Unconstrained Household		All Respondents		Statistical Test
	Count	Percent	Count	Percent	Count	Percent	
Gender							
Male	860	65.05	4684	63.75	5544	63.94	χ^2 = 08,311 (ns)
Female	462	34.95	2664	36.25	3126	36.06	
Age group							
Below 35	137	10.36	818	11.13	955	11.02	
35–55	727	54.99	3582	48.75	4309	49.70	χ^2 = 17.9424 ***
Above 55	458	34.65	2948	40.12	3406	39.28	
Education level							
Primary school or lower	733	55.45	3763	51.21	4496	51.86	χ^2 = 8.0494 ***
High school and above	589	44.55	3585	48.79	4174	48.14	
Borrowed from friends and relatives							
Relatives and friends	550	41.60	927	12.62	1477	17.04	χ^2 = 666.1381 ***
Nonrelatives and friends	772	58.40	6422	87.40	7193	82.96	
Main Occupation							
Farm	1013	76.62	5143	69.99	6156	71.00	χ^2 = 38.5667 ***
Nonfarm	148	11.20	1332	18.13	1480	17.07	
Missing value	161	12.18	873	11.88	1034	11.93	
Household size							
Mean	4.43	-	4.4	-	4.41	-	t = −4.7569 ***
Number of labour							
Mean	11.75	-	11.42	-	11.47	-	t = −0.0826 (ns)
Number of Children							
Mean	2.87	-	2.76	-	2.78	-	t = −1.7816 *
Income							
Less than 20,000RMB	999	75.57	4935	67.16	5934	68.44	
20,000–300,000RMB	113	8.55	655	8.91	768	8.86	
30,000–50,000RMB	133	10.06	914	12.44	1047	12.08	χ^2 = 51.2724 ***
50,000–100,000RMB	58	4.39	667	9.08	725	8.36	
100,000–200,000RMB	15	1.13	147	2.00	162	1.87	
More than 200,000RMB	4	0.30	30	0.41	34	0.39	
Ln (Consumption per capital)							
Mean	10.30	-	10.40	-	10.39	-	t = 3.6044 ***

Note: Significance is indicated by *** (1% level), or * (10% level).

5. Empirical Results

The probit model results are presented in Tables 3 and 4. The different models fit the data quite well, as the chi-square test results strongly rejected the hypothesis of no explanatory power for both equations; χ^2 = 615.83, p = 0.000 for the credit constraint model (model 1); χ^2 = 6889.63, p = 0.000 for informal source borrowing model (model 2). Outcomes are correctly predicted by the credit constraint model in 76.32 percent of the cases, whilst 97.86 percent were successfully predicted by the informal sources borrowing model. The average VIFs are 1.22 for the credit constraint model and 1.06 for the informal sources borrowing model, which confirm that both models do not suffer from multicollinearity. However, the significant estimate of rho leads to the inference that a sample selection bias is an issue in the single equation estimates of the informal borrowing. Formal and informal credit markets are related. We therefore cannot retain the null hypothesis that credit borrowing is uncorrelated and thus independent in both formal and informal markets. The presence of bias is also suggested by the difference in estimated coefficients between the bivariate probit and the univariate models. The results for the bivariate and univariate models of credit constraint and informal borrowing are shown in Tables 3 and 4.

Table 3. Results of probit regressions of credit constraint models.

	Univariate Probit	Marginal Effect	Bivariate Probit	Marginal Effect
Gender	0.0244 (0.502) (ns)	0.0058	0.0320 (0.387) (ns)	0.0023
Age_middle	0.0736 (0.047) **	0.0162	0.0787 (0.037) **	0.0011
Family size	0.0440 (0.000) ***	0.0100	0.0425 (0.000) ***	0.0006
Marital status	0.0205 (0.742) (ns)	0.0077	0.0202 (0.741) (ns)	0.0003
Annual household nonagricultural income	−0.1097 (0.000) ***	−0.02105	−0.1106 (0.000) ***	-0.0030
Education level	−0.1026 (0.004) ***	−0.02108	−0.1016 (0.004) ***	-0.0014
Children	−0.0389 (0.475) (ns)	−0.0043	−0.0386 (0.480) (ns)	-0.0042
Money borrowed from informal sources	0.8723 (0.000) ***	0.2542	0.8910 (0.000) ***	0.0171
rho			−0.982 (0.073) *	

Note: Significance is indicated by *** (1% level), ** (5% level), or * (10% level).

