Study of the Factors Influencing Entrepreneurial Farmers' Formal Financial Credit Demand and Credit Constraints in Sichuan and Chongqing

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Abstract Based on a survey of 939 farmers in Sichuan and Chongqing, this paper analyzes the influencing factors of entrepreneurial farmers' formal financial credit demands and credit constraints with Probit model. It is found that entrepreneurial farmers have strong demand for formal financial credit, which is mainly production investment demand, but the formal financial credit constraint is obvious. Family size, cognition of loan procedures and conditions have a positive effect on entrepreneurial farmers' formal financial demand, while family per capita income, the distance between family location and the nearest formal financial organization, have negative influence. The relationship between householder' age and entrepreneurial farmers' successful formal loan presents inverted U shape, and educational level presents a negative correlation with successful loan. Compared with the traditional scale agricultural business, farmers engaged in other entrepreneurial businesses would get loan from formal financial institutions more difficultly. Understanding level of the loan procedures and conditions has a positive effect on successful loan. Compared with entrepreneurial farmers without employment, employed farmers are more likely to get loans. Statistically, householder' age and educational level, entrepreneurial business choices do not have significant effect on entrepreneurial households' formal financial credit demands. Family size, family per capital income, the distance between family location and the nearest formal financial organization, and the size of loan do not have significant influence on entrepreneurial households' successful loan. To get rid of formal financial credit constraints, we must implement the incremental reform of financial institutions, promote the formal finance of the villages and towns which can adapt to the farmers' financial demand, and create a good financial environment. Meanwhile, it is necessary to give impetus to innovation of financial management, products and services, reduce credit threshold, and adapt to the characteristics and demands of entrepreneurial households.

Key words Entrepreneurial farmers, Formal financial credit demand, Credit constraints, Probit

1 Introduction

Entrepreneurship is the main engine of economic activity (Peter Drucker, 1989), and entrepreneurial economy promotes social progress, leads the direction of industrial development and boosts economic development by creating jobs (Jiao Xiaobo, Guan Pu, 2012). Farmers start up an undertaking by relying on families and friends and relatives to form loose informal organization or create a new organization to seek development opportunities, and increase investment to expand the existing scale or engage in new productive activities to create value and seek development opportunities (Guo Junying, 2006). The entrepreneurial farmers use diversified means to mainly engage in moderate scale farming, breeding, processing and sales of agricultural products and non-agricultural production and business activities, showing a strong sense of the market, and they have the strong market adaptation and self-adjustment capability (Jiang Heping, Cui Kai, 2012). At present, the development of agriculture and rural areas in China is entering a new phase characterized by rising costs of agricultural production, prominent structural contradiction of agricultural supply and demand, rapid transformation of rural social structure and accelerated integration of urban and rural development, vigorously cultivating entrepreneurial farmers and promoting orderly farmers' entrepreneurship is conducive to promoting the transformation of traditional agriculture, enhancing the development of non-agricultural industries, accelerating the transfer of rural surplus labor force, and promoting agricultural modernization, rural industrialization and rural urbanization (Zhang Yingliang, 2012). Due to the financial constraints in the developing countries, farmers are often in a weak position in the lending market, and find it difficult to obtain sufficient funds from the formal financial departments (Edward·S·Shaw, 1973; Ronald·I·McKinnon, 1973). There is a small proportion of farmers who can get loans from formal finance, and the borrowers are mainly concentrated in the hands of a few wealthy people (Pisch *et al*, 1987). Only 27% of farmers in China can have access to formal credit channels, and more than 40% of farmers who have financial demand can not get formal credit support (Zhang Xiaoshan, 2010). The loans of formal financial institutions mainly flow to those relatively affluent farmers with higher social capital (Ye Jingzhong *et al*, 2004; Zhang Qingfang, 2010), or well-educated farmers (Zhang Qingfang, 2010). Funding constraints become a major obstacle to individuals' entrepreneurship (Peter Drucker, 1989), and a shortage of funds has become a key factor restricting farmers' entrepreneurship (Zheng Fengtian, Sun Jin, 2006). The perfect credit markets and ade-

