

Chapter 2

Effectiveness Study of Chinese Monetary Policy Regulation on Economic Growth and Inflation

On using monetary policy for macro-economic regulation, after the 1930s Great Depression when effective demand insufficiency emerges, Keynesianism proposes that proactive fiscal and easy monetary policies shall be introduced. His proposal is later adopted in Roosevelt's New Deal, which greatly help USA climb out of economy recession and achieve prosperity over 20 years.

After sub-prime mortgage crisis and European sovereign debt crisis, countries around the world consistently adopt Keynesian policies, that is, the positive fiscal and ultra-loose monetary policies. In particular, for monetary policy, the US has successively made two rounds of quantitative easing and started a third round recently. Many European countries have also taken measures likewise.

In order to effectively cope with the financial crisis, the Chinese government has taken similarly relative easy monetary policies, which helps a lot in pulling China out of the financial crisis. However, this round of monetary easing also causes controversy in China. This chapter will be dedicated to in-depth study and discussion on the effectiveness of monetary policy regulation on macro-economic growth and inflation in China.

Starting from the related theories on currency effectiveness and based on the Chinese reality, this chapter reviews and empirically analyzes Chinese monetary policies through the years, explores its role in macro-economic regulation, and thoroughly researches the correlation between money supply and Chinese economic growth as well as price level. These are of great significance in clarifying whether China's current monetary policy is in line with the national condition and discussing how to optimize the current monetary policies to promote healthy economic development.

This chapter will first review the development of China's monetary policies and then makes empirical analysis to test the effectiveness of monetary policy regulation on economic growth and inflation.

2.1 Retrospect of Chinese Monetary Policy

China's economical development has obtained great achievement since reform and opening up, and correspondingly, a series of financial reforms of modern significance has been undertaken. The People's Bank of China begins independently performing the functions of the Central Banks from January 1, 1984, which marks the coming into implementation of modern monetary policies as well as the entry of Chinese government's macro-economic regulation into a new historical stage.

Monetary policy regulation and control mainly plays a role in the following four aspects: inflation, economic growth, employment rate, and balance of payments. According to Article 3 of the Law of the People's Bank of China, the aim of monetary policies of the People's Bank of China is to maintain the stability of the value of currency and thereby promote economic growth, that is to say, currency stability and economic growth have long been the official target of Chinese monetary policies.

In order to stabilize goods price and enhance economic growth, Chinese monetary policy has generally experienced the following three stages since 1984. In the first stage (1984–1992), China's monetary policy is still in exploration, flexible and loose/tight monetary policies are taken; in the second stage (1993–1996), monetary policies are constantly optimized and moderately tight monetary policies are performed; in the third stage (1997–present), relatively mature and prudent monetary policies are implemented. The correlation between money supply and economic growth as well as price level shows different characteristics during the three stages.

2.1.1 Exploration Stage: From Reform and Opening up to 1992

The third plenary session of the 11th CPC Central Committee accelerates the pace of economic system reform in our country and helps Chinese economy obtain distinct improvement in the subsequent years, including economic growth, price stability, international payments balance as well as total supply balance. However, there is great fluctuation from 1984 to 1992.

From 1984 to 1985, in order to enhance economic growth, Chinese government implements expansionary or easy monetary policy, namely the government surrenders part of the profits, enlarges enterprises' autonomy in management, and gradually shifts the reform focus from rural to urban areas, which brings about private economy's coming into different operation models and forms. Under this background, bank credit capital demand surges and falls into short supply in many areas, driving economic growth rate jump to 15.2 and 13.5 %, respectively, in 1984 and 1985, and the price of goods reach 9.3 % in 1985. In respond to the circumstances, the People's Bank of China adopts tightening monetary policies in 1985, successively raising deposit and lending rates and strictly controlling credit scale to perform regulation.

From 1988 to 1989, enhanced by price reform and national macro-policy of accelerating coastal development, Chinese macro-economy is once again heating up, with price index soaring up to 18.8 % and the overall price level and product price rising sharply. In 1988, there is a 21.2 % increase in money supply (M2), a 11.3 % increase in economic growth, a 18.8 % increase in price index, reaching a record high of China since reform and opening up. Then in order to prevent the soar, the People's Bank in 1989 begins to tighten monetary policies, that is, use credit amount control, credit structure adjustment, tap capital potential and other measures for economic regulation and control.

