

Fundamental Theory and Research Methodologies for Fictitious Economy

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In this paper, the author describes the fundamental theory and research methodologies in the field of fictitious economy. Fictitious economy refers to all activities of fictitious capital mainly based on financial platform. Compared with real economy, fictitious economy is another economic pattern, including its structure and evolution, existing at economic system, which can be viewed as “software” of economy. Although the concept of fictitious capital was initiated by Karl Marx, it has been expanded to include credit capital, knowledge capital, and social capital. According to this, the development of fictitious economy has five stages: (i) capitalization of spare money, (ii) socialization of profitable capital, (iii) marketization of priced security, (iv) internationalization of financial market, and (v) integration of global finance. The exchange and re-exchange are a major movement of fictitious capital. While the uncertain price of fictitious capital creates the possibility of profitable investment, its expansion produces risk and its movement could not directly increase social wealth. The system of fictitious economy has five characteristics such as complexity, stability, high-risk, parasitism, and periodicity. This paper outlines the challenging research problems, including relationships between fictitious economy and real economy, regulatory factors, risk analysis and prevention, and evaluation system in fictitious economy. In addition, it elaborates on six research methods, known as complexity science, decision making under uncertainty, group decision making,

complex data analysis for decision support, mathematical finance, and computer simulation to deal with fictitious economy problems.

Keywords: Fictitious capital; Fictitious economy; Complexity; Financial markets.

1. Introduction

Study on fictitious economy has been gradually recognized by international community. There are three kinds of categories that belong to the term equal to “fictitious economy” in Chinese translation (Cheng, 1999). The first one is fictitious economy, which refers to all activities of fictitious capital that is mainly based on financial platform. The second one is virtual economy, which refers to the economic activities performed on the basis of information technology, including the well-known e-commerce. It should be translated as “reality-simulating economy” in Chinese. The third one is visual economy, which refers to the visualized economic activities that are simulated with computer. It means a model of a kind of economic activity will be established before using the model for computer simulation. For example, some economic policies may be simulated on the computer before the implementation is carried out. It can also be considered as visualized economy. There are some internal relations between the three categories. The fictitious economy discussed in this paper mainly refers to the first category (fictitious economy).

According to the author’s preliminary investigation on this subject, the most common concept is the virtual economy. But, there are so many different descriptions on the notations and extensions of this concept. It not only includes the above categories, but also the economic activities, such as the online games. In recent years, the international community tends to define it as the creation and transfer of the virtual wealth in the online games. For example, Wikipedia explains the virtual economy as “A virtual economy (or sometimes synthetic economy) is an emergent economy existing in a virtual persistent world, usually exchanging virtual goods in the context of an Internet game. People enter these virtual economies for recreation and entertainment rather than necessity, which means that virtual economies lack the aspects of a real economy that are not considered to be ‘fun’ (for

instance, players in a virtual economy do not need to buy food in order to survive, and usually do not have any biological needs at all). However, some people do interact with virtual economies for ‘real’ economic benefit (Wikipedia)”. On the homepage of Virtual Economy Research Network, it explicitly says: “Some online resources, such as domain name, virtual items in community address, powerful characters in online game, etc. are similar to the real goods that may only be under the control of a single person during a period. Nowadays, this virtual assets are brought and sold by thousands of people in many markets around the world (Virtual-Economy)”. This kind of virtual economy is also developed rapidly in China (Xu, 2008). Although some domestic scholars suggest use virtual economy as the equivalent English terms for Chinese words “Xuni Jingji”, the author insists to use “fictitious economy”. In this way, it not only shows a preciseness in the field of science study, but also inherits the concept of fictitious capital that was initiated by Karl Marx.

The domestic study on fictitious economy began from 1997. At that time, the author took the official position as Director of Management Science Department, National Natural Science Foundation of China. Our department and the Mathematics and Physics Department jointly started a major subject — Finance Mathematics, Finance Engineering, and Finance Management — at the beginning of 1997. After the breaking out the East-Asian Financial Crisis on July 1997, some scholars tried to analyze the crisis with the theory of fictitious economy (Liu, 1998; Cheng *et al.*, 1999). Especially, after the principle of “properly dealing with the relationship between fictitious economy and real economy” (Jiang, 2002) was proposed at the Sixteenth National Congress of CPC, the study on the fictitious economy has been developed vigorously. Up to now, five nationwide fictitious economy forums had been held. There are thousands of papers on fictitious economy which published in domestic newspapers and periodicals.

The domestic study on fictitious economy can be roughly divided into three academic schools, or three kinds of academic viewpoints.

First, fictitious economy is considered as a fictitious value system. This kind of viewpoint is mainly held by traditional economists. It is due to the traditional economics which considered economy as a value system.

In this way, the fictitious economy should be a fictitious economy value system.

Second, fictitious economy is considered as finance itself. This viewpoint mainly comes from the scholars of finance community. From their viewpoint, they are actually talking about finance when talking about fictitious economy. Some of them even think that it is unnecessary to use the term “fictitious economy”.

Third, fictitious economy is considered as an economic activity pattern, which includes structure and its evolution, existing in the economic system as opposed to real economy. The fictitious economy is the “software” in the economy. This viewpoint is proposed by the author in this article and is agreed by a number of scholars in the field of system engineering and natural science and technology.

In my opinion, the domestic research on fictitious economy is now at the beginning stage. There is no fixed paradigm. It is better to freely discuss it from different viewpoints of the scholars and put their opinions under a comprehensive consideration to obtain a consistent view on it. But, the three categories have different thinks and methods. Some of these thinks and methods can be mutually complementary. Some of them may only reach a comparative knowledge after putting them into practice.

Author has been made some studies on the fictitious economy. These studies mainly try to discuss the chaos and self-organization issues in security market, currency market, foreign currency market, future and option market, equity transaction market, financial crisis, inflation and deflation, commercial bank transform, countryside financing, real-estate financing, etc. They also involve the theory and method for fictitious economy (Cheng, 2003, 2007). It is hoped that these studies will help drive the economic and financial reforms. This article tries to present author’s study results and understandings on the fundamental theory and research methods of fictitious economy.

2. Initiation and Development of Fictitious Capital

2.1. *Karl Marx’s fictitious capital theory*

Karl Marx initiated the fictitious capital theory in volume III of his great works *Das Capital* (Marx, 1957). Volume III was published after his death

by his friend Friedrich Engels based on the collection of his scripts. There is also some of Friedrich Engels' contribution to this theory.

According to Karl Marx's quotation, the term fictitious capital was used by Wee Liseem (a banker of Yorkshire) in 1840 in his *Letter About Currency Issues* (2nd enlarged edition in London, 1840). It mainly referred to accommodation bill (bill). In Part 5 of Volume III in his *Das Capital*, especially after Chapter 25, Karl Marx made a thorough study on fictitious capital. His theory on fictitious capital can be briefly concluded into two main viewpoints.

First, he thought that fictitious capital is generated on the basis of loan capital (i.e., interest-bearing capital) and bank credit system (Samezo, 1989). On the basis of the capitalist production, money can be transformed into capital. By the transform, money changes from a fixed value to a self-increasing value. At this time, the use value of money is that it can be transformed into capital to generate profit. Under this meaning, money can be considered as a special commodity. The owner of it can loan it to person who needs capital with some legal forms and conditions. It will be returned to the owner with interests after a period according to the arrangement. Money has become a capital that can bring the interest. Credit is the foundation of loaning.

However, when money is loaned as interest-bearing capitals, the owner cannot get any equivalent as payment as for any normal commodity exchange. They only get a guarantee in some forms that the capital and interest will be paid back in the future. This guarantee (normally in writing) is fictitious capital. After the emerging of bank, it collected a large part of the idle money in society to transform the money into interest-bearing capital. As the enlargement of the credit system, banks began to distribute credits in addition to cash currency, which enable the increasing of the types of fictitious capital. At his time, Karl Marx thought that fictitious capital included the loaning credit of banks (such as bank bills, etc.), capitalized value (such as valuable securities, etc.), and real-estate mortgage bill, etc.

