The Equilibrium and Risk Analysis of Internet Finance under Social Networks Influence

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ABSTRACT

The development of the Internet finance makes the financial network become increasingly complex. Considering of the characteristics of Internet finance and relationship level, a framework including multitiered Internet financial network with investors, Internet financial intermediaries, traditional financial intermediaries and investees was proposed. Increasing relationship levels in our framework are assumed to reduce transaction costs as well as risk and to have some additional value for the decision-makers. From the perspective of cash flow, the competitive and cooperative relationships between various decision-makers were explicated, as well as their behavior and optimality conditions. We found that the decision-makers compete within a tier and cooperate between ties to optimize the whole Internet financial supernetwork. Under the Internet environment, the various decision makers face greater credit risk and operational risk, credit risk and operational risk brought about by the problem is more outstanding. The relationship level has little effect on investors' decision, but it mainly influences the behavior of Internet financial intermediaries and the traditional financial intermediaries.
Keywords: Internet finance, supernetwork, general equilibrium, risk management.

1. INTRODUCTION

The Internet will greatly change the traditional financial operation mode in the future. Internet finance of China began to sprout in the mid-1990s, with the appearance of online bank, securities, insurance etc. The development of Internet finance has entered a new era since 2010, which focused on innovative financial services [1]. A variety of Internet financial modes, which are different from the traditional financial services, have produced, including but not limited to the third party payment, P2P, big data finance, e-commerce + credit and loan, crowd funding, online financial institutions, financial Internet portal etc.[2]. On the other hand, Internet financial has also brought a series of problems in the rapid development, such as part of the P2P platform failures etc. It is necessary to further study the Internet financial general equilibrium problems under the Internet environment, its risk and management, so as to guide the macro development of the financial sector.

In China, the concept of Internet finance was first put forward by Ping Xie [3]. He think that Internet as a representative of modern information technology will have a fundamental impact on human financial model. Lucian Alexandru Frăţilăanalyzed Romania's online banking market from the perspective of cloud computing services [4]. Eunkyoung Lee had an empirical study on the existence of herd behavior in P2P loans, found the marginal diminishing effect on the herding behavior [5]. Ilias Santouridis investigated the decisive factor about whether the Greek bank on the net can be accepted, adopted the interview questionnaire, found the validity, reliability and comfort determines the use of the channels of the bank on the net or not [6]. Internet finance as a new thing, has brought challenges for the traditional financial supervision theory and practice. Ping Xie studied financial governance issues from the angle of network economy [7]. Duoyi Liu facing puts forward policy suggestions on Internet financial supervision vacancy phenomenon [8].

The Supernetwork refers to the system with many nodes, and the network contains the network. Sheffi Y is the first people who use the word supernetwork, who put the concept of super network in transportation system [9]. And Anna Nagurney took the network which is above and beyond the general network as the supernetwork, using the variational inequality theory to research several of the differential equation under the background of the supernetwork model [10]. In addition to traffic network and telecommunication network can use super network for research, it also involves the social network, chemical reactions and metabolic networks, protein networks, food network, knowledge network, and so on contents, [9, 11-15]. Anna studied the risk management problems of financial intermediary network by using the supernetwork theory [16]. Anna also introduces social network into financial supernetwork domain, studied a supernetwork model integrated the international financial network and social network, the reliability of the models are proved by example [17]. Zhang considered the influence of the credit risk and operational risk for each individual and the overall network decision, and established a financial network model with a three layers structure [18].

The original three-layer network structure can't reflect the flow of capital between Internet financial intermediaries and the traditional financial intermediaries and cooperative relations. The development of the Internet finance makes the financial

network become increasingly complex. Considering of the characteristics of Internet finance, a framework was developed for modeling, analysis and solutions to multitiered Internet financial network problems with investors, Internet financial intermediaries, traditional financial intermediaries and investees. From the perspective of cash flow, the competitive and cooperative relationships between various decision-makers were explicated, as well as their behavior and optimality conditions. This paper established the credit penalty function and operational risk function respectively denotes the Internet financial intermediary and traditional financial intermediary credit risk and operational risk faced by financial intermediary.

