Empirical analysis on China money multiplier

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Abstract: The paper firstly represents two kind statements of China money multipliers and theoretically analyzes the relationship between each structure factor and China money multiplier. Secondly, it summarizes the several features and the move trends of China narrow and broad money multipliers and their structure factors. Thirdly, the paper empirically analyzes how and what degree the each structure factor affects China narrow and broad money multipliers holding everything else constant. At last two important conclusions are got, that is, the required reserve ratio is the most associated with China money multipliers and the saving deposit ratio is more associated with that, the required reserve ratio and the interest rates can be used as the ways of affecting money aggregate by the People’s Bank of China.

Key words: empirical analysis; China money multiplier; narrow money multiplier; broad money multiplier; structure factors of China money multiplier

The money multiplier reflects the multiple relationships between the money supply and the monetary base. The stability of money multiplier is one of the key problems for the control of the monetary aggregate and the People’s Bank of China has used the tool of adjusting and controlling money supply. So we must pay attention to researching on China money multiplier.

1. China money multiplier and its structure factors

1.1 The statements of China money multiplier

There are two statements of China money multiplier because of the similarity and the deference between the money policy of China and the one of other countries.

Firstly, the money multiplier can be written as m=M/B from the model of the money supply (M=mB). So China money multiplier can be written as m1=M1/B and m2=M2/B.

Secondly, China money multiplier can be written as

\[ m_1 = \frac{C+D}{R+C}, \quad m_2 = \frac{C+D+T+S+O}{R+C} \]

from the components of the money supply and the monetary base, because China money aggregate can be divided into three tiers, that is, the first tier is the currency in circulation (M₀), the second tier is the narrow money (M₁) = currency in circulation (C) + demand deposits (D), the third tier is the broad money (M₂) = narrow money + time deposits (T) + saving deposits (S) + other deposits (O).

If \( k \) represents the cash ratio or loan cash ratio \((C/D)\), \( r \) represents the required reserve ratio \((R/(D+T+S+O))\), \( e \) represents the excess reserve ratio \((E/(D+T+S+O))\), \( t \) represents the time deposits ratio \((T/D)\), \( s \) represents the saving deposits ratio \((S/D)\), and \( o \) represents the other deposits ratio \((O/D)\), then the money multiplier is given by

\[ m = \frac{1}{r+e} \]

where

\[ r = \frac{R}{D+T+S+O}, \quad e = \frac{E}{D+T+S+O}, \quad t = \frac{T}{D}, \quad s = \frac{S}{D}, \quad o = \frac{O}{D} \]

These relationships are used to restate the China money multiplier in terms of the structure factors.

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The People’s Bank of China implements the same required reserve ratios to all kinds of deposits, such as the demand deposits, the time deposits, the saving deposits and the other deposits.
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deposits ratio \((S/D)\), \(o\) represents the other deposits ratio \((O/D)\), China narrow money multiplier is:

\[
m_1 = \frac{\frac{D + C}{D}}{\frac{C}{D} + (r + e)(\frac{D}{D} + \frac{T}{D} + \frac{S}{D} + \frac{O}{D})} = \frac{1 + k}{k + (r + e)(1 + t + s + o)}
\]  

China broad monetary multiplier is:

\[
m_2 = \frac{\frac{D + C + T + S + O}{D}}{\frac{C}{D} + (r + e)(\frac{D}{D} + \frac{T}{D} + \frac{S}{D} + \frac{O}{D})} = \frac{1 + k + t + s + o}{k + (r + e)(1 + t + s + o)}
\]  

1.2 The structure factors of China money multipliers

The structure of China money multiplier include six factors, that is, the cash ratio \((k)\), the required reserve ratio \((r)\), the excess reserve ratio \((e)\), the time deposit ratio \((t)\), the saving deposit ratio \((s)\) and the other deposit ratio \((o)\). The author respectively analyzes the relationship between each factor and the money multiplier from the theory in the following.

1.2.1 The cash ratio \((k)\)

Holding everything else constant, the cash ratio is negatively related to China narrow and broad money multipliers because loan, which is cashed, would decrease the demand deposits and the capacity of bank credit expansion. The greater the cash ratio \((k)\) is, the more loans will be cashed and the smaller China narrow and broad money multiplier is.

1.2.2 The required reserve ratio \((r)\)

Holding everything else constant, the required reserve ratio negatively related to the narrow and broad money multipliers because the rising of the required reserve ratio means that the People’s Bank of China will absorb more liquidity of the commercial banks and the financial institutions.

1.2.3 The excess reserve ratio \((e)\)

Holding everything else constant, the excess reserve ratio also is negatively related to the narrow and broad money multipliers. If the commercial banks and the financial institutions hold more excess reserves, their liquidity will be decreased as the same as the rise of the required reserve ratio.