Second, Karl Marx thought the fictitious capital has no value for itself. But, it can bring profit through circular movement, that is, produce some kinds of surplus value.

According to Karl Marx's labor value theory, it is stipulated that the value quantity in use value is the social necessary labor time used for

the production of the use value. Because there is no labor quantity in the fictitious capital itself, there is no value in fictitious capital.

In *Das Capital*, Karl Marx viewed that surplus value can only be generated through activities of real economy. It means that the capitalist will use currency as capital. They will turn the capital into production elements through exchange, including hiring of workers, purchase of raw material, erection of plants, purchase of machines, etc. Then, they will produce products through production process; the product will be changed into commodity through circulation process; the commodity will get currency back through exchange. In this circulation of real economy, profits are produced due to the surplus value. This is a very important fundamental viewpoint in *Das Capital*.

In Volume III of *Das Capital*, Karl Marx pointed out that fictitious capital can produce surplus value in some forms through circular movement. But in strictly means, this surplus value is not produced by the fictitious capital itself. They are paid to the owner of fictitious capital by the functional capitalist (industry capitalist or commercial capitalist) from their profits (surplus value) according to the arrangement in the form of interest. So, Karl Marx used “some form” to describe this concept.

Karl Marx described that capital must have two characteristics. First, it must have value. Second, it must be able to produce surplus value. Because the fictitious capital has the second character, it can be considered as capital. But it does not have the first character; that is, it cannot be used to purchase production elements by direct exchange, so it can only be fictitious capital.

We should admit that Karl Marx had strong predictability. It is very uneasy for him to initial the fictitious capital theory in 19th century (he was born on 5 May 1818 and died on 14 March 1883). Of course, after more than 100 years later, we have broader and deeper knowledge on fictitious capital.

2.2. The definition of fictitious capital

The author thinks that fictitious capital is a resource established on the basis of trust relationship that does not have a material form or currency form with uncertain value but can produce profits. They can be used to obtain the usage rights of real capital. But, it has to promise to give a return to the owner

of real capital, or share risks, and profits with the owner of real capital. For example, security promises to pay a return to the owner of real capital. Stock shares risks and profits with the owner of real capital. Most importantly, the emerging of the certificate of title shows the double properties of the capital rights belongings, realizes the separation of the ownership and uses rights, and finally causes the generation of fictitious capital.

As we all know, in real economy, the ownership and the use rights of money are both exchanged with the commodity it purchased during the exchange process. The ownership and the use rights of money are not separated. When somebody uses some money to purchase a kind of commodity, he will lose the ownership and use rights both at the same time. But capital has two characteristics that can be divided into ownership and use rights that can be separated from each other. For example, if somebody uses money to purchase a bond issued by an enterprise, he transfers the use rights of the money to the enterprise. The enterprise gives him a certificate of title, i.e., bond, to certify that the ownership of the money belongs to him. So, he has rights to ask the enterprise to pay back the principal and interest. But stock certifies that the owner of the stock has the rights of a shareholder and bears the liability of shareholder. The mortgage bill of real estate certifies that the ownership of the real estate is transferred to the financial institution or private person and the mortgager who gets the loan only holds the use rights of the real estate. If the mortgager cannot pay back the loan after expiration, the use rights will lose. So, we can see the separation of ownership and use right cause the generation of fictitious capital. It is a very important viewpoint. We can analyze many related issues from this viewpoint.

2.3. Main types of fictitious capital

Fictitious capital has two important supporting points. One of them is that the real capital is assessed and measured by generally accepted symbols of value. Another one is the capitalization of the “soft” elements that relates to technology, education, management, etc. This means we can observe and assess all kinds of “soft” elements in the way that observes and assesses capital in traditional meanings, and conclude these elements as fictitious capital. This construction mode will enable all kinds of fictitious capital and real capital that has been assessed by the symbols of value to

have a match relationship on the economic meanings. We can observe the operational mechanism and efficiency of fictitious capital system through this relationship. So, the relationship becomes the core relationship among the many relationships of fictitious economy.

From the viewpoint of “soft” elements, there are three major types of fictitious capital.

First one is credit capital. The kind of fictitious capital already existed at the age of Karl Marx. Nowadays, it has been developed into the foundation of financial industry. For example, bank absorbs deposits by its credit. Enterprises issue bonds and stocks by their credit. The borrower obtains loan from the bank by his credit. A lot of domestic banks ask the borrower to provide guarantee or mortgage. These banks almost become financial house or hock shop. The bank should give loan according to the credit of the borrower. So, credit capital refers to the use right of real capital that is obtained by the credit of fund raiser.

The second is intellectual capital. Intellectual capital refers to the use right of the capital is obtained by the fund raiser on the basis of his knowledge, technology, trademark, or even consolidated knowledge as standards. The most obvious example is venture capital. The venture capital is the creator uses his creative results to obtain capital from the venture investor. If it failed after investment of the capital, both parties will share the risks. If success, both parties will enjoy the benefits. Venture capital itself embodies the combination of real capital and fictitious capital. The social wealth can only be produced through the combination of these two kind of capital, (Cheng, 2008).

The third one is social capital. The concept of social capital is at first initiated by sociologists. It comes from the theory developed in 1970s on the basis of social network studies. It mainly refers to the relationships in the same social network and among different networks (Portes, 1998). In recent 30 years, the theory and practice of social capital have obtained many developments and renewed of their scopes. The sociology community still has arguments on the definition and effect of social capital. Although some economists pay attention on the effect of social capital on the economy. It is still not popular in economics community. The author transplants the concept of social capital into the fictitious capital to define it as social capital refers to corporation relationship and institutions formed by the

interaction of members of society. In simple words, social capital is the “relationship”. In China, relationship becomes a negative word due to the serious corruption in our society. But whether in China or not, relationship is also a rather important elements in economical life. The member of society will improve the mutual understanding and friendship, strengthen mutual trust and establish corporation relationship during their contacts and social intercourses. It is also possible to institutionalize this relationship and forms the social capital. Social capital had positive effect on the development of economy. For example, someone points out that the northern part of Italy is better developed than southern part due to the original system of the north is republic system and the south is monarchy. As for the private equity fund developed rapidly in recent years, the capital is raised privately by the general partner of the fund from the limited partner. The investor will only give capital to the general partner for him to earning profit for them on the basis of trusts on his ability and moral character.

In summary, the owner of credit capital, intellectual capital, and social capital has no real capital himself. But, he can obtain the use right of real capital. But, he has to give certificate of title to the owner of real capital to admit his ownership and promise some return or sharing of risk and profits with him. The value of these fictitious capitals is uncertain and can only be determined after combined with real capital and liquidated.

In the course of the combination of these three fictitious capitals with the real capital, the title of them will be solidified into the certificate of title. For example, it should stipulate the share percentage of the fund raiser or admit that the profits beside the interest will belong to the fund raiser. Because the certificate of title has no value for itself and only the carrier of fictitious capital, so it can be called as secondary fictitious capital. The credit capital, intellectual capital, and social capital can be called as original fictitious capital. The fictitious capital referred thereafter in the paper mainly referred to the secondary fictitious capital represented by the certificate of title.

3. Definition and Features of Fictitious Economy

Fictitious economy is a mode of economic activities that are compared with real economy. It refers to economic activities that are performed by the fictitious capital, which uses the financial platform as a main support and the

synthesis of all relationship existing in it. In the activities of real economy, capital can only produce profits through a circulation from exchange to production, to circulation, and finally to exchange. But in the process of the activities in fictitious economy, the capital can produce profits without through this circulation.

3.1. Development process of fictitious economy

The development process of fictitious economy can mainly be divided into the following five stages.

The first stage is the capitalization of idle money. This means the people's idle money becomes capital that can produce interest. The earliest origin of fictitious economy can be traced back to the commercial loan behavior among the individuals. For example, Mr. A is urged to purchase some kind of goods but has not enough capital. Mr. B has some amount of idle money. So Mr. A borrows some amount of money from Mr. B. Mr. A promises to pay back the principal and interest in a fixed period. Through this activity, Mr. A gets the use right of this amount of money and can use the property of medium of payment of the money to get profit through actual operating activities. Mr. B remains the title of the money with the promissory note as a certificate and obtained the right to ask for the principal and interest from Mr. A at expiry. The promissory note is an embryonic form of the fictitious capital. This fictitious capital can get increment from the circulation of the lending and repaying. During this process, Mr. B does not do actual economic activities but earns his profits through a kind of fictitious economic activities.

