Conceptualization of Developing SD Financial Model

---A Subsystem of Chinese Macro Economy Model

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Abstract

As Chinese enlarges its opening level, Chinese economy will be widely influenced by world economy. From the systems thinking perceptive, this article closely tested the varying of constant change of the international finance. We built up a research direction aiming at Chinese macroeconomic System Dynamics model. Under the frame of finished and simplified macroeconomic model we began to explore an important subsystem in macroeconomic dynamic model of financial system. At present stage, we have completed a simply dynamic model of macro economy, on whose base finance sub-model is a relatively independent dynamic model. In our whole model assumptions, this is one of important sub-models. This research will disclose the impact of the international financial crisis on national macro economy of a developing country.

Key words: Macro Economy; Financial Crisis; System Dynamics

1. Introduction

In 2002, China GDP reached RMB 10 trillion; annual growth rate was 8%. On the other side, there are still some problems in Chinese macro economy, such as market's inefficient demand for many years, RMB 309.8 billion budget deficit in 2002. Compared with 259.8 billion RMB in 2001, increased 19.24%, and exceeds 3% GDP. It has reached the bottom line of macro economy.   The employment pressure is keep increasing in this country. In 2002, the reported unemployment rate reached 4%, compared to year 2001, and increased 0.4%. According to the estimation of relevant departments, there are 22 million employments to be arranged yearly, and the yearly new created job positions are around 8 million, at the same time, there are still 0.15 billion spared manpower needs to be transferred in country. The Labor and Social Protection Department wishes that the unemployment rate could be controlled within 4.5% in 2003 [1].   Now the only countermeasure government taken is using financial policy to stimulate the domestic market demand, using currency policy to stimulate the consumer market. China economy has continuously increased in the past 20 years, to keep this trend, a large amount of capital investment is necessary, while the low real investment return rate weakened people's investment passion. Once the market more

opens, the stability of financial market will be the core problem of the whole national economy. This is the key issue we will address in this paper, and also the purpose to develop macro economy financial subsystem model.

2. Background

In 1994, financial crisis in Mexico, England Barlin Bank bankrupted, financial industry credit crisis and bankrupt successively took place in Taiwan, Japan and Russia, and bank merger in America. On May 9th 1997 Moody's Investors Services released investigation report on 61 national banks that 58 banks had a high proportion of credit crisis. On July 2nd Thailand central bank changed its foreign exchange policy from USD-pegged currency to free floating rate because of market pressure and shortage of foreign exchange reserve, so in short term the exchange rate dropped by 16.4 percent against US dollar. By the end of December 1997 Thai Baht (B) was devalued by 65.92 percent, which eventually caused Asia Financial Crisis.

Retrospecting to the history, during the period of 60's to 70's last century, Japan was the country with the fastest economy development, which had annual increase rate of 9% to 10%. Until 80's, its increase rate was still 4%, while from 90's, because of the economy bubble broke, the economy growth rate was once negative. During the century alternation, Japan economy growth was almost stopped; annual growth rate has been almost zero for years. But, the Japanese Yen is the only major currency which value of currency has been successively appreciated. Generally speaking, Japanese Yen's appreciation could be classified into four phrases. The first phase the yen appreciated from USD/JPY 506 in 1971 up to USD/JPY 305 in 1976. Just during 6 years Japanese Yen appreciated 40%. The second phrase took place between 1985 and 1990, from USD/JPY 261 up to USD/JPY 146. The third phrase began in 1994, from USD/JPY 192 to USD/JPY 99 in 1995, among which it even reached USD/JPY 79.7. The fourth phase was about on April 1995, Japanese Yen reached its highest level.

