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China's Monetary Policy: 1998 - 2002

by

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I. Introduction

By phasing out credit ceilings for commercial banks in January 1998, China formally adopted modern monetary policy. From 1998 to 2002, China has maintained sustainable economic growth with low inflation; meanwhile, there have been few changes in both financial structure and financial institutions. China's monetary policy experiences from 1998 to 2002 are of high value to shed new light on how to implement monetary policy in a transition economy, both because of their theoretical importance and because of their potential application to policymaking.

Several studies have investigated monetary policy implementation in transition economies, including Balino, Hoelscher and Horder (1997), and Slok (2000). These researchers explore the evolution of monetary policy in Russia and Mongolia, respectively, focusing on the roles of monetary policy instruments in Russia and the relationship between money and inflation in Mongolia. China's researchers, Liu and Liu (2002) pay much attention to analyzing interactions between immediate targets and monetary objectives, and demonstrate that there is a significant bilateral Granger Causality between China's monetary aggregates and economic output. A broader summary of China's monetary policy over 1996 to 2000 can be found in Cheng (2002).

Based on historical data between 1994 and 2002, this paper applies correlation and Granger Causality methods in analyzing relationships between base money and monetary aggregates (M1 and M2). In addition, a cointegrated vector autoregression model was established to explore interactions among monetary aggregates, economic output, and the inflation rate in China. Also, this paper discusses advantages and disadvantages of various monetary policy instruments, the effectiveness of interest rate policy and the central bank's management of foreign exchange inflows.

The paper is organized as follows. Section II describes monetary policy transition in China from 1998 to 2002. Section III investigates monetary policy transmission effectiveness through econometric analysis of the relationship between base money

and money supply, and on dynamic effects among the money supply, economic growth, and inflation. Section IV compares pros and cons of different monetary instruments, Section V discusses the effect of interest rate adjustments on the real economy, and Section VI analyzes China's foreign exchange policy and its implications for People's Bank of China (PBC) offsetting operations in response to foreign exchange purchases. Section VII presents conclusions.

II. Monetary Policy Transition From 1998 to 2002

A. Intermediate targets of monetary policy

With inflation and economic growth as its ultimate objectives, China's monetary policy is targeted at the money supply, and open market operations are the primary policy instrument to control the money base. Table 1 shows target and actual values of money supply, domestic credit, and inflation rate during 1998 to 2002.

Table 1: Target values and real values of China's monetary policy objectives

in RMB billion for domestic credit, others %

Year	M1		M2		Increase in domestic credit		Inflation rate[*]	
Growth rate	Target	Actual value	Target	Actual Value	Target	Actual value	Target	Actual value
1998	17	11.9	16-18	15.3	900-1000[**]	1149.1	5	-2.6
1999	14	17.7	14-15	14.7	1355	1284.6	2	-1.4
2000	15-17	16.0	14-15	12.3	1100	1334.7	1	0.4
2001	13-14	12.65	15-16	14.42	1300	1291.3	1-2	0.7
2002	13	16.82	13	16.78	1300	1847.5	1-2	-0.8

Note: [*]The inflation rate in 1998 is based on retail price, others, the consumer price index. Target value of M2 growth rate is adjusted to 14% in mid-2002.

[**]Increase in domestic credit includes all financial institutions, while the target increase in domestic credit in 1998 only covers state-owned commercial banks (SCBs), the actual increase of domestic credit from SCBs in 1998 was RMB910 billion.

Source: China Financial Yearbook (1998-2002).

B. Monetary policy instruments

1. The reform of required reserves. On March 21, 1998, the People's Bank of

China (PBC) consolidated two formerly separated accounts, the required reserve and excess reserve accounts to one account, and reduced the required reserve ratio to 13 percent. Before that a required reserve ratio of 13 percent plus an excess reserves ratio of 5 to 7 percent added up to a reserves ratio of about 20 percent, which was excessive and restricted the commercial banks' lending. After the reform, of the 13 percent required reserve ratios, 8 percent were legally required, and the remaining 5 percent could be used for clearing and settlement among financial institutions. Reform measures introduced in March 1998 enabled commercial banks to lend 87 percent of funds they absorbed, up by 7 percent. In September 1999, the required reserve ratio was reduced from 8 percent to 6 percent.