Table 4. Results of probit regressions of informal borrowing model.

	Univariate Probit	Marginal Effect of Univariate Probit	Bivariate Probit	Marginal Effect Bivariate Probit
Gender	0.1162 (0.175) (ns)	0.0165	0.1212 (0.161) (ns)	0.0023
Marital status	0.0770 (0.580) (ns)	0.0112	0.0791 (0.595) (ns)	0.0012
Annual household nonagricultural income	−0.0929 (0.027) **	-0.0135	−0.0923 (0.019) **	−0.0030
Children	−0.2682 (0.014) **	−0.0349	−0.2745 (0.011) **	−0.0042
Social networks	5.2277 (0.000) ***	0.9866	5.2415 (0.000) ***	0.1349
Communication expenses	−0.0008 (0.048) **	−0.0001	−0.0008 (0.010) **	−0.0001
rho			−0.982 (0.073) *	

Note: Significance is indicated by *** (1% level), ** (5% level), or * (10% level).

5.1. Determinants of Credit Constraints

The analytic results of both bivariate and univariate models (Table 3) show the positive, significant effects of age (middle), family size, and whether money was borrowed from informal sources on the households' likelihood of being credit constrained from formal credit sources. Annual household nonagricultural income and education level negatively affect the households' credit constrained condition. These results imply that middle-aged households with large family size and which have borrowed from informal sources are more likely to be credit constrained from formal credit sources. This outcome is congruent with the findings of Baiyegunhi, Fraser [24], Chaudhuri and Cherical [66] and Xuan, Bauer [28], all of which showed a positive relationship between age and the probability of being credit constrained. Younger households are more likely to be granted credit because younger households are likely to be more active in obtaining information about credit sources, make use of modern farming technologies and take better advantage of market conditions [28]. This suggests that lenders tend to see younger borrowers as presenting less delinquency or default risk. The studies by Xuan, Bauer [28], Barslund and Tarp [29], Tran, Gan [32] found credit constraint had less or nearly no effect on older farmers. This appears to indicate that lenders think older farmers are more settled and

less likely to take on new and capital demanding initiatives. Our descriptive statistics, presented in Table 1, shows that 54.99 percent of the middle age group respondents are credit constrained, compared with only 10.36 percent in the younger age group (aged less than 35 years).

The effect of family size is positive and significantly affects credit constraint. This indicates that households with larger family sizes have a lesser likelihood of a successful loan application when approaching formal credit organisations. This result may reflect the fact that the cost of looking after family members is a large expense for rural households. This result is similar to the finding by Dong, Lu [11]. High medical cost has been blamed for amplifying poverty in 30 percent of poor households [67]. In China, many rural households often have large and urgent expenditures resulting from the illness of family members or children's education [12]. Further, a household with more dependents is likely to have saved less money than those with fewer dependents. The households' repayment abilities will thus be challenged when they are under payment stress from such medical and educational expenditures [7]. Thus, households with larger families are more likely to be credit rationed.