Although JPY devalued recently, but compared to 1971, JPY versus USD has doubled because of the increase of JPY exchange rate. (Japan 2002 GDP=3.5 trillion USD, U.S.A. GDP = 8 trillion USD)

On the other hand, along with the capital output of Japan, and Asia four dragons, the economy of South-East Asia is developing rapidly Since the end of 1970, China economy was in a high growth rate, but this healthy trend was interrupted by the Financial Crisis. The first place in the trouble was Latin America, the Tequila Effect in 1994 stopped the rapid economy growth of Latin America, and caused a series of credit crisis. In 1997, the same thing happened to Asia. At the end of Dec 1997, the Thai currency dropped 40 percent in value; the Indonesian rupiah (Rp) dropped 80 percent; the Malaysian ringgit by 30 percent; the Singapore dollar by 15 percent; the Philippine peso by 50 percent. Stock markets contracted by similar percentages.

Financial crisis has the severe impact on the developing country economy. What began as an East Asian financial crisis in 1997 spilled over into Brazil in the following year and soon enveloped the whole Latin American continent. The social consequences of the resulting crisis were particularly severe especially in terms of unemployment and growth of poverty. It is because of the fearful impact of such crises on developing countries that any discussion of the New International Financial Order must begin in this part of the world.

The Tequila Effect in 1994, Dragon Effect in 1997, and Tango Effect in 2002 all predicted the fierceness of the financial crisis. One of its characters is out busting. This out busting will be widely spread and expanded in the market together with the Domino Effect. Then, whether China economy market will also be influenced by such financial crisis?

Refer to the recent Chinese economy development, it is expected that Chinese economy compound develop rate will reach 7.5% in the future 10 years, and the most part of increase is stimulated by domestic investment. In the later 10years it is required a large amount of capital investment in China to keep up the economic growth. It is estimated that the investment amount would reach ¥ 50 trillion. While as increase of Chinese opening level, during the process of Chinese economy incorporating into world economy, the main question we must consider is the relationship between development and safety in financial market, while the key to answer this question is an early warning model of the macro economy. Through model simulation experiment we can explore the dynamic relation between development trend in future few years or even decades and financial market in short term. From the previous financial events, it is illustrated that "The agitation oncoming force of financial crisis is unusually turbulent", whose the most noticeable characteristic is its "suddenness". But this is just the conclusion from watching on the result. In fact, occurrence of a crisis is not "the trembling with fear of one day".

According to the statistics in "China – The Growing Up Manufacturing Great Power" by BNP PARIBAS PEREGRINE in Oct. 2002, in coming 5 years, China's real utilized foreign investment will increase to USD 100 billion; annual growth rate will be 16%.

The validity of the capitalization from China domestic stock market is widely doubted. Till 2002, the total market value of Shanghai Stock Exchange was 2536.37 billion, liquid value was only RMB746.73 billion. Total liquid value of Shanghai and Shenzhen was RMB1382.49 billion, compared to the stock market, which shrank 10% in 2001, was different from the development trend of macro-economy. In 2002, total residential savings were RMB9.81 trillion, increased 20% compared to the same time the year before.   Obviously, the main reason is that the stock market does not totally reflect the development trend and operation system of macro economy. It's easy to see that only one-quarter stock can be circulated in the market, and its total market value is less then 30% of the total market value. The market leverage is very limited. After China joined the WTO, in the coming years, the internal operation system and organization barrier

will be eliminated gradually with China financial market opening. Whether the economy growth is positive based on the wishes of government (the compound growth rate has to be at least 7.7%, if it doubles every 10 years) or negative based on the market trend is not the key issue, the most important is stock market will eventually be the key channel of capitalization and play a key role in adjusting market.)

The government control on macro economy will be weakened with the market opens. Being the largest developing country in the world, seems it still to take time for the economy to achieve rapid development. So how to protect the macro-economy from the harm of financial crisis, how to avoid the happening of financial crisis, and how to react when the opening of the enclosed market? Whether the stability of the financial market will be impacted, and how deep the impact is, when the market gradually opens and external capital impacts the market more heavily? Whether the future development of China financial market will be the same as of Japan, which was slowered with the hugeness of market scope, or be the same as of South-East Asia and some Latin America countries, which burst crisis because of the fragility of their market. It's difficult to get the answer, but it's inevitable. From this meaning, our modeling is a firm step towards this problem, no matter it addresses the problem deeply or not, the direction is correct.