2. Rediscount. Formation mechanisms for discount and rediscount rates were reformed and an independent rediscount rate was designated as a PBC benchmark rate on March 24, 1998. Before that the discount rate of commercial banks and rediscount rate of the central bank were determined through floating by 5 percent to 10 percent below the commercial banks loan rates and central bank's lending rate of corresponding maturities respectively, hence discount rates and rediscount rates were isolated. After the reform, rediscount rates were determined on the basis of central bank lending rates, and discount rates were connected with rediscount rates by setting discount rates certain percentage points higher than rediscount rates. From March 1998 to June 1999, there were four consecutive cuts in the rediscount rate by the PBC. In particular, the rediscount rate was cut by 1.8 percentage points in June 1999 from 3.96 percent to 2.16 percent, the relatively large reduction in rediscount rate was intended to give commercial banks a comfortable spread, serving as an incentive for them to expand discount and rediscount activities. Considering there was adequate liquidity within commercial banks and the overall interest rates were relatively low, the PBC raised rediscount rate from 2.16 percent to 2.97 percent in September 2001 to reduce rediscount lending to commercial banks.

From the beginning of 2002, the rediscount rate (2.97%) was higher than the average interest rate (2.2%) in the money market, which in turn led to a sharp decline of rediscount loans. At the end of 2002, the outstanding balance of rediscount lending

stood at RMB 6.77 billion, down RMB 58.77 billion from the beginning of 2002. Together with RMB 60.3 billion recalled in 2001, the central bank recalled a total of RMB 119.07 billion through the rediscount window within two years.

3. Open market operations

The PBC resumed open market operations on treasury bonds in May 1998, and injected RMB 70.1 billion of base money through open market operations in 1998. During 1998, market participants increased from 14 to 29; meanwhile, the operation targets had expanded from short-term treasury bonds to varieties of bonds including treasury bonds, policy financial bonds, central bank bills etc. Since 2000, the policy stance of open market operations has moved from injecting base money in 1998 and 1999 to withdrawing excessive liquidity from commercial banks. On August 1, 2000, open market repos were activated to absorb excessive liquidity.

Owing to the plentiful supply of foreign exchange in 2002, foreign exchange purchases on the open market increased continuously, which resulted in rapid expansion of the monetary base. To stabilize base money growth, the PBC began to withdraw liquidity through repo transactions in the open market.

Table 2：Open Market Operations after 1998　　　　　　　in RMB billion

Year	1998		1999		2000		2001		2002		2003
	First half	Whole year	First half	Whole year	First half	Whole year	First half	Whole year	First half	Whole year	First half
Number of operations	6	36	26	60	23	50	29	54	23	50	33
Increase base money	7.05	71.84	19.73	271.57	4.47	233.5	588.18	822.71	22.35	179.83	246.37
Decrease base money	0	1.69	79.6	79.6	182.5	315.21	772.09	852.32	40.22	281.97	533.93
Net effect on base money	7.05	70.15	-59.87	191.97	-178.03	-81.71	-183.92	-29.62	-17.88	-102.14	-287.56

Note：Negative sign in "Net" row stands for money base decrease, and positive sign stands for money base increase.

Source：Statistics Department, the People's Bank of China.

4. Issuing central bank bills

To deal with the potential bond shortage in open market as a result of repo transactions for several years, the PBC decided to convert the outstanding repo

contracts signed between June 25, 2002 and September 24, 2002 into equivalent central bank bills on September 24, 2002. After the conversion, the number of categories of central bank bills amounted to 19, and issuance volume reached RMB 193.75 billion. From end April to early September 2003, both foreign exchange purchases in the open market and commercial banks' loans increased continuously. To cope with potential oversupply of base money, the PBC actively adopted offsetting operations through issuing central bank bills. From April 22 to September 23, 2003, the PBC issued central bank bills for RMB 545 billion, resulting in a net monetary base withdrawal of RMB425.43 billion.

C. Interest rate policy

From 1996 to 2002, there were eight consecutive reductions in RMB deposit and lending interest rates. Table 3 shows eight times official interest rates adjustments since May 1996.

Table 3：China's official interest rates since 1996.　　　　　　in　%

Interest rate (y-m-d)	Benchmark interest rates of central bank		Deposit rate of commercial banks		Lending rate of commercial banks	
Interest rate adjustment time	Required reserve	Loans to financial institutions (1 year)	Household saving deposit (1year)	Demand deposit	Short-term (1 year)	Medium and long-term (3 years)
1996.05.01	8.82	10.98	9.18	2.97	10.98	13.14
1996.08.23	8.28	10.62	7.47	1.98	10.08	10.98
1997.10.23	7.56	9.36	5.67	1.71	8.64	9.36
1998.03.25	5.22	7.92	5.22	1.71	7.92	9.00
1998.07.01	3.51	5.67	4.77	1.44	6.93	7.11
1998.12.07	3.24	5.13	3.78	1.44	6.39	6.66
1999.06.10	2.07	3.78	2.25	0.99	5.85	5.94
2002.02.21	1.89	3.24	1.98	0.72	5.31	5.49

Source: The People's Bank of China Quarterly Statistical Bulletin (1996-2002): Statistics Department, The People's Bank of China.

