The Analysis of Credit Using and Rationing under Farmer's Risk Attitudes Difference

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Abstract This paper conducts a survey of 237 rural households in Zhangjiagang City, identifies farmers' risk attitude through ELCE method and problem design and empirically studies the relationship between risk attitudes and credit rationing by utilizing Probit and Logit model. The results show that farmers' risk attitude and credit rationing are in a significant positive correlation. The stronger farmers' risk aversion is, the more serious the demanded credit rationing becomes. Such risk attitude determines the risk cost and risk premium, thus affecting the credit behavior and credit rationing degree. In addition, distance between farmers' residence far the city and their land amount have a positive significant influence on credit rationing, while farmers' education level, income, family labor force have a negative significant effect on credit rationing. Based on these findings, the paper further analyzes the relationship between farmers' credit using and credit rationing as to farmers with different risk attitudes. Measures to relieve the farmer's credit rationing must be taken from government, financial institutions and farmers, respectively.

Key words Risk attitude, Credit rationing, Risk cost, Credit using

1 Introduction

Credit plays an essential role in the "issues of agriculture, farmers and rural areas" in China. Through formal and informal financial channels, credit functions in allocating resources, promoting production and transaction, diversifying risk, and thus it promotes rural development in general; through proving circulating capital and investment loan to rural enterprises and rural households, credit makes rural enterprises grasp investment opportunities timely and farmers apply modern agricultural technology and mode of production, and consequently credit speeds up the transference of rural labor force to the secondary and tertiary industries (Zhang Longyao, Jiang Chun, 2011). Rural household credit increases farmers' income as a whole (Zhu Xi, Li Zinan, 2007). If credit rationing exists in rural areas, especially among rural households, farmers will have trouble getting necessary capital, which will have a negative effect on the increase of their welfare (Chu Baojin, et al, 2009) and farmers' average net income will drop 9.55% (Li Rui, Zhu Xi, 2007). But an important question arises: Does such credit rationing exist? If the answer is yes, then what are the reasons? Zhang Jie (2005) regards it as an unsolved mystery. Scholars home and abroad draw different conclusions after their respective research. Cheng Yu and Luo Dan, for example, believe that although "industry re-feeding agriculture and city supporting countryside" policy and the advancement of urban-rural integration relieve the rural credit rationing, it is still not uncommon. It is estimated that China's rural households with credit demand reach over 70%, the average credit gap is 4420 yuan (RMB) and their demanded credit gap accounts for 56.7% of the total. Most of the farmers who have obtained the credit are facing serious "service rationing" and "quantity rationing" (Yang Jun, 2010). Inessa Love and Susana M. Sancbez (2009), after a research of credit and investment of individual entrepreneurs, agriculture and non-agricultural enterprises in Mexico, point out that credit rationing is common especially for individual entrepreneurs. However, Zhu Xi, Shi Qinghua and Li Rui(2010), after the survey of 10357 rural households in the Yangtze River Delta, conclude that credit rationing is closely related to credit using: if the credit is used in agriculture itself, there is no credit rationing; otherwise credit rationing arises. Zhong Chunping (2010) also holds that there is no obvious credit rationing and demanded credit of the majority can be satisfied based on the research conducted in Anhui Province of China. Subhash C. Kochar (1995), Pal (2002), on the basis of a research in developed countries, believe that credit supply for rural households is sufficient and the reason why farmers get less credit is due to inadequate demand. In addition, scholars pay more attention to rural households' credit in less-developed areas (Huo Xuexi, et al, 2010; Zhu Rong, et al, 2010; Chu Baojin, et al, 2009; Kong Rong, et al, 2009; He Mingsheng, 2008), but less attention to that in the developed areas. The reason why the above scholars get various conclusions is mainly because they haven't taken the farmers' individuality into account. Many scholars believe that credit rationing chiefly occur in less developed areas, but farmers' risk attitudes and farmers' credit rationing in developed areas(Zhu Xi, Li Zinan, 2007), is the one of the most important factor in studying farmers' credit issue in

