American Journal of Management Science and Engineering
2022; 7(5): 69-74
http://www.sciencepublishinggroup.com/j/ajmse
doi: 10.11648/j.ajmse.20220705.11
ISSN: 2575-193X (Print); ISSN: 2575-1379 (Online)

A Simulation Experiment of Rural Digital Inclusive Finance on Property Rights Financing Risk Control of Small and Micro Business Entities

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To cite this article:
Zhan Zhimin, Fang Min. A Simulation Experiment of Rural Digital Inclusive Finance on Property Rights Financing Risk Control of Small and Micro Business Entities. *American Journal of Management Science and Engineering*. Vol. 7, No. 5, 2022, pp. 69-74.
doi: 10.11648/j.ajmse.20220705.11

Received: September 4, 2021; **Accepted**: October 8, 2022; **Published**: October 31, 2022

Abstract: The organic combination of rural digital inclusive finance and land property right mortgage financing based on theory and practice is a financial innovation to solve the financing difficulties of small and micro rural economies scientifically. However, due to the vulnerabilities of rural financial markets (such as information asymmetry and digital divide), the control of potential risks in this field urgently needs to be strengthened. In order to promote the development effect of rural digital inclusive finance in an orderly manner, the special complexity of rural inclusive finance environment and rural land property right mortgage financing environment and the discrete characteristics of existing data are taken into account. We intend to use the questionnaire survey limited data to improve the use of modern control models to validate the system simulation experiments. The Simulink program of MATLAB7.0 software is used to simulate by module drawing. It is found that in the mortgaged financing of rural land property rights, rural small and micro enterprises such as farmers have different risk-bearing and risk control compared with financial institutions in a weak position of information and resources. We will actively explore ways to effectively control the risks of farmers and other rural small and micro business entities. It is suggested that special attention should be paid to the control of such risks in ethnic areas with complex social relations. The practice has proved that rural digital inclusive finance is an effective way to solve the financing difficulties of rural small and micro economies.

Keywords: Rural Digital Inclusive Finance, Risk Control, Land Property Mortgage Financing, Simulation Experiment

1. Introduction

The organic combination of rural digital inclusive finance and land property right mortgage financing based on theory and practice is a financial innovation to solve the financing difficulties of small and micro rural economies scientifically. Relevant literature and existing practices have proved that digital financial inclusion in rural areas is an effective way to solve the financing difficulties of small and micro rural economies. [1] However, due to the vulnerabilities of rural financial markets (such as information asymmetry and digital divide), the control of potential risks in this field urgently needs to be strengthened. This is also the urgent matter of rural financial system reconstruction. This is also the basis point of the marginal contribution of this paper.[1-4]

It is limited by the construction of rural financial research database and the complex actual situation that the questionnaire survey data of rural land property mortgage financing and the risk control data of rural land property mortgage financing are partly discrete, partly continuous and not enough to meet the requirements of time series data. Research on the risk of rural land property mortgage financing, in the past, most of the losses and harms caused by the debtor to the creditor were inherited, and it was concentrated on the evaluation, prevention and control of the risk loss of financial institutions. In the process of on-site investigation, we found through the expressions and data analysis of rural small and micro business entities such as farmers that there are two risks in rural land property mortgage financing: one is that there are many losses to

financial institutions caused by default by rural small and micro business entities such as farmers. Risks, such as credit risk, operational risk, interest rate risk, legal risk, etc. First, because the loans of financial institutions cannot satisfy and support rural small and micro business entities such as farmers and other rural small and micro business entities, innovative operations and excessive entrepreneurship bring related risks to rural small and micro business entities such as farmers. Such as policy risk, social risk, term risk, amount risk and spread risk. The literature of different degrees of research on the former is very rare, while the in-depth attention to the latter is quite limited. Fortunately, the central government (2015) has clearly instructed the prevention of social risks on the basis of scholars' "hidden risks". We believe that on the basis of clarifying the complex system of behavioral risks of rural small and micro business entities such as peasant households in rural land property mortgage financing, we will effectively resolve relevant risks and strive to propose reasonable solutions, considering the special complexity of the rural financial land property right mortgage financing environment and the discrete characteristics of the existing data. [5-10]