One characteristic of the latest interest rate adjustment on February 21 2002 is that cuts of short-term interest rates are bigger than that of long-term rates; this aims to stabilize consumer's interest rate expectations in long run, while stimulating consumptions and investments at short run.

The market-oriented interest rate reform had steadily progressed. By the end of 1999, the inter-bank borrowing rate, discount rates for commercial paper, and repos and spot trading rates in the inter-bank bond market were fully liberalized. Policy financial bonds and treasury bonds issuance were market-oriented with interest rates set by bid by purchasers.

Discretionary bands around the lending rate were enlarged. In 1998, the discretionary band for commercial banks' lending rate to small enterprises increased from 10 percent to 20 percent, and for rural credit cooperatives, from 40 percent to 50 percent. In April 1999, lending rates bands for financial institutions below county levels were expanded from 20 percent to 30 percent. Interest rate band for loans to small- and medium-sized enterprises was subsequently widened further with the 1998 ceiling of 20 percent being raised to 30 percent in September 1999. A pilot project on market-oriented interest rate reform for rural credit cooperatives was launched in 2001, with a reform provision that deposit rates could be 20 percent higher and lending rates 70 percent higher than the official rates. After 2002, the pilot project was expanded to 91 counties throughout China, further enlarging the lending bands from 50 percent to 100 percent and deposit bands from 20 percent to 50 percent.

The interest rate on foreign currency deposits was adjusted in a timely fashion to accommodate the local currency interest rate. In 1999, considering interest rates rises in US, the PBC raised foreign currency (mainly US dollar) deposits rates four times. Three reform measures were implemented for foreign currency interest rates in September 2000: financial institutions were given full discretion in setting interest rates on loans, the interest rate for small deposits would be proposed by the Banking Association and approved by the PBC, and the interest rate for deposits of US\$3 million or more would be negotiated between banks and customers. In 2001, the PBC cut the interest rate on foreign currency deposits on nine occasions; additionally, the interest rate on small foreign currency deposits was cut further in November 2002.

D. Credit policy

After 1998, the main developments in credit policy include: 1. Infrastructure projects, such as highways and transportation facilities, financed by commercial banks

can be secured with the projects' future revenues (rights to collect fees) as mortgage collateral; 2. Consumer credit, especially housing and auto loans, increased rapidly; meanwhile, the PBC forbade commercial banks from extending housing loans with zero down payments and consumer loans without well-defined purposes; 3. Credit policy of rural credit cooperatives was adjusted and rural micro-credits were encouraged in line with principles of one time credit approval; 4. To alleviate liquidity shortages of export enterprises resulting from delay in export tax rebate, the PBC authorized commercial banks to provide short-term liquidity loans for export enterprises secured by exports tax rebate accounts. Lending for this purpose should not exceed 70 percent of enterprises' total tax refunding, nor to exceed a maturity of one year; 5. The discretionary band for lending rates to small- and medium-sized enterprises was raised from 20 percent to 30 percent; 6. State-owned-enterprises producing marketable goods were permitted to borrow even if they were in the red; commercial banks strengthened lending support for re-employment and introduced guaranteed small-scale loans to laid-off workers.

E. Development of the money market

The China Inter-bank Bond market was put into operation in June 1997, and by the end of 2002, participants in the Inter-bank Bond market consisted of 945 institutional investors (most of them are financial institutions). Both turnover and liquidity of the Inter-bank Bond market expanded continuously[1], and the stock of tradable bonds had increased from RMB72.3 billion in 1997 to RMB 2360.9 billion by the end of June 2003. Categories of trading bonds increased from one category, covering several kinds of bonds, to four categories (treasury bonds, central bank bills, policy financial bonds and enterprises' bonds) covering 150 kinds of bonds.

Due to the proactive fiscal policy adopted after 1998, issuances of treasury bonds and policy financial bonds greatly increased. During 1998 to 2002, most book-entry treasury bonds and all policy financial bonds were issued on the Inter-bank Bonds

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[1] The turnover of Repo and spot transaction on inter-bank bond market in 2002 reached RMB10.19 trillion and RMB441.2 billion, which had expanded by 330 and 455 times respectively from 1997, see Feng (2003).

market. Expansion of market volume and enhancement of market liquidity had lowered the cost and improved the efficiency of raising money.