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China. Farmers' credit issue in developed areas differs from that in under-developed areas, and farmers' risk attitudes have a different effect on credit rationing and credit using, consequently influencing farmers' credit behaviors. Ma Xiaoyong and Bai Yongxiu (2011), for instance, contend that farmers' risk aversion has less effect on formal credit balance but negative effect on informal credit constraint, while Chen Yu, Han Jun and Luo Dan (2009) hold that farmers' risk aversion enhances their awareness of credit cost, which decreases credit grant expectations and causes demanded credit constraint. According to Von Neumann-Morgenstern (M – N) model, as to the risk attitudes, farmers can be divided into risk lovers, risk averts and risk neutrals. Farmers are traditionally labeled as risk averts and risk neutrals (Zhu Xi, et al, 2007), but Kim Tae-Hun (2011) finds that farmers' attitudes changes with the passage of time. Schultz in his book Reconstructing Traditional Agriculture points out that farmers, like enterprises, are pursuing maximum profit and they will get profits through financing as long as there is investment opportunity. Farmers with different risk attitudes have different credit needs, which causes demanded credit rationing; as to the investment chances, farmers' risk attitudes will change too, so as the process of credit rationing (Millard F. Long, 1968). The past researchers either take it for granted that credit rationing exists in farmers or deny such credit rationing blindly and there lacks consideration of farmers' individuality, especially research of the relationship between farmers' risk attitudes and farmers' credit constraint in developed areas. The paper points out whether there is credit rationing or not, it is mainly because farmers' risk attitudes are determined by risk cost and risk compensation and thus influencing farmers' credit behavior and credit consequences(including credit rationing). With the development of the secondary and tertiary industry, farmers' non-agricultural income is increasing rapidly as results of industrialization of the developed areas and urbanization process. Farmers' risk attitudes (or risk pattern) have changed obviously, and their credit behaviors have taken on such new features as the increase of life-improving credit demand and financial asset allocation demand (Luo Junqin, 2010). In the transitional period of China, there lacks economic literature about farmers' credit conditions in light of their different risk attitudes in developed areas, and this paper just fills such a gap. It is very significant for the financial development of China's middle-income rural areas to study farmers' credit features on the basis of farmers' risk aversion theory. This paper conducts a survey of 237 rural households in Zhangjiagang City of Jiangsu province, puts such variables as risk attitudes, credit constraint, farmers' features and geographical factors into the same model and analyzes farmers' credit behaviors with regard to their various risk attitudes.

2 Theoretical hypotheses of risk attitudes, farmers' credit and credit rationing

When studying farmers' credit behaviors under certain and uncertain condition, Millard F. Long (1968) points out in a given productive chance, farmers' credit behavior is closely related to their own risk attitudes and project yield rate. With the increase of farmers' income, farmers prefer to undertake more risks, making absolute risk aversion drop (J. B. Hardaker, 2004). Furthermore, the features of farmers' risk aversion determines their preference to maintain certain income, but avoid risk cost brought by credit, and then credit constraints are manifested as demanded risky credit constraint. The combination of systematic credit constraint and farmers' risk preference forms the convergence of demanded credit mechanism and reinforces farmers' suppressed preference in credit demand (Chen Yu, et al, 2009), as shown in Fig. 1.

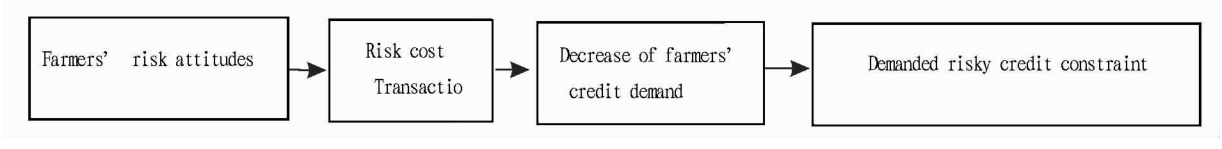

Fig. 1 Logic connection of risk attitudes, farmers' credit demand and credit constraint

Hypothesis 1: The stronger the farmers' risk aversion is, the higher their compensation demand of risk cost, and the more easily they are influenced by credit constraint. As to risk lovers, the less likely they are affected by demanded credit constraints.

If farmers are risk averters, and various transaction cost from credit and risk cost are relatively big, farmers either prefer contracts with certain profits or voluntarily withdraw from the credit, which makes farmers' credit demand lower than expected. Therefore, demanded credit constraint arises, which has a negative impact on farmers' welfare to some degree. As shown in Fig. 2, $\bar{y}$ stands for farmers' average income, is the arbitrary positive deviations from the average income. Farmers' random income can be shown by one half of the two incomes $(\bar{y}+d, \bar{y}-d)$. The expected utility of farmers' random income can be shown as the half of the two income utility level:

$$Eu(y) = \frac{1}{2}(\bar{y}+d) + \frac{1}{2}(\bar{y}-d) \quad (1)$$

The utility function is a concave function (can also be a convex function, or straight), therefore:

$$Eu(y) < Eu(\bar{y}) \quad (2)$$

Suppose $rc = Eu(\bar{y} - Eu(y)$, then rc is the measurement of risk cost of expected utility. In terms of money, producers are asked how much certain income they would like to give up in order to get the same utility of risk cost. Suppose utility level of income $\underset{y}{\$}$ is the same as y, that is, $u(\underset{y}{\$}) = Eu(y)$, then $V_y = \bar{y} - \underset{y}{\$}$ means risk premium.