The second stage is the socialization of the interest-bearing capital. That is, the bank acts as an intermediary institution to borrow idle money from people and loan it out to get interest. Besides, enterprises can raise fund by issuing of bond and stock and promise to pay back the principle and interest after a fixed period or share the risks and profits with investors. People can use their own idle money to buy some kinds of valuable securities such as stock and bonds to get interest. According to this, the socialization of interest-bearing capital brings out the banks and fictitious capital in the different forms such as bonds and stocks. The socialization of the interest-bearing capital can lead the social capital from the people who do

not perform real economic activities such as production, circulation, and exchange to the people who perform real economic activities. The capital distributed in individuals can be collected together to perform economic activities of larger scale and high profits. It optimizes the investment direction and improves the usage efficiency of the capital.

The third stage is the marketization of valuable security. The biggest problem of fictitious capital in its early stage is the lack of liquidity. It is hard to be changed into cash when the owner needs the money urgently. This problem becomes the handicap in the process of transforming the idle money to interest-bearing capital. After the marketization of valuable security, they can be bought and sold freely according to its expected gains. Therefore, the financial markets, such as stock market, bond market, and currency market, used for the transaction of fictitious capital, are generated. The marketization not only can enable the valuable security held by people to be transformed into cash at any time which dramatically improves the liquidity of fictitious capital, but also can lead the capital to flow into the industries and enterprises with better expected profit, which further improves the usage efficiency of the capital. But it also creates possibilities for the speculation with the price fluctuation in security market. In 1898, future exchange of agricultural products was introduced. The future exchange progressively spread to industrial raw materials such as nonferrous metal, crude oil, etc. They became new forms of fictitious capital.

The fourth stage is the internationalization of financial market. It means that fictitious capital can be exchanged across the country boundary. This process can be traced back the fixed rate bond issued by debtor countries and railway companies on the financial market of Britain, France, and German in the middle of the 19th century. But large-scale multinational investment began in 1920s. It stagnated due to the economic recession in the United States in 1930s and the World War II. After 1944, the international financial market with huge scale has been progressively built up with the drive of Bretton Woods Agreements and GATT. The internationalization of financial market can lead the international capital to flow into the industry with better profits and dramatically improve the capital utilization efficiency. At the same time, a new financial market — foreign currency market — was also established. The future exchange becomes more and more virtualized, i.e.,

purchasing of future becomes a method for speculation. After 1960s, the exchange of stock, future, and foreign currency all has prompt and future exchange methods. Option exchange appeared in 1973.

The fifth stage is the integration of international finance. It refers to the increasingly closer relationship between the domestic financial markets of countries to the international financial market with increasingly influence on each other. Since 1980s, the flow rate of fictitious capital in financial market kept on increasing because: (1) the dependency among the economy of various countries has been greatly increased with the development of economic globalization; (2) the scale of fictitious economy has been enlarged with the enhancements on financial innovations and the forming of floating exchange rate system after US dollar's separation with Gold Standards; (3) the flow rate and flow speed of the fictitious capital in financial market has been kept on growing faster with the development of information technology (IT). The three factors accelerated the progressive integration of financial markets of various countries. It makes the relationship between domestic financial market of various countries with the international market become closer with more interaction. Even we can say, one tiny part of its change will bring changes on the whole of it. As we observed from the East Asia Financial Crisis began in 1997, a liquidity crisis in Thailand brings significant influences on the whole East Asia, Asian, and even to the World.

3.2. Movement principle of fictitious capital

3.2.1. Exchange–re-exchange is the main movement process of fictitious capital

The purchasing of bonds or stock is to transfer the use right of real capital for exchange of a certificate of title. After a fixed period, this certificate of title will be exchanged again to get back the use right of the real capital with possible profits. This kind of fictitious capital can enable the capital to bring money from money without the circulation in real economy.

The movement process of fictitious capital includes two parts: exchange and re-exchange. The Exchange not only includes the exchange between the real capital and the certificate of title (virtualization of real capital), but also the exchange between original fictitious capital and the certificate of title (secondarilization of original fictitious capital). The re-exchange

process is the liquidation process of the fictitious capital, and includes the selling it in public market or between individuals.

3.2.2. Uncertainty of the price of fictitious capital makes the speculation possible

The theory of neo-classical economics considers the person who performs economic activities as “economic person”. They pursue the maximization of their own benefits. Their behavior is completely rational. According to this theory, the price of stock is the rational expectation on the future value of the real economic variants that influence the stock price. That is, the rational price of a stock should equal to the present value of its future gains. However, Nobel Economics Winner Herbert Simon pointed out that the person who performs the economic activities is only partially rational. It is difficult for people to know and predict all kind of results with the limitation on the information and knowledge. They usually make decisions on their own subjective judgment. It is also difficult for them to take consideration on all possible solutions during the decision-making process (Simon, 1976). Besides, people’s sense on value and words and behaviors of other people may also affect his correctness on decision making.

The exchange of stock happened in the stock market is due to the differences on the rational prices of same stock by different investors. Some investors think the price of a stock is higher than its’ rational price and decide to sell it. Other investors think its’ price is lower than its’ rational price and decide to buy it. If all investors are rational, then there will be no transaction.

Any stock market is a place for investment and at the same time a place for speculation. Generally, “investment” refers to a long-term investment behavior that plans to enjoy higher dividends and increase on the enterprise’s value after buying of the stock. “speculation” refers to a short-term investment behavior that expects to sell it under favorable conditions after buying it.

Normally, right-sized speculation will not damage the security market but benefit the operation of it. First, it helps increase the transaction of stock to improve the liquidity of market and speed up the turnover of capital. Second, the issue of new stock will be put forward due to the speculators who are more easily taking the risk for issue of new stock. Third, the

speculation that selling at higher price and buying at lower price can regulate the supply and demand relationship in the market and help stabilize the price. The author thinks, that a mature stock market is a market with right scale of speculation. The dynamic balance will be maintained between investment and speculation. Although the market may fluctuate due to the influence from external environment. Normally, the market can maintain a relatively stable operation. It will bring more satisfied return for a large part of investors while promoting the economic development.

In fact, many investors in the stock market have motivation for both investment and speculation. The ratio between them is depended on specific conditions of the individuals and stock markets. If most investor has a significant more speculator behavior, the market will become a market with excessive speculation. As this time, the investor will not care about the operation results of enterprises. The blue chips are ignored. The stocks with larger possibility for speculation will attract investors. Excessive speculation will also boost the short-term behavior in the market and provide conditions for the manipulation of the market. The huge risk with the excessive speculation will become the potential problem that may cause serious fluctuations and further damage to the economy and society.

3.2.3. *The expansion of fictitious capital brings related risks*

The production base of the fictitious capital is the trust of investing party given to the fund-raising party and the profit-earning perspective invested project. The certificate of title given by the fund-raising party to the investing party has no relationship with the own value and currency assets of the fund-raising party. If expectation of the investing party (or fund-raising party) on the profit-earning perspective of the invested project is too optimistic, it will usually bring excessive investment or fund-raising that causes the expansion of the fictitious capital. When the optimistic estimation fails due to subjective or objective reasons, related risks will be generated.

As the development of the science and technology and financial innovation, there are too many kinds of financial derivative products for people to understand and utilize. The original purpose of the financial derivatives is (1) to meet the different preference on safety, profitability,

and liquidity of various investors; (2) to reduce the risks through hedging. But they will provide the market with all kinds of speculation tools that bring a rapid expansion of fictitious capital.