The number of participants in the Inter-bank Bond market also grew fast, reaching 536 at the end of 2002. Based on changes in participant's   capital, the PBC took timely steps to modify each participant's borrowing quota. At present, the seven-day inter-bank borrowing rate and the bonds repo rate have become benchmark rates for China's money market.

Table 4： Money Market Transactions after 1998   in RMB billion

Year	Volume issued in inter-bank bond market			Trading volume in inter-bank bond market		Trading volume in inter-bank offering market
	Treasury bond	Bonds issued by policy-oriented banks	Other bond	Spots trading	Repo trading	
1998	151.4	41.0		3.3	102.1	197.8
1999	209.8	157.0		7.5	394.9	329.1
2000	226.0	164.5		68.3	1578.2	672.8
2001	212.4	269.0	3.5	84.0	4013.3	808.2
2002	319.7	297.5	4.5	441.2	10188.5	1210.7

Source： China Financial Yearbook, 2002, pp5 and Feng（2003）.

F. Foreign exchange administration and Renminbi's exchange rate policy

China's balance of payments had remained strong from 1998 to 2002. First, both the current account and capital account were in surplus, foreign exchange sales to banks exceeded purchases from banks and the amount of net sales to commercial banks increased steadily. Second, the pressure from household demand for foreign exchange had been fully alleviated. In 2002, household sales of foreign exchange had tripled from that of 2001, reaching US$ 17.1 billion; meanwhile, households' purchases of foreign exchange from banks had fallen to less than half the level in 2001, even though restrictions on residents' foreign exchange purchase had been gradually relaxed. Third, foreign exchange supplies exceeded demands on the inter-bank foreign exchange market, and foreign exchange reserves increased

continuously. By the end of 2002, foreign exchange reserves expanded to US$286.4 billion, $74.2 billion more than at the end of 2001.

Having achieved Renminbi convertibility on the current account in December 1996, China maintains administrative controls on the capital account. To strengthen capital account management and prevent putting capital account transactions into the current account; furthermore, to prevent evasion of foreign exchange surrender requirement and fraud of export tax refund through counterfeit export receipts and customs import declaration forms, China maintained the inspection on authenticity of export receipts and import payments. In addition, the anti-money-laundering endeavor was further strengthened by introducing reporting rules for suspicious large-value foreign exchange transactions.

The Renminbi is partially convertible on the capital account, as of the 43 categories of capital account transactions classified by the IMF, 8 are convertible in China, which includes commercial credit between residents and nonresidents, direct investment in China by nonresidents and clearing of direct investment. A further 11 are loosely managed, which include residents' foreign investment and overseas issuing of money market instruments, financial credits and guarantee among residents and nonresidents, domestic purchases and sales of real estate by nonresidents. Eighteen are more restricted and the remaining are strictly controlled.

After China's exchange rate unification in 1994, the Renminbi had been under pressures to depreciate or appreciate on different occasions. To maintain Renminbi stability, the PBC has adopted comprehensive measures ranging from improving the system of foreign exchange purchase-and-sale via foreign-exchange-designated banks, to interest rate policy to open market operations. The East Asian financial crisis, which erupted in 1997, exerted depreciation pressure on RMB. The PBC succeeded in maintaining the currency value by selling foreign exchange in the market, strengthening supervision of foreign exchange purchase on the capital account, strictly inspecting import payments for authenticity and adjusting interest rates on foreign currency deposits. After 2000, to alleviate appreciation pressure induced by expanding capital inflows and foreign exchange reserves, the PBC increased foreign

exchange purchases and relaxed restrictions on sales and purchases of foreign exchange on the current account.

The PBC flexibly adopted policies to improve the system of foreign exchange purchase-and-sale via foreign-exchange-designated banks, and the ceiling balance in foreign exchange accounts of China's enterprises had been increased while foreign exchange controls over the capital account eased. To promote the inter-bank foreign exchange market, the PBC has introduced more foreign exchange trading products, including the Euro and other foreign currencies, established the China inter-bank foreign exchange borrowing market, and allowed the three other SCBs along with the Bank of China to do business on foreign exchange forwards.