2. THE FRAMEWORK OF INTERNET FINANCE SUPERNETWORK

The framework of Internet finance supernetwork is given in Figure 1. We consider investors with sources of capital, such as households and businesses, involved in the allocation of their financial resources among a portfolio of financial instruments which can be obtained by transacting with Internet financial intermediaries, such as P2P, e-commerce + credit and loan, crowd funding etc. and traditional financial intermediaries, such as traditional banks, insurance and investment companies etc. The financial intermediaries, in turn, in addition to transacting with the investors, also determine how to allocate the incoming financial resources among distinct uses, as represented by demand markets with a demand market corresponding to, for example, the market for real estate loans, household loans, business loans, etc. In addition, we add a node to the middle tier of nodes in the Internet financial network only in order to represent the possible non-investment (of a portion or all of the capital) by one or more of the investors.

(1) The relationship level which includes previous business cooperated relations, likely personal relationships, and so on to represent the network flow of social network Combine Social Networking Services (SNS) with the Internet financial supernetwork into an integrated network, study equilibrium of the integrated network and the optimization of risk management problem. Assume that these relationships level are on the interval [0, 1], the increase of relationship level can reduce the transaction cost and transaction risk, which is more conducive to deal. Each decision maker is trying to achieve and maintain a certain relationship level with other decision makers to, and is willing to pay extra money or time.

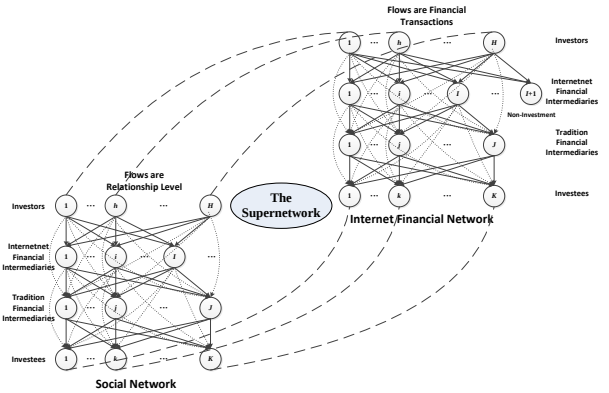

Figure 1 The multilevel supernetwork framework of the integrated Internet financial network and social network

(2) The relationship level cost function describes the costs which various decision makers are willing to pay in order to achieve and maintain a certain relationship level

As we all know, in our social life, people who had cooperated happily will be more willing to continue to cooperate next time. We note that the transaction cost function, the development of credit penalty function and risk function of Internet financial supernetwork not only associated with the volume of business between the decision makers, and is associated with each other the relationship level, the increase of relationship level will reduce transaction cost and the credit risk, but does not affect the operation risk and conversion costs.

3. THE EQUILIBRIUM AND RISK ANALYSIS

The behavior of the investors and their optimality conditions
Define each investors h owned the amount of capital S_h, the investors h invests the capital of q_{hi}^1 to Internet financial intermediation i. There are HI links connecting the participants with sources of capital and the Internet financial intermediation, Cash flow on each link is q_{hi}^1, which is summarized a vector $Q^1 \in R_+^{HI}$; At the same time, the investors h also can invests the capital of q_{hi}^1 to traditional financial intermediation j, there are HJ links connecting the participants with sources of capital and the traditional financial intermediation. Cash flow on each link is q_{hj}^1, which is summarized a vector $Q^2 \in R_+^{HJ}$. Besides, the link from the investors h to the $I+1$ node in the second tier denotes the amount of capital which the investors h may not invest, Cash flow on each link is s_h, that is the remaining amount of the capital of the investors h.

Let f_{hj}^1 denotes relationship cost function between the investors h and the traditional financial intermediation j (the part of the investors undertaken).
v_{hj}^1 denotes the relationship level function between the investors h and the traditional financial intermediation j (the part of the investors facing).
c_{hj}^1 denotes the transaction cost function between the investors h and the traditional financial intermediation j (the part of the investors undertaken).
g_{hj}^1 denotes the credit penalty function between the investors h and the traditional financial intermediation j (the part of the investors undertaken).
r_{hi}^1 denotes the risk function between the investors h and the Internet financial intermediation i, (the part of the investors facing).
From the investors point of view, the equilibrium conditions satisfy all participants can be expressed with the following variational inequality Eq. (1).