3. Concept and Methodology of Modeling

With the opening and globalization of China economy after joining WTO, China economy will be greatly impacted by the world economy. In this case, the authors will build a submodel--financial model in a macro background. And the academic results of modern financial theories will be applied to build such a financial submodel.

The main simulating objective of this model will be macro-economy variables. The variables we need to concern are as follows: which are related to financial policies such as Government bond; related to currency policies such as interest rate (name and real), related to financial market such as "composite stock average index"; related to macro-economy prosperity index such as supply-demand balancing index; related to foreign exchange market such as exchange rate; and related to labor market such as employment rate, and so on.

From the systems thinking perceptive, this paper closely tests the varying of constant change of the international finance. The task of our research aims at building up Chinese macroeconomic System Dynamics model. Under the frame of finished and simplified macroeconomic model the authors began to explore an important subsystem--financial system. Although Chinese economy was not greatly influenced by Asia Financial crisis, the latter still had direct influence on the economy development mode of China. Under WTO as Chinese enlarges its opening level, while its trade develops and incorporates the world economy, Chinese economy will also widely influenced by the world. So, in the background of interaction of international financial system a macro economy subsystem of finance is under building. The macro

economy of China, the interaction inside financial system and the interactions between the parts and the whole are considered as the core of research. The authors take Systems Thinking as the main principle of modeling, synthetically integrate other relative theories such as econometrics, statistic etc., and make use of the latest research results of modern financial theory to set up the financial subsystem.

We assume the predetermined target of model as the following aspects:

1. Financial subsystem model is one part of the whole macro economy model, it has relative independence, and at the same time it plays the leading role in operation of the whole macro economy.

2. As a relatively independent system, construction of financial subsystem stresses operating characteristic of macro economy as the research emphasis, and specially considers financial risk, economic fluctuation and other problems.

3. Taking macro economy amount as the main variables of the system and capturing the dynamic and developing trend of macro economy.

4. The model can be expandable, which lays a solid foundation for its further development.

According to the target we assumed, the model itself should possess the following functions:

1. Setting out from macroscopic, it is an experiment tool to make a basic research on relative financial problems.

2. It can comparatively accurately and dynamically simulate macroscopic trend of financial system, and describe the main variable of macro economy.

3. It can provide functions for macro economy policy tests. Under certain circumstance, and carry out quantitative analysis for macro variables and the development trend of macro economy.

At present stage, we have completed a simplified SD model of macro economy, on whose base financial submodel is a relatively independent part. In the model assumptions, this is one of the most important submodel..
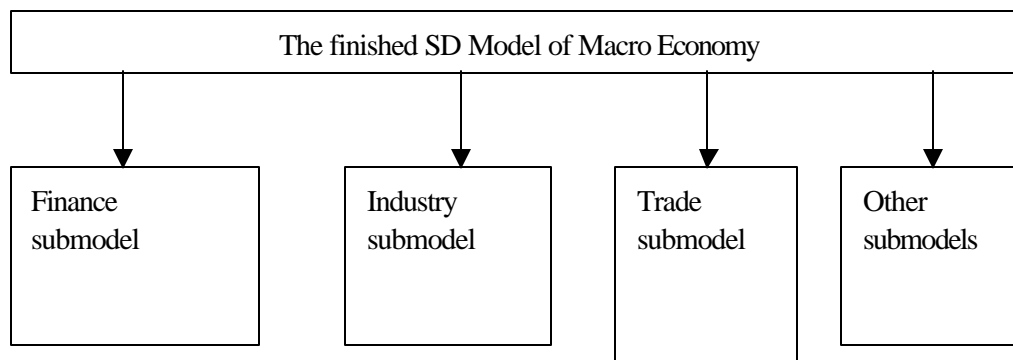

Figure 1 The framework of the whole model

The Figure 1 above is to macroscopically depict the constructive model. The financial subsystem is the most important part. The whole model will possess simulating function for the macro economy, have certain early warning ability of the risk in the

macro financial market, and lay a solid foundation for completing a larger macro economy model.