III. Effectiveness of Monetary Policy Transmission in China

The theoretical assumption underlying China's monetary policy is that on the one hand, monetary policy objectives (GDP growth rate and inflation rate) are closely correlated with intermediate targets (money supply or bank credit); on the other hand, intermediate targets are firmly connected with base money, or equivalently, the money multiplier is stable and the central bank can influence intermediate targets by adjusting base money growth with policy instruments. We will test this hypothesis by investigating two relationships: one is the nexus between base money and monetary aggregates and bank credit; another one is the nexus between monetary aggregates and economic growth and inflation.

A. Relationship of base money with monetary aggregates and bank credit

We first examined items of currency issue and reserves on the central bank's balance sheet between first quarter 1994 and fourth quarter 2002, and found that the outstanding balances of reserves were more volatile than that of currency issue. As far as quarterly increments are concerned, changes of reserves cover most of the changes in base money. From quarter two 1994 to quarter four 2002, contemporaneous

correlation coefficient between base money and reserve was 0.932, while that between base money and currency issues was 0.45.

More importantly, we analyze affiliations of base money with asset items of the central bank balance sheet, that is to say to we investigate the impacts of four different liquidity injecting channels on base money: the PBC's lending to financial institutions, foreign exchange purchase by monetary authority, open market operations on treasury bonds, and the rediscount window.

1. Central bank lending was closely correlated with base money growth.

Among all channels to supply base money, central bank lending was most closely connected with base money; the correlation coefficient between central bank lending and base money is 0.43 for the period quarter two 1994 to quarter four 2002.

2. The correlation coefficient between central bank foreign exchange purchases and base money is 0.18, which is smaller than that between central bank lending- base money and open market operation on treasury bonds-base money.

3. From 1998 to 2002, the correlation coefficient between open market operations on treasury bonds and base money is 0.19, which is smaller than that between central bank lending-base money, while a bit higher than that between foreign exchange purchase and base money.

4. The correlation coefficient between rediscount activity and base money is negative.

Table 5 shows correlation coefficients between base money and four channels to inject it[3]. We find that, even though the removal of the credit ceiling for state-owned commercial banks was a big shock to the money supply, it did not change significantly the correlations of base money with the four channels.

Table 5: Contemporaneous correlation coefficients between quarterly base money increments and the four injecting channels

	Correlation with base money

Time horizon	From 1994 to 2002	Before 1998	After 1998
Central bank lending	0.43	0.72	0.35
Foreign exchange purchase	0.18	0.49	0.11
Open market operation on treasury bonds	0.19		0.19
Rediscount	-0.11		-0.10

Source: The People's Bank of China Quarterly Statistical Bulletin (1996-2002): Statistics Department, The People's Bank of China.

We then move to connections between base money and monetary aggregates, and connections between base money and bank credit.

1.Correlation of base money with M1.

Results of quarterly cross-correlation coefficients and a Granger-Causality test on base money and M1 indicate that the impact of base money on M1 was not strong; the lag length of this impact is around one to two quarters. Central bank lending, Granger-causes M1; its contemporary impact on M1 is most significant, while the total impact can last two years. With lag length around four quarters, impact of foreign exchange purchases on M1 was relatively weak; nonetheless, open market operations on treasury bonds was strongly connected with M1. Its impact on M1 can last one and half years, with a lag length around three quarters. Among all four channels to inject base money, only central bank lending Granger-causes M1.

2. Correlation of base money with M2.

Results of quarterly cross-correlation coefficients of base money with M2 suggest that the impact of base money on M2 was even weaker than its effect on M1, and the lag length of this impact is around three quarters. The lag length effect of central bank lending on M2 was around three to nine quarters, and the impact after nine quarters was most significant. Among all dynamic correlation coefficients between foreign exchange purchases and M2, the contemporaneous one was biggest, while the effects of the other two, with time lags (foreign exchange purchase move ahead of M2) of one quarter and four quarters, were also considerable. The lag length of the impact on M2 by open market operations was about two quarters. Granger-causality tests prove that neither base money nor the four monetary policy instruments Granger-cause M2.

3. Correlation of base money with commercial banks' credit.

Empirical results of quarterly cross-correlation coefficients and Granger-Causality tests illustrate that the lag length of impacts of base money on bank's loans was about two to seven quarters, and the effect of a change in base money was most significant after seven quarters. The Granger-causality test shows that it was the change of bank loans that Granger-caused base money, indicating that the PBC was sometimes in a passive position to adjust monetary policy. In particular, central bank lending Granger-caused commercial bank's loans, and the lag length of its impacts was around four to ten quarters, with the most significant effect after seven quarters; the lag length of foreign exchange purchases was two to five quarters. Considering open market operations on treasury bonds, the lag length of its effect was about two to three quarters, with the strongest effect after two quarters. Commercial banks' loans Granger-caused open market operations, which suggests that only after commercial banks' liquidity had changed did the central bank adjust its policy stance.