2. The Behavior and Risk System Construction of Rural Small and Micro Business Entities Such as Farmers

The survey found that rural small and micro business entities such as farmers involved in rural land property mortgage financing is a complex system that can be divided into individuals and groups including rural small and micro business entities such as individual farmers and professional farmers; small and micro-economic entities such as large professional households, cooperatives, large and small communities, groups of relatives and friends, and family farms. The survey also found that the behavior system of rural small and micro business entities such as farmers can be divided into two types: financing behavior and investment behavior. The mortgage loan behavior risk system of rural small and micro business entities such as farmers can be divided into two types: financing behavior risk and investment behavior risk. Among them, the financing behavior risk of rural small and micro business entities such as farmers can be divided into the risks of financial institutions caused by rural small and micro business entities' behaviors and the risks of rural small and micro business entities such as farmers caused by financial institutions. The latter combined with the research data showed that the quantitative risk caused by insufficient loan quantity, the term risk caused by short repayment period, the spread risk caused by high interest rate, and the serious price of mortgaged land by rural small and micro business entities such as farmers caused by information asymmetry underestimated valuating risk. The investment behavior risk of rural small and micro business entities such as farmers can basically be divided into investment success risk and investment unsuccessful risk. In total, there are 3 sections, 6 categories and 17 sub-items. In view of the concentration of risks of financial institutions caused by the behavior of rural small and micro business entities such as rural households in previous studies, we will focus on the less-concerned section "Farmers and other rural small and micro business entities' financing behaviors lead to rural household risks".

Table 1. *Composite classification table of behaviors and risks of rural small and micro business entities such as farmers.*

Project	Category		
Behavior risk system of farmers	Risk of financing behavior	The financing behavior of farmers leads to institutional risk	Credit risk, market risk, operational risk, legal risk interest rate risk, default risk Valuation risk (1); Quantity risk (2); Term risk (3); Spread risk (4)
		Farmers' financing behavior leads to farmers' risks	
	Risk of investment behavior	Risk of successful investment	
		Risk of unsuccessful investment	

Note: This article only analyzes the risks of farmers and other rural small and micro business entities caused by the financing behavior of rural small and micro business entities.

3. Theoretical Model Construction

Taking into account the actual input and output of the rural land mortgage loan risk system and the validity of the data, referring to classic theories, it is planned to implement the diagonal standard form of the SISO (single input, single output) linear time-invariant system in the parallel mode control model.

Assume that all poles of the characteristic equation of the transfer function of the SISO linear time-invariant system are different (without multiple eigenvalues) and satisfy. [11]

$$s^n + a\,s^{n-1} + \ldots + a$$

$$s + a = (s-\lambda)(s-\lambda)\ldots(s-\lambda)(s-\lambda)$$

In this way, through variable selection, the classic transfer function can be described as the "diagonal standard type" of the state space, and the transfer function of the system can be written as:

$$G(s) = \frac{Y(s)}{U(s)} = \frac{K(s-z_1)(s-z_2)\ldots(s-z_m)}{(s-\lambda_1)(s-\lambda_2)\ldots(s-\lambda_n)}$$

which is

$$X_i(s) = \frac{U(s)}{s - \lambda_i}, \quad i = 1, 2, \cdots, \quad n$$

Select state variable
which is statistics

$$sX_i(s) - \lambda_i X_i(s) = U(s)$$

$$\Rightarrow \dot{x}_i(t) = \lambda_i x_i(t) + u(t)$$

The output equation of the structure obtained as follows:

$$Y(s) = G(s)U(s) = \sum_{i=1}^{n} \frac{c_i}{s - \lambda_i} U(s) = \sum_{i=1}^{n} c_i \frac{U(s)}{s - \lambda_i} = \sum_{i=1}^{n} c_i X_i(s)$$

Is the undetermined coefficient of the corresponding eigenvalue.

$$\Rightarrow \quad C = (c_1 \quad \ldots \quad c_n)$$

Combined with our existing data and the actual situation of risk control of rural small and micro enterprises of rural small and micro business entities such as farmers. Let n=3, the corresponding function equation of x, y, c is:

$$y = \sum_{i=1}^{n} c_i x_i(t) = (c_1 \quad \ldots \quad c_n) \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix} \quad (n=3)$$

4. Data Sample Selection and Variable Description Statistics

(1) Data sample selection. The sample data comes from the 1000 valid samples in Tongxin County of Ningxia we surveyed, and 100 questionnaires were randomly sampled according to the weights of the number of questionnaires at 8 different sampling sites, including Xinhua Village and Wangtuan Village, representing the total sample as our next sample.