From 1990 to 1992, under the impact of the macro-economic regulation and control of 1989 and plagued by inflation, Chinese economy is generally declining in 1990. Therefore, later in 1991, Chinese monetary policies are relatively loosened. When it comes to 1992, due to the booming of real estate industry, the acceleration of fixed investment, the dramatic increase of bank credit, and other similar reasons, Chinese macro-economy is in a state of instability, with the annual economic output value reaching 2.6923 trillion yuan, one of the fastest growths since 1985. The situation drives the Central Bank to tighten its monetary policies.

Generally speaking, Chinese monetary authorities at this stage could actively and flexibly use different monetary policies, in accordance with macro-economic change and specific condition, to regulate monetary supply and adjust monetary policy target and at the same promote economic growth and maintain price stability. However, these policies are not stable enough and in dramatic loose/tight change in implementation, causing radically positive and negative impact. The instability fully reflects the weak of Chinese macro-economic regulation means and a lack of mature experience of operation in the transitional period of China's economic structure, which need further exploration and perfect.

2.1.2 Optimization Stage: From 1993 to 1996

Based on the exploration and practice from 1984 to 1992, Chinese monetary policies come into optimization stage since 1993, when tightened policies are implemented with inflation control as the main target.

With comrade Deng Xiaoping's South Inspection Speech and the holding of the 14th Congress of CPC in 1993, Chinese economy has entered a new stage. This stage brings China an opener market, and simultaneously causes many problems: excessive increase in fixed investment, surge in demand, bank credit turmoil, and economic structural imbalances.

To solve these problems, the central government issues the document of Opinion on Current Economic Condition and Strengthening Macro-control in 1993, requiring strict rectifying of financial order and control of money supply. Under the guidance of the document, China in 1994 continues implementing tightened monetary policies to mainly control inflation. Through the effort in various aspects, such as laws and regulations, administrative system, economic

environment, and measures, by the end of 1994, China's economic growth and price level gradually stabilize and the national economy reaches equilibrium.

From 1995 to 1996, Chinese processing industry expands excessively fast and produces overcapacity, which makes inflation control an important content of macro-economic regulation and control. Based on the original macro-economic measures, Chinese Central Bank continues taking tightening monetary policies for inflation control and thus effectively reduces the high economic growth and price rises by a certain degree.

In 1996, Chinese macro-economic control mechanism takes place fundamental changes from direct to indirect regulation. More often economic approaches rather than administrative means are used for credit scale control and a flexible use of legal deposit-reserve rate, open market operation, and rediscount, and other methods are taken to adjust money supply. By above measures, China's money supply growth rate gradually stabilizes and slips back and the national economy achieves "soft landing."

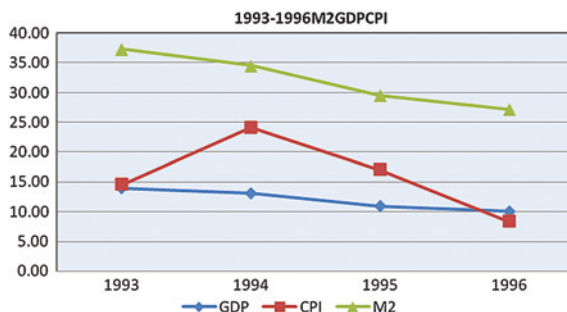
In short, the characteristics of Chinese monetary policies in the period are macro-economic control method shifts from direct means to indirect means; intermediary target of monetary policies changes from inflation control to money supply; among macro-economic variables, M2, GDP, and CPI are highly correlated and have similar fluctuation trend, as shown in Fig. 2.1.

2.1.3 Gradual Maturity Stage: Since 1997

Since 1997, China takes stable monetary policies, marking the entry of gradual maturity stage of China. This stage could be classified into two periods: the first period lasts from 1997 to 2004, and the second is from 2005 and after.

Although Chinese national economy reaches "soft landing" in 1996, the 1997 Asian financial crisis brings severe impact on the national economy system. In this context, Chinese government insists on keeping the value of RMB as it was, causing the decline in domestic investment and consumption and exports, the slowing in economic growth, the decreasing in price rising, and the increasingly apparent domestic deflation.