B. Identifying the dynamics of Monetary Aggregates with Economic Growth and Inflation Rate

Among economists, empirical research on quantifying the dynamic effects of monetary aggregates upon output and inflation has drawn different results. Stock and Watson (1989) and Cover (1992) found that changes in money supply affect outputs in the short-term; their results are similar to those by Friedman and Schwartz (1963) and Tobin (1970). McCandless and Weber (1995) investigated relationships among economic growth, inflation and growth of monetary aggregates for 110 countries over 30 years, and argued that there was no correlation between output and monetary aggregates over a long time horizon. Consistently, research by Kormendi and Meguire (1984) over 50 countries and Boschen and Mills（1995）on the American economy gave the same results. We focus on China's situation within the first quarter 1992 to the third quarter 2002.

1. Correlations of money supply with output and inflation.

(1) Monetary aggregates and GDP

Cross-correlation coefficients of GDP_t with all $M2_{t+j}$, $M1_{t+j}$, and $M0_{t+j}$ (j=0,-1, -2,…), and GDP_t with most $M2_{t+j}$ (j=0, 1, 2,…) are positive; However, cross-correlation coefficients of GDP_t with most $M1_{t+j}$ and $M0_{t+j}$ (j=0, 1, 2,…) are negative. Three curves in figure 1 show that the highest correlation coefficients of GDP_t with M2, M1 and M0 are correlations between $M2_{t+2}$ and GDP_t, $M1_{t-4}$ and GDP_t and $M0_{t-2}$ and GDP_t, with coefficients of 0.48, 0.32, and 0.33 respectively. That is to say, M1 and M0 tend to move ahead of GDP by four quarters and two quarters respectively; notwithstanding this, M2 lags GDP, and only after two quarters of GDP expansion does M2 respond. Figure 1 shows that M1 and M0 move ahead of GDP, while M2 moves behind of GDP.

Figure 1. Cross-correlation coefficients of GDP_t with $M2_{t+j}, M1_{t+j}, M0_{t+j}$
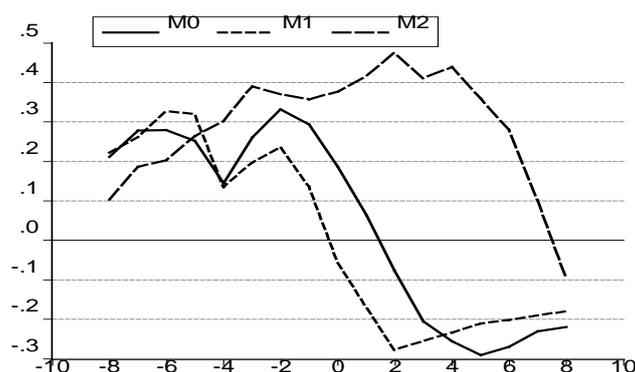
(2) Monetary aggregates and inflation.

The cross-correlation coefficients of the inflation rate $GDPDFL_t$ with all $M2_{t+j}$ (j=0,±1,±2,…), $GDPDFL_t$ with all $M1_{t+j}$ and $M0_{t+j}$ (j=0,-1,-2, …) are positive. The curves in figure 2 show that the highest correlation coefficients of $GDPDFL_t$ with M2, M1 and M0 are correlations between $M2_{t-4}$ and $GDPDFL_t$, $M1_{t-5}$ and $GDPDFL_t$ and $M0_{t-2}$ and $GDPDFL_t$, with coefficients 0.31, 0.69, 0.72 respectively. That is to say, M2, M1 and M0 move ahead of the

inflation rate by four quarters, five quarters, and two quarters respectively, and the monetary aggregates act as   leading indicators of inflation.
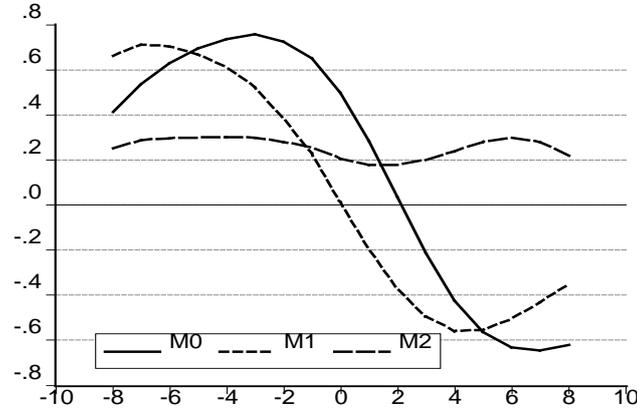

Figure 2. Cross-correlation coefficients of $GDPDFL_t$ with $M2_{t+j}, M1_{t+j}, M0_{t+j}$.