The expansion of fictitious capital can mainly be divided into following type:

- (a) Over-valuation: if investors over-value the value of a certificate of title, the fictitious capital will be expanded. For example, in stock market, if the investors have excessive optimistic evaluation on the profit expectation of a public-listed company, they will purchase its' stock with higher price. Especially in bull market, many investors will purchase this stock based on ideas of "follow the trend" or "bigger fool theory" (believes some will buy it at higher price) and cause bubble on it. These investors will definitely lose money when the bubble breaks.
- (b) Over-debt: the fund-raising party will normally borrow a lot if he thinks his return on asset is higher than the borrowing rate to make more profits. This may result the ratio of his debt to the asset up to several tens or hundreds. When the investor asks for the return of loan due to the bad expectation or refuse to give new loan, the fund-raising party will often be faced with the risk of bankruptcy.
- (c) High guarantee ratio: the transaction with larger amount can be performed with lower guarantee. For example, only 5% guarantee is paid for one future contract in the future market of commodities.
- (d) Multiplier effect: as we all know, the original currency money supply can be multiplied several times to finally form social currency supply due to the currency multiplier effect. Similar to this, the fictitious capital can also be kept on enlarge through multiplier effect. For example, the holder of a kind of bonds can get cash from a bank after pledging these bonds to the bank. Then, he can use this cash to purchase futures and financial derivatives. So the capital used to buy the bonds can be calculated with the unpaid bonds, unclosed future contract (the amount of it may be higher than up to 20 times of the guarantee), and unclosed financial derivatives. It can be enlarged to several tens times on the book value. But the low risks of holding bonds is also becoming the high risks for the futures and financial derivatives. He may get higher payment or lose it all.

3.2.4. The movement of fictitious capital cannot produce social wealth

Because the movement of fictitious capital (fictitious economy activities) is not included in the material production activities, so it cannot produce social wealth. The effect of the fictitious economy is to redistribute of the wealth produced by the real economy. For example, the stock market can only redistribute the wealth that exists in it. The real wealth comes from the listed companies. The speculation on stock may bring someone more wealth. But the winners earn this part of wealth from the losers (after deducting the stamp duty, commission fee of security agency, and the administration fee of stock exchange). So, it is just a redistribution of wealth. When stock market is in a fast bull market, the rapid increase of the stock price brings more capital into the market. It seems that there are only winners, no losers. But when the stock market falls suddenly, the last one enters the market may become the losers. The dividends of the stock comes from a part of the profit distributed to the shareholders after the production of wealth by the listed companies as the repayment for the utilization of the capital. But the fictitious economy can indirectly produce wealth by its optimization on the real economy. For example, the stock market should help the company with good profits and get off the company with bad profits. It should utilize its function on optimization on resources configuration. It should make the enterprises with good performance which needs capital to raise fund at a lower cost than from the bank. It should also make the enterprises with bad profits to be marginalized before they are eliminated from the market.

3.3. Features of fictitious economy system

The fictitious economy system has five features: complexity, metastability, high-risks, parasitism, and periodicity.

3.3.1. Complexity

The normal features of a complex system include huge scale, high degree of coupling, low transparency, dynamics, and openness. But the most essential feature is that its components have some kinds of intelligence. That is the ability to understand its environment, predict the changes of the environment, and take actions on the predefined targets. This is

the internal reason for the organic evolution, technological innovation, economic development, and social progress.

Stock market is a kind of complex system. The main components are natural person and legal person (buyer, seller, and agency). They perform stock transaction in the stock market according to a set of rules. Although everyone of them has the freedom to make decision independently according to their own understanding of the environment and development perspective and their predetermined targets, their decision cannot avoid the influence from the decisions of others and external environment. Although there is easily to have chaos in the system due to the nonlinear interactions among the components, the self-organization effect of the system will make the system show a degree of order and stability in a macro and long-term scope.

In the stock transaction, investors only have a far less than enough understating on the conditions and price changes of the present market and future market. Their investment capability and risk-bearing ability are not the same. There are many differences on their understanding and evaluation on the investment value. The targets and expectations on the investment are also different in many ways. There are many investors who do not know analysis methods on the technical trends of the market. They even do not have basis knowledge of the investment in stock market. They are lack of the ability to recognize and judge the huge market information. So they will follow the trends in blindness and believe all rumors or even make decision on their own instincts and impulses. Therefore, there must be a large amount of chaos in the stock market. But the mutual influences on each other and the leading effect of external environment on peoples' behavior make the stock market show a certain kind of big trends from the aspect of macro and long term. Thus, these trends will be maintained relatively stable in a period, that is, bull market and bear market.

3.3.2. *Metastability*

Meta-stable system refers to a kind of system that stays in a status far from balance, but can maintain relative stability through exchange of material and energy with external environment. It is called system with dissipative structure in system science. Although this system can reach a stability

though self-organization effect, but the stability is very easy to be destroyed by minor disturbances from outside. After destroy of the stability, the system may walk in a certain scope and enters into status of stability or walking in an alternative ways. From a macro-viewpoint, it can be considered as being stabilized in certain scope, i.e., regional stability. But the system may change dramatically or even corrupt after losing of stability. After the corruption, the system may restore its meta-stable with deep structural adjustment. It is also possible for the system to die away. Normally, the system has smaller possibility to corrupt when it has larger inertia.

The stock market is a meta-stable system that has to maintain its relative stability by exchanging the capital with external environment. There are many causes that may be the market meta-stable. But the most essential cause is the instability of the fictitious capital.

The internal instability of the fictitious capital comes from the fictitious nature itself. For example, the stock itself does not have any real value but represent a right to obtain incomes and a certificate of title. It makes the holder of it have the right to claim the part of the surplus value corresponding to his capital paid when he purchases the valuable security. After the stock is traded in the stock market, the prices of the stock will be determined by the subjective prediction of people on its future price. It is because the stock does not have any value itself. Its price cannot be determined by the objective value principle. It is also affected by the conditions of supply and demand. These all make the stock price go far away from the performance of actual economic activities. When the stock price is much higher than its rational expectation, the bubble is formed. The bubble can only be maintained stable by the inflow of capital from outside. But, it is only a kind of false stability that is very easy to be broken. When the inflow of the capital is not sufficient, its price will fall down.

The instability of the fictitious economy system also comes from the virtualization of the currency. It means that currency itself did not really have value. After the separation of the currency from the Gold Standard and Gold Exchange Standard, although the currency still has its value in use as an instrument of payment, it has no value that can be really measured with any kind of commodity. At this condition, the value of currency can only be measured by its purchasing power. The purchasing power is affected by various factors, such as amount of money issued, interest rate, exchange

rate, people's consuming behavior, etc. Therefore, the virtualization of currency will enhance the instability of the fictitious economy.

The positive-feedback existing in the fictitious economy system will also enhance the instability of this system. For example, a stock will be bought by more people if it had been bought by a lot of people. This kind of interaction is a positive-feedback effect. This effect will cause enlarging effects that make the price of the stock go down and up in large extent.

3.3.3. *High-risk*

The risks in economic activities refer to the difference between the expected profits from the actual profits. These risks come from the uncertainty of objective world and people's limitation on their cognitive ability for the objective world. It also comes from the subjective evaluation error of people on the expected earnings. The stock market has high risks but also has the possibility to get high earnings.

The high risks of fictitious economy system come from its complexity and metastability. First, the internal instability results in the unpredictable changes on its price. The enlarging of the transaction scale in financial market and the increasing types of the transaction also make the system more complex. Second, people's predictability is insufficient for the market and environment changes. So far, we still cannot find a better prediction method for expected earnings. Therefore, people are easily to make wrong decisions. Third, many people have limited capability to bear the risks and have no idea when faced with big risks. They may even enlarge the risk through positive feedback effect. At last, many people are willing to take more risks for higher earning. It makes the unstopped innovation with high risks and high return, including various futures, options, forward options, swap options, etc.

Besides, some illegal behaviors also cause the high risks in the financial market. First, untrue disclosure of information that misleads the investors; Second, the insider trading will always make the benefits of medium and small investors to be damaged; Third, the vicious market manipulation will make the banker earn huge profits. According to some studies, people tend to over-estimate their risk-bearing ability and make themselves bankrupted due to the over-venture. For example, if there are several projects that have

the same investment amount of 1,000,000 yuan, with the risk ratio of 80% and 5,000,000 earnings for each project. Because the risks are matched with returns, people always think if they put 5,000,000 yuan in these five projects, the success of one project of them is enough to bearing all the risks. But when it is calculated with “venture bankruptcy rule”, there is only 67% opportunity for one of them to be succeeded with 5,000,000 yuan investment. If you want to get the 95% opportunity for at least one of these kind projects to be succeeded, you need to put 14,000,000 yuan to 14 projects. As we can see, only 5,000,000 yuan is far from enough to bear the risks in them.