Fig. 2.1 M2, GDP, and CPI growth rate of China from 1993 to 1996. *Source* National Bureau of Statistics of the People's Republic of China



In response to the decline in domestic consumption and investment and lack of incentive in economic growth caused by Asian financial crisis, the CPC Central Committee and the State Council determine the guideline of expanding domestic demand. Through sound monetary policies aimed at deflation, they flexibly use different policy tools to keep proper money supply growth, adjust credit policies to guide the direction of loan investment, and promote China's economic transformation. Besides, they also carry out a series of monetary policy reforms, taking indirect monetary policies regulating Chinese macro-economy. It is worth mentioning in the middle of 1998 that the Central Bank timely introduces open market operation in accordance with the actual condition and demand of China, effectively stimulating Chinese economic growth and ensuring the steady and rapid economic development.

In 2005, with rapid growth rate, strong economic vitality, and high enterprise revenue, the overall economic situation of China is good; however, it also brings some problems, one of the major of which is to maintain sustained economic growth and stable price level. Targeted at these problems, the government successively launches a series of policies, including issuing Announcement of the People's Bank of China on Reforming the RMB Exchange Rate Regime, raising legal deposit-reserve rate from 8 to 9 %, and starting issuing short-term financing bonds in inter-bank bond market, which effectively broadens enterprises' channel in direct financing and contributes greatly in enterprise development.

In 2006, Chinese macro-economy has "high growth, high benefit, and low inflation," while the pressure of rising domestic price, robust investment, and oversupplying consumption goods still exists. Thus, China continues prudent monetary policies to promote steady and rapid economic development and stable price level.

In 2007, China's excessively rapid economic growth turns to be overheating. Therefore, Chinese authorities implement tightening monetary policies to deal with inflation by successively raising deposit-reserve rate 10 times (from 9 to 14.5 %, totally 5.5 % up), hiking renminbi deposit and lending rates of deposit-taking institutions 6 times (from 2.52 to 4.14 %, totally 1.62 % up), carrying out liabilities operation by issuing the 129th Central Bank bills amounting to 3.5668 trillion yuan, and offsetting base money of 592.7 billion yuan and others. These measures effectively enhance Chinese economic growth and price stability and play an important role in China's steady financial development.

Due to the dramatic economic climate change at home and abroad influenced by the 2008 international financial crisis, the People's Bank of China takes a series of adjustment in the direction, focus, and intensity of monetary policies. With the further worsening of international economic situation, China begins to implement moderately loose monetary policies to deal with the corresponding shock since September. Chinese government adopts a series of flexible and forceful measures through an integrated use of different monetary policy tools to ensure sufficient liquidity, enhance the stable growth of monetary credit, and strengthen support for economic development. At the end of the year, China's broad money supply balance reaches 47.5 trillion yuan, with a year-on-year growth of 17.8 %; gross domestic product (GDP) amounts to 30.1 trillion yuan, up 9 % from a year earlier.

In general, these monetary policies have helped in some degree in enhancing economic growth and price stability.

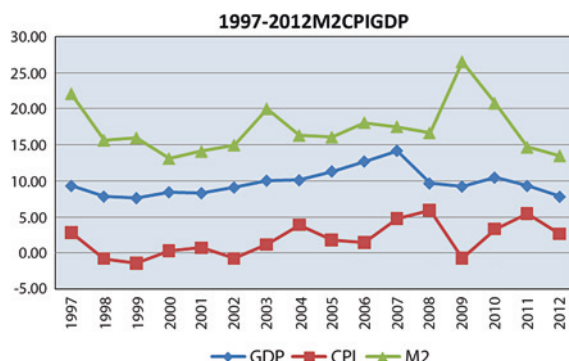
In 2009, in order to continue strengthening financial support for economic development, China keeps implementing moderately loose monetary policies, by retaining ample liquidity in banking system, releasing policies guiding financial institutions to increase credit supply and optimize credit structure and alike, which has gained the expected effect. At the end of 2009, China's M1 balance reaches 22 trillion yuan, up 32.4 % from a year earlier, 23.3 % higher than the previous year, monetary liquidity continually increases and new lending totals 9.59 trillion yuan with a year-on-year increase of 4.69 trillion yuan. On the whole, the money credit support for economic growth is vigorous in 2009 by the effective implementation of moderately loose monetary policies, which makes economic growth rate accelerated by quarter, market confidence clearly enhanced, domestic demand quickly increased, foreign demand recovered in some extent, enterprise profits gradually improved, residents' income increased steadily, and employment situation better than expected.