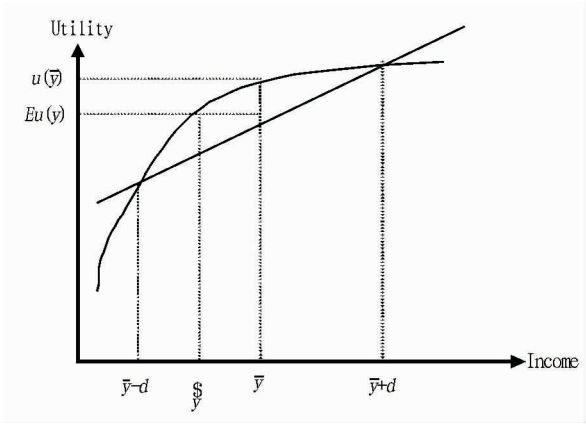

Fig. 2 Farmers' risk aversion

Risk premium V_y depends on both the utility function (whether it is concave, convex or straight) and incomes distribute probability. Curvature stands for the level of risk aversion. If $Eu(y) > u(y)$, farmers are risk lovers; if $Eu(y) = u(y)$, farmers are risk neutrals; if $Eu(y) < u(y)$, they are risk averters.

Suppose farmers' total wealth is W, the part used in production is k; the labor input is L, and production technology remain unchanged. Without credit behaviors, the yield of the farmer is Q^{nb}, and $Q^{nb} = f(kW, L; X)$, in which X is the vector of farmers' feature that affects the production. In order to enlarge production, the amount of credit farmers get is B with the interest r because of credit from financial institutions, and $B = f(W)$; the yield of this time is Q^b, and $Q^b = f(kW + b, L^b; X)$. L^b is the labor input after credit behavior. The probability of success in their project is q; The probability of failure in their project is $1 - q$, therefore Q^{fb} appears, and $Q^{fb} < Q^{nb} < Q^b$. In order to get credit, farmers need to pay interest rB, transaction cost F (including material cost and psychological cost) as well as risk cost due to uncertain income of farmers with different attitudes rc.

The condition under which farmers choose credit is as follows:

$$E(y) = qQ^b + (1 - q)Q^{fb} > Q^{nb} + rB + F + rc \quad (3)$$

where $E(y)$ stands for farmers' expected income with the credit.

According to formula 3, the greater transaction cost F is, the more likely the farmers have to give up credit because of the high cost, and thus the demanded credit rationing arises. Farmers with different risk preferences also tend to abandon credit application for the demanded risk cost can not be compensated, hence the demanded risky credit constraint appears. As shown in Fig. 3, horizontal axis displays farmers' needed funds, vertical axis stands for various costs because of credit. If when farmers' expected income is $E(y)$, there is no transaction cost and risk cost. When there is transaction cost F and risk cost rc, and the funds that farmers need are N_1 and N_2 respectively. Therefore, the constraint amount of risk cost is $N_{cd} = N_0 - N_2$. If farmers' risk aversion is much stronger, the curve moves upward to the left, and bigger N_{cd} is.

Hypothesis 2: Farmers' credit using affects their credit rationing in light of their different risk attitudes. When farmers are

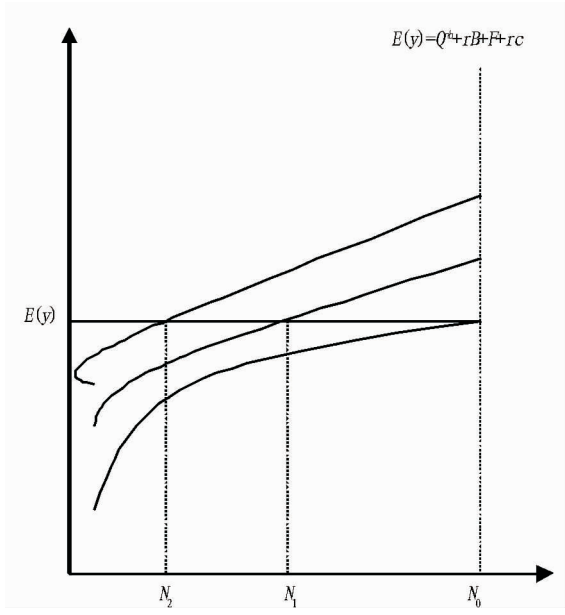

Fig. 3 Demanded risk credit constraint

risk averters, their basic living credit rationing is more; when they are risk lovers, their credit rationing is mainly about life improvement and investment.

When farmers are risk averters, they would try to minimize the risk. And if they have the need for credit and its purpose is for basic living expenses and thus life maintenance credit appears due to the lack of mortgage. With the increase of their income, farmers' attitudes would gradually change to risk-taking. On the one hand, the increase of their income means more opportunities to investment, and their investment benefit will rise too. On the other hand, the increase of their income means farmers will be more optimistic about future expected income, and their credit demand to better their life will increase. However, credit constraint appears because of investment risk, worries about macro economic environment and restrict of financial institutions.

