Nonlinearity of Financial Asset Prices and Dilemma of Monetary Policy

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Abstract

This paper begins with a detailed theoretical analysis and empirical research on the nonlinear features of financial asset prices. And then an IS-LM-FM model is constructed, into which the tradable financial assets are included as a part of a unified macro equilibrium analysis. The paper also provides a simulative and dynamic analysis of monetary policy in the extended macroeconomic frame and notice the new challenges brought by financial asset inflation under the new economic structure. The analysis finds that: 1) there are multiple equilibria in the tradable financial assets market, and the price of financial assets is subject to a positive self-reinforcing feedback in the short term and a negative self-correcting feedback in the long term. 2) The modern economic structure has endured a significant adjustment with the expansion of financial assets, the change of financial asset prices as an endogenous variable should be included in a unified macro equilibrium model. 3) The existence of financial asset inflation makes the causes and effects of inflation more complicated, the indicative significance of inflation to the overall economic operation is reduced, and the controllability of monetary policy to inflation is also significantly reduced. Continuing to adopt inflation-targeting may lead to misjudgment of monetary policy. 4) The new economic structural changes require us to re-examine the monetary policy framework. If the money supply is taken as the intermediary target, it is necessary to add intermediate variables such as the rate of return on financial assets to effectively control the structural distribution of money supply between the real economy and the financial asset market, and to effectively solve the dilemma faced by monetary policy in the new situation.

Introduction

Since the 1980s, the scale of global financial assets has increased rapidly, and the economic structure has changed fundamentally. The quantity of financial assets gradually exceeds the total amount of the real economy, and there are many anomalies in the actual economic operation that cannot be explained with the traditional economic theories which should be revised to keep up with the pace of economic structural changes. The financial assets should be considered as a part of a unified macro equilibrium analysis.

The contribution in this paper is **quadruple. The first contribution** is to provide a detailed theoretical analysis and empirical research on the non-linear features of financial asset prices and it is found that there are multiple equilibria in the tradable financial assets market, and the price of financial assets is subject to a positive self-reinforcing feedback in the short term and a negative self-correcting feedback in the long term.

The second contribution is to take a step towards investigating revision needed in traditional macro-economic assumptions and establish an IS-LM-FM model, into which the tradable financial assets are included as a part of a unified macro equilibrium analysis. In the age of the Keynesian model, the proportion of financial assets in the economic system is relatively low, and the impact of changes in the price and quantity of financial assets on the overall economy exists, but in general it's limited, so the variables such as price or output can basically describe the overall economic state. However, with the major adjustment of economic structure, the traditional economic framework has been unable to adapt to the changes in the new era. In the current economic structure, this analysis basis must be improved, and the change of financial asset prices as an endogenous variable should be included in a unified macro equilibrium model. Only in this way can we fully and accurately understand the macro changes and make a new thinking on the monetary policy framework.

The third contribution is to provide a simulative and dynamic analysis of monetary policy in the extended macroeconomic frame and notice the new challenges brought by financial asset inflation under the new economic structure. It demonstrates that the transmission mechanism of monetary policy has undergone essential changes after considering tradable financial assets. The **price index such as CPI is no longer a good reflection of the overall economic operation.** The dilemma faced by monetary policy can be vividly summarized as the embarrassment of **"two**

pools, one tap". And from the simulation, it can be easily deduced that QE should be used to deal with financial asset crisis.

The fourth contribution is to have some discussion on the reform and remedy of monetary policy framework and some feasible suggestions were given. A new intermediate variable- financial asset return rate- should be added to solve the dilemma of monetary policy, which is mainly used to control the reasonable distribution of monetary supply between the real economy and the financial market, so as to achieve **"two pools and two taps"**.

This paper proceeds as follows. Section 1 provides literature review; Section 2 examines the fundamentals why the financial asset prices are nonlinear; Section 3 demonstrates a nonlinear model of financial asset pricing. Section 4 extends the Keynesian model by including financial assets into a FM-IS-LM model and then a simulative effect analysis of monetary policy is provided in this part; Section 5 is the conclusion.

Section 1 Literature Review

1.1 Literature review on the nonlinear study of financial asset prices

In recent years, more and more scholars begin to use non-classical methods to study financial asset prices. The study of the nonlinearity of financial asset prices is not a question of pricing accuracy, but a question of pricing mechanism.

From linear to nonlinear is a transformation of pricing mechanism. Under the linear paradigm, the financial asset price follows a negative feedback mechanism, and the system is self-correcting and stable which sets up a tendency toward equilibrium. Under the nonlinear paradigm, the financial asset price follows a positive feedback mechanism, and the system is self-reinforcing and unstable which produces dynamic disequilibrium. It is the nonlinear mechanism of financial asset price that often leads to the emergence of financial crisis. Understanding the nonlinear mechanism of financial asset price is the basis of our understanding of modern economy.

As to the micro study of financial asset pricing, Markwitz, Sharp, Fama and others have put forward asset portfolio theory, efficient market theory, CAPM and APT theory.

These theories are based on the general equilibrium analysis of the financial asset market and have laid the foundation of modern finance. However, many studies have found that there are a lot of conflicts with the classical financial theory in the real financial market, which causes people to reflect on the classical financial theory. Therefore, scholars put forward revisions to classical financial theories from behavioral finance, bubble theory, heterogeneous trading behavior theory, noise trading theory and other aspects. At present, the micro research on non-classical financial asset pricing is mainly concentrated in the following six directions.

1.11 Heterogeneity theory of financial asset prices

LeBaron and other scholars have conducted a lot of research work based on heterogeneous investors, aiming at the unreality of the homogenous rational assumption in the classical micro-theory of financial asset prices[1]. All these theories are based on limited rational investors, and assume that there are differences among investors, so as to find the mechanism of financial asset price fluctuations, and establish non-classical financial pricing models to describe the dynamic behavior of financial asset prices.

Brock and Hommes (1997, 1998) proposed the Adaptive Belief System (ABS) theory. The basic idea is that investors in the market are heterogeneous and have different beliefs about the future[2]. In order to adapt to the environment, investors' beliefs are changeable. Through continuous learning, people choose forecasting rules with good performance to adapt to the changing environment, which leads to the change of the proportion of different types of investors, and then affects the change of financial asset prices, and the change of prices in turn affects investors' choice of forecasting rules, forming an evolutionary system of interaction between the two. ABS model provides a good explanation for some important empirical results and market phenomena, such as: unpredictability of returns, wide tail distribution, speculative bubbles and volatility clustering.

Brock, Hommes and Gaunersdorfer extended the original model in later studies. Chiarella and He (1999, 2000) also developed the ABS system to a certain extent.

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[1] See Arthur, Holland, LeBaron, Palmer and Taler (1997), Brock (1993,1997), Brock and Hommes (1997, 1998), Brock and LeBaron (1996), Chiarella (1992), Chiarella and He (2000), Gaunersdorfer (2001), Gaunersdorfer and Hommes (2000), Lux (1995), Taisei Kaizoji (2000) and others.

- [2] Heterogeneity of beliefs.

1.12 Synergy theory of investment behavior

The Cooperative market hypothesis (CMH) proposed by T. Vaga (1991, 1999) holds that the probability distribution of market prices is based on the changes of two types of factors: economic (or basic) environmental factors and market sentiment[3]. As the combination of these two factors changes, so does the state of the market. In different cases, four different phases can be achieved: random walk, transitional market, chaotic market and collaborative market. Although this theory lacks empirical test, it has a good ability to describe market price changes.

Lux Model (1995) and Kaizoii (1998) believe that the formation of investors' expectations mainly comes from the judgment of market conditions and other investors' expectations and behaviors. In turn, the change of each investor's behavior (that is, buying and selling) will change the market supply and demand conditions, and then affect the change of prices. Therefore, the formation of investors' herd behavior or mutual imitation phenomenon happens. Lux model can well explain the formation, bursting (excessive volatility) and mean recovery of stock market bubbles.

1.13 The microstructure theory of financial markets

The microstructure theory of financial market studies the trading mechanism, information transmission mechanism and price formation mechanism of financial market.

Ananth Madhavan (2000) summarized the research of market microstructure theory into four aspects:

1. Price formation, including the dynamic process of information absorption;

2. Market structure and design, including the relationship between price formations and trading rules;

3. Market transparency, the ability of market participants to observe information about the trading process;

4. Other financial applications, including asset pricing.

Compared with the previous financial theories, the financial market microstructure theory has two characteristics: the former financial theory focuses on macro analysis and aggregate analysis, while the market microstructure theory focuses on micro analysis and structure analysis; Previous financial theories used deductive methods,

[3] Or group thinking level.

while market microstructure theories mainly used econometric models for empirical analysis, and also paid attention to deductive reasoning and behavioral analysis methods.

This reflects that contemporary financial theory attaches great importance to the study of "human", the subject of financial and economic activities, which is an important manifestation of the development of contemporary financial theory and economic theory. In the theory of market microstructure, the analysis of inventory model and price behavior emphasizes the analysis of human rational behavior and irrational behavior and their causes, which makes the analysis of price changes in the market more deep and close to reality.

1.14 Experimental Finance

Experimental finance is the quantitative simulation and experiment of financial market. The paper written by Authur W.B., J.H. Holland, B.LeBaron, R.G. Poulmer, P.J. Turner[4] published in 1997 marked the birth of experimental finance.

Experimental finance uses computer technology to simulate real financial markets (such as stock markets, foreign exchange markets, futures markets, etc.). Under the established market structure, the macro characteristics of the market are revealed by studying the behavior of the micro-level investors (agents). At present, the research field of experimental finance mainly focuses on the stock market and foreign exchange market. In the research of stock market, there are mainly artificial stock market model (ASM) of SFI Institute, which is established on the basis of market structure described by rational expectations equilibrium model, and can produce time series with the same statistical characteristics as the real stock market. In foreign exchange market research, Jasmina Arifovic from the Department of Economics at Simon Fraser University proposed a multi-point equilibrium theory in the price space based on the general equilibrium theory of the foreign exchange market.

1.15 Behavioral Finance

Based on game theory and experimental economics, behavioral finance theory focuses on the study of human individual and group behavior.

The micro basis of behavioral finance is the decision-making process of financial

[4] They are all researchers at the Santa Fe Institute (SFI).

market participants. Its basic view differs from traditional financial theory in that investors are not perfectly rational and markets are not perfectly efficient. Behavioral finance regards the investment process as a psychological process (including the cognitive process of the market, the emotional process and the volitional process), and studies the psychological basis of investors' behavior and the influence of cognitive biases (such as overconfidence, loss aversion, psychological accounts, etc.) on decision-making in the investment process.

Statman and Shefrin proposed the Behavioral Asset Pricing Model (BAPM) and the Behavioral Portfolio Theory (BPT) based on traditional financial theory.

BPT was developed on the basis of Modern Portfolio Theory (MPT). Portfolio theory holds that the optimal portfolio should be on the efficient frontier of the mean/variance. Unlike CAPM, investors in BAPM are divided into two categories: information traders and noise traders. Information traders are rational traders who act strictly according to CAPM, and there will be no systematic deviation. Noise traders, on the other hand, do not act according to CAPM and will have various cognitive biases. Two types of traders interact to determine the price of financial assets.

Kahneman and Tversky (1979) found that most investors do not always behave rationally. Most investors are risk-averse where profits are possible; In the event of a possible loss, most investors become risk-takers. In general, when the amount of profit and loss is the same, people become more depressed when they are losing and less happy when they are making a profit. According to Tversky and Kahnemn, investors are more willing to take risks to avoid losses than to take risks to maximize profits.

1.16 Noise Theory

A. Semifer, L.H. Semmers and R.J. aldman (1990) put forward the noise trading theory in the DSSW model, and they divided the transactions into two categories: (1) transactions between noisy traders; (2) Arbitrage activities carried out by rational traders taking advantage of the mistakes of noise traders.

In the DSSW model, the equilibrium price deviates from the underlying value due to the influence of noisy trading. The existence of noise leads to positive feedback behavior in financial markets. Speculators who concentrated on short-time trades usually buy stocks when they rise and sell when they fall. If the short-term speculators buy more than the rational speculators sell, it will push the price of the security to continue to rise, and the price of the security will further deviate from the underlying

value and form a bubble. Because this deviation is Self-fulfilling, it is said that "Noise traders create their own space." That is, noise trades create noise prices driven by "noise traders." Therefore, in the financial market with noise trading, there may be a financial asset price bubble or even a vicious bubble.

1.2. Literature on the relationship between financial assets and monetary policy

At present, the research literature on financial asset prices and their macro effects is mainly based on traditional economic theories. Reinhart (1998), Lettau & Ludvigson (2001) and Mishkin (2001) analyzed wealth effect to determine the influence of financial asset price changes on consumption in the real economy. Blanchard et al. (1993) analyzed Tobin's q effect to judge the influence of financial asset price changes on investment in the real economy. Filardo (2000) analyzed the information effect of changes in financial asset prices and believed that asset prices contained information about future economic growth, so financial asset prices exerted influence on economic operation through information channels. Ben Benanke, Gerlter (1995); Forrest Capie, Geoffrey Wood (1997); IMF (2000) believes that price changes of financial assets affect investment and consumption through wealth effect and capital cost changes, and affect the assets and liabilities of financial institutions through balance sheet channels, thus affecting the stability of the financial system.