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quate credit support will be conducive to entrepreneurship generation and business growth (Black & Strahan, 2002; Klappera & Laevena & Rajan, 2006), and the loan has a significant positive impact on farmers' entrepreneurial behavior (Wei Jifei *et al.*, 2008). Rural financial constraint has always been a hot research issue for scholars. Overall, domestic recent studies are based on macroeconomic and microeconomic perspectives. The macroeconomic perspective is based on Stiglitz's incomplete market theory, which believes that the rural financial development strategy can be supplied to promote reform of China's rural financial system, and eliminate financial constraints; the microeconomic perspective is based on Menger's adaptive evolution and Hayek's spontaneous extended market order theory (1967), which believes that the ideal financial system must meet the financial needs of the micro body, and it is necessary to design rational institutional arrangement to eliminate rural financial repression (Xu Zhangyong, Wang Hongli, 2009). Currently, based on microscopic investigation of farmers, the scholars mainly carry out empirical analysis from farmers' credit demand and its influencing factors. The explanatory variables include farmers' household characteristics variables, rural householder's characteristic variables, production and management features, loan characteristics, financial ecological variables and so on. The dependent variables mainly include the amount of loans, the substitution variables indicating whether there is lending or whether the lending is successful, and the substitution variables indicating credit degree or whether the bank lends or not. The research methods mainly include polynomial regression (Pal, 2002), Probit regression model (Li Rui, Zhu Xi, 2007; Zhang Qingfang, 2010; Qin Jianqun *et al.*, 2011; Tang, 2009; Huang Zuhui *et al.*, 2009; Wang Dingxiang *et al.*, 2011; Xiao Huafang, Bao Xiaolan, 2011), Logistic regression model (Li Cuimei, Chen Qiaoling, 2007; Xu Zhangyong, 2009; Zeng Xuewen, Zhang Shuai, 2009; Bai Yongxiu, Ma Xiaoyong, 2010; Wang Xiuhua, Tan Kaitong, 2012; Shi Zhiping, Zhang Wenqi, 2012; Tong Xinyue *et al.*, 2011), Tobit regression model (Gong Jianqiang, Zhang Bing, 2008; Han Jun, *et al.*, 2007), simultaneous equation model (Zhu Xi, Li Zinai, 2006), and other models (SEM structural equation model, Wang Jining, Zhao Shunlong, 2007; multinomial choice and stereotype Logistic, Chen Peng, Liu Xiliang). The conclusions of the study vary due to the difference in the sample size, study farmer selection, sample time span and sample space span. Income level, education level and use of the loans are the main factors influencing farmers' credit demand (Yazdani and Gunjal influence, 1998; Zhou Xiaobin *et al.*, 2004; Xiong Xueping, *et al.*, 2007; Chaudhary and Ishfaq, 2008; He Mingsheng, Shuai Xu, 2008; Cheng Yu *et al.*, 2009; Wang Dingxiang *et al.*, 2011). In terms of formal financial demand and credit constraints, He Guangwen (1999), Wen Tiejun (2001), Zhu Shouyin *et al.* (2003), Wang Yuzhou (2004), Xiong Jie *et al.* (2004), Guo Xiaoming *et al.* (2005), and Liu Lingling *et al.* (2007) believe that the Chinese farmers are prone to formal financial credit constraints. The proportion of relatively affluent farmers borrowing money from rural credit cooperatives and other formal financial institutions is higher than the proportion of farmers with low income level (Zhu Shouyin, 2003). The formal channel loans have a significant positive correlation with the investment (Zhang Xinmin *et al.*, 2001). The scholars at home and abroad gradually change the research focus from qualitative study to econometric model study, and lay equal emphasis on macroeconomic research and microeconomic research. However, there is little literature on farmers' credit behavior and credit constraints from the perspective of agricultural ecology, and there are few studies on entrepreneurial farmers' credit demand, credit supply, credit choice and influencing factors. This paper selects entrepreneurial farmers' formal financial credit constraints as the research object, to analyze entrepreneurial farmers' credit demand, formal financial credit wishes and influencing factors, and analyze the formal financial credit constraints from the perspective of entrepreneurial farmers' credit demand.

2 Study theory and methods

2.1 Analytical framework The theory of financial constraints believes that the credit constraints mainly include supply-based constraints and demand-based constraints. The former maintains that the credit constraints arise from inadequate supply of formal financial institutions or credit exclusion, while the latter believes that the credit constraints arise from insufficient effective credit demand of farmers. Under information symmetry, farmers can better understand the credit procedures and conditions of formal financial institutions, and reduce the cognitive biases and opportunity cost. In the context of urban and rural dual financial system, the external constraints of rural formal financial institutions such as withdrawal from rural areas and absence of rural financial services, increase the formal financial credit acquisition costs. Farmers' economic characteristics, householder's personal characteristics and the characteristics of industries that farmers are engaged in, by a certain degree determine the availability of financial resources and financial credit repayment capacity. Entrepreneurial farmers' formal financial demand preferences and choices also follow the cost- benefit principle, and the factors influencing net income and repayment ability of entrepreneurs include business owners' characteristic variables, industry variables and firm characteristic variables. The formal financial institutions are faced with a serious problem of information asymmetry, and in the process of making credit decision, the financial institutions judge borrowers' risk type to address the adverse selection problem caused by information asymmetry based on the characteristics of rural households. Under given loan interest rate, the higher the financing costs of financial institutions, the lower the willingness to grant loans to farmers; the better the level of financial development in the areas where rural loan applicants live, the better the individual characteristics of the loan application farmers, and the richer the rural household's resource endowments and social capital, then the lower the likelihood of formal financial constraints; the farmers with

better collateral are less likely to be vulnerable to credit exclusion.

2.2 Theoretical model The farmers' credit behavior is jointly determined by demand willingness and credit constraints. Based on the theoretical model analysis of Xiao Huafang and Bao Xiaolan (2011), it is assumed that the entrepreneurial farmers apply for loans from formal financial institutions in accordance with the cost-benefit principle. The net income function is as follows:

$$Y_i^* = X_{1i}\beta_1 + \mu_{1i} \quad (1)$$

where Y_i^* represents entrepreneurial farmers' net income; X_{1i} represents the vector of factor influencing entrepreneurial farmers' net income; β_1 represents the coefficient vector; μ_{1i} represents the residual term. Then the probability of entrepreneurial farmers applying for loans from formal financial institutions is as follows:

$$Pro(apply = 1) = Pro(X_{1i}\beta_1 + \mu_{1i} \geqslant 0) = Pro(\mu_{1i} \leqslant X_{1i}) \quad (2)$$