3 Descriptive analysis of farmers' risk attitudes, socio-economic conditions and credit characteristics

Farmers' risk attitudes determine farmers' credit behaviors and the consequences. As to the measurement of the risk attitudes, direct method of N-M model and its indirect method (equivalent method) are applied. In practice, based on ELCE and ELRO, interview and experimenting are uses to find out respondents' risk attitudes. Given farmers' ability to answer questionnaire, distribution of risk attitudes and common methods used home and abroad, the paper mainly applies ELCE to find out farmers' risk attitudes. In ELCE method, the equivalent is obtained from risk produce and utility value matching method. Suppose utility value of the best risk produce is 1, utility value of the worst is 0 (Hardarker, et al, 2004), and probability of the both is 0.5. Risk prospects of discrete pay is shown as $(x_1, x_2, \cdots, x_n; p_1, p_2, \cdots, p_n)$, in which x_i is the pay of i, p_i is the probability of the pay of i, and $\sum_{i=1}^{n} p_i = 1$.

First, farmers are asked to identify between the best and the worst risk produce a non-risk produce (certain equivalent), which equals the combined utility value of the two risk produces. Then farmers are inquired again to identify between the last non-risk produce and the worst risk produce(or the best risk produce) another non-risk produce, whose utility value equals the combined utility value between the former non-risk produce and the worst risk produce (or the best risk produce). The above process will be carried out continuously until farmers' risk attitudes are completely elicited. As to measure risk constraint, the questions in the paper are designed as follows: Do you need credit? If yes, do you obtain the total amount you have asked for? Do you apply for credit voluntarily or do you give it up right after the application or is your application rejected? If farmers don't need credit or they have obtained the full amount of their credit, they are not restricted by credit constraint. If farmers who need credit don't apply voluntarily or give it up automatically after the application, such cases are defined as demanded credit constraint. The survey of this paper is conducted in Zhangjiagang City, a relatively developed eastern city with 8 towns and one modern agricultural demonstration park under its jurisdiction. Scale economy and individual household economy coexist there, and there are strong motivations for financing demand. First, the total sample sum is determined, and then the household number of each town (including the agricultural demonstration park) is fixed according to its respective population and the two-stage sampling method is used here. In the first stage, villages are randomly selected from each town. In the second stage, farmer households are randomly selected from the villages chosen from the first stage. The survey was conducted by students from Southwest University in July and August of 2011 with the help of urban-rural integration office of Zhangjiagang City. The survey chiefly covers the households' features, risks they have, agricultural characteristics, geographic factors and rural financing market. 244 households have been investigated while 237 valid questionnaires have been collected.

3.1 Sample farmers' risk attitudes As shown in Table 1, among 237 sample farmers, risk averters are 76, accounting for 32.06%, while risk neutrals and risk lovers amount to 35.44% and 32.50% respectively. It is interesting that the percentages of all the three risk types are very close, whereas the past researches show that most farmers are risk averters. The reason may be that sample farmers are in developed areas and economic situations there in general are quite good, whereas farmers' risk attitudes are closely related to wealth.

Table 1 Sample farmers' risk attitudes

	Risk averters	Risk neutrals	Risk lovers
Number	76	84	77
Proportion (%)	32.06	35.44	32.50

3.2 Sample farmers' features and social economy Among the 237 households, the distances between their home and the city vary: some live in the city, the farthest distance is 50 kilometers while most live about 20 kilometers away from the city. As to the number of the family, the minimum is 1 person and the maximum is 8 persons in total and the average is about 4 persons. The labor force of the family reflects its ability to create wealth, and the average labor force is 2, which shows that micro-unit of rural economy is rather small in general. The various distances cause the asymmetry of credit information, which may lead to credit constraint. Without mechanized farming, fewer labor forces may cause less family income, which may result in family fund gap.

Table 2 Sample farmers' location and population

Variables	Minimum	Maximum	Average	Mode	Median	Sd
Distance (kilometers)	0	50	22.88	20	20	13.60
Population (person)	1	8	4.19	3	4	1.25
Labor (person)	0	6	2.56	2	2	0.98

As shown in Table 3, the average age of householders is 41.46, and the percentage of householders aged from 30 to 50 reaches 82.70%. The reason why there are fewer younger householders is that many youths go out to work due to rural labor surplus. The general education level is high, the average level is high school and the percentage of those with above high school diploma accounts for 81.01%. The total family operating income below 10000 yuan amounts to 2.53%, the average family operating income is 70230 yuan, and the total family income above 100000 reaches 23.63%. The above data show that the farmers in Zhangjiagang City have comparatively higher education level and much wealthier, which is tied up with its developed economy and favorable geographic location and market influence.

When answering the question "What is the main source of your income?", 145 farmers choose industry, accounting for 61.18%; those who choose plantation is 38.82%; and only 28 people choose agricultural product processing. Family operating income and salary form work in the city are the main sources of family total income because developed industry of Zhangjiagang City provides farmers with many job opportunities.