There is also much discussion about the interaction between financial asset price changes and inflation. James H. Stock & Mark W. Watson (2001) analyzed the role of asset price changes as prospective indicators of output and inflation from both historical documents and empirical studies. Michael F. Bryan et al. (2002) argues that US inflation may be underestimated because it does not take into account the impact of asset price changes. Monika Piazzesi & Martin Schneider (2007) discussed the impact of inflation illusion on financial asset prices. As to Chinese researchers, Wu Zhiwen (2003) argued that with the development of the capital market and the continuous enrichment of financial products, more and more money is removed out of the circulation of the real economy sectors and enters the capital market, which is transformed into financial assets instead of directly affecting the prices of goods and other physical objects. Therefore, an expansion of the money supply need not cause inflation. Zhao Yue and Ge Ying (2006) analyzed the change of money flow velocity and argued that the increase of financial assets and their transactions changed the money demand function,

thus changing the original relationship between money supply and inflation. Wang Haibin and Zhu Jingping (2006) found that the expansion of the size of the stock market would absorb part of the funds of the overall money supply, and gave a certain explanation for the phenomenon of rapid growth of China's money supply and low price growth. Wang Guogang (2009) believes that the specific causes of price changes in different periods are different, and there is no stable and reliable functional relationship between monetary growth and inflation.

As to whether monetary policy should pay attention to asset prices, there are two main views:

One point of view is that asset prices should not be the target of monetary policy, and monetary policy cannot actually change the long-term interest rate environment that affects asset prices. Former Federal Reserve Chairman Alan Greenspan epitomizes this view. They believe that the determinants of asset prices are complex and diverse, with non-fundamental factors as well as fundamental ones. Central banks cannot effectively predict and judge asset bubbles, central banks are not dominant in monetary asset price information and evaluation of asset prices, and cannot change human irrational emotions. If asset prices are included in the target of monetary policy, it will undoubtedly increase the difficulty of monetary policy implementation, and monetary policy will aggravate economic fluctuations by considering financial asset price fluctuations. Reinhart (1998) and Cogley (1999) found that if the Fed reacted to changes in stock prices, it would not only increase the volatility of stock prices, but also destroy the stability of the overall economy. Bernanke and Gertler (1999) and Filardo(2001) argued that under the premise that the central bank adopts a systematic response to changes in stock prices, if it does not respond actively to changes in expected inflation, the output gap and prices will fluctuate more. If the central bank responds aggressively to expected inflation, it does not make much difference in stabilizing prices and output. Bernanke and Gertler (2001) believed that only when asset price changes have an impact on inflation, it is necessary for central banks to respond with monetary policy. Dai Genyou (2000) also believes that when stock prices are inconsistent with the real economy, monetary policy should not pay attention to asset prices.

Another point of view is that monetary policy should focus on changes in asset prices. One representative of this view is former Federal Reserve Chairman Ben Bernanke. He believes that "only when the changes in asset prices amount to the extent that affect expectations of inflation, will the changes affect the central bank's policy", that means whether monetary policy should respond to asset price fluctuations depends

on whether asset price fluctuations affect the central bank's expectations of inflation. Cecchetti(2000) believes that central banks should incorporate stock price movements into their monetary policies. Qian Xiaoan (2001) believed that the price of financial assets is an important macroeconomic indicator, which has a predictive effect on the macro economy, and monetary policy formulation should pay attention to the state of asset prices. Xia Bin and Liao Qiang (2001) believe that due to the institutional constraints of loan interest rate control and abnormal development of the securities market, the public's expectation of returns on securities investment and fixed asset investment is inconsistent, which leads to the obstruction of the transmission mechanism of China's monetary policy.

In short, the current research literature on financial asset prices and their impact on macroeconomics is mainly based on traditional economic theories. In these analyses, the financial asset price is introduced as an exogenous variable, focusing on the analysis of its impact on the real economy variables, which makes the financial asset price free from the vision of economic theory and economic policy making. However, in recent years, the financial asset crisis and its impact on the overall economy have forced scholars and policy makers of various countries to face up to the "hidden meaning" of financial asset price changes.

Section 2 Cause analysis for the nonlinearity of financial asset prices

This part will analyze the fundamentals underlying the non-linear changes in financial asset prices. It is believed that the uncertainty of the anchored target and the non-uniform distribution of information lay the market foundation for the non-linear behavior of financial asset prices, while the motivation driven by anticipation in investment makes the inflation mechanism possible in the financial asset trading.

2.1 The anchored target of financial asset-the nonlinearity of the benchmark value

The uncertainty of the benchmark value is the basis of the non-linear change of financial asset prices. The value of a financial asset is different from the value of a physical commodity in that its value is determined by the present value of the future

income it can bring to the investor. We have

$$P_0 = \sum_{t=1}^{T} \frac{I_t}{(1+\rho_t)^t} + \frac{P_t}{(1+\rho_t)^t} \quad \textbf{(2.1)}$$

Let T be the holding period of the financial capital, P_t be the price of a financial asset at maturity， ρ_t be the discount rate, and I_t be the dividend income from period t.

Therefore, the benchmark value of financial assets depends on the change of future income, discount rate and future price. However, due to the uncertainty of future income, discount rate and future price, the benchmark value of financial assets faces great uncertainty.

Changes in the benchmark value of financial assets may come from:

1) Changes in expectations of future earnings, which may be caused by hidden fundamental changes that are not observed.

2) Changes in expectations of future long-term interest rates.

3) Changes in expectations about future changes in financial asset prices.

4) Changes in institutional factors such as financial liberalization or tax reform that are conducive to optimize the economic structure, thus drive up the price of financial assets;

5) Changes in risk appetite. Investors' judgment of risk may be influenced by the policy environment. Other things being equal, if people believe that the government is likely to step in to protect the stock market once the stock price falls, the risk premium required will be reduced, which sometimes causes the price of financial assets to rise.

2.2 The information in financial asset price formation

Since the price of financial assets is anchored in a series of expected values such as future returns, future long-term interest rates and future price changes, and investors' expectation stems from the current information and their existing knowledge. Therefore, information plays an extraordinary and particularly important role in the formation of financial asset prices.

The influence of information on the formation of financial asset prices is concentrated in four aspects: the completeness of information; Uniformity or symmetry of information; Differences in shared information; Information flow and learning process.

2.21 Completeness of information

The completeness of information mainly refers to whether the information set owned by the investor contains all the information of the investment object, such as historical price, earnings, macroeconomic data, etc.

In traditional financial theory, it is assumed that the information set for all investors is the same and they share the same common information. In this way, there will be no information advantage or disadvantage among investors, and no effect of information flow on transaction prices. Due to the same common knowledge, there will be no learning process among investors, and they will form a common value of financial asset prices, and all transactions will be carried out at such a same price. Actually, no transaction will occur in this case.

In reality, the completeness of information is an idealized hypothesis, which is impossible to achieve. The information set of each investor can only be a subset of the total information set, and the information set for different investors may be different. Each investor can only assess the future value of financial asset prices based on their own subset of information and make investment decisions. Because the information subset of each investor does not contain all the information of the total information set, investors are faced with a learning process of constantly absorbing other information and adjusting the original judgement and the price of financial assets is changing accordingly in the process.

2.22 Uniformity or symmetry of information

Since each investor has an incomplete information subset, the differentiation of information determines the differentiation of financial asset price evaluation.

Those investors with information advantage may take advantage of the pricing difference to carry out arbitrage trade and push the price toward the equilibrium, while the investors with information disadvantage will bear the trading loss in the process.

2.23 Differences in shared information

Traditional financial theory is based on the premise that there is no difference in obtaining and perception of the shared information. However, the differences in shared information among investors are not only often obvious, but also have a significant impact on price formation.

It is precisely the differences that make imitation behavior happen in investment and trading, and this kind of learning may develop into a collaborative behavior (herding effect). Some professional investors have distinct theoretical and empirical

advantages in obtaining and dealing with the shared information, and they can filter, screen and mining the information thoroughly to form a better evaluation on financial asset prices. On the other hand, the ordinary investors who are lack of information source as well as professional knowledge and experience suffer sever information disadvantage. Their judgement are formed mainly on the imitative learning and adaptive inference, which means that they adjust their investment and trading by imitating their previous investment or trading behavior. When this kind of imitative learning reaches a certain level as a group, it usually leads to herd effect.

2.24 Learning process and information flow

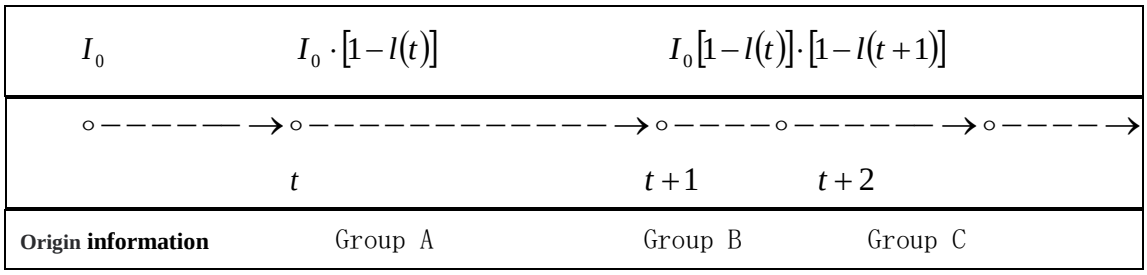
The learning process is a process in which investors, based on their own information subset, adjust their information, knowledge and behavior by observing the changes of external information sets.

In traditional financial theory, prices are instantaneously responsive to information. When a piece of information appears, it is immediately and fully reflected in the market price. This is based on the premise that supply and demand are infinitely elastic with respect to price, and that even an inside information known by only one person will set the market price to adjust immediately toward the equilibrium because of his unlimited buying and selling, regardless of whether others know the information or not. However, the assumption of instantaneous price response to information is unrealistic, and so is the assumption of infinite elasticity of supply and demand. Therefore, there is a transmission process of information in the market, which makes price changes and trading behavior to be sequential. The sequential usually appears to be a decaying process in a damped oscillation, but sometimes to be an overshooting process.

The exchange of information between people is a continuous flow process, and people are at different positions of this flow. Therefore the time to receive information, the degree of distortion and the loss of information are different, so are their reactions. As shown in Figure 2-1, assuming that the initial original information I_0 is transmitted to the first group after a period time of t, and the degree of information distortion is $l(t)$, then the information received by the group A is $I_0 \cdot [1 - l(t)]$. After a period time of $t+1$, it is transmitted next to the second group B, during which the information distortion degree is $l(t+1)$, then the information received by the second group B is

$I_0[1-l(t)]\cdot[1-l(t+1)]$.

Figure 2-1 Information Transmission and Distortion



Source: self-drawing.

At time of t, group A and group B are in a state of asymmetric information. A can make decisions based on the information available, while B can only infer what information A has, I_A, by observing A's behavior. At time of t+1, both A and B have information, but A's information is more accurate[5] than B's, and C has no information. So C can only predict information by observing the behavior of A and B.

The learning process is the basis for financial asset prices to follow a self-fulfilling positive feedback mechanism. After investors observe that the price of financial assets rises, they will form the expectation that the price will continue to rise and increase capital investment, so that the continuous inflow of funds will promote the price to rise further, and the price expectation can be self-realized. This feedback will further strengthen the learning process of investors, and then further form the expectation of price rise and increase capital investment. It is in this learning process that the self-actualization mechanism of financial asset prices is realized.

2.3 Micro trading mechanism of financial asset prices

2.31 Value-added effect in ‘zero-sum’ transactions without lending

When analyzing stock trading, a zero-sum trading assumption is usually employed that the gain of one part of the market will cause the loss of another part. In effect, when we apply a dynamic perspective to the transactions in a closed system, we will find that there will not always be a "zero-sum transaction", but may form a value-added effect, which is the micro-transaction basis for the formation of financial asset inflation.

[5]because $I_0\cdot[1-l(t)]\geq I_0[1-l(t)]\cdot[1-l(t+1)]$.

For example, there are 10 people, each has 10 USD dollars, A takes $1 to buy shares, and then sells $2 to B. B pays $2, sells it to C for $3, and then circulates the ninth person I who sells it to J for $10, thus the first round ends. See the picture below:

$$\overset{I}{\left(A \xrightarrow{2} B \xrightarrow{3} C \xrightarrow{4} D \xrightarrow{5} E \xrightarrow{6} F \xrightarrow{7} G \xrightarrow{8} H \xrightarrow{9} I \xrightarrow{10} J \right)}$$

In the second round, J sells the share to A for $11, $J \xrightarrow{11} A$ and then continue the selling in turn as shown in the following figure:

$$J \xrightarrow{11} A \xrightarrow{12} B \xrightarrow{13} C \xrightarrow{14} D \xrightarrow{15} E \xrightarrow{16} \cdots$$

Since there is no lending, A cannot sell the stock to B for $12. Because B only has $11 in cash. This round of transaction ends.