3.3.4. *Parasitism*

There are close relationships between the fictitious economy system and real economy system. The fictitious economy system is generated on the basis of real economy system and is attached to it.

There are close associations between the fictitious economy and real economy. The risks in the real economy system, such as products overstock, bankruptcy of enterprise, will all be transferred into the fictitious economy and make it lose its stability. The risks in the fictitious economy system, such as large falling down of stock index, rapid fall down of real estate price, great increase of bad debt in banks, serious depreciation of currency, will also cause serious influence on the real economy. These are the action and reaction between the real economy and fictitious economy. Nowadays, the finance becomes the core of the economy. The real economy cannot be operated by itself without the fictitious economy. Therefore, if we consider the real economy as the hardware of the economy system, then the fictitious economy can be considered as the software of the economy system. Any one of them will not operate well without the other. The software can only be operated when attached to the hardware.

The stock is the stock certificate issued by the limited liability company to the investor. It represents the ownership of their holder (shareholder) to the limited liability company. Because the stock is a kind of valuable security without repayment terms, it can only be sold to other investors in the secondary market without the rights to ask for withdrawal after purchasing them in the primary market. Theoretically speaking, the value of stock

is mainly determined by the future performance of the listed company whether in primary market or secondary market. In other words, it should be the present value of future earnings. In spite of the irregular fluctuations of the price on stock market, the stock is essentially parasitic to the listed company. The stock market is parasitic to the real economy. Therefore, the listed companies are the foundation of the stock market.

Because the investor's judgment on the prices of any stock is based on the predication on its future performance, the parasitism of the stock is mainly showed when the market price of the stock usually is affected by the information on the limited liability company that issues this stock. The information includes the information disclosed by the company itself, information on the changes of external environment and the information go around in the society, etc.

On the other hand, stock market has a significant reaction on real economy. The raising of the stock market will strengthen peoples' confidence on economy perspective. People will increase their consumption under the influence of "wealth effect". The consumption will drive the economy up. On the contrary, when the bubbles in stock market breaks, people will not only reduce consumption but also undersell the financial assets. These behavior will cause economic recession or even economic crisis.

3.3.5. *Periodicity*

The evolution of fictitious economy system generally shows some features of periodicity. These features normally include stages such as the accelerated growth of real economy, beginning of the forming of economic bubbles, progressive expansion of currency and credit, general raising of all kinds of financial assets, the optimistic mood spread all over, the price of stock and real estate keep on raising, the economic bubble breaks under the external disturbs, all kind of financial index drops rapidly, people all sell real assets and financial assets, deceleration of real economy or negative growth, etc. But this periodicity is not a simply circulation and reciprocation. It is a wavy, spiral up periodicity.

The operation of the stock market also has periodicity. The bull market and bear market will appear alternatively. The stock market is mainly built upon investor's optimistic expectation on the future earnings (after all the

optimistic expectation on the economic development). From the macroview, there is definitely some bubble in the stock market. The expansion and break of the bubble cause the fluctuation of the market. But this fluctuation is a wavy and spiral-up trends. For example, when the US stock market falls dramatically on 19 October 1987 (Black Monday), the Dow Jones Index was under 3,000 points. But 13 years later, the Dow Jones Index reaches over 12,000 points.

4. Research Fields of Fictitious Economy

The research fields of fictitious economy generally include four aspects.

4.1. *The relationship between fictitious economy and real economy*

First of all, the relationship between fictitious economy price and the corresponding entity price is considered. Fictitious capital in itself has no value, and the intrinsic value of an ownership certificate is only that of a piece of paper. However, the price bases on people's confidence with the entity which attaches to. For example, generally speaking, the PE ratio of one stock should not exceed the inverse of Bank Interest Rate. If the stock return is only equal to interest income on bank deposits, there was no need for people to buy stocks. Even though many listed companies in our country have the PE ratio higher than the inverse of Bank Interest Rate, some people who buy stock are not optimistic about its current value, but the value in the future. In other words, they estimate that the future value of the fictitious capital would be higher than today's price of the entity. Another example is in the future market, where the difference between commodity future price and spot price also exists.

Second is the relationship in the operation cycle between fictitious and real economy. As it is well known, real economy appears periodic, and there are cycle theories in short, medium, and long term. The author considers that the fictitious economy also has periodicity, but the cycle is not entirely consistent with real economy, as it is affected by many factors.

The analysis of the cycles of fictitious and real economy in our country presents that sometimes the two cycles were consistent, but sometimes not. Usually, the stock market is regarded as the economic climate. There is

some truth in this, but not absolute. In some cases, the cyclical behavior in stock market is depended on that in real economy. For example, as the stock market is based on the listed company and real economy, the situation of the stock market should approximately reflect the real economy from the point of macro and long term. The real economy can be indicated by the GDP, while the stock market is normally represented by the stock index (e.g., Dow Jones Index). Although the cycle of the stock market may lead over or lag behind the economic cycle, the deviation in long term is abnormal. It should also be noted that the stock index is only compiled by several weighted stocks with statistical methods, as there are so many stocks in the market, it cannot comprehensively reflect the whole.

In recent years, some people challenged the statement that the stock market was economic climate. They considered that the stock market situation had no necessary connection with the economy, as the deviation had actually happened that the stock market raised its price while the economy was slowdown. From the point of view of complex science, the stock market and real economy is not a simple linear relation, but intricate nonlinear relation with multifactor. First, the GDP and stock index cannot adequately represent the status of real economy and stock market; secondly, both of them are affected by many factors, e.g., economic environment, social institution, government's policy, public confidence, and so on, which do asymmetrical and asynchronous influence on GDP and stock index; thirdly, status in stock market often deviates from real economy in short or long term, and their developments are not synchronous as a result of many factors; finally, the reaction that stock market appears to economy makes the relationship and interaction much more uncertain and obscure. It is emphasized that, when the excessive speculation, black manipulation, and oversize policy implication, do present in the stock market, the deviation from real economy will appear.

In addition, the impact of the stock market on real economy is also up to its scale. The total market value is around 93% of its GDP in the stock market all over the world, this figure is 130% in developed countries. The scale of circulating share is less than 50% of GDP in our country as the majority of shares are not yet in circulation. As a result, the stock market cannot be the economic climate. For example, during the rapid growth in our economy from 2001 to 2005, the stock market was in a bear market.

However, while the slight increase in 2006–2007, the stock market boomed. Then, the Shanghai Composite Index is a poor representation. On one hand, stocks in Shenzhen Stock Exchange are not included in this index that can only represent about 70% of the stock market. On the other hand, it is made up of the weighted total market value of all the listed companies in Shanghai Stock Exchange, so the graill stock has a very large weight, which brings out virtual rising and falling.

The risk in real economy may transmit to the fictitious economy, and vice versa. So some topics, e.g., the procedure, mechanism, influence factors, etc. should be investigated in the risk transference.

Fictitious economy is a double-edged sword, which has not only promoting effect, but also has untoward effect to real economy. In this respect, how to go after profits and avoid disadvantages should be discussed.

4.2. Institutional factors in fictitious economy activity

Even though the word “institution” was in common use for the past few years, the understanding of the essence varied with each individual. Generally, institution is considered as the norms for all the people to observe. In academic circles, it is often regarded as the system of politics, economy, culture, etc. forming in a specific historical condition. At the beginning of the 20th century, institutionalism rising in America focused on institution research, and analyzed the important role of institutional factors in economic and social development. They thought organization and regulation of economy were much more important than resource allocation, income distribution, and the level of income, product, commodity price, etc. They stressed the great role of factors relating to society, history, politics, psychology, culture, etc. to the social and economic life. They also advocated institutionalism and structured analytical method. The inspiration of institutional economics is that the fictitious economy research must pay special attention to the role of institutional elements.