1.2.4 The time deposit ratio \((t)\)

Holding everything else constant, the time deposit ratio is negatively related to China narrow monetary multiplier, but it is positively related to China broad money multiplier.

The first reason for that is the time deposits implement the same required reserve ratios as the demand deposits in China. When the time deposits increase the commercial banks and the financial institutions must keep more reserve deposits with the People’s Bank of China. So their capacity of credit expansion would be decreased in the condition of China narrow money multiplier.

The second reason is that the amount of the time deposits rising is greater than that of the time deposit reserves in the condition of China broad money multiplier. The rising of the time deposits would raise the commercial banks and the financial institutions’ capacity of credit expansion.

1.2.5 The saving deposit ratio \((s)\) and the other deposit ratio \((o)\)

Holding everything else constant, the saving deposit ratio and the other deposit ratio are all negatively related to China narrow money multiplier, but they are positively related to China broad money multiplier. The reasons for that are the same as the time deposit ratio.
2. The move trends of China money multipliers and their structure factors

2.1 The move trends of China money multipliers

The author changes the equation $M_1=m_1B_1$ and $M_2=m_2B_2$ into the logarithm $\log M_1=\log m_1+\log B_1$ and $\log M_2=\log m_2+\log B_2$ to calculate China narrow and broad money multipliers ($m_1$ and $m_2$) of 2000 to the first quarter of 2009. Then he drew the figure of the move trends of China narrow and broad money multipliers from 2000 to the first quarter of 2009 (Fig. 1). Finally he discovered that China narrow and broad money multipliers from 2000 to the first quarter of 2009 had several obvious features, they were:

1. China narrow money multiplier ($m_1$) is more stable, it has a decreased trend form the fourth quarter of 2006. The highest point of the narrow money multiplier ($m_1$) is the third quarter of 2003 (that is 0.3468555) in the all term. After this point it has decreased and been further stable. The fourth quarter of 2008 is the lowest point (that is 0.1311554) in this time period. The spread between the highest point and the lowest one is 0.2157.

2. China broad money multiplier ($m_2$) is also more stable in the time period and it has a decreased trend form the fourth quarter of 2006 as the same as the narrow money multiplier ($m_1$). The highest point, which is 0.7802966, is the third quarter of 2003; the lowest one, which is 0.5908545, is the fourth quarter of 2008 in this time period. The spread between the highest point and the lowest one is 0.1894.

3. From above analysis, we can see the highest and lowest terms of China broad money multiplier (the third quarter of 2003 and the fourth quarter of 2008) are the same as that of China narrow money multiplier. Therefore, they nearly have the same move trend, but China broad money multiplier is more stable than the narrow money multiplier and all money multipliers have decreased trends for recent years.

4. The average multiple value of the ratio of China broad money multiplier to the narrow money multiplier is 2.89, but the ratio had been increased from 2004. The smallest ratio is the third quarter of 2003 in this period, that is 2.25 times, but the greatest one is the fourth quarter of 2008, that is 4.51 times. So the spread between China broad money multiplier and the narrow money multiplier is expanding for recent years, especially from 2007 to the first quarter of 2009.

![Fig. 1  Move trends of China m1 and m2 from 2000 to the first quarter of 2009](image)
2.2 The move trend of the structure factors of China money multipliers

Using the datum, which the People’s Bank of China had published, the author drew the figure of the structure factor move trends of China narrow and broad money multipliers from 2000 to the quarter of 2009 (Fig. 2), and discovered that the structure factors of China narrow and broad money multipliers have several obvious features, which are shown as follows:

(1) The required reserve ratio was continually raised from the fourth quarter of 2003. At the second quarter of 2008 (June 25, 2008), it had been raised from 6% to 17.5%. Its rising may result in China money multipliers’ decrease.

(2) There is a decreasing trend in the excess reserve ratio. For example, in this period the highest point of the excess reserve ratio is 6.88% (the fourth quarter of 2004) and the lowest one is 1.02% (the first quarter of 2009), and their spread is 17.79%.

The average value of the excess reserve ratio of 2007, which is 3.27% and that of 2008, which is 2.78%, are less than that of all the period, which is 4.68%. The excess reserve ratio after the second quarter of 2008 is the lowest stage of that in all the time period. The reason for that is the People’s Bank of China had published the required reserve ratio increase several times from 9% to 17.5% during the period from 2007 to 2008; The financial institutions must meet their required reserves by reducing their excess reserves. The decreasing of the excess reserve ratio may result in China money multipliers’ increase.