The final outcome is: A holds the stock purchased for $12, and has no cash in hand; the other nine held $11 each in cash and no shares, making a 10% profit. This profit comes from the cash portion of A. If the price of A's stock does not fall, he thinks he has made a profit.

2.32 The intervention of credit intensifies the volatility of financial asset prices.

1) The formation of financial asset prices in the presence of private lending

We consider a simple case first, assuming that only private lending is allowed to occur.

B might borrow $1 from anyone (except A) to buy the stock, and then sell it to C for $13. At this point, C only has $11 in cash, and in order to make the transaction, C can borrow $2 from anyone, and so on. See the figure below:

$$A \xrightarrow{12} B(1) \xrightarrow{13} C(2) \xrightarrow{14} D(3) \xrightarrow{15} E(4) \xrightarrow{16} F(5) \xrightarrow{17} G(6) \xrightarrow{18} H(7) \xrightarrow{19} I(8) \xrightarrow{20} J(9)$$

After completing the second round, the final outcome is: everyone realizes 20% profit, J holds the stock at 20 yuan. The total loan amount is: 1+... Plus 9 = 45$.

Let's proceed into the third cycle, private lending is still allowed to happen. At this time, the transaction can only occur until D, because the total loan amount has reached

91 $, leaving only 9 $ for lending, and if E wants to buy stocks, it needs to borrow 14 $, which cannot be satisfied. The transaction ends. See the figure below:

$$J \xrightarrow{21} A(10) \xrightarrow{22} B(11) \xrightarrow{23} C(12) \xrightarrow{24} D(13) \xrightarrow{25} E(14)$$

At this time, the final outcome is: A, B, C to achieve 30% profit, E, F, G, H, I, J to achieve 20% profit, D holds 24 $ of stock, borrowed 13 $. There's $9 left in cash, so the stock price can't go up.

But when the loan comes due, D will be forced to sell the stock at a low price of $23, a loss of $1. Consider the reverse order, $D \xrightarrow{23} C$ 。

C currently holds cash of 24 $ and liabilities of 12 $. After buying the stock, C holds 1 $ in cash, 12 $ in debt, and 23 $ in stock market value. C does not have enough cash to repay the debt, and when the loan is due, he has to sell the stock at a lower price.

So in reverse order, after C sells to B for $22, B has $1 in cash and $11 in liabilities. $B \xrightarrow{21} A$, A has $1 in cash and $10 in liabilities. $A \xrightarrow{20} J$, J has $1 in cash and $9 in liabilities. And so this round goes on until B sells to A for $11, with $1 in cash and $1 in liabilities, so he can pay off his liabilities. A doesn't have to be forced to sell, so the stock price might stabilize. See the figure below:

$$J(9) \xrightarrow{19} I(8) \xrightarrow{18} H(7) \xrightarrow{17} G(6) \xrightarrow{16} F(5) \xrightarrow{15} E(4) \xrightarrow{14} D(3) \xrightarrow{13} C(2) \xrightarrow{12} B(1) \xrightarrow{11} A$$

At this point, A buys the stock at $11, B,C,D,... J were armed with cash.

2) The price fluctuation of financial assets with the involvement of bank's credit

If there's A bank in the third cycle, A... .J deposited funds into the bank immediately after each transaction. Then A offers $1 from the bank to buy the stock followed by the same process, and then the sequential will be extended. The share price can also rise further until one of them has borrowed 100 $ (then the share price is 100 $), the bank can no longer meet the loan needs, and the debtor has to repay the loan, so the share price crashes, and the bank crisis happens.

It can be seen that the intervention of credit, especially bank credit, will aggravate the price inflation of financial assets, and often become the reason for triggering the sudden fall of financial asset prices.

2.4 The self-actualization mechanism of financial asset price expectation

2.41 Multiple equilibria of financial asset prices

Soros (1987), Cooper and John (1998) established a multiple symmetric Nash equilibrium model[6] under the game analysis method. It is believed that the behavior and strategies of all market investors are interactive.

The pricing mechanism of financial market in reality is different from the assumptions of neoclassical economics and classical micro-price theory of financial assets, which require a series of assumptions such as sufficient elasticity of prices and complete information of investors to achieve general equilibrium. However, the financial market in reality is not complete. Due to the limited rationality of investors, investors can only make decisions based on their own incomplete information and through the learning process in the interaction with the market.

According to the economic theory of institutional evolution, in the uncertain state, the behavior of economic agents is guided by their mental model, which depends on the cognitive structure of the actor and the institutional mechanism of the market. Therefore, the investment orientation is determined by the learning mode[7].

Assuming that the investor's cognitive variable of the market is y and the market state variable is x，then the interaction between the investor and the market can be expressed as a pair of iterative functions：

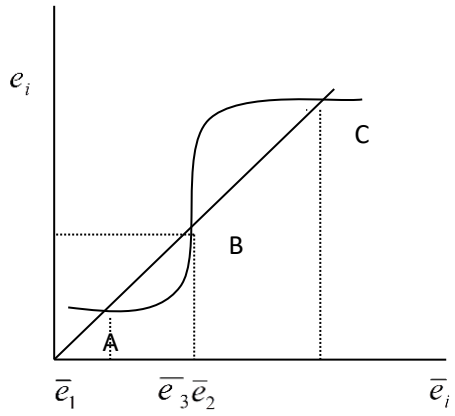
$$\begin{cases} x = g[f(x)] \\ y = f[g(y)] \end{cases} \quad \textbf{(2.2)}$$

Where: cognitive function y=f(x), indicating the learning process of investors; The participation function x=g(y) indicates the impact of investor behavior on the market.

This interaction leads to multiple equilibria in financial asset prices. See the figure below.

Figure 2-2 Multiple equilibria under interaction

[6] Or multiple symmetric uncooperative equilibrium model.
[7]Learning mode: stimulus → cognition → response mode.



Source: self-drawing.

2.42 The self-organizing mechanism of financial asset prices

Due to the uncertainty of the basic value of financial assets, the wide existence of information exchange, behavior imitation and learning process, investor behavior is much more complicated.

Firstly, this complexity manifests itself in price characteristics of financial assets in different time dimensions. In the short term, the price of financial assets appears to be a self-fulfilling positive feedback process, that is, the rise in the early period usually leads to the rise in the next period, and the fall in the early period leads to the fall in the next period. In the long run, the price of financial assets appears to be a self-correcting negative feedback process, that is, the price rises in one period will decline in the next period. In this way, financial asset prices in different time dimensions form a nested structure: a short-period positive feedback process is nested within a long-period negative feedback process.

Secondly, the main mechanism of this complex nested structure is the interaction effect of financial asset return rate and capital flow. In the short cycle, the rise in the rate of return of financial assets causes more funds to flow into the financial asset trading market, pushing the price of financial assets to rise further, and forming a short cycle of positive feedback process in turn. We have

$$\begin{cases} \dot{R}_f = f\left(R_f, M_f, \mu\right) \\ \dot{M}_f = g\left(R_f, M_f, \upsilon\right) \end{cases} \qquad \begin{cases} f_M > 0 \\ g_{R_f} > 0 \end{cases} \tag{2.3}$$

However, in the long run, due to the gradual absorption of capital flow, the external constraints of capital come into play. $\dot{M}_f$ begins to gradually decelerate， As a result,

the amount of capital inflow is not enough to support the growth of market value, resulting in a decline in the trading speed and the rise rate, and a decline in liquidity, which makes the growth rate of financial asset prices gradually decline, so that a turning point occurs and a self-correcting negative feedback process begins. we have

$$\begin{cases} \dot{R}_f = f\left(R_f, M_f, \mu\right) \\ \dot{M}_f = g\left(R_f, M_f, \upsilon\right) \end{cases} \qquad \begin{cases} f_M < 0 \\ g_M < 0 \end{cases} \tag{2.4}$$

$$\lim_{t \to T} \dot{M}_f = 0$$

Where T is time length of the long cycle.

Section 3 Nonlinear Model of Financial Asset Pricing

This part mainly discusses the mathematical characteristics of the price and quantity changes of financial assets.

Rational bubbles explain the reason why the market deviates from the basic economic conditions from the perspective of rational expectations and partial equilibrium. Hahn (1966), Samuelson (1967), Shell-Stiglitz (1967), Blanchard, Watson (1982), Granger-Swanson (1994) used the martingale process to solve the rational bubble solution. Blanchard and Watson (1982) established a "rational bubble model" under the efficient market hypothesis, and proved the endogenous problem of bubbles in efficient markets from the perspective of rational expectations. If there were no limit to the capacity of the market, the bubble would expand to infinity.

On this basis, Tirole (1985) added the hypothesis of rational bubbles into the overlapping generations model (OLG) and found that the existence of bubbles would eventually violate budget constraints and make the value of bubbles exceed the total social wealth. Bubbles can only exist in an economy where there is excessive accumulation of capital (interest rates below the rate of economic growth). Flood, R.P. and P. M. Garber (1986), West, K.K. (1986), Sargent and Wallace (1988), etc., also made further research on the theory of financial asset bubbles.

From the analysis above, we can see that there is an interactive mechanism between the price of financial assets and the inflow of funds. Therefore, we can build a continuous dynamic model represented by differential equations according to this interaction mechanism.

3.1 Second order differential equation model of financial asset price

Let R_f denote the return on financial assets. Let $\dot{R}_f$ denote the rate change of return on financial assets. Let M_f denote capital stock in financial asset market. Let $\dot{M}_f$ denote rate change of capital stock in financial asset market.

According to the previous analysis, we shall see the rate change of return on financial assets $\dot{R}_f$ is a function of R_f and $\dot{M}_f$. We obtain,

$$\dot{R}_f = f\left(R_f, \dot{M}_f, \mu\right) \qquad \textbf{(3.1)}$$

$\dot{M}_f$ is also a function of R_f and M_f. We obtain,

$$M_f = g\left(R_f, M_f, \upsilon\right) \qquad \textbf{(3.2)}$$

Where μ and υ are structural parameters.

The two equations are combined to form a system of differential equations:

$$\begin{cases} \dot{R}_f = f\left(R_f, M_f, \mu\right) \\ \dot{M}_f = g\left(R_f, M_f, \upsilon\right) \end{cases} \qquad \textbf{(3.3)}$$

Eliminate M_f and $\dot{M}_f$, the second order differential equation of R_f is obtained.

$$F\left(\ddot{P}_f, \dot{P}_f, \mu, \upsilon\right) = 0$$

According to the theory of differential equations with variable parameters, the solution of the equation set (3.3) is:

$$R_f = Ae^{\lambda_1 t} + Be^{\lambda_2 t} \qquad \textbf{(3.4)}$$

$$M_f = Ce^{\lambda_3 t} + De^{\lambda_4 t} \qquad \textbf{(3.5)}$$

Where, λ is the eigenvalue of the Jacobian matrix of the system (3.3).

The Jacobian matrix J is

$$J = \begin{pmatrix} \dfrac{\partial \dot{R}_f}{\partial R_f} & \dfrac{\partial \dot{R}_f}{\partial M_f} \\ \dfrac{\partial \dot{M}_f}{\partial R_f} & \dfrac{\partial \dot{M}_f}{\partial M_f} \end{pmatrix}$$

If we choose，

$$p = -trJ = -\left[\frac{\partial \dot{R}_f}{\partial R_f} + \frac{\partial \dot{M}_f}{\partial M_f}\right]$$

$$q = \det J = \frac{\partial \dot{R}_f}{\partial R_f} \cdot \frac{\partial \dot{M}_f}{\partial M_f} + \frac{\partial \dot{R}_f}{\partial M_f} \cdot \frac{\partial \dot{M}_f}{\partial R_f}$$

Then the eigenvalue λ satisfies the following eigenequation，

$$\lambda^2 + p\lambda + q = 0 \qquad \textbf{(3.6)}$$

The eigenvalues obtained are

$$\lambda_{1,2} = -\frac{p}{2} \pm \sqrt{\frac{p^2}{4} - q} \qquad \textbf{(3.7)}$$

3.2 Stability analysis and topological structure of financial asset price

3.21 Stability analysis of financial asset price

If the fixed point is (R_f^*, M_f^*), then

1) If the real part of root λ, Re λ>0, the financial asset prices described in equation (3.3) will diverge exponentially. In the vicinity of the fixed point (R_f^*, M_f^*) is unstable, and small perturbations such as δR_f and δM_f are bound to be amplified exponentially.
2) If the real part of root λ, Re λ<0, the financial asset prices described in equation (3.3) will decline exponentially. In the vicinity of the fixed point (R_f^*, M_f^*) is stable, trace perturbations such as δR_f and δM_f will not only not expand, but also they will exponentially converge to the fixed point.

3.22 Topological structure of financial asset price

The financial asset prices described in equation (3.3) are topologically expressed as a set of attractors on the phase plane.