In 2010, China continues implementing moderately easy monetary policies and, at the same time, strives to improve policy pertinence and flexibility according to the new situation and conditions by an integrated use of various monetary policy tools to guide monetary conditions gradually recover from anti-crisis status to normal circumstance. Because of loose liquidity worldwide and China's large trade surplus in international balance of payments, in 2010, on the whole, Chinese banking system still faces excess supply in liquidity, and the authorities thus raise the reserve requirement ratio of the country's deposit-taking institutions for six times, by 0.5 % each, 3 % up in total. Frequently using reserve requirement ratio, open market operation, and other similar tools help a lot in reducing the shock by the excess liquidity of banking system.

In 2011, prudent monetary policies are performed around maintaining general market price level, the primary task of macro-control. In the first half of 2011, the authorities raise the reserve requirement ratio six times and at the same time perform open market operation to offset excess liquidity and thus help monetary conditions return from loose to normal status. They also raise loan and lending rates 3 times totally by 0.75 % and guide an appropriate increase in inter-bank market interest rates. In addition, they further promote the reform of the RMB exchange rate regime and make RMB appreciate in some extent against the dollar, which helps in reducing domestic inflation pressure and to a certain extent the impact of international bulk raw material and oil price rise on domestic inflation.

In 2012, with the spread of the sovereign debt crisis in Europe and the predicament of high unemployment and high debt in the USA, destabilizing factors and uncertainties of world economic recovery are clearly on the rise. "Achieving steady growth, controlling prices, and adjusting economic structure" are the important issues of 2012. China continues following prudent monetary policies, though with their focus changing from inflation control of 2011 to enhancing structure adjustment and maintaining steady economic growth of 2012; continues implementing regulation policies on real estate to help house prices return to

Fig. 2.2 M2, CPI, and GDP growth rate in China from 1997 to 2012. *Source* National Bureau of Statistics of the People's Republic of China, The People's Bank of China



reasonable levels; continues pushing forward the transformation from business tax to added value tax and promote the reform of property tax pilot; and continues encouraging RMB's flexibility in both directions.

The correlation between money supply change, economic growth, and price level from 1997 to 2012 is shown in Fig. 2.2.

The expected M2, CPI, and GDP growth rate in 2013 are, respectively, 13, 3.5, and 7.5 %. This study takes the data from 1997 to 2012 for empirical research and analysis.

2.2 Intermediary Target: An Important Guarantee for Monetary Policy Effectiveness

Monetary policy's effectiveness is usually under the influence of three factors: monetary policy tools, intermediate targets, and monetary goals. Monetary policy tools include reserve requirement ratio, discount rate, and open market operations; intermediate targets refers to the conducive and easy-to-regulate financial variables selected for helping realizing monetary goals, including interest rate, credit scale, money supply, and similar; monetary goals contain economic growth, price stability, full employment, and balance of international payments. According to the Law of the People's Republic of China on the People's Bank of China, the ultimate goal of China's monetary policies is to maintain the stability of currency and thereby promote economic growth. It is important to note that one certain monetary policy by the Central Bank cannot simultaneously achieve multiple monetary policy goals.

Unable to directly control but in order to ensure the ultimate goal of monetary policies, the Central Bank has to select the directly regulatable financial indexes that are closely related to the ultimate goal and measurable in the short run, so as to realize the adjustment and control of the ultimate goal. That indicates that selecting intermediary target is vital in determining the effectiveness of monetary policies.