After entrepreneurial farmers apply for loans, the formal financial institutions make assessment and make decisions. It is assumed that the formal financial institutions make lending decisions based on the borrower's repayment ability, then the entrepreneurial farmers' repayment ability is expressed as follows:

$$B_i^* = X_{2i} + \alpha_2 + \upsilon_{2i} \quad (3)$$

where B_i^* is entrepreneurial farmers' repayment ability; X_{2i} is the vector of factor influencing entrepreneurial farmers' repayment ability; α_2 is the coefficient vector; υ_{2i} is the residual term. Then the probability of formal financial institutions lending loans to entrepreneurial farmers is as follows:

$$Pro(grant = 1/Apply = 1)\,Pro(X_{2i}\alpha_2 + \upsilon_{2i} \geqslant 0) = Pro(\upsilon_{2i} \leqslant X_{2i}\alpha_2) \quad (4)$$

If the residuals follow the standard normal distribution, then we can perform the Probit model analysis. The factors influencing entrepreneurial farmers' net income and repayment ability also include entrepreneurial householder characteristics, entrepreneurial farmer characteristics, entrepreneurship situation, and financial ecology in the place where entrepreneurial farmers live.

2.3 Variables Both supply and demand contribute to the low level of participation of farmers in formal credit markets (Huang Zuhui, Liu Xichuan, 2009). The interest rate of rural financial market is exogenous, and the interest rate is not a major consideration for the borrowing farmers; farmers' household income, production and operation characteristics, and household characteristics are the determinants of farmers' credit demand behavior (Han Jun, *et al.*, 2007). In this study, we consider the factors influencing entrepreneurial farmers' formal financial credit demand mainly from the characteristics of entrepreneurial rural householder, family characteristics, formal financial ecology, and farmers' entrepreneurial characteristics. (i) Characteristics of entrepreneurial rural householder. The characteristics of entrepreneurial rural householder mainly include householder's gender, age and education level. Theoretically, householder's gender affects the entrepreneurship format choices, thereby affecting the expected benefits of entrepreneurship. In terms of age, the entrepreneurial success is related to the maturity of entrepreneurs. The householder's education level is closely related to householder's identification of business opportunities, credit procedures, knowledge and social capital. There are existing research results agreeing that education level is one of the main factors affecting the credit needs of farmers, and has a certain impact on farmers' formal credit constraints (Wang Dingxiang *et al.*, 2011). (ii) Entrepreneurial farmers' household characteristics. Farmer is the basic subject of agricultural entrepreneurship, and the average annual household income reflects the farmers' ability to repay loans, and is the fundamental factor determining the farmers' loan demand (Han Jun, *et al.*, 2007). There may be a substitutional relation between high household income and financial lending. Meanwhile, the rural household size theoretically has a positive impact on entrepreneurial farmers' formal financial credit demand. (iii) Formal financial ecology. Farmers' formal financial credit participation is not only affected by farmers' demand, but also affected by formal financial credit supply. The availability of formal financing for farmers' entrepreneurship hinges on whether the formal finance can provide appropriate credit products for entrepreneurial farmers. Meanwhile, the farmers' cognition of formal financial credit difficulty, and their mastery of lending procedures and loan knowledge to a certain extent determines the farmers' formal financing needs. (iv) The scale of demand for loans and entrepreneurship format features. Foreign scholars generally believe that in the developing countries, farmers' formal credit demand is mainly focused on production, while the non-formal credit demand is mainly focused on non-production (Kochar, A., 1997; Manfred Zeller, 1994; F. N. Okurut, A. Schoombee, S. Van Der Berg., 2005; Pham BaoDuong and Yoichi Izumida, 2002). Wang Sangui (2001), He Guangwen, Li Lili (2005) find that the loans of China's formal financial institutions are mostly used for production, while the non-formal loans are mostly used for consumption; the production loans are far greater than consumption loans. The entrepreneurial farmers' loans are mainly for production investment, the scale is large, and the repayment period is long. The entrepreneurial format features to a certain extent reflect the entrepreneurial profitability, and is an important factor for the formal financial institutions' credit check. In this study, we choose 9 factors influencing entrepreneurial farmers' formal financial credit demand and credit success. The definition of variables is shown in Table 1.

3 Sample selection and variable features

3.1 Sample selection and data sources There are three principles for the sample selection: (i) The entrepreneurs are rural residents; (ii) The entrepreneurship location is village or township; (iii) The entrepreneurship industries are divided into traditional large-scale operation, establishing new industries, specialized production, develop new business, and building new organizations. The data sources are mainly based on questionnaire survey. In May 2011, the research group first conducted a pilot survey in Chongqing and finally decided to hand out questionnaires and carry out case interviews in Shuangliu County, Suining County of Sichuan Province, and Hechuan District, Kaixian County,

Tongliang County and Rongchang County of Chongqing City. The survey used the stratified random sampling method, involving five industries. A total of 960 questionnaires were recovered, and 939 valid questionnaires, were obtained after excluding 21 questionnaires with untrue information and incomplete information. The valid response rate was 97.8%.