1) In the first quadrant (p>0, q>0), the price and quantity of financial assets are stable, and their final state will be to reach an equilibrium point, whose

topology is a stable attractor (confluence or stable focus).

2) In the second quadrant (p<0, q>0), the price and quantity of financial assets are unstable, their final state will be divergent, and their topology is the focus or source point of instability.
3) In the third and fourth quadrants (p<0, q<0), the price and quantity of financial assets are semi-stable states, and their final states are inward regression in one direction and outward dispersion in the other direction, whose topological structure is the saddle point.

On the parameter (p,q) plane, the p-q coordinate plane is divided into 5 parts according to the two coordinate axes(p = 0 and q = 0)and the curve $p^2 = 4q$. In these five regions, the topological distribution of the final state of financial asset prices is shown in Figure 3-1.

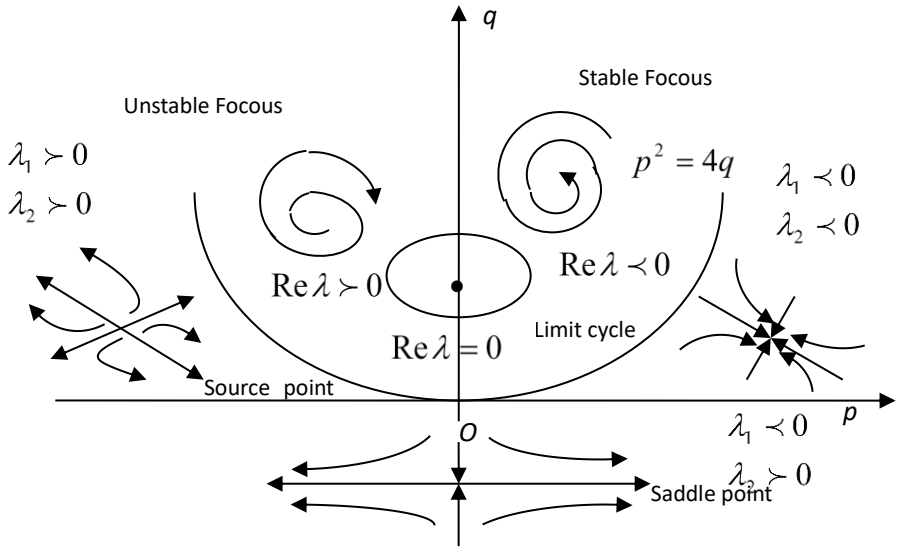


Figure 3-1 Topology of the final state of financial asset prices

Source: self-drawing.

3.3 Financial asset price changes and its topology analysis

By analyzing the change process of financial asset price and its topological structure, we can clearly understand the nonlinear characteristics of financial asset price and quantity. The Financial asset prices will undergo the following six phases of evolution.

The first phase: The initial period of financial asset price rise.

In the initial period, the initial rise in prices often prompts investors to form expectations of further rises, thus guiding the increase of capital inflows, which means $\frac{\partial \dot{M}_f}{\partial P_f} \succ 0, \frac{\partial \dot{P}_f}{\partial P_f} \succ 0, \frac{\partial \dot{R}_f}{\partial M_f} \succ 0$, and $\frac{\partial \dot{M}_f}{\partial M_f} \succ 0$.

We obtain $p = -\left[\frac{\partial \dot{R}_f}{\partial R_f} + \frac{\partial \dot{M}_f}{\partial M_f}\right] \prec 0,$, and this makes the q indeterminate. So in the first stage, the return on financial assets R_f and M_f stay in the unstable region or the saddle point region and they will diverge. Topologically, it appears as a spiral structure gradually spiraling out in the second quadrant, as shown in Figure 3-2.

The second phase:

The convergence of investors' cognition leads to the acceleration of capital inflow and the market enters a mania period, which means $\frac{\partial \dot{R}_f}{\partial R_f} \succ 0$ and $\frac{\partial \dot{R}_f}{\partial M_f} \succ 0$. The capital inflows have also increased further, which means $\frac{\partial \dot{M}_f}{\partial R_f} \succ 0$ and $\frac{\partial \dot{M}_f}{\partial M_f} \succ 0$.

We obtain $p \prec 0$ and it starts to get bigger and bigger, which makes q indeterminate. Topologically, it appears as a spiral structure gradually spiraling out in the second quadrant, and gradually begins to move toward the first quadrant as the value p increases in the later period. See Figure 3-2.

The third phase:

As peripheral capital declines, capital constraints come into play and the inflows capital declines, which means $\frac{\partial \dot{R}_f}{\partial R_f} \prec 0, \frac{\partial \dot{R}_f}{\partial M_f} \prec 0, \frac{\partial \dot{M}_f}{\partial M_f} \prec 0$.

We obtain $p \succ 0$ and $q \succ 0$. Topologically, it appears as a gradually inward spiral structure after passing through the vertical axis from the second quadrant.

The fourth phase:

Capitals begin to flow out while yields are still rising but with a decelerating rate,

which means $\frac{\partial \dot{R}_f}{\partial R_f} \prec 0$, $\frac{\partial \dot{M}_f}{\partial M_f} \prec 0$, $\frac{\partial \dot{M}_f}{\partial R_f} \prec 0$. We obtain $p \succ 0$ and $q \succ 0$. Topologically, it appears as a spiral structure with gradual inward precession.

The fifth phase：

The rate of return on financial assets fell rapidly, and a large amount of capital flowed out, which means $\frac{\partial \dot{R}_f}{\partial R_f} \prec 0, \frac{\partial \dot{M}_f}{\partial R_f} \prec 0, \frac{\partial \dot{R}_f}{\partial M_f}, \frac{\partial \dot{M}_f}{\partial R_f}$. we obtain $p \succ 0$ and $q \succ 0$. Topologically, it appears as a spiral structure with gradual inward precession.

The sixth phase:

Either the outflow of capitals or the decline of yield rate begins to decelerate, which means $\frac{\partial \dot{R}_f}{\partial R_f} \prec 0$ and $\frac{\partial \dot{M}_f}{\partial R_f} \prec 0$, which means $p \succ 0$. However, as the value p decreases at the late stage, it appears topologically as a spiral structure that gradually turns inward, begins to move to the left, and eventually crosses the vertical axis.

3.4 Financial asset price topological structure change -- Bifurcation

From the analysis above, it can be seen that in different stages, the change of financial asset return rate and capital flow leads to hyperbolic destruction[8] of the eigenvalue λ of the Jacobian matrix, then the points located in the second, third and fourth quadrants of the p-q plane may enter the first quadrant, and the stability of financial asset prices will change. See Figure 3-2.

[8] Change from $\lambda_1\lambda_2 > 0$ to $\lambda_1\lambda_2 < 0$.

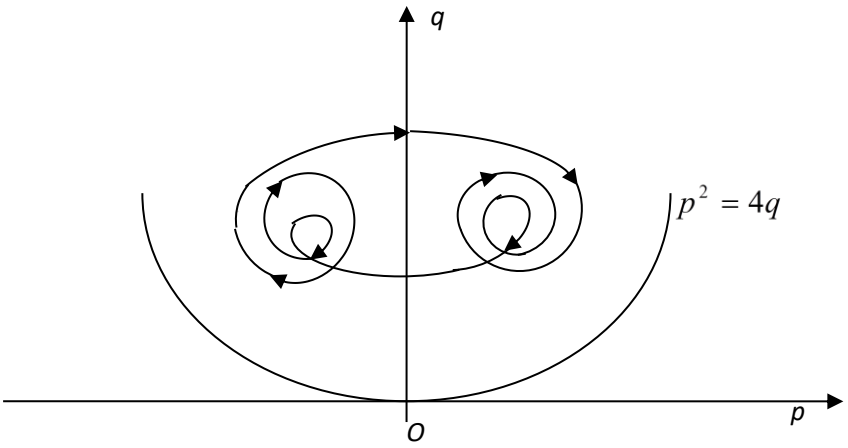


Figure3-2 Anti-hope Bifurcation

Source: self-drawing.

3.41 Anti-hope bifurcation

In the initial state, if the return rate of financial assets and the change of funds are in the second quadrant of the p-q plane, the system will gradually spiral out with the increase of $\dot{R}_f$ and $\dot{M}_f$. And when the rate of change reaches an extreme value, it begins to move to the right. At this time, the financial asset prices are gradually fluctuating upward.

When it comes exactly on the vertical axis and Re λ=0, $e^{\pm iat}$ is the form of the solution of the system. The price of financial assets will be in a cyclical movement, and the price of financial assets moves in a circle with the fixed point $\left(P_f^*, M_f^* \right)$ as the center. At this time, the financial asset prices will oscillate at a high level.

When the q axis continues to push to the right, the system will be in a state of inward spiral motion. At this time, the financial asset prices are gradually fluctuating downward.

3.42 Reverse saddle-knot bifurcation

If the rate of return on financial assets and the change in funds are within the fourth quadrant of the p-q plane in the initial state, the system will cross the horizontal axis

(p-axis) with the increase of $\dot{R}_f$ and $\dot{M}_f$. At this time, the whole system will gradually evolve from the saddle point located below the horizontal axis($p = 0^-$)into the confluence point [9]above the horizontal axis($p = 0^+$). This transition of financial asset prices from the semi-stable saddle-point to the stable confluence-point is called the reverse saddle-knot bifurcation.

3.43 Source-sink bifurcation

If the return rate of financial assets and the change of funds are located on the curve $p^2 = 4q$ in the initial state, the eigenvalue λ of the Jacobian matrix J will be the double root, i.e. $\lambda_{1,2} = -\frac{p}{2}$.

When the initial state is in the first quadrant ($p \succ 0$), which means $\lambda < 0$, and the final state of financial asset prices is attracted to the fixed point, which is a convergence point. When the initial state is in the second quadrant ($p \prec 0$), which means $\lambda > 0$ and then the price of financial assets is repulsed and diverge from the fixed point, and the fixed point becomes a source point.

This is the special case studied by rational bubble theory.

Section 4 Extended Keynes model: FM-IS-LM

In the traditional macroeconomic theory, there are actually only non-tradable financial assets (deposits, bonds), and investors' investment motivation is limited to the holding income of financial assets, but they fail to consider the transaction motivation brought by the change of capital gains on financial assets.

In the age of the Keynesian model, the proportion of financial assets in the economic system is relatively low, and the impact of changes in the price and quantity of financial assets on the overall economy exists, but in general it’s limited, so the variables such as price or output can basically describe the overall economic state.

However, with the change of economic reality, this analysis basis must be

[9] $\lambda_1 = -\varepsilon$（ε is an extremely positive number）and $\lambda_2 = -p$.

improved in the modern economic structure. At present, the proportion of financial assets in the world's major economies has reached a fairly high proportion. In the table below, which compares equity assets to household disposable income, the ratio has reached more than 100% for countries such as the United Kingdom, the United States and Canada, where direct financing is dominant.

Table 4-1 Share of residents' stock assets to disposable income

Country	1990	1995	1999
Canada	54	72	94
France	87	85	183
Germany	12	42	78
Japan	49	40	33
UK	57	76	111
USA	52	97	174

Source：OECD，Economic Outlook 68, 2000.12

As a result, changes in the price and quantity of financial assets have an increasing impact on the overall economy and are often the source of fluctuations in the overall economy. For example, the Japanese economic crisis in the 1990s occurred in the "good" state of relatively stable prices and balanced economic growth, and the "financial asset crisis" triggered the financial crisis, which led to the overall economic recession. Similarly, the 1997 Asian financial crisis and Subprime crisis also originated from the financial assets crisis.

In order to make a comprehensive analysis of the price changes of financial assets and their impact on the economy, there should be an extension to the traditional economic theoretical model, into which the tradable financial assets will be incorporated. Therefore, the new extended model established here is a general equilibrium model that includes four markets: financial asset trading market, money market, commodity market, and human resources market[10].

4.1 Partial equilibrium analysis of each market

4.11 Equilibrium of tradable financial asset market

The financial asset prices have different characteristics in different time

[10] We leave aside the human resource market here.

dimensions. In the short term, the price of financial assets appears to follow a self-fulfilling positive feedback process. In other words, after the initial rise in the price of financial assets, the return rate of financial assets R_f will increase, and the original equilibrium will be broken, so the monetary total will be reallocated, and part of the capital will flow into the financial asset trading market, which will further increase the price of financial assets and further expand the quantity. At the same time, such fund reallocation may lead to the contraction of the real economy. At this time, if the monetary authorities increase the money supply in accordance with the traditional economic theory to stimulate the recovery of the real economy, since the return rate of financial assets exceeds the return rate of investment in the real economy, the increased money will mainly flow to the financial asset trading market, resulting in further expansion of financial assets.

However, in the long run, the price changes of financial assets follow a negative self-correcting process. The main reason is that there are limits to monetary overexpansion. When the monetary expansion slows down, the flow of funds into the financial asset trading market will also slow down to the point that it will not be enough to support the further growth of financial asset prices, and then the expected return on financial assets will reverse (see Figure 4-1, 4-2).