$$
\begin{aligned}
&\sum_{h=1}^{H}\sum_{i=1}^{I}\left[\alpha_h\frac{\partial r_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial q_{hi}^1}+\frac{\partial c_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial q_{hi}^1}+\frac{\partial g_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial q_{hi}^1}-\rho_{hi}^{1*}\right]\times\left(q_{hi}^1-q_{hi}^{1*}\right)\\
&+\sum_{h=1}^{H}\sum_{j=1}^{J}\left[\alpha_h\frac{\partial r_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}+\frac{\partial c_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}+\frac{\partial g_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}-\rho_{hj}^{1*}\right]\times\left(q_{hj}^1-q_{hj}^{1*}\right)\\
&+\sum_{h=1}^{H}\sum_{i=1}^{I}\left[\alpha_h\frac{\partial r_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial f_{hi}^1\left(\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial c_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial g_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}-\beta_h\frac{\partial v_{hi}^1\left(\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}\right]\times\left(\eta_{hi}^1-\eta_{hi}^{1*}\right)\\
&+\sum_{h=1}^{H}\sum_{j=1}^{J}\left[\alpha_h\frac{\partial r_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}+\frac{\partial f_{hj}^1\left(\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}+\frac{\partial c_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}+\frac{\partial g_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}-\beta_h\frac{\partial v_{hj}^1\left(\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}\right]\times\left(\eta_{hj}^1-\eta_{hj}^{1*}\right)\\
&\geq 0\\
&\forall\left(Q,\mathrm{H}\right)\in K^1, K^1\equiv\left\{\left(Q,\mathrm{H}\right)\mid q_{hi}^1\geq 0, q_{hj}^1\geq 0, 0\leq\eta_{hi}^1\leq 1, 0\leq\eta_{hj}^1\leq 1\right\}
\end{aligned}
\tag{1}
$$

The behavior of other participants and their optimality conditions

Similar to previous analysis of investors' behavior, other participants' behavior and their optimality conditions are as follows. The equilibrium conditions for the Internet financial intermediaries satisfy all participants can be expressed with the following variational inequality Eq. (2).

The equilibrium conditions for the traditional financial intermediaries satisfy all participants can be expressed with the following variational inequality Eq. (3).

The equilibrium conditions for the investees at demand markets satisfy all the traditional financial intermediation can be expressed as the variational inequality Eq. (4).