The author ever uses the complex science to analyze the institutional problem, and considers that institution should include both aspects of the regime and mechanism. Regime is the status and structure of the system at

a certain time point and mechanism refers to the process and dynamics of the system evolution. The regime and mechanism are interdependent that the regime is the starting point and the result of the system evolution, while the mechanism is the evolution path. Owing to the interaction between the system and external conditions as well as between different agents within the system, self-organization should emerge, leading to the formation of the hierarchical structure and function structure, and promote the system evolution in a certain direction.

In the eyes of fictitious economy development, the institution in fictitious economy is the result of evolution; meanwhile, the proposition that “transaction prior to the rules” is still true in the fictitious economy. For example, the “South Sea Bubble” had already generated in Britain before the equity financing regulation was issued. The “South Sea Bubble” was the result of failure to make timely control after the fictitious capital transaction emerged. But it proved that transaction could in advance exist without institution. After the “Mississippi Bubble”, although politicians in France extremely objected to the stock market and equity financing, the Credit Mobilier founded by Peter Laird Brothers also involved in investment banking steering clear of the financial control. Consequently, it is difficult to find fictitious institution at least for the formal rules unless the transaction involved.

On the other hand, we must also focus on the reaction of institution to the transaction behavior. After the interaction between institution and transaction can be available, institution often becomes a crucial factor in further development of the fictitious economy, even in the change of the development path. Examples of macrocontrol were too numerous to mention individually after the popularity of Keynesian, while monetarism, financial, and monetary policy managed by supply-side economist had greatly changed the internal operational locus of financial system as well as the impact of financial system on real economy in the United States and Europe. After the middle of the 20th century, the supervision models and the corresponding supervision rules had an increasingly effect on the activities of agents in the fictitious economy system.

The author believes the institution in fictitious economy could be divided into three levels. The first level is formal legal system rooted

in different cultures to regulate the behavior of the market players, the basic relationship in the market and the competitive order, which plays a fundamental role in fictitious economy transaction. The second level is related supervision including various regulation, direction, suggestion, and recommendation that we sketched by the executive supervision authority considering the legal principles and administrative discretionary power. The third level is the so-called “hidden rules” developing on the basis of day-to-day trading habits in fictitious economy. There is a certain and complementary relationship in these three levels so that they can arise from compulsive institutional change (external-organization), as well as evolving from the induced institutional change (self-organization).

In accordance with the complex science point of view, a certain institution for fictitious economy can stabilize the expectation of the main market players. Under the given institutional framework, the market players know others’ rule of action as all of them are rational. If so, the institution should be appropriate and stable. Otherwise, if the market players are difficult to play their roles, while the business opportunities are hard to achieve under such framework, the institution must be changed. It is through the interaction between the institutional environment and the market players that the integration of self-organization and external-organization promotes the development and evolution of fictitious economy.

The study of financial institution should integrate normative approach and empirical approach, and widely absorb the theories and research methods in psychology, sociology, management, mathematical finance, behavioral finance, decision-making technique of uncertainty, computer simulation, etc. Both microfoundation and macroeffect should be investigated. The policy research should object the trend of simple explanation, mechanical copy and vulgarization, attach particular importance to the validity of research results, enhance its persuasiveness and make contributions to improve the institutional environment of fictitious economy.

4.3. Generation and precaution of risk in fictitious economy

Risk is defined as difference between expected return and actual return. There are some debates today about this definition. Some people consider only negative difference as risk not the positive one. In other words,

lower-than-expected earnings is risk, the contrary is not. This in fact is to consider unilaterally or bilaterally to evaluate the risk. At present, although the unilateral method is the mainstream, the author does not agree. An actual return over the expected one means an excessive amount of input, as the expected return can be achieved using less input, so that the risk of wasting resource also exists. Considering the risk unilaterally may encourage people to waste resource to chase “safety”. However, the bilateral consideration could encourage people to try to make the expected return correspond closely to the actual one and get a reasonable balance in safety and profitability.

The risk originates from the uncertainty of the objective world and the limitation of people’s cognitive ability, as well as the subjective estimate error of the expected return. The author divides the risk into two types: one is called objective risk and the other one is subjective risk. The objective risk derives from the uncertainty of the objective world and the limitation of people’s cognitive ability as the objective world moves and changes so continuously that people cannot fully understand it. As Lenin said, “To really understand things needs to master and study clearly all aspects, relationships and ‘mediators’ of it. We could never achieve this completely” (Lenin, 1986). While the surrounding environment and the objects themselves are changing all the time, we cannot get an absolute “real-time” result, as well as “reconstructing” the status of that moment because we do study in a certain point of time. In addition, as indicated in the chaos theory, the deterministic system still has uncertainty. For example, the butterfly effect is superposition of a series of small probability events, but may bring about the result that “the flap of a butterfly’s wing may cause a big storm”. Consequently, the uncertainty of the objective world cannot be grasped completely by people.

For example, the rational price of stock should be the present value of the future earnings of the listed company. The price depends on the future earnings and discount rate related to the economic fundamentals, so that it must be predicted using past and current data. In fact, the future earnings depend on business performance of the listed company, which is indeterminate. The discount rate is based on interest rate, which is also affected by the market fluctuations. As a result, the future earnings and the discount rate are both uncertain since the rational price cannot be figured out. Both

of the uncertainty will cause the risk, which is objective and independent of people's will, as we cannot fully understand the changes in fundamentals of real and fictitious economy. In recent years, the forecasting techniques have made significant progress, such as technologies in data mining, knowledge discovery in database, symbolic data analysis, group decision making, etc. There have been considerable improvements in forecasting using the historical data and the experience of experts. However, the future cannot be predicted with total accuracy as the objective risk always exists.

The subjective risk derives from the subjective estimate error of the expected return. Because the development of the stock market relies on the positive psychological expectancy, it could not be without speculation, bubble, and risk. If all the investors are rational and predict the future accurately, the share price would be fixed so that the trading volume would be zero. The speculators focus on the bid-offer spread, not the future discounted earnings. The existence of the spread is based on the estimation for the future price of some people, who may buy the stock over its rational price while they are over-optimistic. Therefore, coming with speculation, there is bubble, consequently, the risk, which dubbed the subjective risk. This kind of risk is easy to be magnified as the result of its positive feedback. As a general rule, people often tend to overestimate their risk tolerance that means ability to protect the security under a certain degree of probability and normal luck which is often overlooked. Taking the classical coin case for instance, getting the head and win one dollar, vice versa. How much should one prepare to prevent from losing all at the 90% probability when the Jesus stands just in the center of two guys? It is said that because the probability of head and tail sides are both 50%, people dare to gamble while they have two dollars. But the fact is that the probability of no less than once head in twice throws is only 75%, so one should prepare four dollars to get the 90% probability in normal luck according to the binomial theorem. As throwing coins for 1000 times, the opportunity of head is generally equal to the tail following the law of large numbers. But it is not true while throwing only twice. It is very likely to gamble away while throwing for fourth tail side. Therefore, people often over-estimate their risk tolerance. For example, it is precarious to speculate in stocks with mortgage loan, while people only have a thought of making money and do not fully considerate their risk tolerance.

Based on the principles of complex science, the subjective estimates of future are various in a complex system including people. A kind of self-organization which allows the system to continuously move in one direction could emerge as a result of the interaction between different people and the direction of the external environment. The subjective risk will accumulate gradually in the presence of self-organization, as well as constantly enlarge due to the role of positive feedback. Consequently, the stock price is much higher than its rational price.

4.4. Evaluation system of fictitious economy

The establishment of one evaluation system follows five steps in accordance with the principle of system engineering. First, the index system including many indicators should be established; the second is the determination of the measurement method for each indicator; the third is expressions of the measurement results that some could be expressed in a quantitative way and others in a qualitative way; the fourth is a judging method of the quality for each measurement result; finally, the integrated judging method for the measurement results should be determined to get the quality evaluation of the entire system. The weighted aggregate method is generally used which gets the summation of each indicator multiplied by the corresponding weight. Actually, this method has some limitations as ignoring the interaction between each indicator, so that the further research and improvement should be proposed.