3.3 Analysis of farmers' credit behaviors When answering the question: "what is the major channel for you to get credit?", 30.26% householders have chosen private capital, especially their relatives and friends as shown in Table 5. 59.63% farmers have chosen financial institutions (including Rural Credit Cooperatives, Agriculture Bank of China and other commercial banks), 5.81% have chosen usury and other channels accounts for 4.28%. The above statistics proves that farmers still rely on loan from relatives and friends, which is contrary to the theory that in the developed areas formal financial institutions shall be the major channel. This

mainly results from the high transaction cost, complicated credit procedures and high credit risk with loan from formal financial institutions.

Table 3 Farmers' general household features

Variable	Situation	Number	Average	Median	Standard deviation
Age of householder	Below 30	12	41.46	45	8.34
	30 – 40	96			
	40 – 50	100			
	50 – 60	22			
	Above 60	7			
Education level	Primary school or below	6	3.17	3	0.79
	Middle school	39			
	High school	101			
	College and above	91			
Family income (10000 yuan)	Below 1	6	7.23	7.5	3.59
	1 – 5	67			
	5 – 10	108			
	Above 10	56			

Note: As to education level, 1 stands for primary school or below, 2 middle school, 3 high school and 4 stands for college and above.

Table 4 Major sources of farmers' income

Trade	Plantation	Livestock breeding	Agricultural product processing	Industry	Construction	Service	Others
number	92	45	28	145	26	61	58

Note: Farmers can choose more than one item as their main sources of income.

As to credit period shown in Table 5, farmers mainly have chosen 6 – 12 months and 1 – 3 years, and that is to say, the medium term loan reaches 51.79%. The credit period within three months amounts to 7.18%, while that over 5 years is 7.18%. In short, rural credit in Zhangjiagang City is chiefly medium term, whereas the short term and long term are less.

Table 5 Rural credit period

Credit period	Within three months	3 – 6 months	6 – 12 months	1 – 3 years	3 – 5 years	Above 5 years
Proportion (%)	14	37	44	57	29	14

The amount of financing reflects how much fund farmers need. As shown in Table 6, 61.42% farmers have the credit limit of above 30000 yuan, which shows that the credit amount is relatively high in Zhangjiagang. 18.78% farmers have the credit limit of over 100000 yuan, while only 17.26% farmers have the credit limit of below 5000 yuan.

Table 6 Farmers' credit limit

Credit limit (10000 yuan)	Below 0.1	0.1 – 0.5	0.5 – 1	1 – 3	3 – 5	5 – 10	Above 10
Number of households	7	27	17	25	37	47	37

3.4 Analysis of sample farmers' credit rationing According to the six types of demanded credit rationing put forward by Zhao Binqi (2010), Table 7 shows the distribution of the various types.

Table 7 Distribution of farmers' credit rationing

Rationing Type	Non-credit price rationing	Risk rationing	Punishment rationing	Transaction cost rationing	Social emotion rationing	Relation rationing
Rationing percentage	44.69	50.75	6.82	29.55	15.91	29.54

The credit rationing percent of sample farmers reaches 55.70%, among which 50.75% credit rationing appears because farmers are afraid of the loss of mortgages or they are pessimistic about investment prospects. 44.69% farmers choose not to get credit due to the high credit rate, 29.55% farmers withdraw from credit because of complicated credit procedures, 29.54% farmers don't apply for credit just because of their poor social relations, 15.91% farmers abandon credit because of the worry of losing face, while 6.82% farmers are afraid of the harsh punishment as a result of breach of contract.

3.5 Credit using and rationing of farmers with different risk attitudes Data shows credit using and rationing of risk averters, risk neutrals and risk lovers respectively. As to risk averters, the credit is mainly used to pay children's tuition, medi-

cal care and house building, and the number is 27, 27 and 26 respectively. Then 18 households use credit for holding marriage or funeral ceremonies, while 15 pay for daily necessities. As to credit rationing, 27 households pay for children's tuition, 25 for house building and 24 for medical care. As to the degree of credit rationing, the percentages of tuition, marriage or funeral, day necessities, breeding and planting, purchase of farm machinery and private car all reach 100%. So as to risk averters, whether in terms of the absolute quantity or the relative proportion, credit rationing for basic living expenses is comparatively larger than others. Because for farmers in China, tuition, medical care and house building still account for the large proportion of the family total expenses, while the increase of inflation and slow rise of farmers' income make it inadequate for farmers to pay their basic expenses. The absolute amount of such credit as investment or life-improvement of running a business, purchase of farm machinery and private car is small, but the percentage of such credit rationing is alarmingly high. Such case shows that farmers with risk aversion attitude also have a strong desire to improve their life. Additionally, farmers under instigation are mainly aged 30 to 50, and the rapid development of China's automobile market and other peers' influence urges them to buy a car. Thus credit rationing appears due to their expected benefit of investment and the incomplete social security. As to risk lovers, 39 farmers use credit to run a business of their own, 26 to purchase a car and 23 to build their house. As to the credit rationing, 11 households are for business whereas 7 for cars. In general, credit rationing for risk lovers are relative low, and credit is used for investment and such consumption as improving their life quality. Finally, as to risk neutrals, 34 farmers use credit to build house, 28 to run a business and 24 to buy a car. As to the absolute quantity of credit rationing, 15 households buy cars, 14 run a business, 12 build houses and 11 hold marriage or funeral ceremonies. As to credit rationing, breeding and planting amounts to 77.78%; agricultural product processing reaches 75%; purchase of farm machinery is 66.67%; purchase of cars is 62.5%; holding wedding or funeral ceremonies is 61.11%, and all of these have large proportions. As to such risk neutrals, credit rationing is manifested by credit used investment, which serves as an effect evidence of Hypothesis 2.