Informal loan appears to have a positive and significant relationship with credit constraint by formal credit sources. Analysis shows that rural households that borrowed from informal sources increase their probability of being credit constrained by 25.42 percent. This supports the findings of Feder, Lau [15], Turvey, Kong [20], Jappelli [68]. Households apply for loans from informal sources because they either fear rejection by a bank considering their request or their loan applications have been rejected by formal credit sources. These people were considered to be credit constrained [15,68]. Households which have previously been denied a loan are more prone to borrow from informal sources. Unfortunately, many poor rural households lack qualified collateral, which often leads to serious credit rationing problems from formal credit institutions [12,69]. Informal borrowing is likely to be preferred because of concern over the high collateral requirements and higher transaction costs associated with formal institutions [4, 70]. Rural households with less financial ability are more likely to borrow informally. This is especially so for some regions of rural China because they have limited access to formal credit as a result of credit rationing or institutional availability [20,70]. Our analysis confirms that informal credit is often used as an alternative to formal borrowing in rural areas of China. Informal borrowing often requires no fixed repayment scheme and is frequently short term, with low or even no interest rate attached to the loan. Informal loans frequently rely on social norms for control and are therefore unlikely to be contract-based. In comparison, formal credit is usually granted for relatively longer terms with specific terms of repayment built into a binding contract [46].

Nonagricultural income has a significantly negative effect on credit constraint. This result reinforces the findings of previous studies such as Xuan, Bauer [28], Duong and Nghiem [71]. The variable "income" indicates, to a degree, the households' financial ability; households with higher incomes minimize repayment defaults [72]. Our study results also show that higher education levels in households improve accessibility to formal credit. Households with more education generally earn higher incomes, which have stronger loan repayment abilities [12]. Moreover, more highly educated rural households are thought to allocate credit more efficiently [32]. The studies by Petrick [73] Jia, Heidhues [7], Ali, Deininger [36] support the notion that households with better financial abilities are more likely to receive sufficient funds from loans.

Additional information can be obtained through an analysis of the marginal effects calculated as the partial derivatives of the nonlinear probability function, evaluated at each variable's sample mean [64]. Marginal effects analysis reveals that among factors affecting credit constraint from formal sources, borrowing from informal sources has the strongest marginal effect on the probability of credit constraint by the formal institutions. This was followed by annual household nonagricultural income, educational level, age (middle) and family size. The last column in Table 3 is based on the magnitude of the marginal effect. The impact of education, for example, is substantial. Respondents who have a high school or higher education have a 10.26 percent decrease in their probability of being credit constrained.

5.2. Determinants of Informal Borrowing

The bivariate and univariate models' results summarised in Table 4 show that borrowing from informal credit sources is affected by annual household nonagricultural income, whether households have children, social networks and communication expenses. A social network is defined as friends, relatives (parents/parents in law, children, siblings, and other relatives) and other individuals that know each other with the respondents [46,49,50]). The coefficient for social networks demonstrates a positive effect on the probability of informal borrowing. This analytic result is consistent with the Turvey, He [9], Li, Li [12], Rui and Xi [18], Jia, Xiang [46], Yuan and Xu [49] studies, where a rural household's social network is the primary source relied upon to meet the farmers' demand for credit.

Rural farmers in China are more likely to borrow from their relatives and friends for both consumption and production. Based upon data drawn from a survey of 3000 rural households in China's ten provinces in 2003, Rui and Xi [18] showed that about 67.8 percent of Chinese rural households' loans were from relatives and friends. Rural households appear to have more flexibility in borrowing from friends and relatives. Repayment practices, for example, can involve farmers repaying loans to their friends and relatives with agricultural products, rather than with money [12].

Higher nonagricultural household income is negatively related to informal borrowing, which indicates that households with greater financial resources either have greater access to formal credit or sufficient personal funds to cover their needs [20]. Households with more off-farm income are more likely to borrow from formal credit sources [7]. Our results also show that households with children have more difficulties in accessing the informal credit market [49]. Households with children need more credit to support them in their daily lives and provide for the cost of education [4]. Our results confirm that households with less financial ability are more likely to be constrained in the informal credit market. It is not surprising to see that communication expenses decreases the possibility of rural households borrowing from informal sources. This reflects the increase in households' expenses, which decrease the rural households' repayment ability.

Similar to model (1), marginal effects analysis shows that among the demographic variables affecting the respondents' borrowing from informal sources, social networks has the strongest marginal effect. Social network dominates the rural farmers' access to informal credit. It is clear from our analysis that rural households who can borrow from friends and relatives increases their probability of borrowing from informal credit sources. Households with children is ranked as the second most important factor that impacts the households' borrowing from informal sources. This is followed, in order of decreasing impact, by the annual household nonagricultural income and communication expense variables.