5. Research Methodology of Fictitious Economy

There are six kinds of methods to research fictitious economy.

5.1. Complexity science methodology

Complexity science aims to study complexity and complex systems, which is the advanced stage of system science. Because of the interaction among elements of the system, as well as between systems and the external environment, the system will produce a self-organizing effect. It will form hierarchy and functional structure of the system and promote the system evolution in some direction. At present, there are five genres in complexity

science in general. Among them the prevailing theory is self-organizing, self-learning, and adaptive theory, advocated by the Santa Fe Institute, the United States. For example, in the market economy, each enterprise is autonomous decision making, managing its own business. However, in fact, the decision making in each business is inevitably influenced by other company's decisions and also by the external environment. To some enterprise the system, when the emergence of new competitors, the company can change the behavior, that may need to improve quality, reduce production, or develop new products. From the external environment, when the banks tighten or easing money supply and cause changes in loan costs, the company's decision making usually will be changed accordingly. Because of blind expansion, some enterprises in our country are plunged into liquidity crisis at the circumstances of tightening the money supply, resulting in a loss or even bankruptcy. From a macroview, the self-organization effect should have a certain direction in a long time, which forms the ascending or decline phase of business cycle. It is the same in the stock market. For each person, making the decisions of what stocks to buy, when to buy, when to sell is his personal behavior. But he could have been influenced by the surrounding people — if most people buy, he may not sell. Consensus is also a kind of important influencing factor. For example, if public opinion is advocating “the expected ten thousand points” or “ten years of gold bull market”, the investor may feel that we should buy. Affected by self-organization, the stock market will form bull or bear market.

Firstly, we have to study how the self-organization effect forms structure (Ilya and Nicolis, 1977). There are two types of structure, which are hierarchical structure and functional structure. For example, the organizational structure of an enterprise is probably such a hierarchy that includes the team, workshop, factory, the division, and the headquarters. Besides, there will form a kind of cross-hierarchical functional structure in the enterprise, such as financial subsystem, personnel subsystem, production subsystem, logistics subsystem, and so on.

Secondly, we need to study how the self-organization effect promotes the system evolution, which is self-organizing, self-learning, and adaptive. That means the system is not only able to self-organize, but also to obtain experience and lessons through self-learning and adapt to environmental

changes, since the components in the system are intelligent. Any effective policy must be able to influence the behavior of members within the system. If the policy cannot change the behavior of members, the effect of this policy is small. Some government departments in our country always regard the policy as panacea and think policy can change the behavior of market players. But in fact it is not necessary. As pointed out by Mao Zedong: “external factors are conditions causing changes; internal changes are basis of changes; external factors work via internal factors” (Mao, 1991). If policy is exogenous, it has to work via changing behavior of the members in the system. For example, when the stock market soaring during the first half of 2007, the government has taken some actions, including raising interest rates several times, raising the stamp duty, issuing special treasury bonds and so on. These actions in fact aims to prevent the stock market overheating. Chinese people are generally agreed that the market will not fall before 17th CPC National Congress or the Olympic Games. Based on this consideration, the policy cannot change people’s expectations, and they will continue to buy at the high point till the bubble crash at 6,100 point, which caused the stock market slump and investors suffer enormous losses.

We will not only study the behavior of individuals, but also investigate the organizational behavior. Organizational behavior depends on the self-organization effect among the members in this organization, between individuals and groups (a group of people in organizations) as well as between organizations and external environment. Organizational behavior will react to the behavior of its members. To our opinion, we will study organizational behavior based on the characteristics of fictitious economy and the theory of Institutional Economics.

The basic methods of researching complexity science include the following four (Cheng, 1999).

(1) Combining qualitative determination and quantitative calculation. Some of the economists in our country decline to qualitative analysis, and some decline to quantitative analysis. One type is the researchers to study Marxist economics, including some famous economists. They usually are not good at quantitative analysis, and nearly use no any mathematical tools in their published papers. They often have enough knowledge and experience of economics and can make sharp, qualitative judgments. Another type is the economic researchers used to study engineering before.

They usually do well in quantitative tools, but are limited in knowledge of economics, which causes their calculated results often hard to be explained. Therefore, we must combine these two. We have to learn quantitative methods and cultivate common sense of economics in the meantime. We need to set up the conceptual model of the system and subsystem by qualitative judgments, then transform it into mathematical model and solve the problems by calculation or simulation. At last, we should summarize the conclusions derived from quantitative tools by qualitative analysis, to form a proposal to solve the problem.

(2) Combining microscopic and macroscopic analysis. Microanalysis aims to research the system elements and their hierarchical structure, while macroanalysis aims to understand the functional structure of the system and its formation process. For example, when we research the stock market, it is necessary to research both individual stocks and the overall stock market. The overall stock market is definitely not the sum of individual stocks. Certainly bubble of the stock market begins from some individual stock. When the evaluation of a stock is on the high side, it will produce foam, and the people holding this stock will sell it to make money. In a bull market, people earning money will not quit the stock market, but speculate those potential soaring stocks including rubbish shares, conceptual shares and so on, which cause bubble to those individual stocks. Finally we will see the bubble of overall stock market. The bubble of an individual stock is different with the whole market. Some excuse for the stock market bubble is said, “The bubble of China’s stock market is structural”, which is nonsense indeed. In any stock market, it is impossible that all of the listed companies have bubble. There is always part of them are good. Even in the stock market crash of “Black Monday”, in 1987, at the United States, there still were 16 shares gained.

(3) Combining reductionism and Holism. Reductionism gives emphasis to microstructure and seeks explanation of the macrosituation based on it, such as explaining the biological phenomenon through physical–chemical laws. Holism thinks that the relationship and interaction among the members in the system determine the macronature of the system. However, it is difficult to grasp the overall system if there is no a deep understanding of the system’s microstructure. Complexity science is to discover the overall

property and behavior of the system by deeply studying on individuals. It can be said that Reductionism is the prevailing methodology since Newton's times. From the view of Reductionism, divide a system into several subsystems, and then research every subsystem respectively. In this way, the issue has been thoroughly studied. But, in fact Reductionism cannot really solve the problem. It is necessary to combine it with Holism, which is one of the backgrounds of complexity science establishment. Holism is not only to look at each part, but also to study the interaction and influence between each part, which is the principle that the whole is larger than the total of the parts. Researching fictitious economy, we should not only study stock market, exchange rate market, and currency market respectively, but also explore their mutual contact and influence. For example, the changes of money market, foreign exchange market, and real estate market will affect the stock market, and they also affect each other.

(4) Combining scientific reasoning with philosophical speculation. Scientific theory is a conceptual system with some logical structure and tested by experiment. Scientists are always striving to explain some scientific theory with symbolic expression to make it an Axiomatic system. However, the development of science has proved that any theory is often not seamless and there exist some "anomalies". At this time, we must explain them with philosophical thought, such as the laws of individual and general, inevitability and contingency, as well as opposite, unity, and negation of negation.

5.2. Decision making method under uncertainty

Fictitious economy is high risk, and it faces the subjective and objective risk, that is, it faces the problem of uncertain decision making. There are following four methods of uncertain decision making.

(1) Quantify qualitative variables. Variables can be divided into quantitative, semiquantitative, and qualitative variables. Qualitative variables have two types — order variable and nominal variable. The so-called order variables are not numerical, but have differences with each other, and can be sorted according to some index, such as high, medium, and low. The order variables can be treated by a certain method, such

as multidimensional scaling or generalized quantization techniques. The variable of a nominal variable does not have any meaning itself, for example, the 5th basketball player does not mean he is better than the 1st. Illustrated in traffic study, it is necessary to assign a value to every transport mode, such as 1 for road transportation, 2 for railway, 3 for water, 4 for airlines, 5 for pipeline, and so on. It facilitates modeling and operation in computer.

(2) Determining the experience probability. This includes data mining, knowledge discovery in databases, intelligent mining, and so on. That is to infer the future based on the historical and existed data. It is usually the longer time span to infer, the greater its margin of error. Hence this method is suitable for short term prediction, not for the medium, or long-term prediction.