$$
\begin{aligned}
&\sum_{i=1}^{I}\sum_{j=1}^{J}\left[\alpha_i\frac{\partial r_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}+\frac{\partial c_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}+\frac{\partial g_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}-\frac{\partial e_{ij}^2\left(q_{ij}^{2*}\right)}{\partial q_{ij}^2}-\rho_{ij}^{2*}+\gamma_i^*\right]\times\left(q_{ij}^2-q_{ij}^{2*}\right)\\
&+\sum_{i=1}^{I}\sum_{k=1}^{K}\left[\alpha_i\frac{\partial r_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial q_{ik}^2}+\frac{\partial c_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial q_{ik}^2}+\frac{\partial g_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial q_{ik}^2}-\frac{\partial e_{ik}^2\left(q_{ik}^{2*}\right)}{\partial q_{ik}^2}-\rho_{ik}^{2*}+\gamma_i^*\right]\times\left(q_{ik}^2-q_{ik}^{2*}\right)\\
&+\sum_{h=1}^{H}\sum_{i=1}^{I}\left[\alpha_i\frac{\partial \hat{r}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial c_i\left(Q^{1*}\right)}{\partial q_{hi}^1}+\rho_{hi}^{1*}+\frac{\partial \hat{c}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial q_{hi}^1}+\frac{\partial \hat{g}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial q_{hi}^1}-\gamma_i^*\right]\times\left(q_{hi}^1-q_{hi}^{1*}\right)\\
&+\sum_{i=1}^{I}\sum_{j=1}^{J}\left[\alpha_i\frac{\partial r_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}+\frac{\partial f_{ij}^2\left(\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}+\frac{\partial c_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}+\frac{\partial g_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}-\beta_i\frac{\partial v_{ij}^2\left(\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}\right]\times\left(\eta_{ij}^2-\eta_{ij}^{2*}\right)\\
&+\sum_{i=1}^{I}\sum_{k=1}^{K}\left[\alpha_i\frac{\partial r_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial \eta_{ik}^2}+\frac{\partial f_{ik}^2\left(\eta_{ik}^{2*}\right)}{\partial \eta_{ik}^2}+\frac{\partial c_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial \eta_{ik}^2}+\frac{\partial g_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)}{\partial \eta_{ik}^2}-\beta_i\frac{\partial v_{ik}^2\left(\eta_{ik}^{2*}\right)}{\partial \eta_{ik}^2}\right]\times\left(\eta_{ik}^2-\eta_{ik}^{2*}\right)\\
&+\sum_{h=1}^{H}\sum_{i=1}^{I}\left[\alpha_i\frac{\partial \hat{r}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial \hat{f}_{hi}^1\left(\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial \hat{c}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}+\frac{\partial \hat{g}_{hi}^1\left(q_{hi}^{1*},\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}-\beta_i\frac{\partial \hat{v}_{hi}^1\left(\eta_{hi}^{1*}\right)}{\partial \eta_{hi}^1}\right]\times\left(\eta_{hi}^1-\eta_{hi}^{1*}\right)\\
&+\sum_{i=1}^{I}\left(\sum_{h=1}^{H}q_{hi}^{1*}-\sum_{j=1}^{J}q_{ij}^{2*}-\sum_{k=1}^{K}q_{ik}^{2*}\right)\times\left(\gamma_i-\gamma_i^*\right)\geq 0\\
&\forall\left(Q,\mathrm{H},\Gamma\right)\in K^2, K^2\equiv\left\{\left(Q,\mathrm{H},\Gamma\right)\mid q_{hi}^1\geq 0, q_{ij}^2\geq 0, q_{ik}^2\geq 0, 0\leq\eta_{hi}^1\leq 1, 0\leq\eta_{ij}^2\leq 1, 0\leq\eta_{ik}^2\leq 1, \gamma_i\geq 0\right\}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
&\sum_{j=1}^{J}\sum_{k=1}^{K}\left[\alpha_j\frac{\partial r_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial q_{jk}^3}+\frac{\partial c_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial q_{jk}^3}+\frac{\partial g_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial q_{jk}^3}-\frac{\partial e_{jk}^3\left(q_{jk}^{3*}\right)}{\partial q_{jk}^3}-\rho_{jk}^{3*}+\gamma_j^*\right]\times\left(q_{jk}^3-q_{jk}^{3*}\right)\\
&+\sum_{h=1}^{H}\sum_{j=1}^{J}\left[\alpha_j\frac{\partial \hat{r}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}+\frac{\partial c_j\left(Q^{2*}\right)}{\partial q_{hj}^1}+\rho_{hj}^{1*}+\frac{\partial \hat{c}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}+\frac{\partial \hat{g}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial q_{hj}^1}-\gamma_j^*\right]\times\left(q_{hj}^1-q_{hj}^{1*}\right)\\
&+\sum_{i=1}^{I}\sum_{j=1}^{J}\left[\alpha_j\frac{\partial \hat{r}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}+\frac{\partial c_j\left(Q^{3*}\right)}{\partial q_{ij}^2}+\rho_{ij}^{2*}+\frac{\partial \hat{c}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}+\frac{\partial \hat{g}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial q_{ij}^2}-\gamma_j^*\right]\times\left(q_{ij}^2-q_{ij}^{2*}\right)\\
&+\sum_{j=1}^{J}\sum_{k=1}^{K}\left[\alpha_j\frac{\partial r_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial \eta_{jk}^3}+\frac{\partial f_{jk}^3\left(\eta_{jk}^{3*}\right)}{\partial \eta_{jk}^3}+\frac{\partial c_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial \eta_{jk}^3}+\frac{\partial g_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)}{\partial \eta_{jk}^3}-\beta_j\frac{\partial v_{jk}^3\left(\eta_{jk}^{3*}\right)}{\partial \eta_{jk}^3}\right]\times\left(\eta_{jk}^3-\eta_{jk}^{3*}\right)\\
&+\sum_{h=1}^{H}\sum_{j=1}^{J}\left[\alpha_j\frac{\partial \hat{r}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}+\frac{\partial \hat{f}_{hj}^1\left(\eta_{hj}^1\right)}{\partial \eta_{hj}^1}+\frac{\partial \hat{c}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}+\frac{\partial \hat{g}_{hj}^1\left(q_{hj}^{1*},\eta_{hj}^{1*}\right)}{\partial \eta_{hj}^1}-\beta_j\frac{\partial \hat{v}_{hj}^1\left(\eta_{hj}^1\right)}{\partial \eta_{hj}^1}\right]\times\left(\eta_{hj}^1-\eta_{hj}^{1*}\right)\\
&+\sum_{i=1}^{I}\sum_{j=1}^{J}\left[\alpha_j\frac{\partial \hat{r}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}+\frac{\partial \hat{f}_{ij}^2\left(\eta_{ij}^2\right)}{\partial \eta_{ij}^2}+\frac{\partial \hat{c}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}+\frac{\partial \hat{g}_{ij}^2\left(q_{ij}^{2*},\eta_{ij}^{2*}\right)}{\partial \eta_{ij}^2}-\beta_j\frac{\partial \hat{v}_{ij}^2\left(\eta_{ij}^2\right)}{\partial \eta_{ij}^2}\right]\times\left(\eta_{ij}^2-\eta_{ij}^{2*}\right)\\
&+\sum_{j=1}^{J}\left(\sum_{h=1}^{H}q_{hj}^{1*}+\sum_{i=1}^{I}q_{ij}^{2*}-\sum_{k=1}^{K}q_{jk}^{3*}\right)\left(\gamma_j-\gamma_j^*\right)\geq 0\\
&\forall\left(Q,\mathrm{H},\Gamma\right)\in K^3,\ K^3\equiv\left\{\left(Q,\mathrm{H},\Gamma\right)\mid q_{hj}^1\geq 0,q_{ij}^2\geq 0,q_{jk}^3\geq 0,0\leq\eta_{hj}^1\leq 1,0\leq\eta_{ij}^2\leq 1,0\leq\eta_{jk}^3\leq 1,\gamma_j\geq 0\right\}
\end{aligned}
\tag{3}
$$