2. Regressions of output and inflation on money supply

(1) A single-equation regression.

We can formulate a two-equation model to describe output and inflation,

$$GDP_t = \sum_{i=1} a_i GDP_{t-i} + \sum_{i=0} b_i M2_{t-i} + e_{1t}$$

$$GDPDFL_t = \sum_{i=1} c_i GDPDFL_{t-i} + \sum_{i=0} d_i M2_{t-i} + e_{2t}$$

Here $GDP, GDPDFL, M_2$ are logarithms of real GDP, the GDP deflation index, and broad money. We choose $i=6$ in the GDP_t equation and $i=5$ in the inflation($GDPDFL_t$) equation based on the Schwarz/Hannan-Quinn Information Criterion. The OLS estimation results can be found in Table 6 and Table 7：

Table 6：Regression results of GDP

GDP$_t$=0.68GDP$_{t-1}$-0.14GDP$_{t-2}$+0.02GDP$_{t-3}$+0.56GDP$_{t-4}$-0.32GDP$_{t-5}$+0.05GDP$_{t-6}$
(0.13)   (0.14)   (0.10)   (0.09)   (0.12)   (0.11)
-0.28M2$_t$+0.32M2$_{t-1}$+0.26M2$_{t-2}$-0.33M2$_{t-3}$-0.49M2$_{t-4}$+1.01M2$_{t-5}$-0.45M2$_{t-6}$+0.84
(0.22)   (0.36)   (0.33)   (0.33)   (0.31)   (0.31)   (0.19)   (0.48)
R^2=0.996
Serial Correlation Lagrange-multipler Test LM=1.16[0.32]
Residual Normality Jarque-Bera Test   J-B=1.07[0.58]

White Heteroskedasticity Test	WH=1.07[0.42]

Assuming the null hypothesis $\sum b_i = 0$, the result on testing null hypothesis illustrates that the probability that we cannot reject the null hypothesis is 12%. It is clear that M2 has significant effects on output in the short-term. The results of single-equation estimation of the inflation rate are shown in Table 7.

Table 7：Regression result of inflation rate

GDPDFL$_t$=0.22GDPDFL$_{t-1}$+0.11GDPDFL$_{t-2}$+0.13GDPDFL$_{t-3}$+0.45GDPDFL$_{t-4}$

　　　　　(0.12)　　　　(0.12)　　　　(0.11)　　　　(0.16)

-0.005GDPDFL$_{t-5}$ +1.08M2$_t$-0.039M2$_{t-1}$-0.89M2$_{t-2}$+0.21M2$_{t-3}$+1.31M2$_{t-4}$-1.58M2$_{t-5}$-0.9

　(0.12)　　　　　　(0.44)　　(0.72)　　(0.69)　　(0.68)　　(0.67)　　(0.41)　(0.34)

R^2=0.984
Serial Correlation Lagrange-multipler Test LM=1.30[0.28]
Residual Normality Jarque-Bera Test   J-B=3.42[0.18]
White Heteroskedasticity Test   WH=1.09[0.39]

Again we assume the null hypothesis $\sum d_i = 0$, and it, finding that the probability that the null hypothesis could not be rejected is 3.4%, which indicates money supply does affect the inflation rate. The above regression results can be summarized as follows: in the short-term, money supply affects both output and inflation, while in the long-run, changes in monetary aggregates have significant effects on inflation and no effects on output. As a matter of fact, a money supply increase of one percent over a long time horizon will result in an increase of inflation rate by 1.0065 percent, essentially one percent. That is to say, long-run changes in the money supply will fully reflect themselves in changes in the price level.

(2) A Vector Autoregression analysis.

By taking money supply, output and inflation rate as a system, we can formulate a k-order vector autoregression(VAR) model,

$$Z_t = \Pi_1 Z_{t-1} + \cdots + \Pi_k Z_{t-k} + e_t$$

Here the vector $Z_t = (GDP_t, GDPDFL_t, M_{2t})$, and $\Pi_1 \cdots \Pi_k$ are 3×3 matrices. After transformation we have：

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \cdots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Gamma_k Z_{t-k} + e_t$$
$$\Gamma_i = -I + \Pi_1 + \cdots + \Pi_i, i = 1, \ldots, k$$

A vector error-correction model is established,

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \cdots + \Gamma_{k-1} \Delta Z_{t-k+1} - \alpha \beta' Z_{t-k} + e_t.$$ After unit-root and cointegration

tests, we have the impulse response functions which are described in Figure 3. Figure 3 plots output and inflation responses to money supply shocks.