(3) Improvement of subjective probability. Subjective probability is given by experts based on their determination and analysis. Improvement of subjective probability means to improve the subjective probability by group decision making.

(4) Case study and integration of priori information. Case study is very important. Research work requires the researchers to master statistical data, has the ability to forecast, and is to be able to study the case. Though case study is individual, a “drop of water” can often reflect “the whole world”. The individual case can discover a lot of specific problems, even some special cases not in conformity with common sense. Of course, we should not regard the results of case study as a universal law, because after all it is the individual event. Now some researchers abuse induction and treat illustration as a proof. That is wrong. If illustration equal proof, we can prove Sichuanese does not eat chili, for example. It is not difficult to find out several persons eating no chili from tens of millions Sichuaneses. Mr. Chang is Sichuanese and he does not eat chili; Mr. Wang is Sichuanese and he does not eat chili too; Mr. Li is Sichuanese and he does not eat chili either, which comes to the conclusion: Sichuaneses do not eat chili. Obviously this is wrong. Therefore, example cannot be taken as proof. In addition to case study, priori information is also very important. In the above case, Sichuaneses like chili is a priori information. Thus, we will doubt the conclusions that Sichuaneses do not eat chili. With priori information, case study cannot be puzzled by some superficialities.

5.3. Group decision making method

In the decision-making process, the judgment of experts is very important. Group decision making is an effective means of improving expert judgments. The author sorts group decision making into two types, collaborative, and coordinative decision making.

Collaborative decision making is to study how to centralize the scattered views to form the optimal collective decision while the decision makers have the consistent goal, when the effect of group decision making will be better than any individual personal decision making. Delphi method is a practice of collaborative decision making in the early time. The process is to ask experts make their own judgments, then integrate their views and back to the experts. Each expert can revise his judgments according to the feedback. Slowly the dispersive views concentrate and finally a conclusion with majority agreement can be obtained. Now the decision makers have access to adequate information in advance by various means such as computers, and can gradually arrive at optimal decisions via integration of computer.

Coordinative decision making is to study how the participants with conflict of interest make a satisfactory decision making. That requires find a compromise point using cooperative game theory, such as the Shapley value solution and Nash agreement. For example, budget assignment is a typical case of coordinative decision making. When several departments discuss budget assignment, each department expects more. In the meantime, each department hopes to arrive at a result; otherwise they all cannot get money. Therefore, interest conflict and appropriate compromise both exist in coordinative decision making. There are many problems worthy of study.

In group decision making, we should consider the difference of knowledge and experience of all participants, the influence of information asymmetry between each other, and their behavior in the decision-making groups, to prevent the drift of the optimal decision point because of authority or herd effect. Probably, there are authoritative decision makers in the group, and others do not dare to oppose their points. That is so-called authority effect. In this circumstance, group decision making does not work. The so-called herd effect refers everybody go with the stream, which also cannot take the role of group decision making. In addition, we should

develop and improve democratic centralism relying on modern decision-making science, to make it the decision-making system with Chinese characteristics.

5.4. Complex data analysis for decision support

Decision-making needs two types of knowledge for evaluation and prediction, knowledge about system quality and evolution. These two types of knowledge are both extracted from the data, for which the complex data analysis methods are necessary for research. There are now commonly used principal component analysis, factor analysis, cluster analysis, correlation analysis, regression analysis, regression tree, the logic of data analysis. There is a relatively new method of partial least squares, symbols, data analysis, data analysis functions, and so on.

5.5. Mathematical finance methods

Mathematical finance is to apply mathematical tools and models to study the financial problems. The following four methods research should be mastered in fictitious economy research.

(1) According to the principle of fictitious economy, the pricing of financial assets has relationship with the adhered real economy. For example, pricing of a company's stock has relationship with the enterprise's assets and performance. In fact, there are three types of enterprise assets pricing. The first is pricing of tangible assets, which has mature theories and methods in Accounting and Finance, including depreciation, tangible and intangible loss, and so on. The second is the pricing of intangible assets. Now, there are many state-owned enterprises in China, whose tangible assets almost have been depleted after the decades' depreciation. Their values lie in the intangible assets, such as its trademark, customers, technology, skilled workers, and so on. At present, people are still willing to merger and acquisition to those state-owned enterprises with very few tangible assets, because of achieving their intangible assets. However, the pricing of intangible assets has always been a problem. For lower price may cause loss of state-owned assets and higher price will stop people to buy. The third is dynamic pricing, which is to expect the future value. Many equity investments, especially private fund investment, depend on

the future value of investing object. The major roles of private fund are mergers and acquisitions. After M&A business, private fund will enhance the value through improving management and related systems, and then sell it again. Therefore, private fund has no interest in enterprise operation and development. Similar with venture capital funds, private fund aims to find the future value of the object. There is no good solution for how to find the future value of enterprises, which is exactly what we should study deeply. It is meaningless to discuss whether suffering disadvantage in M&A, when there is no proper evaluation methods, because we do not know the exact value of companies. If the future value of enterprise will have significant growth after M&A, it will be worthy. Both two sides have received corresponding return. However, if the future value of enterprise after M&A has no or little growth, it is not a successful M&A.

(2) Fractal market analyses (Peters, 2002; Yang *et al.*, 2008) are a branch of nonlinear science to describe complex system with irregular structure. Fractal refers to the frame that has some similarity (usually from the view of statistics) between some parts and the overall of the system. Fractal dimension, which is noninteger dimension, is quantitative characterization and basic parameter of fractal. Fractal market hypothesis is proposed since the traditional efficient market hypothesis is difficult to explain the trend of price behavior in capital market. Fractal market analysis tries to analyze the generalized capital markets on holism theory, which can better explain the diversity of investors. Fractal market analysis has overcome the limitations of efficient market theory, and taken into account nonrational expectations of investors and the nonlinear relationship of market reacting to information. The most important finding of fractal market analysis is that the stability of market is based on the diversity of investors. When there are many investors with different investment periods to participate, it can ensure the market stable.

(3) Autoregressive Conditional Heteroscedasticity Analysis (ARCH) (Mills, 2002) was introduced in 1982. It has been considered by many researchers as a better nonlinear financial time series model. To obtain more flexibility, some researchers extended ARCH further to GARCH (General Autoregressive Conditional Heteroscedasticity). Many empirical studies have shown that the volatility of stock returns is time-varying (conditional heteroskedasticity) and nonlinear characters. Single variable

model of GARCH has captured this dynamic behavior of volatility to a certain extent by the means of describing volatility as a linear equation of past forecasting mean square error. But, the parameters of GARCH are not stable in the time dimension. Some research has also pointed out that sometimes the predicted results based on simple GARCH model are poor. Therefore, all sorts of improvements have been performed to ARCH, including nonlinear ARCH (NARCH), threshold ARCH (TARCH), asymmetric ARCH (AARCH), quadratic ARCH (QARCH), noninteger integral ARCH (FIGARCH), ARMA-ARCH, and so on. ARCH is an important method of mathematical finance, which has been widely used in financial analysis such as futures analysis, stock market analysis. But we also realize its limitation as a black-box method. We must explore the methods combining ARCH analysis and mechanism analysis, and do not rely too much on the conclusions of ARCH analysis.

(4) Financial risk theory covers definition, measurement, processing, control, and management of risk. With accumulation of the financial data and development of statistical methods, the traditional financial risks theory, such as option pricing and hedging theory, is facing challenge (Phillipe and Marc, 2002).

5.6. Computer simulation methods

The final method of complexity sciences is computer simulation. Computer simulation methods generally have two types. One is the so-called discrete event simulation, which is traditional methods of computer simulation, such as GPSS, symscript, and so on. The other is agent-based simulation, which has been widely used in complex sciences research. There are two tools in agent-based simulation. One is Swarm Simulation Toolkit, developed by Santa Fe Institute, the United States. The other is NetLogo, developed by Northwestern University. Other well-known relative simulation tools include Artificial Life, Cellular Automata, Co-opetition, and so on.

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