Generally, the model is built for the macro economy simulation. Its framework is shown in Figure 1. This article will only be outspread from financial sub-system. From systems thinking, it's a practical shortcut to build the model by dividing the whole country's macro economy into several sub-systems. In order to plot out the behavior of complicated social-eco system, once the relative stable boundary is confirmed, SD methodology provides us a convenient analyzing tool – simulation experiment. But to get this purpose, firstly, we have to build the financial SD sub-mode, which is based on the framework of macro economy model. Currently we have built this macro economy model[2], and have simulated some of the variables in the model. Based on this, financial submodel will be based on the financial market, dynamically simulate the relationship between the economy variables of financial market and macro economy.

4. The framework of the Model

Figure 2 is the framework based on financial subsystem; it reflects the co-relationship and interactions among the subsystems. Analyzed the logical relations of the main influenced factors, the model is divided into three layers. The upper layer is financial market, a relative macro concept. It is the main layer that influencing the entire finance subsystem, and the first layer to react on the macro economy prosperity status. The second layer is the capital market; this is a relatively detailed capital flowing layer. It directly reflects the economic functions, which are caused by the impacts of capital flowing on the macro economy. The third layer is the capital market in the real world, such as stock market, foreign exchange market, insurance market, and bank business etc. They are the practical units in the finance subsystem, the results caused by the series of economy operations. Partially speaking, it is the final result of the whole finance subsystem after a dynamic development cycle. Certainly, during the dynamic simulating process, the third layer's financial result will feedback to its upper financial market. The model will utilize the advantage of SD approach, systemically unite the whole finance and other subsystems. So as to simulate the complex causal relationship, it will dynamically plot out the basic characters of financial subsystem in macro-economy, and provide relative scenarios and for policy tests.

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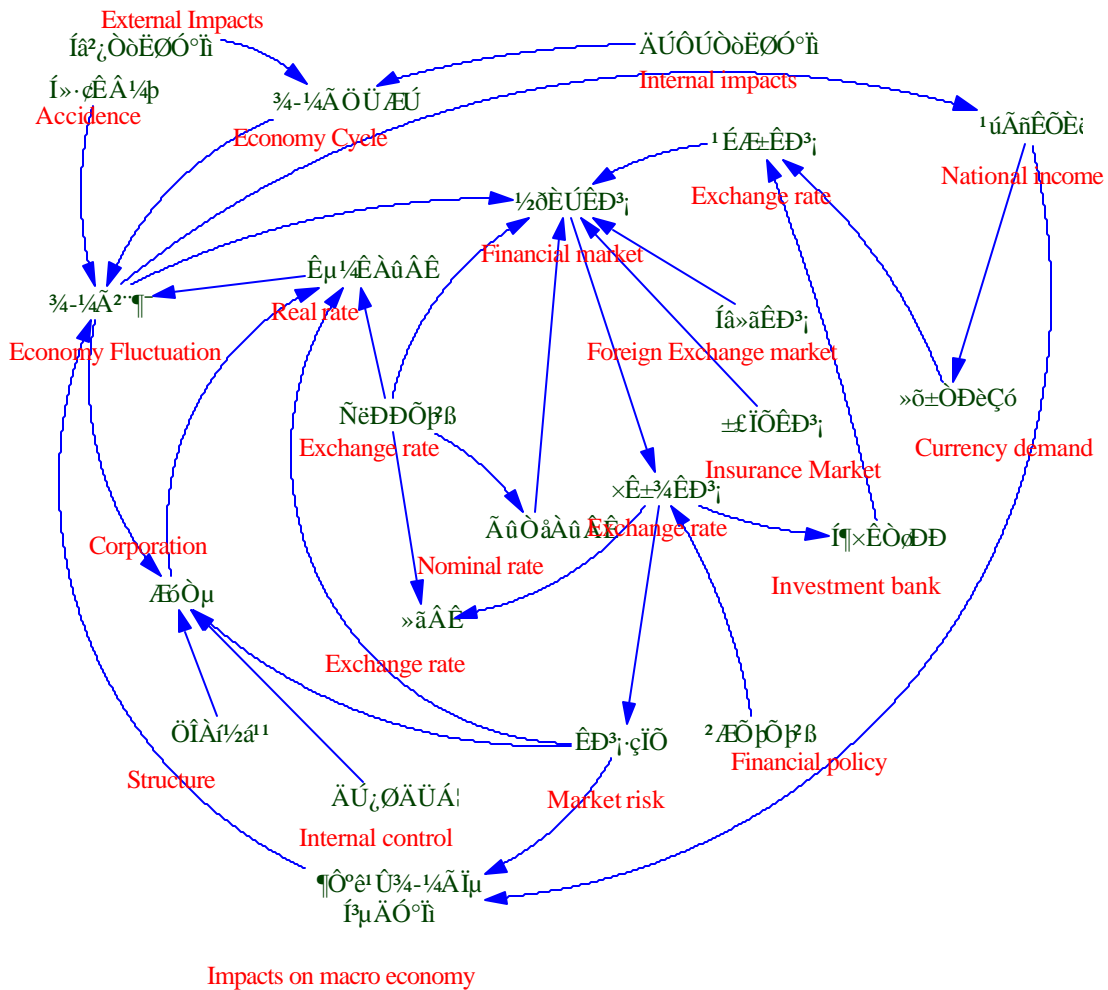
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Impacts on macro economy