Table 1 The definition of model variables

Variable name	Variable definitions and values	Priori judgment
Variables to be explained		
Y_1	Whether the entrepreneurial farmers have credit demand or not: yes = 1; no = 0	
Y_2	Whether the entrepreneurial farmers with credit demand have obtained loans from formal financial institutions: yes = 1; no = 0	
Explanatory variables		
X_{11}/X_{21}	Square of householder's age	Uncertain
X_{12}/X_{22}	Householder's education level: illiterate or semi-literate = 1; primary school = 2; junior high school = 3; technical secondary school and junior college = 4; undergraduate and above = 5	Positive
X_{13}/X_{23}	Household population	Positive
X_{14}/X_{24}	Annual household per capita income	Negative/positive
X_{15}/X_{25}	The type of industry that entrepreneurial farmers are engaged in: traditional large-scale operation = 1; others = 2 (establishing new industries, specialized production, develop new business, building new organizations)	Uncertain
X_{16}/X_{26}	The distance between the family location and the nearest financial institution	Negative
X_{17}/X_{27}	The degree of understanding the loan conditions and procedures: do not know = 1; know little = 2; know well = 3	Positive
X_{28}	The expected amount of the loan	Positive
X_{29}	Whether to hire labor for the family entrepreneurship: yes = 1; no = 0	Positive

3.2 Basic features of sample variables

3.2.1 Entrepreneurial farmers' formal financial credit demand. (i) Formal financial credit willingness. Different from ordinary farmers and poor farmers, the entrepreneurial farmers have a growing demand for money with the expansion of business scale and their credit demand is also constantly enhanced. From Table 2, it can be found that the entrepreneurial farmers have a strong formal financial demand, and the entrepreneurial farmers willing to get loans from formal financial institutions account for 79.54% of respondents.

Table 2 The sample entrepreneurial farmers' formal credit demand

Formal credit demand	Number of households	Proportion//%
Having formal credit demand	747	79.54
Having no formal credit demand	192	20.46
Total	939	100

Source: Statistical results of survey data.

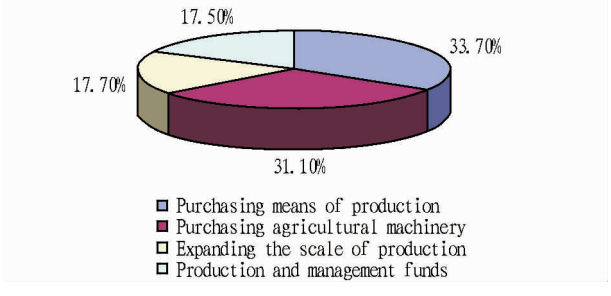
(ii) Formal financial credit channel selection. The entrepreneurial farmers have a tendency when selecting the formal financial credit channel. From Table 3, it shows that 35.12% of the sample farmers tend to get loans from the rural credit cooperatives; 29.76% of the sample farmers tend to get loans from ABC; 28.05% of the sample farmers tend to get loans from RCC; 7.07% of entrepreneurial farmers tend to get loans from other institutions (ICBC, CBC, BOC, *etc.*). For most of the farmers who have formal credit demand, rural credit cooperative is the primary source of funding for the entrepreneurial farmers, followed by ABC and RCC.

3.2.2 Entrepreneurial farmers' formal credit purposes. The survey finds that the sample farmers' formal credit is mainly used for productive investment, rather than life consumption. Fig. 1 shows that 96.18% of the sample farmers use the formal credit for production, including 33.7% of farmers purchasing means of production, 31.1% of farmers purchasing agricultural machinery, 17.7% of farmers expanding the scale of production and 17.5% of farmers using the formal credit for production and management funds. Only 3.82% of sample farmers use the formal credit for life purposes.

Table 3 Entrepreneurial farmers' formal credit channel selection

Financial institutions	Number of farmers tending to get loans	Proportion//%
Rural credit cooperatives	261	35.12
ABC	222	29.76
RCC	210	28.05
Other financial institutions	54	7.07
Total	747	100

Source: Statistical results of survey data.

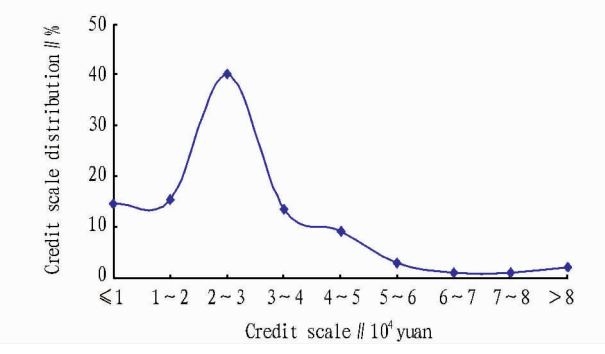


Source: Statistical results of survey data.

Fig. 1 Sample entrepreneurial farmers' productive credit purposes

3.2.3 Entrepreneurial farmers' formal credit demand scale. To

investigate the entrepreneurial farmers' formal credit demand scale, we divide the demand scale into nine levels: A≤10000, 10000 < A≤20000, 20000 < A≤30000, 30000 < A≤4000, 40000 < A≤50000, 50000 < A≤60000≤, 60000 < A≤70000, 70000 < A≤80000. From Fig. 2, it is found that entrepreneurial farmers' formal credit demand scale presents left-skewed distribution. 14.6% of entrepreneurial farmers' formal financial credit demand scale is less than 10000 yuan; 15.49% of sample farmers' loan size is between 10000 to 20000 yuan; 40.12% of sample farmers' credit demand scale is between 20000 yuan and 30000 yuan; the credit scale of 30000 – 40000 yuan drops by 13.42%. The credit demand during farmers' entrepreneurship has exceeded the scope of micro-credit support. In particular, the incidence of micro-credit of less than 5000 yuan is very low, and the incidence of super large credit is also low. The scale of loans is concentrated in 20000 to 30000 yuan.