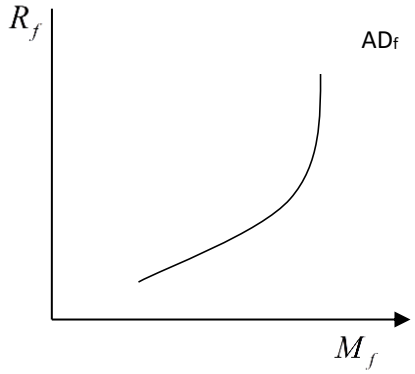


Figure 4-1 Demand function for financial assets

Source: self-drawing.

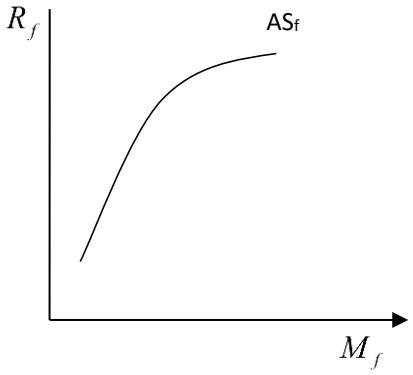


Figure 4-2 Supply function for financial assets

Source: self-drawing.

Secondly, when the financial asset trading market reaches partial equilibrium (see Figure 4-3), it is represented by multiple equilibria. It means that the AD_f and the AS_f have at least two points of intersection E_A, E_B. The low equilibrium point E_A, usually represents the low-level equilibrium of the financial asset market. The high equilibrium point E_B usually represents the high-level equilibrium of the financial asset market.

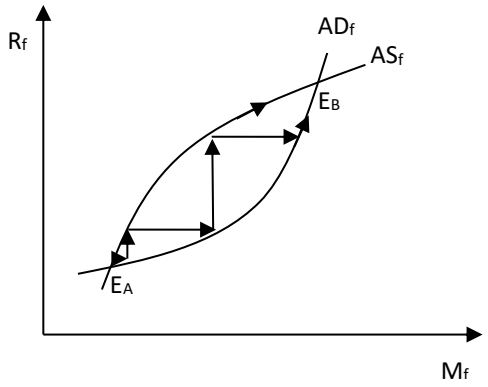


Figure4-3 Equilibrium of tradable financial asset market

Source: self-drawing.

4.12 Equilibrium of commodity market

The model continues to follow the IS curve analysis method of Keynesian theory. When the point (i, y) is on the IS curve, the supply and demand in the commodity

market reach an equilibrium (see Figure 4-4).

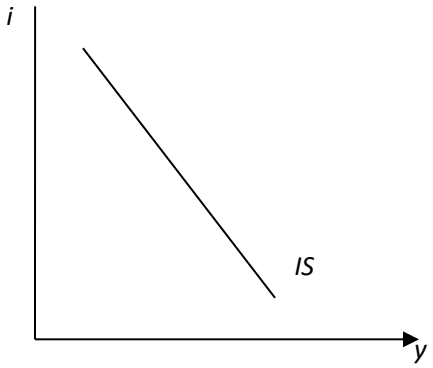


Figure 4-4 Equilibrium of commodity market

Source: self-drawing.

4.13 Equilibrium of money market

Due to the existence of tradable financial assets, the analysis of money market equilibrium needs to be greatly expanded.

In traditional macroeconomic theory, it limits investors' investment motivation to the holding income of financial assets, and fails to consider the transaction motivation caused by the capital gains from trading. Therefore, the financial assets in its model are actually only non-tradable financial assets (deposits). This makes the speculative motive of investors only related to the change of interest rate, and has nothing to do with the change of its trading price.

Therefore, in traditional economic theory, the demand for money is only related to output and interest rates, and has nothing to do with the transaction price of financial assets. To wit. We obtain

$$L(i,Y) = L_1(Y) + L_2(i) \qquad \textbf{(4.1)}$$

Under this assumption, when the interest rate i falls, the speculative demand for money falls, money flows out of non-tradable financial assets and enters the real economy to promote the growth of the real economy. When i rises, speculative demand for money rises, money flows out of the real economy to buy non-tradable financial assets, and real economic growth decelerates.

However, with the rapid development of tradable financial assets, the capital gains coming from financial asset transaction have an increasing impact on investors' investment motivation. In this case, the investor's investment motivation for financial assets no longer depends only on the holding income, but also depends on the capital gains. So we obtain

$$L_2 = L_2(i, R_f)$$

For the convenience of analysis, L_2 can be further devided into the money demand for investment in non-tradable financial assets $L_2(i)$ and the money demand for investment in tradable financial assets $L_3(R_f)$.

Therefore, considering the money demand for investing in tradable financial assets, the money demand function extends to be

$$L(Y, i, R_f) = L_1(Y) + L_2(i, R_f) = L_1(Y) + L_2(i) + L_3(R_f) \quad \textbf{(4.2)}$$

In this case, the changes in the money demand function tend to be complicated. When the interest rate i falls, on the one hand, the demand for money to invest in non-tradable financial assets $L_2(i)$ falls, and money flows out of the non-tradable financial asset market. On the other hand, the decline of interest rate i promotes the rise of financial asset prices. Since the time lag of the change of capital gains rate in tradable financial assets is shorter than the change of return rate of investment in real economy, the demand for the money invested in tradable financial assets $L_3(R_f)$ rises rapidly, attracting funds to enter the financial asset trading market. And since the change of $L_1(Y)$ is difficult to determine, the change of investment I in commodity market is also difficult to determine.

When the interest rate i rises, the increase in interest rate i forces the transaction price of financial assets to fall, the return on capital gains of tradable financial assets drops sharply, and the demand for currency in financial asset transactions $L_3(R_f)$ declines. Funds will flow out of the financial asset transaction market, which may flow to non-tradable financial assets or to the real economy.

This complexity can be further seen in a dynamic analysis of changes in the

currency market.

Suppose that the money market is in equilibrium initially, we obtain

$$L(\cdot) = M^S$$

Taking the full differential of (4.2), there is

$$dL(\cdot) = L_y \cdot dy + L_i \cdot d_i + L_{R_f} \cdot dR_f \qquad \textbf{(4.3)}$$

Considering the externality of the money supply, we suppose M^s is constant and we obtain

$$dL(\cdot) = L_y \cdot dy + L_i \cdot d_i + L_{R_f} \cdot dR_f = 0 \qquad \textbf{(4.4)}$$

Where, $L_y \succ 0$, $L_i \prec 0$, $L_{R_f} \succ 0$.

1) Consider that output y is unchanged in the short run ($dy = 0$), so the monetary transaction demand of the real economy is unchanged, i.e. $dL(y) = 0$, So we obtain

$$L_i di + L_{R_f} dR_f = 0 \qquad \textbf{(4.5)}$$

$$\frac{dR_f}{di}\Big|_{dy=0} = -\frac{L_i}{L_{R_f}} \succ 0 \qquad \textbf{(4.6)}$$

Therefore, under the condition of constant output in the short run, the slope of the money demand curve $LM|_y$ is greater than 0, and the curve slopes to the upper right (see Figure 4-5).

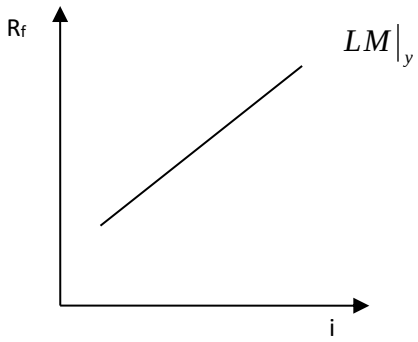


Figure 4-5 Monetary equilibrium curve with constant short-term output

Source: self-drawing.

2) If interest rate i is unchanged, $di = 0$,then we obtain

$$L_y d_y + L_{R_f} dR_f = 0 \quad \textbf{(4.7)}$$

$$\frac{dR_f}{dy}\Big|_{di=0} = -\frac{L_y}{L_{R_f}} \prec 0 \quad \textbf{(4.8)}$$

Therefore, under the condition of constant interest rates, the slope of the money demand curve is less than 0, and the curve $LM|_i$ slopes to the lower right (Figure 4-6).

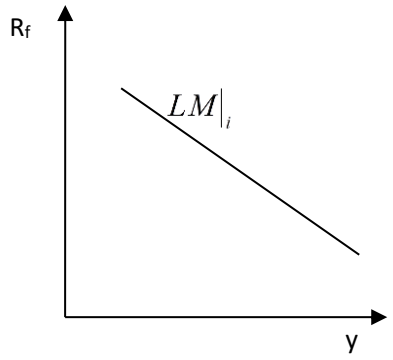


Figure 4-6 Monetary equilibrium curve with constant interest rate

Source: self-drawing.

3）If the return rate of financial assets R_f is unchanged, and $dR_f = 0$, then (4.4) is simplified to the traditional economic model, we obtain

$$L_y dy + L_i di = 0 \Rightarrow \frac{dy}{di}\Big|_{R_f} = -\frac{L_i}{L_y} > 0 \quad \textbf{(4.9)}$$

Under the condition of a constant return rate of financial assets, the slope of the money demand curve $LM|_{R_f}$ is greater than 0, and the curve slopes to the upper right (see Figure 4-7).

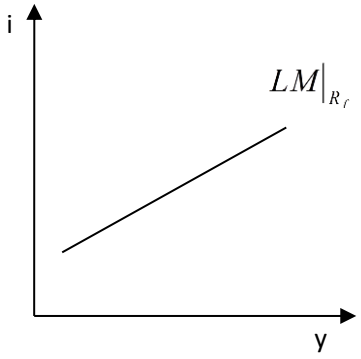


Figure 4-7 Monetary equilibrium curve with constant return on financial assets

Source: self-drawing.

4.2 General equilibrium analysis - FM-IS-LM Model

In order to analyze the general equilibrium of the total economy and incorporate the financial asset market as a part of a unified macro equilibrium analysis, the supply and demand functions and equilibrium conditions of the financial asset market, commodity market and money market should be first established.

4.21 Financial asset market

The demand of buyers is mainly related to the return rate of tradable financial assets R_f and the money stock in the tradable financial assets market M_f, which can be expressed as

$$AD_f = f(R_f, M_f) \quad \textbf{(4.10)}$$

The willingness of sellers is also mainly related to the return rate of tradable financial assets R_f and the money stock in the tradable financial assets market M_f, but the function is different, which can be expressed as

$$AS_f = g(R_f, M_f) \quad \textbf{(4.11)}$$

The equilibrium condition is that the buyer's demand can be matched with the seller's willingness. We obtain

$$AD_f = AS_f \quad \textbf{(4.12)}$$

4.22 commodity market

We are here use the traditional economic theory model.

Total supply is $Y = Y(\cdot)$ **(4.13)**

Total demand is $E = C + I + G$ **(4.14)**

The equilibrium condition is $Y = E = C + I + G$ **(4.15)**

4.22 Money market

According to the allocation of money stock in different markets, the money stock is divided into two parts as below

$$M^s = M_r^s + M_f^s \quad \textbf{(4.16)}$$

Where, M_r is the money stock existing in the real economy, and M_f is the money stock existing in the financial asset market.

Similarly, the demand for money can be divided as below

$$L(y,i,R_f) = L_r + L_f = L_1(y) + L_2(i) + L_3(R_f) \quad \textbf{(4.17)}$$

The equilibrium condition of money market is：

$$M^s = M_r^s + M_f^s = L = L_1 + L_2 + L_3 \quad \textbf{(4.18)}$$

In order to compare with the IS-LM model, the FM-IS-LM framework diagram can be established on the basis of the above functions (see Figure 4-8).

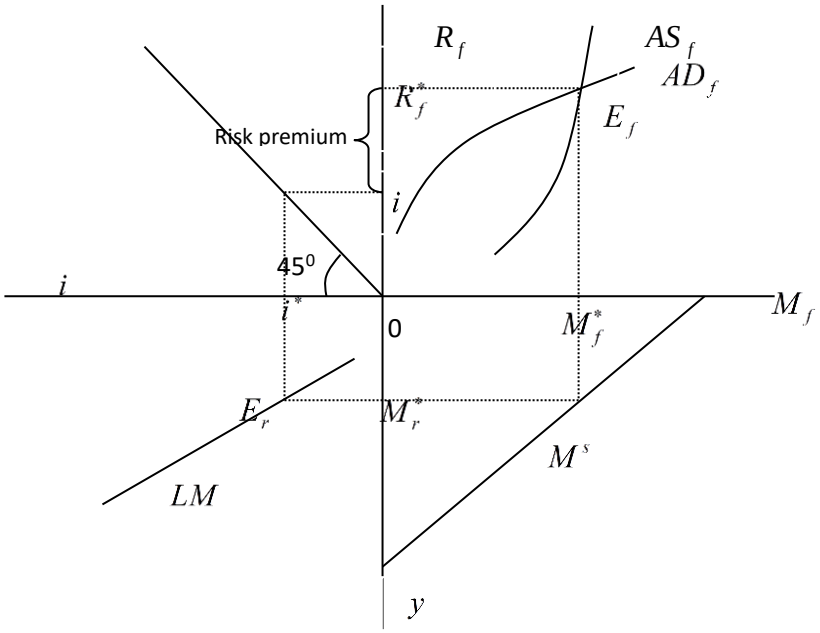


Figure 4-8 General equilibrium analysis including financial asset market

Source: self-drawing.