2.2.1 Interest Rate, an Immature Choice

Interest rate, as an important variable of economic system, can reflect the cost price of capital and time preference of consumers and provide great reference for investment and consumption. In developed countries, interest rate is highly market-oriented, which can well present the correlation between income and risk and well guide resource allocation. While in China, since neither an interest rate management system nor a reasonable interest rate decision system is well established, China's present interest rate system fails to play a role as that in developed countries. Therefore, China's present interest rate has not been seen as ready to be the perfect choice as the intermediary target.

2.2.2 Interest Rate, an Immature Choice

Taking foreign currency as the intermediary target of monetary policies needs satisfying three conditions: (1) a country's macro-economic system is highly opened, and its foreign currency's stability on price level is reached by stabilizing exporting, which requires the country's foreign trade be an important part of macro-economy; (2) a country has a high degree of openness in finance and a larger number of transnational capital outflow or inflow, thus by regulating foreign currency, the country's transnational capital flow and then economy can be adjusted; (3) a country has comparatively smaller domestic economic scale and high economic dependence on another large country.

However, China fits none of the three requirements. Though been a member of WTO, China's capital account still lacks openness, making free outflow or inflow impossible and financial openness relatively small. Generally speaking, taking foreign currency as China's intermediate target is clearly not an ideal choice.

2.2.3 Money Supply, an Ideal Choice

Money supply, first of all, as measurable, controllable, correlated, adaptive and anti-jamming, could meet the five requirements of intermediary target. It is measurable because the relative data have been published monthly since 1999; it is controllable because it is under the direct supervision of the Central Bank, which can be directly or indirectly regulated through different means; it is correlated because money supply, economic growth, and price level of China have been proven from the above analysis as highly correlated. Therefore, we could claim that money supply has met all the conditions and demands as an ideal choice for intermediate target.

Presently in China, money supply is under the influence of the endogeneity of economic growth, the derivation of all kinds of savings of commercial Banks and

other depository institutions, and the variation of monetary velocity under different economic environment, whose controllability is weakened. However, judging by the general status and basic national conditions, money supply is a preferred intermediary target for monetary policies. Moreover, in the future, along with economic development and further marketization, market interest rate of inter-bank offer can gradually be developed as another good choice.

After determining money supply as intermediary target, we also need to specify whether M1 or M2 should be taken for regulation tool. M1 contains the currency and demand deposits in circulation, closely related to real production, consumption, investment, and other economic activities, while M2 refers to M1 plus savings deposits, including not only immediate purchasing power, but also the near money presenting future purchase capacity. Since closely related to both current and middle-term/long-term economy compared with M1, M2 is of great theoretical and practical significance in drawing out and performing money supply regulation.

2.3 Empirical Effectiveness Research on China's Monetary Policy Regulation on Economic Growth and Price Level

China has relative less theoretical and practice experiences in using monetary policies for macro-regulation. The experience of the People's Bank of China in independently performing the functions of the Central Bank, or the history of monetary policy regulation, lasts only more than 20 years. However, when it comes to 1990s, monetary policies begin to play a more and more important role in macro-economic regulation, enhancing economic growth as well as maintaining price stability.

As money supply is being attached much importance to and considered the intermediate target of monetary policies, which marks Chinese macro-economic change from under direct to under indirect regulation, whether money supply is correlated with economic growth and price level and what is their correlation thus becomes an urgent question and raises great attention of both theoretical and practical researchers.

2.3.1 Model Establishment

Between different markets and asset types of real economy usually exists mutual impact. Therefore, setting up corresponding combinations to disperse, hedge, and mitigate the risk of price fluctuation and perfect macro-economic control has become a necessity. Multivariate GARCH (MGARCH) model is just a good choice for measuring their volatility correlation. According to existing literatures, MGARCH is divided into two categories: VEC and BEKK model. BEKK

model allows the mutual impact of different variables' conditional variance, which explains the co-movement among them. Therefore, this chapter will establish a ternary diagonal BEKK model as below on money supply (M2), consumer price index (CPI), and GDP to discuss the fluctuation correlation of monetary policy, inflation, and economic growth:

$$\varepsilon_t = H_t^{1/2} \xi_t, \xi_t \sim i.i.d.N(0, I)$$

$$H_t = W'W + \sum_{k=1}^n A' \varepsilon_{t-k} \varepsilon_{t-k}' A + \sum_{k=1}^n B' H_{t-k} B.$$