Source: Statistical results of survey data.

Fig. 2 Sample entrepreneurial farmers' formal credit scale distribution

3.2.4 Entrepreneurial farmers' formal financial credit pattern. From Table 4, it is found that 35.18% of sample entrepreneurial farmers choose the credit pattern of mortgage loans; 19.44% of farmers choose secured loans; 24.25% of farmers choose micro-credit loans; 21.11% of farmers choose multi-household joint guarantee. The mortgage loans occupy the highest proportion. As to the choice of collateral, 42.47% of sample farmers choose housing as collateral; 26.34% of sample farmers choose farm machinery and household appliances as collateral; 17.2% of sample farmers choose arable land as collateral; 13.98% of sample farmers choose to use the agricultural products harvested in the future as collateral.

Table 4 Sample entrepreneurial farmers' formal credit pattern

Credit pattern	Number of farmers	Proportion // %
Mortgage loans	264	35.18
Secured loans	144	19.44
Micro-credit loans	180	24.25
Multi-household joint guarantee	159	21.13
Total	747	100

Source: Statistical results of survey data.

3.2.5 Entrepreneurial farmers' formal credit constraints. The survey finds that the probability of farmers getting loans from formal financial institutions is small. From Table 5, we see that there are 747 sample farmers having formal financial demand; 441 farmers never get loans from formal financial institutions due to various reasons, accounting for 59.03%; 306 farmers have received the formal financial credit, and some of them have only received a portion of expected loans.

Table 5 Whether the entrepreneurial farmers get loans from formal financial institutions

Loans of formal financial institutions	Number of farmers	Proportion // %
Having received loans from formal financial institutions	306	40.97
Having not yet received loans from formal financial institutions	441	59.03
Total	747	100

Source: Statistical results of survey data.

3.2.6 The entrepreneurial rural householder with formal financial demand and household characteristics. (i) Rural householder characteristics. (a) Gender. The male entrepreneurial farmers have stronger credit demand than female entrepreneurial farmers. The female rural householders with formal financial demand account for 13.74%, while their male counterparts account for 86.26% (see Table 6).

Table 6 Male and female householders' formal credit demand

Householder's gender	Male	Female
Number of entrepreneurial farmers with formal credit demand	645	102
The incidence of formal credit demand // %	79	63

Source: Statistical results of survey data.

Table 7 The formal credit demand of entrepreneurial rural householders of different ages

Householder's age	Number of farmers with formal credit demand	The incidence of formal credit demand // %
18 – 25	78	69.18
26 – 30	96	70.23
31 – 35	78	72.10
36 – 40	138	83.62
41 – 45	144	80.2
46 – 50	117	75.98
51 – 55	51	65.41
56 and above	45	64.17

Source: Statistical results of survey data.

(b) Age. The incidence of entrepreneurial rural householder aged between 36 and 45 having credit demand is highest. Leighton (1989) believes that for the 40-year-old householders, they have accumulated a certain amount of skills and funds. For the age groups of 18 – 25, 26 – 30, 31 – 35, 36 – 40, 41 – 45, 46 – 50, 51 – 55, 56 and above, the incidence of formal credit demand is 69.18%, 70.23%, 72.10%, 83.62%, 80.20%, 75.98%, 65.41%, and 64.17%, respectively. Meanwhile, it is found that

the entrepreneurial farmers are getting younger, and some college students return home to start their own undertaking, becoming an emerging group of agricultural entrepreneurship.

(c) Education level. The survey divides the education level of entrepreneurial rural householders into five levels: illiterate or semi-literate, primary school, junior high school, technical secondary school (senior high school), junior college, undergraduate and above. It can be found from Table 7 that the incidence of formal credit demand of householders with different education levels is 89.49%, 82.17%, 80.72%, 79.06% and 68.93%, respectively. The proportion of entrepreneurial farmers with different education levels is 1.59%, 21.73%, 42.17%, 25.24% and 9.27%, respectively. On the one hand, from the incidence of formal credit demand, the incidence of formal credit demand of entrepreneurial farmers with low education level is high, and they have a strong credit demand and are eager to change the existing production and living conditions through entrepreneurship. On the other hand, from the proportion of number of farmers, the education level of entrepreneurial rural householders is concentrated in junior high school, technical secondary school and junior college, constituting the main education level of entrepreneurial farmers.

Table 8 The formal credit demand of entrepreneurial farmers with different education levels

Education level	Illiterate or semi-literate	Primary school	Junior high school	Technical secondary school (senior high school), and junior college	Undergraduate and above
Number of farmers with formal credit demand	15	162	315	186	69
The incidence of formal credit demand//%	89.49	82.17	80.72	79.06	68.93

Source: Statistical results of survey data.

(ii) Entrepreneurial farmers' household characteristics. For the sample farmers, the average household size is four. There are three labor forces aged more than 16 in the household on the average, and there is one schoolchild on the average for each household. The proportion of farmers with 3 – 5 labor forces in the household is highest, reaching 78.31%. Table 9 shows that with the expansion of family size, the incidence of formal credit demand is gradually increased, and the sample farmers with formal financial demand are mainly concentrated in 3 – 5 person households.