(3) There is a slow-decreased trend in the cash ratio. The highest point is the first quarter of 2000, that is 46.52% and the lowest one is in the fourth quarter of 2007, which is 24.51%. The reason for its decreasing is that more and more people has used electronic money (such as bank cards, credit cards and network bank, and so on) to purchase goods or pay service fee. The decreasing of the cash ratio would result in China money multipliers rising.

(4) There is an increased trend in the time deposit ratio. The lowest level of the time deposit ratio is the first quarter of 2002 (29.93%). After that time it has increased continually. The highest level is the third quarter of 2008, which is 64.75%. All the year of 2008 is the fastest period in the growth speed of the time deposit ratio from 2000 to the first quarter of 2009. The four quarters’ time deposit ratio of 2008 respectively is 57.38%, 61.61%, 64.75% and 63.43%. They are so high.

The reason for that is the People’s Bank of China had raised the interest rates of the deposits again and again from October 29, 2004 for controlling the high inflation rate. The result is the amount of the time deposits fast increasing because of the depositors for getting more returns. The increased trend in the time deposit ratio will result in China narrow money multiplier decreasing and the broad money multiplier increasing.

(5) The curve of the saving deposit ratio shows that there is a great fluctuation in the saving deposit ratio. The highest level of the saving deposit ratio is the first quarter of 2006, that is 1.875, but the lowest point is the fourth quarter of 2007, that is 1.407. The moving level of the saving deposit ratio in the time period is 46.76%.

The saving deposit ratio began to decrease from the fourth quarter of 2006 and then it began to increase from the second quarter of 2008 because of the price of China stock markets fast rising during this time period and a large amount of the saving deposits flowing into the stock markets. Although the People’s Bank of China continually had raised the interest rates, the banks cannot absorb more saving deposits. Contrary situation occurred during the second quarter of 2008 for the price descending of China stock markets.

The decrease of the saving deposit ratio will result in China narrow money multiplier increasing and broad
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money multiplier decreasing, and vice versa.

(6) There is a great fluctuation in the other deposit ratio. The highest level of the other deposit ratio is the first quarter of 2002, which is 27.13%, and the lowest one is the first quarter of 2006 (that is 2.267%). The spread is 24.86%.

The structure of other deposits includes the foreign money deposits and the trust deposits. Therefore, the change in the other deposit ratio would be affected by fluctuations of the price of the stock market, RMB exchange rate, interest rates and other factors. The reason for great fluctuation in the other deposit ratio is that there is a fluctuation of the price of the stock market, RMB exchange rate, interest rates, etc.

The average value of 2007, which is 13%, and that of 2008, which is 11.33%, is lower than that of this time period, which is 15.44%. The decrease of the other deposit ratio will result in China narrow money multiplier increasing and the broad money multiplier decreasing, and vice versa.

Fig. 2  Move trends of the structure factors of China monetary multipliers

3. The effect of each structure factor on China money multipliers

Suppose other factors unchanged, the following equations can be used to calculate the effect of each structure factor, such as the required reserve ratio on China narrow and broad money multipliers.

\[
\Delta m_1^n = \frac{1 + k_t}{k_t + (r_t + e_t)(1 + t_t + s_t + o_t)} - \frac{1 + k_{t-1}}{k_{t-1} + (r_{t-1} + e_t)(1 + t_{t-1} + s_{t-1} + o_{t-1})}
\]

\[
\Delta m_2^n = \frac{1 + k_t + t_t + s_t + o_t}{k_t + (r_t + e_t)(1 + t_t + s_t + o_t)} - \frac{1 + k_{t-1} + t_{t-1} + s_{t-1} + o_{t-1}}{k_{t-1} + (r_{t-1} + e_t)(1 + t_{t-1} + s_{t-1} + o_{t-1})}
\]

In the above equations, \( r_t \) represents required reserve ratio at time \( t \), \( r_{t-1} \) represents the required reserve ratio at time \( t-1 \), etc. According to the rule we can respectively get the equations of the effect of the other structure factors, such as the excess reserve ratio, the cash ratio, the time deposit ratio, the saving deposit ratio and the other deposit ratio on China money multipliers (omitted). The actual effects of the structure factors on China money multipliers as following (all of figures omitted).
3.1 The cash ratio ($k$)

Holding everything else constant, the cash ratio is negatively related to China narrow and broad monetary multipliers. The effect of the cash ratio on China broad money multiplier is greater than that on China narrow money multiplier. The average effect of the cash ratio on China narrow money multiplier is $1: -0.0499$, that is, if the cash ratio increases 1%, China narrow money multiplier will decrease 0.0499%. The average effect of the cash ratio on China broad money multiplier is $1: -0.254$, that is, if the cash ratio increases 1%, China broad money multiplier will decrease 0.254%, holding other factors constant.