In this formula, W is a lower triangular matrix, A and B are both $N \times N$ parameter and diagonal matrixes. a_i , the element of $N \times N$ matrix A , reflects the ARCH effect of fluctuation. b_i , the element of $N \times N$ matrix B , reflects the persistence of volatility transmission, also known as the GARCH effect of fluctuation. The empirical study of most GARCH models shows that one order lag model has better allocation on time series. Therefore, this book will select ternary-variable diagonal BEKK (1, 1, 1) model, which can be written in the form of matrix vector:

$$\begin{bmatrix} h_{11t} & h_{12t} & h_{13t} \\ h_{21t} & h_{22t} & h_{23t} \\ h_{31t} & h_{32t} & h_{33t} \end{bmatrix} = \begin{bmatrix} w_1 & 0 & 0 \\ w_2 & w_4 & 0 \\ w_3 & w_5 & w_6 \end{bmatrix}^T \begin{bmatrix} w_1 & 0 & 0 \\ w_2 & w_4 & 0 \\ w_3 & w_5 & w_6 \end{bmatrix} \\ + \begin{bmatrix} a_1 & 0 & 0 \\ 0 & a_2 & 0 \\ 0 & 0 & a_3 \end{bmatrix}^T \begin{bmatrix} \varepsilon_{1t-1}^2 & \varepsilon_{1t-1} \varepsilon_{2t-1} & \varepsilon_{1t-1} \varepsilon_{3t-1} \\ \varepsilon_{2t-1} \varepsilon_{1t-1} & \varepsilon_{2t-1}^2 & \varepsilon_{2t-1} \varepsilon_{3t-1} \\ \varepsilon_{3t-1} \varepsilon_{1t-1} & \varepsilon_{3t-1} \varepsilon_{2t-1} & \varepsilon_{3t-1}^2 \end{bmatrix} \begin{bmatrix} a_1 & 0 & 0 \\ 0 & a_2 & 0 \\ 0 & 0 & a_3 \end{bmatrix} \\ + \begin{bmatrix} b_1 & 0 & 0 \\ 0 & b_2 & 0 \\ 0 & 0 & b_3 \end{bmatrix}^T \begin{bmatrix} h_{11t-1} & h_{12t-1} & h_{13t-1} \\ h_{21t-1} & h_{22t-1} & h_{23t-1} \\ h_{31t-1} & h_{32t-1} & h_{33t-1} \end{bmatrix} \begin{bmatrix} b_1 & 0 & 0 \\ 0 & b_2 & 0 \\ 0 & 0 & b_3 \end{bmatrix}$$

In these formulas, h_{iit} is the conditional variance of a certain variable, h_{ijt} is the conditional covariance of two variables, $a_i a_j$ is the impact of ARCH effect, two variables' mutual influence, on future co-fluctuation relationship, $b_i b_j$ is the impact of two variables' volatility persistence on their future co-movement correlation. We set $i, j = 1, 2, 3$, with 1 representing economic growth rate, 2 representing money supply growth rate, 3 representing consumer price index growth rate. If the correlations of GDP, money supply, and consumer price index have volatility spillover effect, the statistical parameters of $a_1 a_2$, $a_1 a_3$, $a_2 a_3$, $b_1 b_2$, $b_1 b_3$, and $b_2 b_3$ will be significant. Under the condition of normality assumption, we can use logarithm likelihood function to estimate the parameters of diagonal BEKK model parameters:

$$l(\theta) = -\frac{TN}{2} \log 2\pi - \frac{1}{2} \sum_{t=1}^T (\log |H_t| + \varepsilon_t' H_t^{-1} \varepsilon_t)$$

In which, θ is the parameters to be estimated, N is asset quantity, T is the number of observations and others refers to the same as in the previous model. Since the maximum likelihood estimation for θ is in asymptotic and normal distribution, we can adopt the traditional method for statistical inference.