From Figure 4-8, we can see that when the financial asset trading market reaches the equilibrium state E_f, the equilibrium value of the financial asset return rate is R_f^*, and

the currency demand in the financial asset trading market is M_f^*; If at the same time the money market also reaches equilibrium M^s, and the corresponding money demand of the real economy is M_r^*; when the M_r^* is determined, the equilibrium state E_r in the real economy will have a corresponding output, so the corresponding equilibrium interest rate i^* is determined by the curve LM.

In the second quadrant, the 45^0 line will be used to refract the i^* to the axis R_f, and you can see that there is a difference between R_f^* and i^*, which is usually the risk premium of the financial asset.

4.3 Financial asset inflation, financial asset crisis and FM-IS-LM analysis

4.31 Time series analysis of accommodative monetary policy

When the central bank adopts accommodative monetary policy (cutting interest rate i and increasing money supply M^s), in the short term, due to the difference in response time between the dynamic characteristics of the return rate of financial assets and the return rate of the real economy, the return rate of financial assets rises rapidly, while the return rate of the real economy does not change significantly.

In the financial asset trading market, the increase in the return rate of financial assets drives the demand function curve of financial assets AD_f to move to the right, and the equilibrium moves from E_1 to the upper right E_2. The rate of return of financial assets increases to R_{f_2}, at the same time more funds are attracted into the financial asset trading market, and the funds in the financial asset trading market increase from M_{f_1} to M_{f_2} (Figure 4-9).

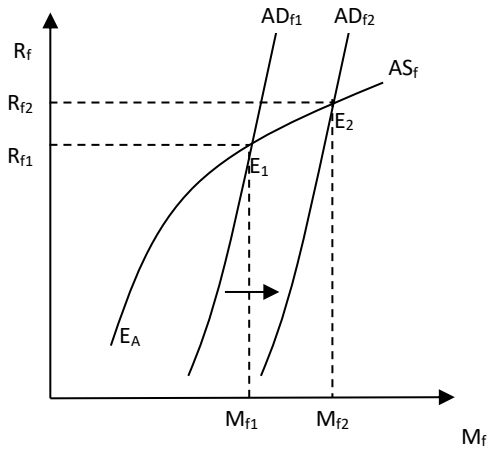


Figure 4-9 Financial asset inflation

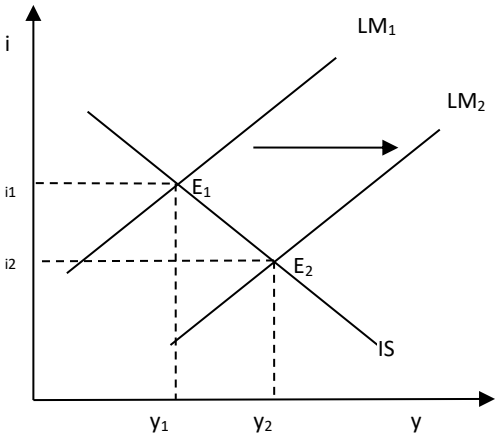


Figure 4-10 Growth of output

Source: self-drawing.

Due to the scale of financial assets and the degree of financial asset inflation vary from country to country, the impact of this change on the real economy is discrepant and there may be three different scenarios.

Scenario 1 If the increase ΔM^s in the money supply M^s is greater than the increase of money in the financial asset trading market ΔM_f, some of the money flows into the real economy ($\Delta M_r = \Delta M^s - \Delta M_f \succ 0$). This causes the LM curve in the real economy to shift to the right, while the IS curve remains unchanged in the short run, which leads to a further decline in interest rates and an increase in output from Y_1 to Y_2. In this case, there is not only an expansion of financial assets, but also growth of the real economy, that is, a dual growth (see Figure 4-10).

Scenario 2 If the increase ΔM^s of money supply M^s is less than the increase of capital ΔM_f in the financial asset trading market, a part of the capital flows out of the real economy and enters the financial asset trading market, so the LM curve in the real economy moves to the left, the interest rate rises, and the output also falls from Y_1 to Y_2, and the real economy shrinks. In this case, the economic system is in a state of financial asset inflation and deflation (Figure 4-11).

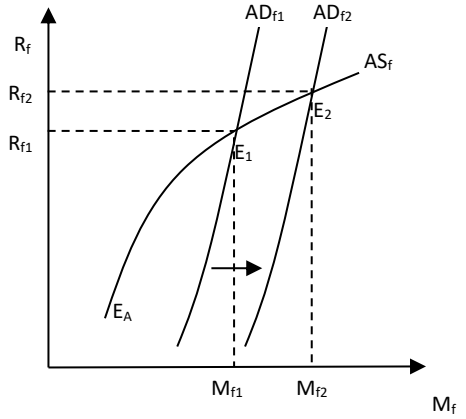


Figure 4-11 Financial asset inflation

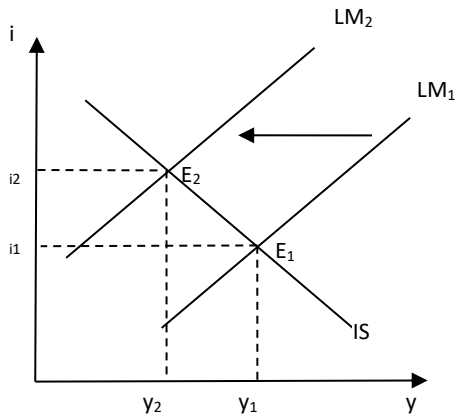


Figure 4-11b Deflation in real economy

Source: self-drawing.

Scenario 3 If the increase ΔM_s of money supply M^s is close to the increment of funds in the financial asset trading market ΔM_f, it means that the increased money supply mainly flows into the financial asset trading market, but has no obvious impact on the real economy, so the LM curve and the IS curve are basically unchanged, and prices may remain unchanged or rise slightly. In this state, the financial asset inflation coexists with the stability of the real economy[11].

In the short and medium term, there is a positive self-reinforcing effect on financial asset prices. From the above analysis, it can be seen that when the accommodative monetary policy is implemented, the increase in the overall monetary stock of the real economy $\Delta M^s \succ \Delta M_f$ is much greater than the inflow of funds in the financial asset trading market ΔM_f in the initial stage, that is, so a considerable part of funds flows into the real economy $\Delta M^s \succ \Delta M_f$, and the increase in the monetary stock in the real economy M_r causes the LM curve to shift to the right. In the short run, the IS curve changes little, so output increases from y_1 to y_2, while interest rates fall from i_1 to i_2 (Figure 4-12).

The endogenous easing effects caused by further declines in interest rates i and further increases in the money supply M^s have stimulated further increases in financial asset returns and in the stock of funds in financial asset markets (see Figure 4-13). The

[11]The situation can be seen in Japan from 1987 to 1990.

demand function for financial assets AD_f is further moved right from AD_{f2} to the position AD_{f3}. At this time, the rate of return of financial assets R_{f_2} further rises to R_{f3}, and the stock of money in the financial asset trading market also increases from M_{f2} to M_{f3}.

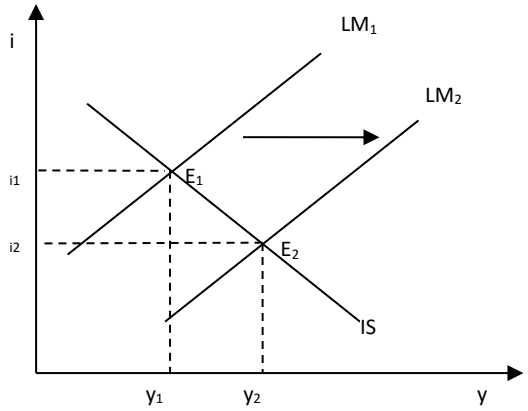


Figure 4-12 Short-term expansion effect of real economy

Source: self-drawing.

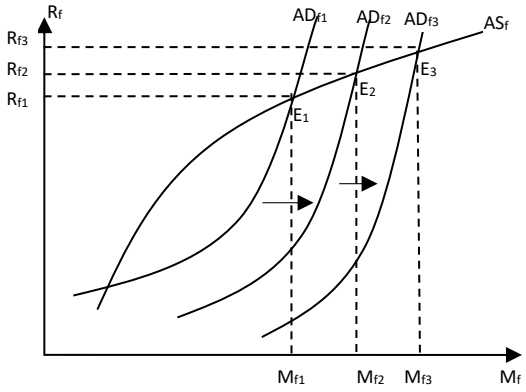


Figure 4-13 Short-term positive feedback effect of financial asset market

Source: self-drawing.

In the long run, the price changes of financial assets are subject to a negative self-correcting mechanism. Over a longer period of time, the supply will get adjusted and the IS curve moves right, making the equilibrium point to $E_1^{'} \rightarrow E_2^{'}$. In the real economy,

output increases Y_1 from to Y_2, while interest rates rise i_1 from to i_2 (Figure 4-14).

The rise of interest rate i leads to a decline of M^s through the signal effect and the inner tightening of money supply, which causes the trading price of financial assets to fall, and the return rate of financial assets R_f to decrease accordingly, as shown in Figure 4-15, the curve shifts to the left from AD_f to E_3 (Figure 4-15).

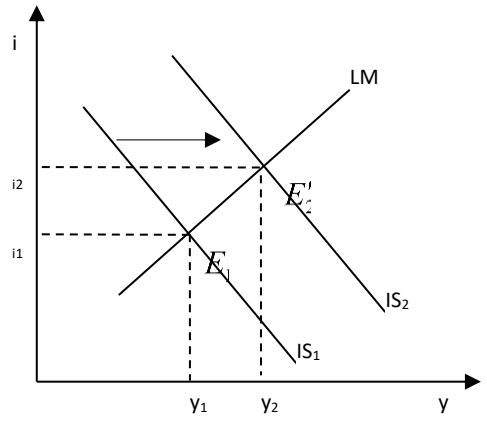


Figure 4-14 Long-term changes in the real economy

Source: self-drawing.

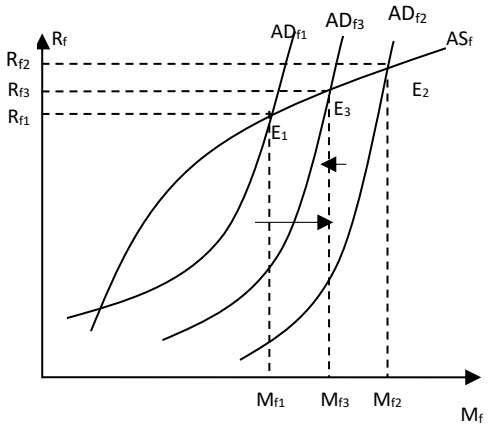


Figure 4-15 Long-term negative feedback effect of financial assets

The difference in the price change of financial assets will lead to two different situations in the real economy. One scenario is a slow and sustained decline in the rate of return on financial assets R_f, which will lead to a gradual outflow of funds from the

financial asset trading market to the investment and consumption in the real economy, thus promoting the rapid increase in investment demand in the real economy and driving the growth of the real economy and rising prices. The economy is exhibiting a combination of financial asset deflation and inflation.

In the other case, financial asset prices suddenly collapse (Figure 4-16). The demand function curve AD_f of financial assets fell sharply from AD_{f2} to the position AD_{f3}, the demand willingness of financial assets shrank sharply, and the price of financial assets fell indefinitely, resulting in the inability to withdraw funds in the financial asset market. Meanwhile, the financial situation of enterprises deteriorated and a large number of bad debts appeared in banks, which resulted in a sharp reduction in the endogenous money supply.

In this case, on the one hand, in order to avoid a liquidity crisis, banks are forced to shrink credit, not only does the capital flowing out of the financial asset trading market stay in the banking system instead of entering the real economy, but also even the monetary authorities' endeavor to increase the money supply to get rid of this situation will be ineffective because of the banks' eagerness to increase liquidity. On the other hand, due to the double impact of the deterioration of the financial situation of enterprises and the tightening of bank credit, the investment demand has declined sharply, and household consumption has also declined due to the pressure of consumer credit (Figure 4-17).

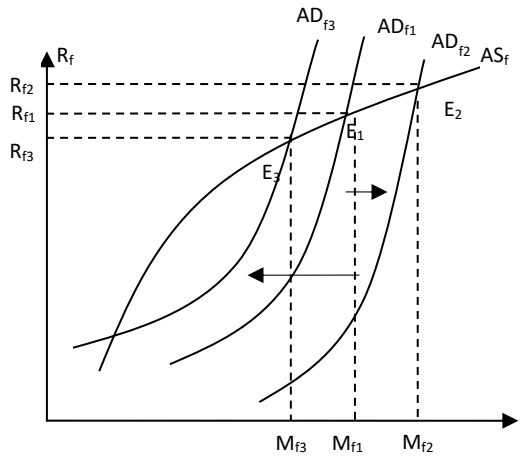


Figure 4-16 Rapid decline in the return on financial assets

Source: self-drawing.