3.2 The required reserve ratio ($r$)

Holding everything else constant, the required reserve ratio is negatively related to China narrow and broad money multipliers. The average effect of the required reserve ratio on China broad money multiplier is slightly greater than that on China narrow money multiplier. The average effect of the required reserve ratio on China narrow and broad money multiplier is respectively $1: -0.473$ and $1: -1.324$, that is, if the People's Bank of China raises 1 percent of required reserve ratio, China narrow money multiplier will be reduced 0.473% and China broad money multiplier will be reduced 1.324%, holding other factors constant.

3.3 The excess reserve ratio ($e$)

Holding everything else constant, the excess reserve ratio is negatively associated with China narrow and broad money multipliers. The average effect of the excess reserve ratio on China broad money multiplier is also greater than that on China narrow money multiplier. The average effect of the excess reserve ratio on China narrow and broad money multiplier is respectively $1: -1.507$ and $1: -4.213$, that is, if the commercial banks and financial institutions increase 1% of their excess reserve ratio, China narrow and broad money multiplier will be reduced 1.507% and 4.213%, holding other factors constant.

3.4 The time deposit ratio ($t$)

Holding everything else constant, the time deposit ratio is negatively associated with China narrow money multiplier, but it is positively associated with China broad money multiplier. The average effect of the time deposit ratio on China narrow money multiplier is $1: -0.0244$, that is, if the time deposit ratio rises 1%, China narrow money multiplier will decrease 0.0244%. The average effect of the time deposit ratio on China broad money multiplier is $1: 0.0274$, that is, if the time deposit ratio rises 1%, China broad money multiplier will also increase 0.0274%, holding other factors constant.

3.5 The saving deposit ratio ($s$)

The saving deposit ratio is negatively related to China narrow money multiplier, but it is positively related to China broad money multiplier, holding the other factors constant. The average effect of the saving deposit ratio on China narrow money multiplier is $1: -0.0786$ and that on China broad money multiplier is $1: 0.1084$. In other words, if the saving deposit ratio rises 1%, China narrow money multiplier will decrease 0.0786% and China broad money multiplier will increase 0.1084%, holding other factors constant.

3.6 The other deposit ratio ($o$)

The other deposit ratio is negatively related to China narrow money multiplier, but it is positively associated with China broad money multiplier, holding the other factors constant. The average effect of the other deposit ratio on China narrow money multiplier is $1: -0.046$ and that on China broad money multiplier is $1: 0.084$. In other words, if the other deposit ratio rises 1%, China narrow money multiplier will decrease 0.046% and China broad money multiplier will increase 0.084%, holding other factors constant.
4. Conclusions

Some following conclusions are got from the above empirical analysis on China narrow money multiplier, broad money multiplier, and their structure factors.

4.1 The required reserve and saving deposit ratio associated with China money multipliers

The required reserve factor is the most associated with China narrow and broad money multiplier of all factors using the datum from 2000 to the first quarter of 2008 (cut out several abnormal points) to regress, under everything else constant. The saving deposit ratio is more associated with China narrow and broad money multipliers than other factors, under everything else constant. Other factors, e.g. the cash ratio, the excess reserve ratio, the time and other deposit ratios, are respectively less associated with China narrow and broad money multipliers under everything else constant.

The result told us that the People’s Bank of China can affect China money multipliers and money aggregate through adjusting the required reserve ratio and the saving deposit ratio. If the People’s Bank of China raises the required reserve ratio, China narrow and broad money multiplier and the growth rate of money aggregate will be decreased. If the saving deposit ratio increases, China narrow money multiplier will be decreased, but China broad money multiplier will be increased, vice versa.

4.2 The People's Bank of China can use the tools of the required reserve ratio and the interest rates to affect the money multipliers and money aggregate

The most valid way of the People’s Bank of China affecting the money multiplier is increasing or decreasing the required reserve ratio, but the saving deposit ratio also is a more valid method. The People’s Bank of China can affect the money multiplier by leading people’s saving flow direction, for example, raising the interest rates of the saving deposits to draw more saving deposits. It results in the growth rate of the narrow money aggregate decreasing and that of the broad money aggregate increasing. So increasing or decreasing the interest rates will be another strong method of adjusting the macro economy for the People’s Bank of China, besides raising or reducing the required reserve ratio.

The People’s Bank of China was aimed at liquidity surplus of the economic system to raise the interest rates and the required reserve ratio several times in the last several years. The above empirical analysis proves that using the tools of the required reserve ratio and the interest rates is correct for controlling liquidity and the growth of the money aggregate.

References:

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