4 Measurement model of risk attitudes and farmers' credit constraint

4.1 Choice of models and relevant reasons Dependent variable in this paper is binary choice model, Probit and Logit are generally used in discrete choice model, and thus both of them are used in the paper to measure the relation between farmers' risk attitudes and the credit restraint.

The basic form of Logit model is as follows:

$$\log \frac{p_i}{1-p_i} = b_0 + \sum_{i=1}^{N} b_i X_i + g_i Z_i + e_i \quad (1)$$

where $\log \frac{p_i}{1-p_i}$ stands for the log probability of whether farmers can obtain credit, X_i is the vector of farmers' characteristics and geographic features, Z_i is farmers' risk attitudes, b_i, g_i is the parameter vector to be estimated, e_i is the residual item, and $e_i \sim (0, s^2)$.

$$probit(T) = \int_{-\infty}^{T} j(n)\, d_n \quad (2)$$

where $T = b_0 + \sum_{i=1}^{n} b_i X_i + g_i Z_i$

The explained variable in the paper is whether farmers obtain credit rationing. The variables mainly include: (i) Geographic features, such as the distances between farmers' house and the city as well as the types of their village. If the farmer lives far away from the city and the village they live is ordinary, the chances to get credit are fewer, the transaction cost is higher and credit constraint is more likely to appear. (ii) Farmers' features: the first is the education the householder has received. Generally speaking, the higher education they have gotten, the easier for householders to get access to financial knowledge, the more intention they have to invest and therefore the less the credit constraint becomes. Second, whether one of the family members is a leader in the village. In general, with a leader in the family, the household tend to be richer and have stronger social connection and is less likely to be influenced by credit constraint. The third is the annual average income of the household. Households with low income mean lack of pledges and no guarantee to repayment, and they are more affected by credit rationing. The fourth is the number of labor force in the household, which manifests indirectly how much burden the household bears. The fifth is credit using. Other minor variables include population of the household, the age of the householder and the land farmers own. (iii) The farmers' risk attitudes have been discussed and analyzed in the last part. Eviews7.2 software is used for data process and measurement.

4.2 Risk attitudes and results of farmers' credit rationing As shown in Table 9, the estimated results from Probit and Logit are almost the same, and there are no obvious differences of estimated coefficients as to every variable. Therefore conclusions can be drawn as follows. First, farmers' risk attitude and credit rationing are in a significant positive correlation. The stronger the farmers' risk aversion is, the more serious credit rationing becomes. And such a conclusion is in correspondence with Hypothesis 1. This is mainly because risk averters usually demand more risk premium to compensate risk cost, and thus they are affected by demanded risky credit rationing. In contrast, risk lovers focus more on investment returns and benefit, and they will grasp investment opportunities with the help of credit and consequently they are less likely to be influenced by credit rationing. Second, distances between farmers' residence and the city, land they have and credit rationing are in a significant positive correlation. If farmers live far away from the city, the transaction cost in financial business tend to be much higher on the one hand; on the other hand, their poor access to information make them more liable to credit rationing. Furthermore, the more land farmers have, the more land investment they have and the more fund they need. In addi-

tion, in China rural land remains collectively owned, farmers only have right of management and use, and land transfer market is incomplete, which result in credit rationing. Third, farmers' education level, income, labor force and credit rationing are in a significant negative correlation. The higher education farmers have means stronger ability to create wealth and less likelihood to suffer from credit rationing. High family income means less need for money and more mortgage ability for credit, and so such family is more likely to obtain credit. Additionally, more labor means more power to become richer and to satisfy family's need for money and less family burden to bear. Fourth, such variables as age, leader, population and village type don't have significant influence on credit rationing. The older the farmer is, the more accumulated wealth he has, which means less credit rationing. Old age, however, also means less ability to earn money but more expenses, which makes stronger risk aversion and more demanded credit rationing. Effects of age on credit rationing depend on the strength of the two. If there is a leader in the family, the family may have more social capital asset, which in theory means less credit rationing but in practice there is no noticeable result. Such phenomenon arises because in developed area, market mechanism plays a more significant role and financial institutions pay more attention to farmers' wealth in the process of credit. The larger the family population is, the more money the family need and the heavier the family burden become, which may lead to credit rationing in theory but in practice this is not the case. This is mainly because the good social security of Zhangjiagang City may relieve credit rationing. Farmers of ordinary villages are more liable to credit rationing than those of center villages.