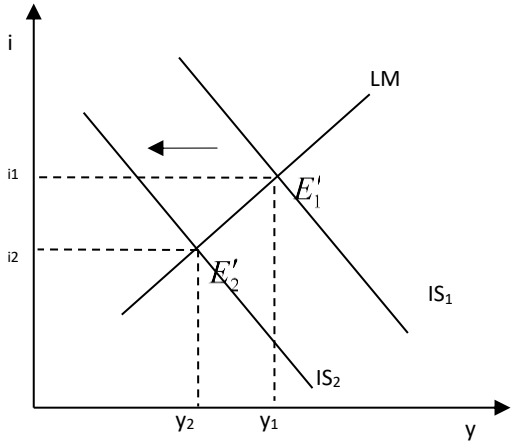


Figure 4-17 Big shock on the real economy

Source: self-drawing.

4.32 Time series analysis of tight monetary policy

When the central bank implements tight monetary policies (raising interest rates and reducing money supply), due to the short time lag of the change of financial asset prices, the price of financial assets will adjust immediately and the return rate of financial assets will decline. At the same time, funds began to flow out of the financial asset trading market, which shifted the curve of the financial asset demand AD_f left from AD_{f1} to AD_{f2} (see Figure 4-18).

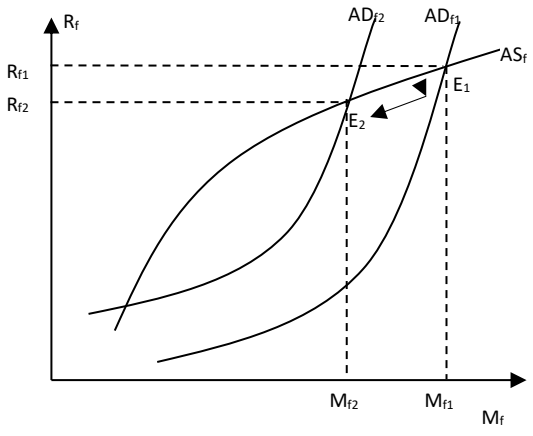


Figure 4-18 Impact of tight monetary policy on financial asset markets

Source: self-drawing.

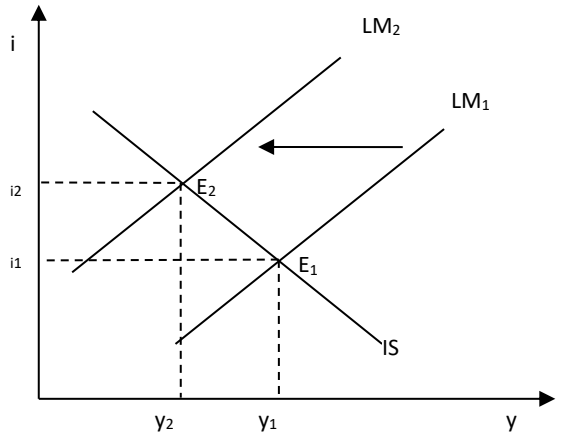


Figure 4-19 Contraction of financial assets leading to contraction of real economy

Source: self-drawing.

The impact of changes in the financial asset trading market on the real economy can be divided into two scenarios due to the different structure of capital flow.

Scenario 1 (Figure 4-19) If the overall decrease ΔM^s in the money supply M^s is greater than the decrease of money in the financial asset trading market ΔM_f [12], then in the real economy, a left shift of the LM curve leads to lower output, lower prices, and higher interest rates. Therefore, the contraction of financial assets will lead to the contraction of the real economy and a state of "double contraction"[13]will happen.

Scenario 2 (Figure 4-20). If the overall decrease ΔM^s in the money supply M^s is less than the decrease of money in the financial asset trading market ΔM_f, it means that some of the money flowing into the real economy from the financial asset trading market. The incremental money in the real economy pushes the LM curve to the right, resulting in an increase in output, a rise in prices, and a gradual decline in interest rates. The real economy has gradually entered a state of recovery and even inflation. There will be a mild inflation caused by the contraction of financial assets[14].

- [12]The money supply in the real economy M_r has also fallen.

[13]There have been many times in history, such as the Great Depression caused by the stock market crash in the United States in the 1920s and 1930s, which leaded to a double contraction which has lasted for more than a decade. The most recent example is the sustained depression of Japan in the 1990s, triggered by asset-price deflation, which has also lasted for more than a decade.

[14]This usually occurs during the slow contraction of financial assets that follows the expansion of

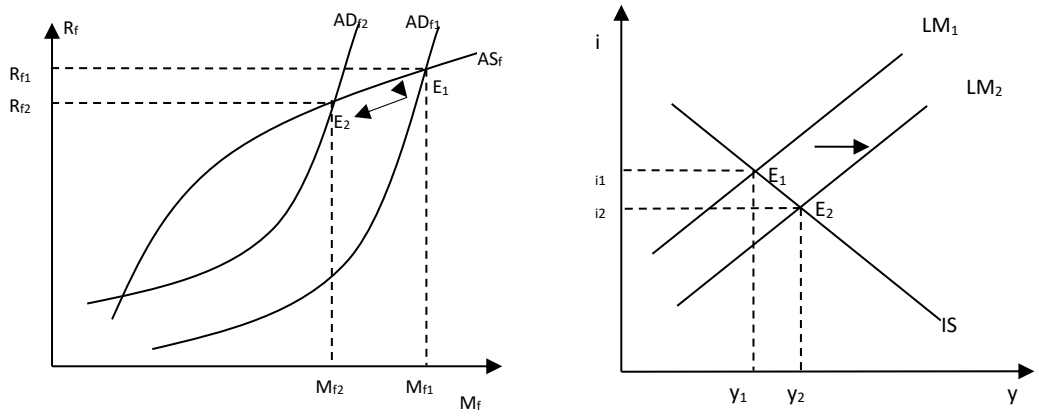


Figure 4-20 Inflation with financial asset deflation

Source: self-drawing.

In the short and medium term, the change of financial asset price subjects to positive feedback. In the initial period of the implementation of tight monetary policy, the reduction of funds in the financial asset trading market ΔM_f is slower and smaller. At this time, the reduction of the total money stock is much greater than the outflow of capital from the financial asset trading market, so there is a considerable amount of capital outflow in the real economy. In the real economy, the LM curve shifts to the left due to the decrease of the money stock M_r. In the short run, the IS curve changes little, so output decreases from y_1 to y_2, while interest rates rise from $i_1$to i_2 (see Figure 4-21).

Due to higher interest rates and lower output, the money supply M^s will be further reduced, which will promote the intensification and exacerbation of the financial asset contraction. The demand function curve of financial assets AD_f moves left further from AD_{f2} to AD_{f3}, while the yield rate R_f decreases further and M_f gradually decreases either (Figure 4-22).

non-malignant financial assets.

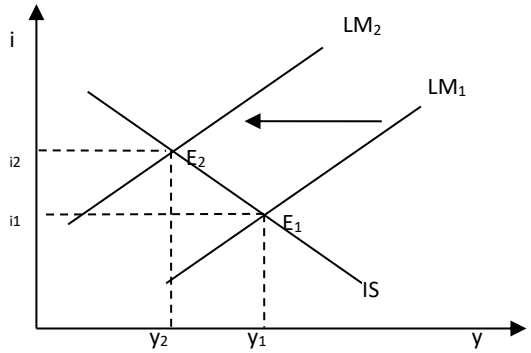


Figure 4-21 impact of tight monetary policy on the real economy

Source: self-drawing.

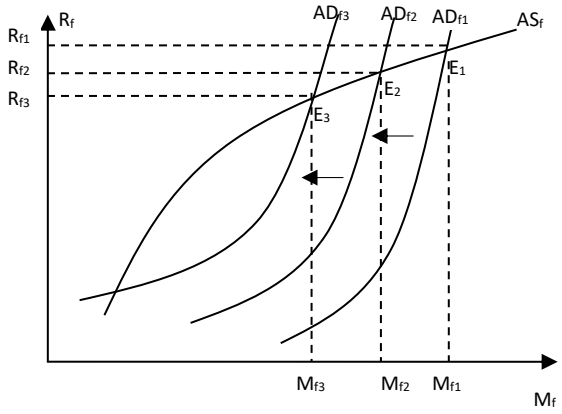


Figure 4-22 positive feedback effect of financial asset prices

Source: self-drawing.

In the long run, the change of financial asset returns subjects to negative feedback effect. After a long period of time, the supply of the real economy will adjust accordingly, and the IS curve moves left from IS_1 to IS_2, so the equilibrium point of the real economy moves from E_2 to E_3, then the interest rate i gradually decreases from i_2 to i_3. In the financial asset trading market, the return on financial assets R_f began to rise again, and the funds in the financial asset trading market gradually increased, pushing the curve AD_f to the right (Figure 4-23).

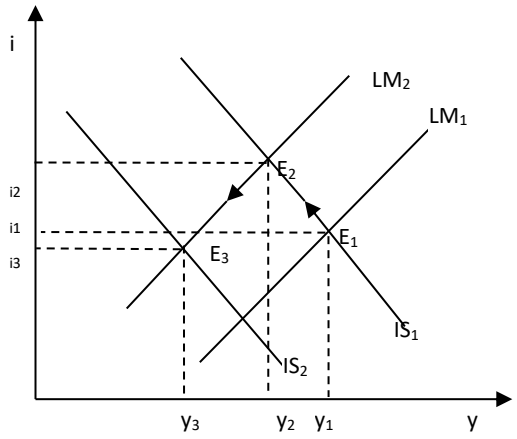


Figure 4-23 Long-term effects: The real economy adjusts

Source: self-drawing.

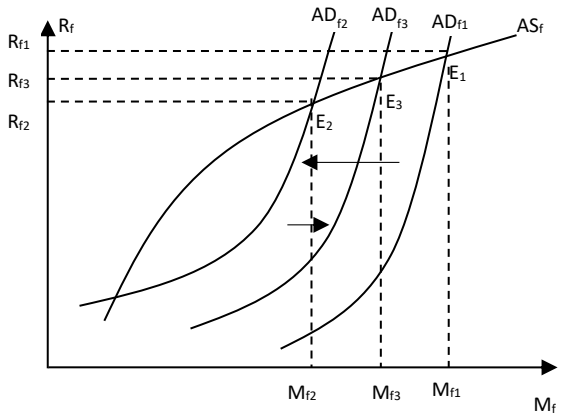


Figure 4-24 Long-term effects: negative feedback on financial asset prices

Source: self-drawing.

From the analysis above, we can see that financial asset inflation, financial asset crisis, inflation, deflation and other phenomena are manifestations of imbalances in different parts of the same economy. Therefore, there is unity between financial asset inflation, financial asset crisis, inflation, deflation and other phenomena.

In terms of external manifestations, inflation is manifested as the continuous rise of commodity (and service) prices. The inflation of financial assets means that the price of financial assets continues to rise.

In terms of the carriers, the carriers of inflation are real commodities and real assets;

while the carriers of the financial asset expansion are all kinds of financial assets, especially investment financial assets.

In terms of the causes, the cause of inflation is that too much money is chasing relatively few physical commodities and assets, resulting in the imbalance between supply and demand. Financial asset inflation is the continuous rise of financial asset prices caused by excessive money chasing relatively few financial assets, resulting in an imbalance between supply and demand.

In terms of economic dynamics, both of them are a disequilibrium state.

In terms of economic consequences, the consequence of inflation is the readjustment of the allocation of real resources; the financial asset inflation mainly means the readjustment of the allocation of financial resources.

However, the dynamic performance of the two is different due to the difference of their anchoring basis. Inflation follows a negative feedback process. There is a mechanism setting up a tendency automatically toward equilibrium, and its equilibrium state is a stable fixed point. However, financial asset inflation follows a nested process of short-term positive feedback and long-term negative feedback, and its equilibrium state is an unstable fixed point, so it has a mechanism of self-reinforcing to the initial disturbance.

To sum up, both financial asset inflation and inflation are caused by the excessive growth of money supply. It is the external manifestation of money supply imbalance in two different parts of the same economic system. In essence, financial asset inflation is the price inflation of financial assets, while inflation is the price inflation of real assets and commodities. As a unified concept, we can generally call it asset price inflation.

4.4 FM-IS-LM model with bank credit

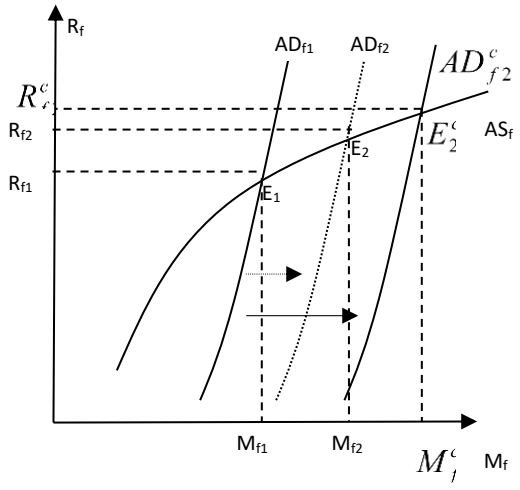
In the above discussion, we did not consider the influence of bank credit's intervention in the financial asset trading market through the mortgage of financial assets, but the depth of bank credit intervention is often the main factor affecting the volatility of the financial asset trading market, so it must be taken into account.