Table 9 The formal credit demand of sample farmers with different household size

Household size	2	3	4	5	6	6 and above
Number of farmers with formal credit demand	45	168	231	180	57	60
The incidence of formal credit demand//%	66.50	79.02	82.51	81.04	83.07	85.12

Source: Statistical results of survey data.

3.2.7 Entrepreneurship characteristics of entrepreneurial farmers with formal financial demand and entrepreneurial farmers successfully getting loans.

(i) Entrepreneurship characteristics of entrepreneurial farmers with formal financial demand. The survey finds that for the sample entrepreneurial farmers with formal credit demand, the proportion of farmers engaged in traditional large-scale agricultural operation is highest (75.90%), and entrepreneurial farmers are highly dependent on traditional agriculture. The proportion of entrepreneurial farmers establishing new industries and engaging in specialized production is small (5.22% and 4.41%, respectively); the proportion of entrepreneurial farmers launching a new business and establishing new organizations is 7.23% (see Table 10).

Table 10 The regional distribution of sample entrepreneurial farmers and industry

Entrepreneurial type	Shuangliu	Suining	Rongchang	Kaixian	Hechuan	Tongliang	Total
Traditional large-scale agricultural operation	156	66	39	153	72	81	567
Establishing new industries	6	3	6	15	6	3	39
Specialized production	12	0	0	15	3	3	33
Launching a new business	45	0	0	9	0	0	54
Establishing new organizations	15	0	0	21	18	0	54
Total	234	69	45	213	99	87	747

Source: Statistical results of survey data.

From the incidence of formal credit demand, the incidence of formal credit demand of entrepreneurial farmers engaged in traditional large-scale agricultural operation and establishing new industries is more than 70%; the incidence of formal credit demand of entrepreneurial farmers choosing the other three industries is significantly increased, more than 80%.

(ii) Entrepreneurship characteristics of entrepreneurial farmers successfully getting loans. The survey finds that the entrepreneurial farmers choosing the business type of traditional large-scale agricultural operation have the highest success rate of formal financial credit (48.13%), significantly higher than the incidence of formal credit behavior of overall samples (40.97%).

The incidence of formal credit behavior of entrepreneurial farmers engaged in specialized production and establishing new industries declines slightly, while the incidence of formal credit behavior of entrepreneurial farmers launching a new business and establishing new organizations becomes very low, down to about 33%.

Table 11 Formal credit demand of entrepreneurial farmers engaged in different industries

Business format	I (traditional large-scale agricultural operation)	II (establishing new industries)	III (specialized production)	IV (launching a new business)	V (establishing new organizations)
Number of farmers with formal credit demand	567	39	33	54	54
The incidence of formal credit demand//%	75.02	70.16	81.75	83.49	87.29

Source: Statistical results of survey data.

Table 12 Different business formats and success rate of formal credit

Business format	I (traditional large-scale agricultural operation)	II (establishing new industries)	III (specialized production)	IV (launching a new business)	V (establishing new organizations)
Number of farmers getting loans from formal financial institutions	207	21	18	33	27
Success rate of formal credit//%	48.13	46.34	42.78	34.59	33.05

4 Model estimation results and discussions

4.1 Model estimation This paper selects binomial Probit model, to analyze entrepreneurial farmers' formal financial credit demand and the factors influencing formal financial credit. The model is as follows:

$$Y_j = C_j + \beta_{ji} X_{ji} + \mu_j \quad (j = 1, 2; i = 1, 2, \cdots, n_1; i = 1, 2, \cdots, n_2) \tag{5}$$

where Y takes the value of 1 (having the formal credit demand; having the formal credit demand and having obtained loans from formal financial institutions) and 0 (having no formal credit demand; having the formal credit demand but never obtaining loans from formal financial institutions); X_{ji} is the factor influencing the entrepreneurial farmers' formal financial credit demand and formal financial credit success; j takes the value of 1 (whether there is formal credit demand) and 2 (whether having obtained loans from formal financial institutions); n_1 is the number of explanatory variables concerning "whether there is formal credit demand"; n_2 is the number of explanatory variables concerning "whether having obtained loans from formal financial institutions". To avoid the heteroscedasticity by linear model and non-normality problem of random disturbance term, the latent variables Y_j^* is introduced. Assuming that when $Y_j^* > 0$, $Y_j = 1$; when $Y_j < 0$, $Y_j = 0$. Meanwhile, let u_j^* follow N (0, 1) distribution, the following is obtained:

$$Y_j^* = \alpha + \beta_{ji} X_{ji} + \mu_j^* \tag{6}$$

In this paper, we use Eviews6.0 software to estimate model (6), and the estimation results are shown in Table 13. From the model fitting results in Table 13, the estimation results of model likelihood ratio function and goodness of fit indicate that the overall fitting effect of model is good.