2.3.2 Data Collection and Processing

This chapter takes the money supply and consumer price index of quarter four and the monthly GDP from 1996 to 2012 for samples, with each variable assigned a total of 68 observation values and M2 taken for money supply. Also, we use arithmetic average method to correct the originally monthly M2 and consumer price index to quarterly data, add 100 to all the above data to get index, then take their logarithm to eliminate heteroscedasticity. If we take $m2_{1t}$ for the money supply at quarter t , then its growth rate can be expressed as $y_{1t} = \log m2_{1t} - \log m2_{1t-1}$; if we take CPI_{2t} for the consumer price index at quarter t , then its growth rate can be expressed as $y_{2t} = \log CPI_{2t} - \log CPI_{2t-1}$; and if we take gdp_{3t} for the GDP at quarter t , then its growth rate can be expressed as $y_{3t} = \log gdp_{3t} - \log gdp_{3t-1}$. All the data are taken from Wind.

2.3.3 Basic Statistical Characteristics

Table 2.1 shows the result of descriptive statistical analysis on GDP, money supply (M2), and consumer price index (CPI) growth rates from the first quarter of 1996 to the fourth quarter of 2012. According to the table, consumer price index (CPI) has the largest maximum and minimum difference (35.03 %), standard deviation (10.73 %), and variation coefficient (1.14), indicating that in this decade, consumer price is in dramatic fluctuation. GDP growth rate has the minimum fluctuation, which shows that China’s economy presents steady and rapid growth in the last 10 years. Money supply (M2) average and GDP average have a 7.9 % gap, reflecting the overall loose monetary policy in the near decade.

Table 2.1 Descriptive statistics results of sample data from Q1 of 1996 to Q4 of 2012

variable	Minimum	Maximum	Average	Median	Standard deviation	Variable coefficient
GDP growth rate (%)	6.60	14.50	9.87	9.70	1.82	0.18
M2 growth rate (%)	13.00	29.31	17.78	16.81	4.19	0.24
CPI growth rate (%)	−2.03	33.00	9.44	4.93	10.73	1.14

Table 2.2 Stability and normality test of sample data

Variable	Inspection type (<i>c, t, p</i>)	ADF statistics	ADF critical value (5 %)	JB statistics (<i>P</i> value)
GDP growth rate	(<i>c, 0, 0</i>)	−7.50	−1.95	30.55 (0.00)
M2 growth rate	(<i>c, 1, 0</i>)	−5.68	−3.48	25.41 (0.00)
CPI growth rate	(<i>c, 0, 0</i>)	−2.39	−1.95	0.78 (0.68)

Note *c*, the first item in inspection type row, refers to the constant term of the estimation equation in stability test; *t*, the second item in inspection type row, is the term for time trend; *p*, the third item in inspection type row, indicates the length of auto-regression lag; consumer price index (CPI) is an accumulated value with 1996 as the base period; variation coefficient equals the standard deviation divided by the average, and the bigger the variation coefficient is, the greater the volatility becomes

We conduct unit root test (ADF) and normality test (JB) to all the reduced data, finding they are stable at significance level 5 % and in normality assumption, as shown in Table 2.2.

2.3.4 Empirical Analysis Based on MGARCH-BEKK Model

According to Table 2.3, estimated values of a_2 , a_3 , b_1 , b_2 , and b_3 are significant at confidence level 95 %. B_1b_3 ($0.88 \times 0.71 = 0.6248$) shows that the co-movement of inflation and economic growth has the strongest GARCH effect, which indicates the persistence of fluctuation impact between inflation and economic growth. The current interaction of inflation and economic growth can affect their future correlation. It is clear that there is volatility spillover effect between them. B_1b_2 ($0.88 \times 0.54 = 0.4752$) reveals the strong GARCH effect between co-movement of money supply and economic growth, which means the persistence of fluctuation impact between money supply and economic growth. The current interaction between money supply and economic growth can influence their future correlation. There is spillover effect between them. A_2a_3 ($-0.39 \times 0.67 = -0.2613$) indicates the strong ARCH effect and time-varying variance between money supply and inflation. The estimated value of a_3 is negative, which indicates negative correlation of inflation lag term. The value of a_2a_3 is negative, which shows that the next inflation can be effectively mitigated by regulating money supply. B_2b_3 ($0.54 \times 0.71 = 0.3834$) demonstrates the strong and persistent GARCH effect between money supply and inflation. The current correlation between money supply and inflation can influence their future correlation. There is spillover effect between them.