Table 8 Variables and explanations

Variables	Variable assignments
Dependent variables Credit rationing	0 = "no credit rationing", 1 = "having credit rationing"
Independent variables distance	(kilometer)
Village types	1 = central village, 2 = non-central village
Education	1 = elementary school and less, 2 = middle school, 3 = high school, 4 = college and higher
Leader	1 = yes, 2 = no
Household annual average income	1 = less than 10,000 yuan, 2 = 10,000 – 30,000yuan, 3 = 30,000 – 50,000yuan, 4 = 50,000 – 70,000yuan, 5 = 70,000 – 100,000yuan, 6 = more than100,000yuan
Labor	(person)
Household scale	(person)
Age	1 = below 30, 2 = 30 – 40, 3 = 40 – 50, 4 = 50 – 60, 5 = more than 60
Land	(mu)
Credit using	– 1 = basic living credit, 0 = improvement credit, 1 = investment credit
Risk attitude	– 1 = risk lover, 0 = risk neutral, 1 = risk averter

Table 9 Results of Probit and Logit model influencing credit rationing

Variables	Probit model			Logit model		
	Estimated coefficients	Standard error	P	Estimated coefficients	Standard error	P
RA	1.4269***	0.2365	0.0037	2.4553***	0.4501	0.0037
Age	–0.0576	0.1223	0.6374	–0.0939	0.2108	0.6559
Distance	0.0146*	0.0075	0.0502	0.0237*	0.0127	0.0629
Education	–0.2401**	0.1578	0.0281	–0.3948**	0.2692	0.0425
Income	–0.3469***	0.1279	0.0067	–0.6199***	0.2337	0.0080
Labor	–0.0141*	0.1237	0.0796	–0.0218*	0.2167	0.0801
Leader	–0.1686	0.4006	0.6739	–0.2791	0.6718	0.6777
Population	0.0758	0.0996	0.4468	0.1243	0.1719	0.4694
Village	0.3359	0.2977	0.2591	0.5598	0.4983	0.2612
Land	0.0073**	0.0364	0.0431	0.0081**	0.0765	0.0439
Constance	–1.3384	1.1489	0.2440	–2.3924	1.9697	0.2245
LR		92.26			91.6878	
McFadden R – squared		0.2845			0.2827	
Prob(LR statistic)		0.0000			0.0000	
AIC		1.0679			1.0704	

Notice: *** means it is noticeable under 1%, ** noticeable under 5%, and * noticeable under 10%.

4.3 Credit using and rationing under different risk attitudes The regression result shows that when under different risk attitudes the model with small LR and P is more noticeable than others. Models with smaller AIC is more concise and accurate. In terms of the relation between credit using and rationing, as to risk averters and risk lovers, the influence of credit using on credit rationing is obvious under 10% and 5% respectively. With risk averters, the credit using is basic living expenses and their credit rationing is as large as 0.8785. As to risk lovers, when the credit is used for investment, its credit rationing is 0.2106. As to risk

neutrals, when credit is used to invest, its credit rationing is 0.5941, but such influence is not noticeable. So as to farmers with different risk attitudes, the effect of credit using on credit rationing is also different, which conforms to Hypothesis 2. This is mainly because risk attitudes play a decisive part in farmers' wealth. Generally speaking, farmers with more wealth are more likely to be risk lovers and their credit using is to better their life as well as to gain higher investment rate and benefits while making full of the market opportunities. Farmers with risk aversion attitudes apply for credit to meet their basic living need due to small wealth, and their credit is often short-termed and of small amount. As to other variables, influence of age on risk preference is negative: the older the farmer, the less the credit rationing. Old age means more accumulated wealth and social asset, which make them less likely be influenced by credit rationing. The influence of education on risk averters and risk lover are both negative and apparent: -1.6290 and -0.7126 respectively. The influence of family income on the above three risk attitudes is all negative and apparent. As to risk averters, whether there is a leader in the family has an obvious influence on credit rationing. The possible reason may be that leaders in the family have wider social network and stronger ability to get credit through various channels and thus less credit rationing. As to risk averters and lovers, large family population means more credit rationing. Because more family members means more living expenses and less anti-risk ability and more liable to credit rationing. As to risk averters, the more land the farmers own, the less credit rationing, which is obvious under 10% and mainly because the land is the main source and guarantee of their income. But to risk lover and neutrals, more land means more credit rationing. Because risk lovers use land management as a major investment for more investment benefit and repay, and thus such farmers need more credit (such as technology input, machines and equipment), which increases credit rationing. To risk averters, the amount of labor force decreases credit rationing, because more labor means more power to get income. But to risk neutrals and lovers, such influence is not noticeable.