Figure 2   The causal feedback loops of financial subsystem

The objective of macro economy study is the fluctuation of economy cycle, but finance system has its own characteristics. The core of the study on finance system is the formation of the event of turbulence crisis. Figure 3 is the description and assumption of this problem. Analyzed on a relative independent country's macro economy system, it plots out the macro structure and the possible reasons that caused the system unbalance, fluctuate, and financial crisis. It also judges the polarity of the co-relationship. Actually, by analyzing the main causal loop, Figure 3 has given out all the important factors that cause financial crisis. The key of this problem is how to transfer these factors into quantitative math model. The main object of the model is the macro economy variables. Currently those variables we need to consider are: variables related to financial policy such as government bond; variables related to currency policy such as exchange rate (nominal and real); variables related to finance market such as composite stock average index; and variables related to labor market such as employment rate and so on. In the initial stage of the simulation, the value of these variables are definitely quite different from the real ones, but we have to note that the objective of modeling is not simulating the real world, but predict the related policies

and economy fluctuation. So the key of the modeling will be the consistency of the system itself and the fact, at least keep the reality of the quantitative relationship. This is the basic requirement and standard of the model we are going to build.
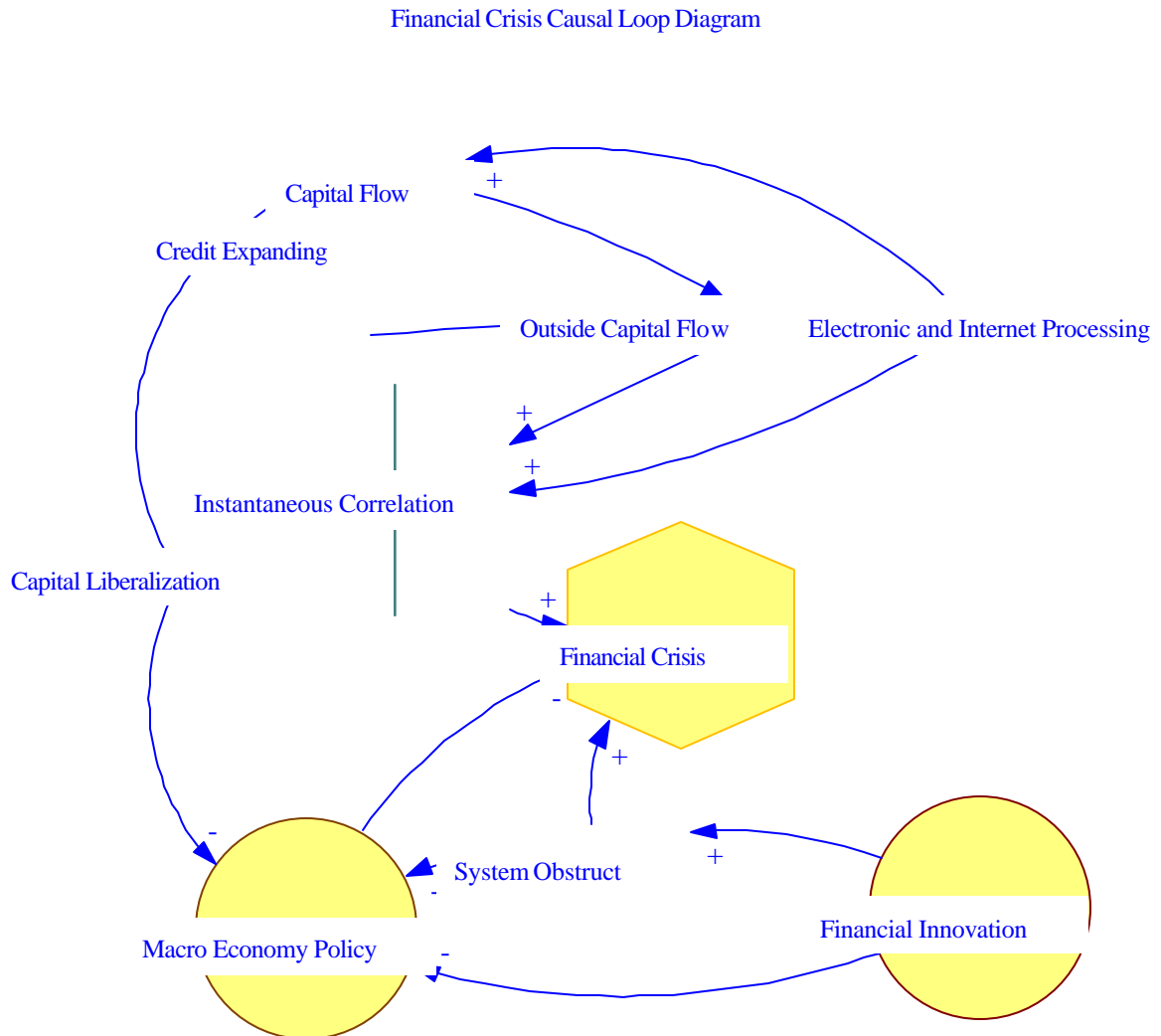
Financial Crisis Causal Loop Diagram

Figure 3 the important factors that cause financial crisis

5.   Existing Studies and Problems