Table 13 Econometric model regression results

Dependent variable	Y_1	Dependent variable	Y_2
Estimation method: ML – Binary Probit			
Number of samples	939	Number of samples	747
$Y_1 = 0$	192	$Y_2 = 0$	441
$Y_1 = 1$	747	$Y_2 = 1$	306
Independent variable		Independent variable	
X_{11}	5.54E – 05 (0.207707, 0.8355)	X_{21}	–0.000892** (–2.375344, 0.0175)
X_{12}	0.108709 (0.686846, 0.4922)	X_{22}	–0.794820** (–2.229810, 0.0258)
X_{13}	0.190436* (1.331237, 0.0997)	X_{23}	–0.035503 (–0.222273, 0.8241)
X_{14}	–0.088967* (–1.923507, 0.0544)	X_{24}	–0.079878 (–1.081908, 0.2793)
X_{15}	–0.183400 (–0.379031, 0.7047)	X_{25}	–0.756446* (–1.375952, 0.1088)
X_{16}	–0.104548** (–2.352755, 0.0186)	X_{25}	–0.018073 (–0.287807, 0.7735)
X_{17}	1.632223*** (4.328649, 0.0000)	X_{27}	1.917384*** (3.147316, 0.0016)
		X_{28}	0.039032 (1.014152, 0.3105)
		X_{29}	2.166322*** (3.260214, 0.0011)
McFadden R-squared	0.40	McFadden R-squared	0.42
Mean dependent var	0.80	Mean dependent var	0.62
Log likelihood	–35.42	Log likelihood	–30.45

Note: The first figure in the brackets is z statistic, and the second figure is probability; ***, **, * indicate that it is significant at level of 1%, 5%, 10%, respectively.

4.2 Results (i) At the 5% significance level, square of householder's age (X_{11}/X_{21}) does not pass the test in the entrepreneurial farmers' formal credit demand model, but pass the test in the model of factors influencing entrepreneurial farmers' borrowing success. The householder's age has no significant impact on farmers' formal credit demand, and there is an inverted U-shaped relationship between householder's age and credit success. There is an inverted U-shaped relationship between householder's age and "whether having obtained loans from the formal financial institutions", consistent with China's reality. Age is an important factor in the assessment of bank lending, and bank favors the middle-aged entrepreneurial farmers, who have high human capital accumulation, strong entrepreneurial opportunity recognition ability and stronger ability to repay. (ii) At the 5% significance level, householder's education level (X_{12}/X_{22}) does not pass the test in the entrepreneurial farmers' formal credit demand model, and householder's education level has no significant impact on the entrepreneurial farmers' formal credit demand. However, it passes the test in the model of factors influencing entrepreneurial farmers' borrowing success, and there is a negative correlation. The entrepreneurial rural householders with lower education level more easily obtain loans from formal financial institutions, because the size of loans of entrepreneurial farmers with lower education level is often small, and it is easier to get credit support. Meanwhile, the entrepreneurial rural householders' education level is concentrated in junior high school and technical secondary school, mainly responsible for the negative correlation between farmers' entrepreneurial credit success and education level. (iii) At the 10% significance level, household population (X_{13}/X_{23}) passes the test in the entrepreneurial farmers' formal credit demand model, but does not pass the test in the model of factors influencing entrepreneurial farmers' borrowing success. There is a positive correlation between household population and entrepreneurial farmers' formal credit demand. In the case of large-scale agricultural operation and slow agricultural scientific and technological progress in the western region, the more the labor force, the greater the demand for venture capital, and the greater the formal financial needs. But in the current situation, the family size is not the main reference variable for lending decisions of formal financial institutions, and large-scale labor forces may not mean the easier access to loans from formal financial institutions. (iv) At the 10% significance level, annual household per capita income (X_{14}/X_{24}) has a negative impact on entrepreneurial farmers' formal financial credit demand, and it has no significant impact on farmers' formal financial credit success. The annual household per capita net income has a substitution effect on entrepreneurial farmers' formal financial demand, so they are negatively correlated, but the annual household per capita net income is not positively correlated with the formal financial lending as expected. (v) At the 5% significance level, the type of industry that entrepreneurial farmers are engaged in (X_{15}/X_{25}) does not pass the test in the entrepreneurial farmers' formal credit demand model, and it is not a major factor influencing the formal financial demand. At the 10% significance level, it passes the test in the model of factors influencing entrepreneurial farmers' borrowing success. The entrepreneurial farmers engaged in traditional large-scale operation are easier to get loans from formal financial institutions. The technical requirements, risks and benefits of traditional large-scale operation are in line with the majority of farmers' mental capacity and mental expectations, so they are still dependent on traditional large-scale operation. Few farmers choose other types of entrepreneurial industry and the proportion of loans obtained is relatively small, which reflects the defects of other types of entrepreneurial industry and entrepreneurial farmers' credit market potential. (vi) At the 5% significance level, the distance between the family location and the nearest financial institution (X_{16}/X_{26}) passes the test in the entrepreneurial farmers' formal credit demand model, but fails to pass the test in the model of factors influencing entrepreneurial farmers' borrowing success. The distance between the family location and the nearest financial institution has a negative impact on the entrepreneurial farmers' formal credit demand, indicating that the stronger the formal financial availability, the greater the entrepreneurial farmers' credit demand. The distance between the family location and the nearest financial institution has no significant impact on entrepreneurial farmers' formal financial credit success. The short distance from the financial institutions can facilitate bank's understanding of borrowing farmers, but it is not the main factor affecting the bank's lending decisions. (vii) At the 1% and 5% significance levels, the degree of understanding the loan conditions and procedures (X_{17}/X_{27}) passes the test, and it has a positive impact on the formal financial demand and formal financial credit success. Entrepreneurial farmers' understanding of the loan conditions and procedures can help entrepreneurial farmers to make decisions based on their own needs and socio-economic conditions and reduce the wrong cognition of formal financial credit. The withdrawal of formal financial institutions and financial services from agriculture and rural areas, combined with the complex credit procedures and high lending conditions, has exacerbated the information asymmetry between farmers and formal financial institutions, and strengthened the formal financial credit exclusion. (viii) The expected amount of the loan (X_{28}) does not pass the test in the model of factors influencing entrepreneurial farmers' borrowing success. The entrepreneurial farmers' credit is mainly the productive investment loan, with a large sum, to a certain extent reflecting the investment scale and profitability of entrepreneurial agriculture. (i) At the 5% significance level, whether to hire labor for the family entrepreneurship (X_{29}) passes the test, showing a positive correlation. The entrepreneurial farmers who hire labor for the family entrepreneurship are easier to get loans from formal financial institutions. Farmers' entrepreneurship is a special economic behavior in the rural economy, and whether to hire labor for the family entrepreneurship to some extent reflects the entrepreneurial scale, operating earnings and revenue expectations, which can serve as an important indicator of banks' entrepreneurial project evaluation.