Table 10 Regression result with Logit model under different risk attitudes

Variables	Risk averters		Risk neutrals		Risk lovers	
	Estimated coefficient	P	Estimated coefficient	P	Estimated coefficient	P
Using	−0.8785*	0.0713	0.0699	0.5941	0.2106**	0.0403
Age	−0.1888	0.7109	0.0119	0.9523	−0.6269*	0.0643
Distance	0.0513	0.1325	0.0059	0.4522	0.0079	0.6412
Education	−1.6290**	0.0375	0.0272	0.8527	−0.7126*	0.0981
Income	−0.9769**	0.0172	−0.0638***	0.0018	−0.1621 *	0.0714
Labor	−0.5513	0.0750	0.0136	0.9156	0.2841	0.3215
Leader	−15.985*	0.099	−1.0867	0.1578	−0.6625	0.3956
Population	0.7114*	0.0729	−0.1539	0.2623	0.0540*	0.0934
Land	−0.6353*	0.0612	0.2476**	0.0459	0.1691*	0.0758
Constant	2.9744	0.5543	0.5429	0.0153	2.5155	0.3088
LR	18.1687		18.6717		10.0448	
McFadden R-squared	0.2553		0.0860		0.0622	
Prob(LR statistic)	0.0199		0.0281		0.0468	
AIC	0.4010		1.3816		1.1656	

Notice: * * * means it is noticeable under 1%, * * noticeable under 5%, and * noticeable under 10%.

5 Conclusions and policy recommendations

Little attention has been given to farmers' risk attitudes and credit rationing in China's rural financial market for a long time. The research of this paper shows that farmers' risk attitude and credit rationing are in a significant positive correlation. The stronger the farmers' risk aversion is, the more serious the demanded credit rationing becomes, because risk attitude determines the risk cost and risk premium, and it consequently affects the credit behavior. In addition, the distance of the farmers' residence from the city and their land amount have a positive significant influence on credit rationing; while farmers' education degree, income level, family labor force have a negative significant effect on credit rationing. As to farmers with different risk attitudes, their credit using is closely related to credit rationing. As to risk averters, credit rationing of basic living expenses is larger, while to risk lovers, credit rationing of investment and life-improvement expenses is larger. In order to relieve the farmer's credit rationing and improve its coverage and sustainability, measures must be taken from government, financial institutions and farmers respectively. The government can provide fiscal subsidies to decrease farmers' risk aversion, accelerate and perfect land transfer market to make the farmers' land become their real asset, and speed up urbanization and industrialization to promote farmers' non-agricultural income and scale economy. Financial institutions can make various invisible cost become noticeable, renovate financial products and realign and optimize original products and business process in order to channel, create and fulfill farmers' credit needs. As to relieve credit rationing, rural labor training shall be reinforced, the quality of rural human resources shall be promoted and more chances shall be provided for farmers' employment and start of their own business.

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5.2 Carbon emission effect of Chinese trade of paper and paper products is not significant Based on IPCC inventory guidelines, it is calculated that the consumption of energy (coal) for China's papermaking industry was 26.5809 million t in 2012, and the total carbon emission was 17.83185 million t. And the carbon emission effect of Chinese trade of paper and paper products was 0.5136 million t in 2012. This result is equivalent to only 2.7% of carbon reduction effect of Chinese trade of papermaking raw materials, and the carbon emission effect is not significant. This is mainly because China is not only a major importer of papermaking raw materials, but also a major producer and consumer of paper products; the production of paper and paper products is mainly to meet domestic consumption, and the net exports of paper and paper products are too trivial or insignificant to mention. In 2012, the national production of paper and paperboard was 102.5 million t, and the production of paper products was 48.04 million t, a total of 150.54 million t. At the same time, the net exports of paper and paper products were only 4.33 million t, accounting for less than 3% of total production. It can be seen that the "pollution haven" hypothesis does not hold in the paper industry.

5.3 Overall, the Chinese trade of paper products has significant carbon reduction effect In 2012, the carbon reduction effect of the Chinese trade of papermaking raw materials was 190.211 million t, and the carbon emission effect of trade of paper and paper products was 0.5136 million t. Overall, the Chinese trade of paper products has significant carbon reduction effect, and the specific value is 18.5075 million t. This result fully proves that the China's trade structure of paper products is conducive to the reduction of domestic carbon emissions, and the offsetting effect is obvious. In summary, the conclusion can provide an important scientific basis for the structural adjustment of China's trade of paper products.

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