(2) Variable design. Considering that the module function of Simulink system is used for experimental operation, the design of ln1 module represents valuation risk, ln2 module represents quantitative risk, and ln3 module represents term risk, and is used as a control system input variable assignment design; out1 is a comprehensive output module; others are as follows 1 indicates the controller and information feedback sensor of the system environment respectively.

(3) Descriptive statistics. This paper takes the future loan willingness of rural small and micro business entities such as farmers as the dependent variable (y). According to our research ideas, we divide the risks of environmental risks, rural small and micro business entities such as rural households and institutional risks. Choose the gender of rural small and micro business entities such as rural households (x1), the number of family members above high school (x2), the number of loans (x3), Land valuation (x4), loan term (x5).

Table 2. *Variable selection and descriptive.*

Variable generation	Code	Variable definitions are all	meanValue	Standard deviation

The willingness of the business entity to borrow in the future	y	very unwilling = 1;
		unwilling = 2;
		willing = 3;
		very willing = 4
			2.938	0.8085

Gender of the head of rural small and micro businesses	x1	female=0; male=1	0.6829	0.4656

Number of people with high education in the family	x2	none=0;
		one=1;
		two=2;
		more than three=3;
			0.9990	0.7174

Number of loans	x3	1 time=1; 2 times=2; 3 times=3	2.3424	0.7544

Land valuation	x4	very low=1;
		low=2;
		almost=3;
		okay=4
			1.5980	0.7859

Loan term	x5	1 year=1; 2 years=2; 3 years=3;	2.0712	0.7897

(4) Variable regression selection and research hypothesis. With the help of the field data used in the questionnaire survey in Tongxin County, Ningxia, we selected 1,000 samples to synthesize our existing factor analysis research results. Select design variables from the perspective of farmers and other rural small and micro business entities' financing behaviors that cause their own risks. Logistic regression analysis found that the main factors affecting the risks of rural small and micro business entities such as rural households are that the rural land valuation is too low, the amount of rural land property mortgage financing is too small, the repayment period is too short and the interest rate is too high. Questionnaire statistics show that these four factors accounted for 98.5%, 97.3%, 95.6% and 98.7% of the effective questionnaires returned.

From this we give the following hypothesis: the valuation of rural land is too low. There are too few rural land property rights mortgage financing, too short repayment period and high-interest rate. The risks corresponding to the four influencing factors are valuation risk, quantity risk, maturity risk and spread risk (The spread risk is combined analysis with the interest rate risk of the financial institution risk). The valuation risk, quantity risk, and maturity risk analyzed in this case are ranked in order according to the proportion of questionnaires: valuation risk, quantity risk, and maturity risk.

5. Simulation Experiment

Use the Simulink program that comes with the MATLAB7.0 software to simulate and simulate through the module drawing. The basic process is: link theory with reality to construct the state equation and objective function; construct the simulation system block diagram in MATLAB software or in Simulink system through programming language and modules; computer operation and dynamic demonstration of simulation experiment; output simulation experiment results after correction is determined, Carry out risk control analysis.

(1) Theoretical model improvement

Through the MUX module, change the multiple input to multiple single input and single output mode. Construct a simulation structure block diagram of multiple single-input single-output (Figure 1). The input variables 1, 2, and 3 respectively represent the evaluation risk, quantitative risk and term risk in the sample. And our theory combined with actual assumptions that these three risks are arranged in descending order of risk. And by default, various risks can be divided into different levels. Correspondingly, three information feedback loops are arranged to control and improve the stability of the system.

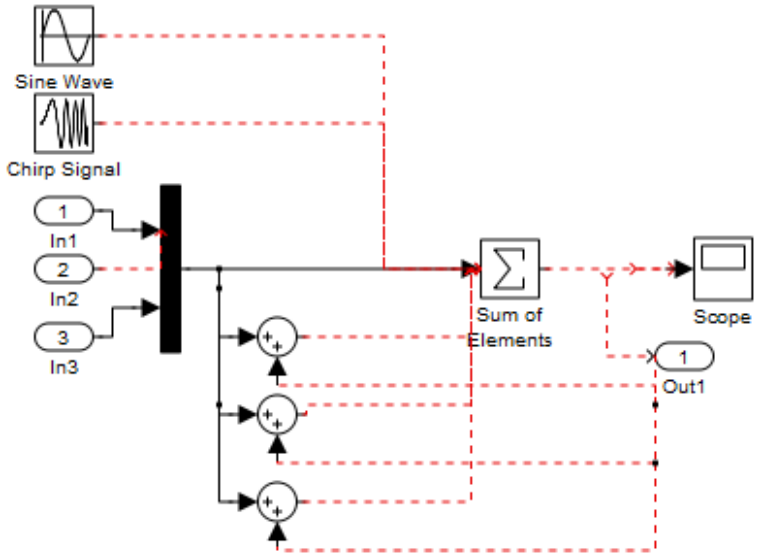

Figure 1. *Self-made system simulation block diagram.*

(2) System simulation dynamic demonstration:

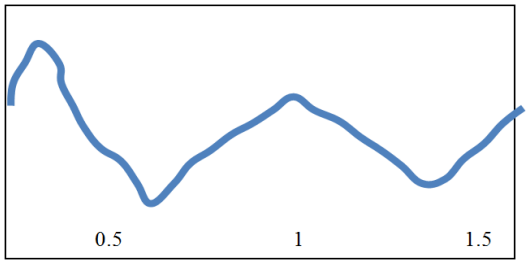

Figure 2. *Simulated system simulation output diagram.*

(3) Analysis of simulation experiment results

Observation found that through the adjustment and control of the feedback control system, the system is basically stable. However, the simulation results show that the system fluctuates greatly, and the control effect is not very satisfactory, and the control needs to be further optimized. The simple improvement methods are: the simplification of the control simulation block diagram is possible by designing the package subsystem.

(4) Experimental optimization control

We choose the network diagram to do further optimization technical means. Usually we use dynamic programming method minimum discrete value rule and approximate calculation method. With the help of the shortest path selection problem solving method, the optimal decision-making method is used to simulate the optimal control path selection method. Designate vertical areas B, C, and D as the farmers and other rural small and micro business entities studied in this article. The financing behavior of rural small and micro business entities such as farmers causes the valuation risk (B), quantity risk (C) and term risk (D) of farmers and other rural small and micro business entities. Each risk control is divided into three different levels (B1-B2-B3, C1-C2-C3 and D1-D2-D3), and the level of risk is represented by the number marked on each ray. As shown in Figure 3: [12]

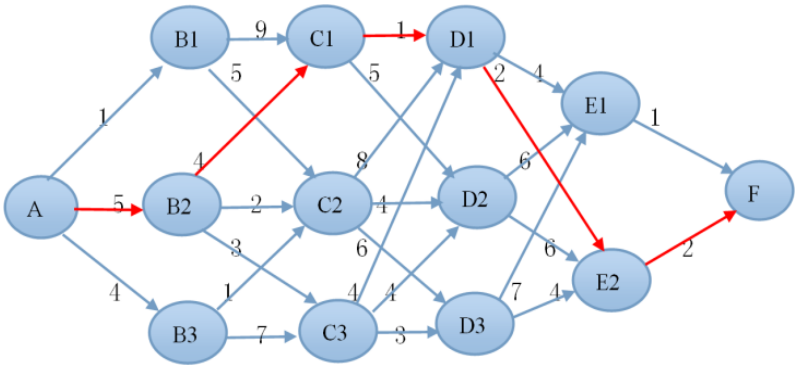

Figure 3. *Improved optimal control decision tree.*

The shortest path selection network control chart and solution settings: A-F has five levels, corresponding to the five levels of control decision-making; the numbers on each ray are simulated experimental data and the control distance between two points. In connection with the principle of optimization, "part of the optimal decision is also optimal", it is to avoid the calculation path of A-F, calculate one by one from F-A and select the optimal selection path for each segment. We compare it to the optimal decision-making network control chart of the most financial risk control and solve it accordingly. The optimization result, that is, the red control path (A-B2-C1-D1-E2-F) of A-F in the figure is the optimal solution.

The brief simulation solution is based on the above objective function formula 2 and the decision tree selection rule of large, medium and small (as shown in Figure 3). Knowing that J1(E2)=2, J1(E1)=1, the calculation is as follows:

The comparison shows that J2(D1)=4 is the smallest, which is the analytical solution of the optimal control path in the F-E-D section. Path F-E2-D1 is the optimal control path selection for this segment.

By analogy, adverse selection calculations are:

$$J3(C1)=5,\ J4(B2)=9,\ J5(A)=14$$

Among them, J3(C1)=5, J4(B2)=9 are the optimal control options for the C-D section and B-C section, respectively. That is, the C-D section selects the path D1-C1, and the B-C section selects the path C1-B2. In this way, the optimal control path has been clearly defined as: A-B2-C1-D1-E2-F path (as indicated by the red line). Similarly, J5(A)=14 is the optimal path length for the entire A-F control.