5 Conclusions and recommendations

5.1 Conclusions The entrepreneurial farmers have a strong formal financial demand, and most of the demand is productive investment demand, but there are constraints on entrepreneurial farmers' loans from formal financial institutions. Based on an survey of 939 farmers in Sichuan and Chongqing, this paper analyzes the influencing factors of entrepreneurial farmers' formal financial credit demand and credit constraints with Probit model. It is found that the household size has a positive impact on entrepreneurial farmers' formal credit demand; per capita household income has a negative impact on the formal financial credit and household income has a substitution effect on formal financial credit; the distance between the family location and the nearest financial institution has a negative impact on entrepreneurial farmers' formal financial demand, and the improvement of financial ecology is conducive to enhancing entrepreneurial farmers' formal financial credit demand; entrepreneurial farmers' understanding of lending procedures and conditions helps to improve the entrepreneurial farmers' formal financial credit demand, and the withdrawal of formal financial institutions and financial services from agriculture and rural areas has strengthened the formal financial credit exclusion; the constraints of lending procedures and conditions inhibit the farmers' credit demand; there is an inverted U-shaped relationship between householder's age and credit success; householder's education level is negatively correlated with credit success; compared with the traditional large-scale agricultural operation, other types of entrepreneurial industry is developed insufficiently, having exacerbated the information asymmetry between farmers and formal financial institutions, and increased the credit risks; lending procedures and conditions have played a good "filter" role, and entrepreneurial farmers' understanding of the loan conditions and procedures is positively correlated with the credit success, and can help entrepreneurial farmers to make decisions based on their own needs and socio-economic conditions and reduce the wrong cognition of formal financial credit; the entrepreneurial farmers who hire labor for the family entrepreneurship are easier to get loans from formal financial institutions; statistically, household size, per capita household income, the distance between the family location and the nearest financial institution and the expected size of loans, have no significant impact on the formal financial credit success.

5.2 Recommendations (i) In the places where conditions permit, it is necessary to promote the development of township banks and rural community banks to make up for the credit supply shortage of RCC, ABC and other commercial banks. In the development of township banks and rural community banks, it is necessary to strengthen supervision and expand farmers' agricultural entrepreneurial loans while ensuring the interests of depositors to foster the new body of agriculture. (ii) It is necessary to promote the rural and agricultural credit service innovation, increase support to entrepreneurial farmers in the case of risk control. When conditions permit, there is a need to build the rural credit system to reduce the information asymmetry between formal finance and farmers, and establish the interest rate system to meet entrepreneurial farmers' credit demand. Meanwhile, in the loan review process, it is necessary to set up "rural community-loan officer-bank" review system, gradually increase the project loans according to farmer's credit situation in the case of controlling credit risk, gradually reduce lending procedures, and actively use a variety of channels to make farmers understand the lending procedures and conditions and reduce the credit constraints arising from information asymmetry. (iii) When conditions permit, it is necessary to actively build agricultural development and agricultural entrepreneurship foundation, to support farmers' agricultural entrepreneurial behavior, draw on the foreign experience of cultivating new body of agriculture, and provide the venture start-up capital to the entrepreneurial farmers who lack collateral, guarantees and other formal financial credit conditions.

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the stable development of marine economy in Liaoning Province.

5 Conclusions

The construction of operation monitoring and evaluation system for marine economy in Liaoning Province is not only a need of development of marine economy in Liaoning Province, but also a need of overall operation monitoring and evaluation capability construction in China, so it is of important practical significance. System construction helps to fully grasp the province's comprehensive information on marine economic operation, grasp the province's actual situation of marine economic operation and ensure the implementation of the province's marine economic macro-control. At the same time, the study of operation monitoring and evaluation system for marine economy is pioneering research work, and the study results can provide scientific decision-making basis as well as effective operational means and methods for the operation management of marine economy in Liaoning Province. In the future, it is necessary to focus on the study of how to rationally use monitoring data, how to rationally assess the marine industry development trend in coastal areas in accordance with the monitoring data, and how to provide reasonable recommendations for government according to the monitoring and evaluation results.

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