5.3. Impact of Credit Constraints on Household Welfare

This study also empirically evaluated the impact of households' demographic factors, social networks and the provision of informal credit on Chinese rural households' welfare, measured by consumption expenditures. Using the endogenous switching estimation model (ESR), analysis further showed that borrowing from informal sources does not significantly improve rural household welfare. Table 5 shows the results obtained from the ESR model. The Wald test confirms the significance of all repressors, except the constant. The likelihood ratio test (LR test) is significant at the 1 percent level (χ^2 = 163.01), indicating that the endogenous switching model describes the observed relationships better than the exogenous model. Moreover, the significance of ρ_1 implies that the sample may suffer from selection bias and thus that OLS estimation would result in biased estimates [63,74]. The predictors of consumption per capita are essentially the same for credit unconstrained and constrained households in terms of significance and sign. Therefore, the ERS results show there is no difference in consumption expenditure (welfare) for credit unconstrained and constrained rural households. This suggests that the providers of credit tend to ignore poor rural households. This group of borrowers are more likely to need credit for personal consumption rather than for investment in rural production. Previous studies [75–77] confirm that poor rural households are more likely to

have minimal access to credit sources in general and are seldom clients of formal credit institutions. Li, Gan [78] found that most clients of microfinance institutions in rural areas of China are nonpoor. Thus, credit programs of many financial institutions have not reached the poor so much as relatively wealthy rural households in China. Wealthier rural households tend to demand larger amounts when borrowing. They do so to conduct more profitable business activities and do not use these for consumption. In contrast, rural poor households depend heavily on securing credit in the informal market, relying on friends and relatives [46]. Therefore, the conditions of formal credit unconstraint and constrained credit do not have an impact on rural household welfare in China.

Table 5. Impact of credit constraints on household's consumption per capita.

	Endogenous Switching Model		OLS	
Variable Name	**Credit Unconstrained**	**Credit Constrained**	**Credit Unconstrained**	**Credit Constrained**
Gender	−0.0328 (0.116) (ns)	0.0263 (0.597) (ns)	−0.0326 (0.096) (ns)	0.0170 (0.719) (ns)
Age middle	0.2064 (0.000) ***	0.1963 (0.000) ***	0.1895 (0.000) ***	0.2056 (0.000) ***
Family size	0.0666 (0.000) ***	0.0761 (0.000) ***	0.0613 (0.000) ***	0.0696 (0.000) ***
Marital status	−0.2027 (0.000) ***	−0.2249 (0.008) ***	−0.1842 (0.000) ***	−0.1972 (0.014) **
Annual household nonagricultural income	0.0437 (0.000) ***	0.0501 (0.044) **	0.0556 (0.000) ***	0.0553 (0.023) **
Education level	0.2663 (0.000) ***	0.1957 (0.000) ***	0.3060 (0.000) ***	0.2589 (0.000) ***
Children	−0.3997 (0.000) ***	−0.4355 (0.000) ***	−0.4403 (0.000) ***	−0.4184 (0.000) ***
Communication expenses	0.0017 (0.000) ***	0.0023 (0.000) ***	0.0017 (0.000) ***	0.0025 (0.000) ***
Social networks	−0.0236 (0.425) (ns)	0.2494 (0.105) (ns)	−0.0265 (0.357) (ns)	0.2544 (0.083) *
Money borrow from informal credit sources		−0.2150 (0.159) (ns)		−0.2449 (0.094) *
Constant	9.924 (0.000) ***	8.862 (0.000) ***	9.7497 (0.000) ***	9.5111 (0.000) ***
ρ_0			0.7538 (0.000) ***	
ρ_1			0.5114 (0.001) ***	
Log likelihood			−12004.219	
Wald test			2847.58 ***	
LR test			163.01 (0.000) ***	

Note: Significance is indicated by *** (1% level), ** (5% level), or * (10% level).