The study found that the optimal control principle is an economical and effective optimal control method. For discrete systems and continuous systems, linear systems and nonlinear systems are compatible.

6. Related Discussion

There are many studies on the behavior of rural small and micro business entities such as farmers in the project of the research on the subject of rural land property mortgage financing, and the risk of rural land behavior has also begun to be involved. However, from the perspective of farmers and other rural small and micro business entities' financing behaviors that cause their own risks, we conduct key research and simulation experiments based on household survey questionnaire data and statistical analysis of actual conditions, including valuation risk, quantitative risk, and term risk, and further explore and optimize risk control. The choice of these methods is mainly limited by the limitations of the construction of the rural financial research database and the rural land property rights mortgage financing questionnaire survey data and the rural land property rights mortgage financing risk control data are partially discrete, partially continuous, and insufficient for the complexity of the time series data requirements The actual situation. There is also the original intention of striving to innovate research methods. It would be very gratifying if it can play a role in inducing jade.

What needs to be improved is: (1) Flaw in the simulation experiment is that there is no more scientific data analysis effect. Moreover, the behavioral risk control system of rural small and micro business entities such as rural land property mortgage financing farmers, which is a complex system, requires the construction of a more scientific theoretical model and the integration of the simulation structure block diagram. Further, we can use the ANMSim system to perform joint risk control simulation experiments and path analysis for optimization. No analysis is done here, and it is left to further study and improvement in the future. (2) Although our simulation laboratory is successful, the simulation results are valid. However, our simulation structure block diagram is not concise enough, and the design needs to be further optimized. Because the simplicity of the simulation block diagram is an important indicator to show the science of system simulation experiments. The reasonable arrangement of MUX module and DMUX module will be necessary and effective when solving the problem of multiple input and output. (3) Combining the actual situation of our research on the behavioral risk control of rural small and micro business entities such as rural land property mortgage financing farmers and the complexity of the research data, the improved design of more scientific theoretical models is also the difficulty and focus of our further research. (4) If it is possible to collect survey data and update statistical analysis methods

in future practical research, establish a time series database as soon as possible, especially the establishment of a time series database of household investment and financing of rural small and micro business entities such as farmers. Through panel data modeling and simulation experiments, I believe our research results will be more scientific and valuable.

7. Conclusion

The conclusions of the theoretical research and simulation experiment in this paper are: (1) Output result of the simulation experiment shows that the risk control system designed in this research is basically stable. It shows that it is feasible to normalize the three inputs designed by our theoretical assumption into a single-input single-output (SISO) model mechanism simulation block diagram; the simulation experiment is successful; the experimental output results have the function of theoretical explanation. Basically, the theoretical model can be combined with the actual research, and it has also indirectly verified the analysis conclusions of influencing factors explained by most scholars through Logistic regression. It can more scientifically reflect the current behavioral risk control of rural small and micro business entities such as rural households in rural land property mortgage financing in western rural areas: in the process of rural land property mortgage financing, the behavioral risks of rural small and micro business entities such as rural households are manifested as financing behavior risks and investment There are two types of behavioral risks. Among them, the financing behavior of rural small and micro business entities such as rural households causes their own rural land estimation risk, financing volume risk, repayment period risk, and interest rate spread risk. The risk of rural land estimation, financing quantity risk, and repayment period risk is the most prominent. Further measures need to be taken to optimize control. (2) The improvement of the optimization control method by the network analysis method on the one hand confirms that our research hypothesis 1 explained by the simulation experiment is valid. On the other hand, the mathematical analysis reveals the rationality of our research hypothesis 2 on rural land estimation risk, financing quantity risk, and repayment period risk in the behavioral risks of rural small and micro business entities such as farmers. What is more practical is that the research of analogy shortest path optimization control has found a graphical method of the optimal control path for the behavioral risk control of rural small and micro business entities such as farmers. It should have enlightenment for our future related risk control research.

Acknowledgements

Guangzhou Social Science Fund Project (2021GZGJ76), Donghua University of Technology Doctoral Fund Project (DHBK2018092), Guangdong University of Finance and Economics Huashang College Doctoral Project (2019HSXS08), Guangzhou Huashang College "Venture Capital" bilingual course ideological and political topic (HS2022ZLGC47).

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