4.41 Analysis of the effect of accommodative monetary policy with intervention of bank credit

The loan issued by banks with financial assets as collateral is usually determined by a certain proportion of the market value of financial assets.

As the price of financial assets rises, the market value of financial assets increases rapidly. On the one hand, the amount of funds that investors can borrow increases rapidly. On the other hand, the willingness of banks to issue financial asset collateral credit also increases further due to the good returns of the financial asset trading market. The loans issued by banks with financial assets as collateral provide incremental funds for the financial asset trading market, thus promoting the expansion of financial asset trading market.

In Figure 4-25, we can see the involvement of bank credit is represented by a further right shift of the financial asset demand function curve from AD_{f_2} to $AD_{f_2}^c$ [15]. This makes the rate of return on financial assets further increase to $R_{f_2}^c$ （$R_{f_2}^c \succ R_{f2}$）, and the amount of funds in the financial assets trading market also increases significantly[16].



[15]Compare with the situation without bank credit AD_{f_2}.

[16]Move to $M_{f_2}^c$, and apparently $M_{f_2}^c > M_{f2}$.

Figure 4-25 Movement of equilibrium in the financial asset market with bank credit

Source: self-drawing.

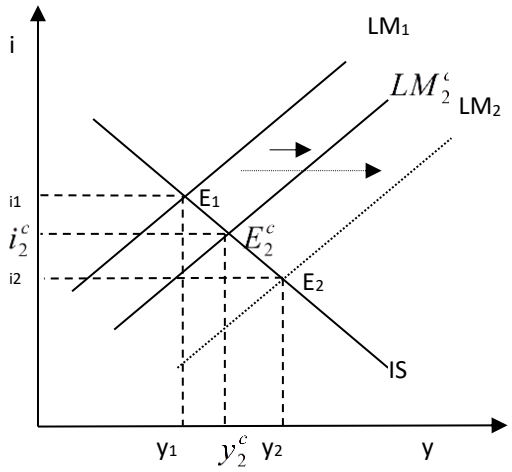


Figure 4-26 Movement of equilibrium of real economy with bank credit

Source: self-drawing.

The intervention of bank credit in financial asset trading market will not only promote the rise of financial asset prices, but also aggravate the fluctuation of real economy. The increase of bank loans to the financial asset trading market will usually crowd out the loans to the real economy to a certain extent, resulting in the growth rate of bank loans to the real economy to decline or even decrease. In Figure 4-26[17], this crowding-out effect is manifested as a smaller shift to the right of the LM curve, and perhaps even a shift to the left of the initial position. Therefore, despite the loose monetary policy, the real economy has not recovered significantly as expected.

At the same time, it can be seen from Figure 4-26 that the transmission mechanism of interest rate is biased, and the endogenous decline of long-term interest rate becomes smaller[18]. Output growth and price growth were also smaller than they would have been without the access of bank credit to financial asset markets[19].

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[17] In Figure 26, the curve LM_2^c moves further to the left compared with the curve LM_2 when no bank credit funds are involved in the financial asset trading market.

[18] The interest rate here is i_2^c, not $i_2, i_2^c \rangle i_2$.

[19] The specific situation depends on the degree of involvement of bank credit.

The poor performance of the real economy often prompts the monetary authorities to further implement loose monetary policies such as lowering interest rates and increasing money supply to stimulate the growth of the real economy. However, the looser monetary policy has injected new force into the expansion of financial assets, allowing the price and quality of financial assets to further expand, and attracting more bank credit into the financial asset trading market.

Therefore, the intervention of bank credit not only intensifies the development of financial asset inflation, but also may inhibit the promotion of loose monetary policy to the real economy.

4.42 Analysis of the effect of tight monetary policy with intervention of bank credit

Rising prices and expanding quantity of financial assets induce banks to extend credit and increase the money supply, which often causes central banks to worry about future inflationary pressures. Therefore, the monetary authorities will eventually adjust the direction of monetary policy and implement a contractionary monetary policy.

With the implementation of tight monetary policy, the financial asset trading market reacted first, and the price of financial assets began to decline.

During the financial asset crunch (or crisis), the non-performing rate of bank loans using financial assets as collateral will rise rapidly due to the deterioration of the debtor's financial condition resulting from the continuous decline in the price of financial assets. At the same time, the rapid decline in the market value of financial assets used as collateral makes it difficult for banks to recoup loans by selling them. This puts enormous pressure on banks' liquidity, forcing them to tighten credit and increase excess reserves.

In the financial asset trading market, due to the credit crunch of banks and the deterioration of the financial situation of residents and enterprises, the purchase intention of financial assets will decline more sharply, so the leftward movement of the

demand curve for financial assets AD_f will be greater than that when no bank credit funds are involved (see Figure 4-27a) [20]. The increase in the leftward movement of AD_f makes the decline in the return rete on financial assets R_f more serious (moves from R_{f2} to $R_{f_2}^c$). At the same time, the funds in the financial asset trading market are more lost than when no bank credit funds are involved (moves from M_{f2} to $M_{f_2}^c$).

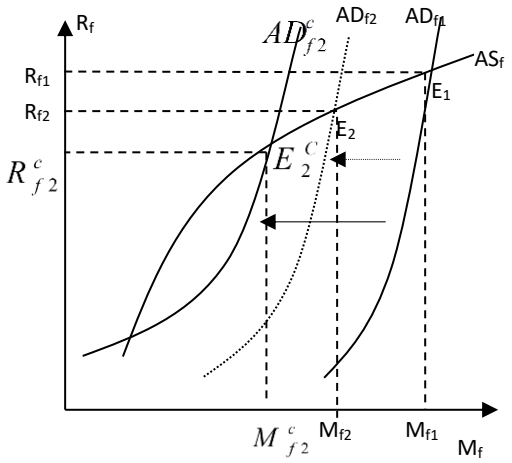


Figure 4-27a Movement of the financial asset equilibria with bank credit

Source: self-drawing.

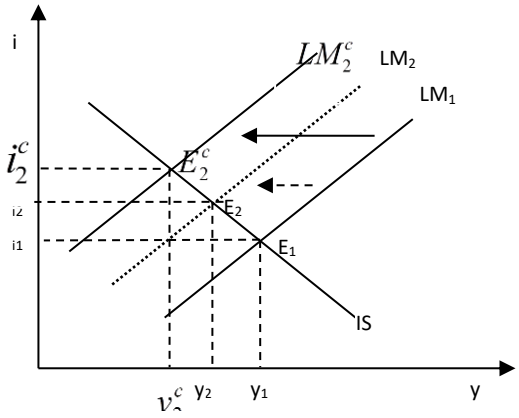


Figure 4-27b Movement of equilibria of real economy with bank credit

[20] Move left further from AD_{f_2} to $AD_{f_2}^c$.

Source: self-drawing.

The contraction of financial assets will exacerbate the performance of real economy through the endogenous contraction of bank credit. Hit by the squeeze on financial assets, banks were forced to tighten credit, causing the LM curve to shift sharply to the left (see Figure 4-27b). LM curve moves left from LM_1 to LM_2^c; At the same time the interest rate I goes up dramatically from i_1 to i_2^c; Output fell sharply ($y_2^c \prec y_2$), prices fell, and the real economy suffered a relatively severe recession.

4.5 Simulation conclusion

Historical experience and theoretical analysis show that the economic structure has endured significant transformation, it is necessary for the monetary policy relying too much on the state of inflation and economic growth to pay proper attention to the operation state of financial assets. From the simulation analysis above, we have some conclusions summarized as following:

First, under the conditions of modern market economy, the real economy is only a part of the overall economy, and with the development of economy and the change of economic structure, the proportion of the real economy may further decline, while the total amount of financial assets will not only grow rapidly, but also far exceed the total amount of real assets, which makes the operating state of financial assets have an increasing impact on the overall state of the economy. **Therefore, it is necessary for monetary policy to pay more attention to the operation of financial assets.**

Second, the price index is no longer a good reflection of the overall economic operation. According to traditional economic theory and experience, prices in Japan were very low and stable in the 1980s, even during the period of 1986-1990 when the expansion of financial assets accelerated. It is precisely the mistake of the Bank of Japan that its monetary policy relies too much on the judgment of inflation status only according to its original experience and traditional theories, and fails to pay attention to the operation status of financial assets, and fails to take into account the impact of

monetary policy on the operation status of financial assets, which leads to the occurrence of financial asset inflation, and then fails to do anything in the subsequent financial asset crisis and banking crisis. This led to a credit crunch and a real recession.

Third, the interaction mechanism between the operation of financial assets and bank credit enhances the endogeneity of money supply, changes the transmission mechanism of monetary policy, and the traditional monetary policy tools are ineffective and even appear off-target.

During the period of financial asset inflation, the rapid rise of the "nominal value" of financial assets provided the endogenous basis for the excessive enlargement of bank credit. In the period of financial asset crisis, the rapid decline in the "nominal value" of financial assets caused banks to pile up a large number of non-performing loans and even face liquidity crisis. At this time, although the central bank tried to implement loose monetary policies, the endogenous decline of bank credit resulted in insufficient money creation, resulting in the coexistence of loose monetary policies and tight monetary forms. Therefore, it is necessary to improve the traditional monetary policy, increase and change policy tools to effectively change the interaction mechanism between the operation of financial assets and bank credit, and regulate their development according to the expected goal. **Therefore, it can be easily deduced that QE should be used to deal with financial asset crisis. The accommodative monetary policy is used to ensure an adequate money supply, and active fiscal policy is intended to directly stimulate credit expansion.**

Fourth, if we consider the financial asset trading market, the demand for money will be split into two parts: the demand for money in the "real economy" and the demand for money in the "financial asset trading market". Even if other conditions remain unchanged, the frequent structural adjustment of money demand between the "real economy" and the "financial asset trading market" will have a great impact on the performance of economic and financial markets. **It demonstrates clearly that the transmission mechanism of monetary policy has undergone essential changes after considering tradable financial assets. The dilemma faced by monetary policy can be vividly summarized as the embarrassment of "two pools, one tap".**

When the central bank carries out expansionary monetary policy, if most or all of the funds flow to the financial asset trading market, then it is easy to appear "financial asset prices rise, real prices are stable", that is, loose monetary policy is ineffective in stimulating the real economy.

When the central bank tights its monetary policy, the price of financial assets is more sensitive to monetary liquidity, and there may be a significant adjustment. If funds flow from the financial asset trading market to the real economy at this time, there may be a situation of "falling financial asset prices and rising real prices", that is, the tightening monetary policy has no tightening effect on the real economy. Instead, the real economy expanded as markets for financial assets shrank.

Fifth, if some feasible suggestions were given, a new intermediate variable-financial asset return rate- should be added to solve the dilemma of monetary policy, which is mainly used to control the reasonable distribution of monetary supply between the real economy and the financial market, so as to achieve "two pools and two taps".

Section 5 Conclusion

The increasing expansion of financial assets alters the economic structure, the liquidity of investment, and therefore economic operation rules. This thesis begins with a detailed theoretical analysis and empirical research on the nonlinear features of financial asset prices. And then an IS-LM-FM model is constructed, into which the tradable financial assets are included as a part of a unified macro equilibrium analysis. With the simulative and dynamic analysis of monetary policy in the extended macroeconomic frame, we have noticed the new challenges brought by financial asset inflation under the new economic structure. We have conclusions as follows:

1）There are multiple equilibria in the tradable financial assets market, and the price of financial assets is subject to a positive self-reinforcing feedback in the short term and a negative self-correcting feedback in the long term.

2） The modern economic structure has endured a significant adjustment with the expansion of financial assets, the change of financial asset prices as an endogenous variable should be included in a unified macro equilibrium model. Only by incorporating financial asset inflation into the unified framework of macro-economy can we better understand the current law of world economic change and better regulate macro-economic operation.

3）The existence of financial asset inflation makes the causes and effects of inflation more complicated, the indicative significance of inflation to the overall economic operation is reduced, and the controllability of monetary policy to inflation is also significantly reduced. Continuing to adopt inflation-targeting may lead to misjudgment of monetary policy.

4）The existence of financial asset inflation requires us to re-examine our monetary policy. It is necessary to consider the monetary policy as a historical product which is constantly changing. Therefore, when the economic and financial structure changes occur, we can no longer stick to the traditional framework, but should revise and optimize the traditional monetary policy accordingly. If the money supply is taken as the intermediary target, it is necessary to add intermediate variables such as the rate of return on financial assets to effectively control the structural distribution of money supply between the real economy and the financial asset market, and to effectively solve the dilemma faced by monetary policy in the new situation.