The coefficient for communication expenses documents a positive and significant impact on welfare outcomes. This suggests that besides households' demographic factors, rural households will benefit more as they spend more on communication with their friends or relatives [28,48]. New communication technologies, such as mobile phones and more widespread access to wireless networks, enhances the connections of people and enables greater involvement of friends and family members [79,80]. In return, friends and family members provide information about credit programs to potential borrowers and reduce search costs [81].

Our study results also confirm that rural households' welfare is not influenced by the utilisation of money borrowed from informal sources. This is because rural households with low financial ability are more likely to be excluded from informal credit markets. They are thus not fully able to enjoy the benefits informal credit would bring about [49,51]. Further, private borrowing relies heavily on social networks [43]. Poor rural households, however, generally do not have extra money with which to contact friends and relatives and engage in other socially-related activities. Rural households with low incomes are more likely to be credit constrained due to their limited social capital [49].

The correlation coefficients $P_{\rho_0} = 0.000$; $P_{\rho_1} = 0.001$ are both statistically significant. Since both ρ_0 and ρ_1 are positive, the credit constrained and unconstrained households' welfare are positively related. Individuals that are credit constrained have similar levels of welfare (indicated by their consumption expenditures) as random individuals from the sample who are credit unconstrained.

6. Conclusions

Credit markets in China have played an important role in financing rural development. However, not all rural households are able to enjoy the benefits that formal credit sources can provide. This is demonstrated by the low agricultural sector contribution to China's total gross domestic product, reflecting low farming productivity. The contribution of agriculture to China's national gross domestic product was only 8.83 percent in 2015 [1]. By contrast, the industry and construction contribution were 40.93 percent, with the services industry contributing 50.24 percent. Widespread poverty, especially in the mid-west and other less densely populated regions, remains a major challenge for sustainable development. In order to design credit schemes to encourage rural investment, it is essential to identify factors that influence household access to both formal and informal credit as well as how credit constrained and unconstrained conditions effect households' welfare.

Our study empirically tested how household demographic characteristics effect access to formal and informal credit sources. Our utilisation of the 2013 China Household Finance Survey (CHFS) provides a large, robust data set with national representation. Our analysis confirms that credit constraint is affected by age, family size, annual household nonagricultural income, level of education and a history of informal borrowing. Moreover, our study has examined factors that influence gaining informal credit. Our findings show that annual household nonagricultural income, the presence of children, communication expenses and borrow from personal social networks, such as friends and relatives, significantly impact informal lending. Borrowing from friends and relatives is both necessary and popular in China, and in fact dominates the informal borrowing activity.

An endogenous switching model was utilised in our study to examine the impacts of credit constraint on rural households' welfare in China. Our testing shows that the factors in our model make no marginal contribution to households' welfare for both credit constrained and unconstrained households.

This study provides implications for poverty reduction policies, regardless of the credit source that rural households rely upon. Policy makers can choose to intervene in the rural credit lending system by liberalising policy to more accurately reflect the characteristics of potential borrowers and in light of their current borrowing strategies. This study supports the conclusion of Xuan, Bauer [28], Barslund and Tarp [29] that a "one size fits all" method to scaling up subsidized credit is not going to be the most advantageous. Our study shows a diverse impact of credit constraint, varying by the different socio-economic characteristics of those attempting to borrow. This effect was especially true for borrowers from different age groups and educational levels. Policies that focus on improving the access of rural households to education and nonfarm employment could be effective ways of enhancing their credit accessibility. In addition, policy makers could also consider encouraging formal financial institutions to increase the amount of money they lend to rural households with innovative loan models and diversified lending policies.

The government might also consider further development of the informal credit market in order to make it a more reliable source of financing for rural households, and working toward diversifying rural financial institutions to enhance competition. For example, they might revise policy to permit nonfinancial institutions to provide some form of financial service to rural households. Eventually, informal credit would likely serve as more than just a substitute for formal credits, fulfilling their own, separate function.

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