Table 2.3 Parameter estimation results based on MGARCH-BEKK model

Parameter	a_1	a_2	a_3	b_1	b_2	b_3
Parameter estimate	0.29	0.67	−0.39	0.88	0.54	0.71
<i>T</i> statistic	1.57	2.56	−2.03	14.5	2.04	4.90
<i>P</i> value	0.12	0.01	0.04	0.00	0.04	0.00

2.4 Conclusions on the Effectiveness of Money Policy Regulation

From the above analysis and empirical results, we can conclude that:

1. Money supply has significantly positive influence on output (GDP), suggesting we should enhance the flexibility of money policy regulation and adjust money supply in accordance with economic change so as to maintain the steady and stable macro-economic development.
2. Inflation can greatly influence economic growth, indicating moderate short-term inflation has certain positive stimulation on the economy.
3. Money supply can obviously affect inflation, revealing that we should comprehensively examine the current macro-economic condition, specify regulation target, and conduct regulation flexibly and accurately, ensuring the effectiveness of money policies and avoiding the corresponding economic fluctuation.
4. In recent years, reserve requirements and other quantitative tools rather than price tools are more often adopted in China, which will easily lead to financial imbalance in case of serious inflation. And also because renminbi deposit and lending rates are strictly controlled in China, quantitative tools and price tools are strongly independent free from effective market transmission, only using quantitative tool cannot reach comprehensive regulation on macro-economy.
5. As Chinese people hold strong adaptive expectations on inflation, which will weaken the macro-control on inflation, the Central Bank should perform decisive measures to change people's expectation models.
6. We should strengthen the independence of the Central Bank as the main body of macro-economic control. The effect of macro-economic control in some extent depends on the independence of the Central Bank, the higher its independence is, the better the macro-economic control effect gets. The independence of the Central Bank generally presents in three aspects: independently formulating and performing monetary policies, independently supervising the running of national economy, and controlling the whole financial system and national economic system. Therefore, it is advisable that the Central Bank keep relatively independent. China's Central Bank is mainly concerned with consulting and policy performing, rather than policy formulating. In addition, China's monetary policy, especially its major tools and formulating, is often under the influence of different factors, such as deposit-reserve ratio, interest rate, exchange rate, and similarly, which largely influences the Central Bank's timing judgment and weakens the effect of monetary policies. Therefore, it is suggested that the Central Bank should be given more independence, autonomy, and flexibility in monetary policy formulating.
7. We should perfect and integrate China's current financial regulation system, which is composed of two layers: macro and micro. The macro-layer mainly involves the Central Bank, which manages financial institutions through monetary policies, and micro-layer is in charge of the China banking regulatory commission, securities, and insurance regulatory commission, which regulate

financial institutions' business practices by drafting specific regulatory policies. Though holding a clear division of responsibilities, in real practice, macro- and micro-regulation layer will influence and offset each other, leading to the "reduction" in policy effectiveness. Therefore, China should reform the present regulation model of "one bank and three commissions," strengthen regulation mechanism coordination, establish a systemic risk council as in the USA and Europe, set up communication and coordination mechanism between macro-prudent regulation level and banking, insurance, securities, funds, and other micro-regulation level, and establish a risk control index system with net capital as the core at micro-level to ensure the regulation effectiveness at both levels.

8. The new administration should intensify financial reforms, and the Central People's Bank shall actively promote market-based interest rate reform and exchange rate reform with recent years the time is ripe for financial reform. Many regions at the moment are striving to enhance financial reform and exploration, such as the offshore RMB business in Shenzhen, the cross-strait financial cooperation between Quanzhou and Xiamen, the folk financing market exploration in Wenzhou. However, in general, these explorations all demand higher level of comprehensive planning and reform enhancing. And interest rate marketization, RMB internationalization, and exchange rate reform will enable the Central Bank to possess more policy tools in regulating macro-economic growth.
9. We should keep close watch over banks' off-balance-sheet business and shadow banking. Banks' in-balance-sheet credit scale is controlled in some degree since 2011, while their total amount of social financing remains high with a large scale of off-balance-sheet business, shadow banking, and financing products by trust or capital pools, which deserves great attention of the Central Bank for macro-economic regulation by monetary policies.

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