For the modeling development, currently a simple macro economy model has been developed. And the study on the finance subsystem has been carried out for almost one year, some fundamental studies have been done, the framework has been finished. The variables in the current macro economy model are: levels 15-20, equations around 300. Finance subsystem has been simulated and analyzed based on macro economy policies,

and has been connected with macro economy main model. At the same time, we still need to consider keeping a room for industry subsystem.

There are some constraints during the modeling process. The main difficulty is to find the experience functions to simplify the relationship among variables during the dynamic simulating process. This is exploiting job, because in different system the experience functions is different. For example, it's difficult to describe the quantitative relation between people's saving, government bond, and financing capital. In the real world, these 3 factors are definitely co-related, so we have to build this relationship into the model. In order to describe this in a middle sized model, we have to use correlation functions, which is difficult. This is the weakest point in SD methodology.

Although currently we are clear about the objective we are going to study, the fact we are going to simulate, and the boundary of all the variables, the modeling process is still being explored. To achieve what we want, there are still lot of hard works to be done.

6. Conclusion

The concept of the model is primary, our objective is to describe the relation between fluctuation and crisis from macro growth trend, so as to achieve the simulation and experiment analysis on long-term macro economy policies, to basically analyze the quality of macro economy operation. From our current study results, this work still has great difficulties, but it's worth if we see from the tragedy brought by the financial crisis. It is a pity that the study hasn't been recognized enough. Although we have tried our best, the process is not satisfied [5] Hopefully in the near future, the authors can show you an integrated model.

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