$$
\begin{aligned}
&\sum_{i=1}^{I}\sum_{k=1}^{K}\left[\rho_{ik}^{2*}+\hat{c}_{ik}^2\left(Q^{4*},Q^{5*},\mathrm{H}^{4*},\mathrm{H}^{5*}\right)+\hat{g}_{ik}^2\left(q_{ik}^{2*},\eta_{ik}^{2*}\right)-\rho_k^{4*}\right]\times\left(q_{ik}^2-q_{ik}^{2*}\right)\\
&+\sum_{j=1}^{J}\sum_{k=1}^{K}\left[\rho_{jk}^{3*}+\hat{c}_{jk}^3\left(Q^{4*},Q^{5*},\mathrm{H}^{4*},\mathrm{H}^{5*}\right)+\hat{g}_{jk}^3\left(q_{jk}^{3*},\eta_{jk}^{3*}\right)-\rho_k^{4*}\right]\times\left(q_{jk}^3-q_{jk}^{3*}\right)\\
&+\sum_{k=1}^{K}\left[\sum_{i=1}^{I}q_{ik}^{2*}+\sum_{j=1}^{J}q_{jk}^{3*}-d_k\left(\rho^{4*}\right)\right]\times\left(\rho_k^4-\rho_k^{4*}\right)\geq 0\\
&\forall\left(Q,\rho^4\right)\in R_+^{IK+JK+K}
\end{aligned}
\tag{4}
$$

The equilibrium analysis

The equilibrium state of the Internet financial supernetwork with intermediation and variable weights is one where is a group of optimal satisfy the sum of variational inequality.

For the uniqueness condition of equilibrium solution : assume that vector function F is strictly monotonic for $(Q^1,Q^2,Q^3,Q^4,Q^5,\mathrm{H}^1,\mathrm{H}^2,\mathrm{H}^3,\mathrm{H}^4,\mathrm{H}^5,\rho^4)$, there must be a unique financial flaw $(Q^{1*},Q^{2*},Q^{3*},Q^{4*},Q^{5*})$, a unique relationship level $(\mathrm{H}^1,\mathrm{H}^2,\mathrm{H}^3,\mathrm{H}^4,\mathrm{H}^5)$and the unique demand price vector ρ^{4*} meeting the Internet financial network equilibrium conditions of Internet financial network.

4. CONCLUSIONS

In this paper, a supernetwork for the whole financial system that including Internet finance and social network was proposed. Using variational inequality to transform the graph model into mathematical model, then got general equilibrium.

For future research work, we can deeply study the dynamic evolution of financial super-network, and consider the game relationship among the financial participants including the regulatory authorities. And we can build a game super-network model to provide theoretical basis for the development of financial system supervision under Internet finance, especially macro-prudential supervision.

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