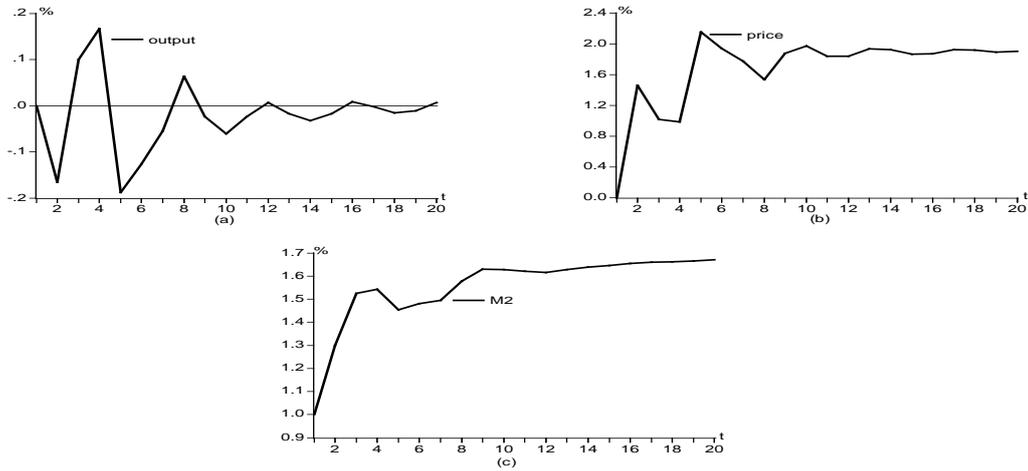Figure 3: impulse response curves (in %)

Figure3 (a) shows that changes in money supply affect output in the short-run. However, long-run changes in the money supply do not have permanent effects; hence, money is neutral. Figure 3 (b-c) also indicates that the money supply has systematic effects on the inflation rate, both in the short and long run.

When the money supply increases by one percent, the inflation rate rises   after two quarters; moreover, due to the interactions between the price level and the money supply, the money supply itself increases further. For a one percent increase in money supply, after 12 quarters the price level will increase by 1.71 percent, while money supply growth rate itself will move from 1 percent to 1.69 percent. Changes in the

money supply are mainly embodied in changes of price level. Results of forecast error variance decomposition on output and inflation are reported in Table 8.

Table 8: Forecast error variance decomposition

8-1: output

Horizon	Shocks of output（%）	Shocks of inflation（%）	Shocks of money supply（%）
2 quarters	98.07	1.26	0.67
4 quarters	95.14	3.53	1.33
8 quarters	94.12	4.65	1.23
20 quarters	90.03	9.45	0.52

8-2：inflation

	Shocks of output（%）	Shocks of inflation（%）	Shocks of money supply（%）
2 quarters	4.92	83.53	11.55
4 quarters	6.86	76.64	16.50
8 quarters	9.07	64.77	26.16
20 quarters	9.83	59.96	30.21

Table 8 decomposes output and inflation fluctuations into components induced by output shocks, inflation shocks and money supply shocks. More than 90 percent of fluctuations on output can be explained own shocks, while less than 10 percent of output fluctuations can be attributed to shocks from inflation and money supply. However, a relatively large share of inflation fluctuations are due to money supply shocks, while output shocks account for less than 10 percent of inflation movements.

To sum up, within the short term, the money supply affects output and money is not neutral; nevertheless, the impacts of money supply on output lasts no more than eleven quarters. In the long run, money is neutral and the impacts of money supply on output are not of a permanent nature.

In both the short and long term, the money supply is closely related to inflation; changes in the money supply will have permanent effects on the inflation rate and will be fully transformed into changes in the price level.

IV. Choice of Monetary Policy Instruments

China's monetary policy instruments can be classified into four categories[4]: (1) instruments with ratios: required reserve ratios, (2) interest rates: rediscount rate, central bank interest rate on reserve requirements, central bank lending rates, deposits and lending interest rates of financial institutions, (3) quantity instruments: central bank lending, open market operations (on treasury bonds and foreign exchange), rediscount, and (4) other instruments: central bank bills (after September 2002), central bank bonds, special deposits on central bank, standing facility and moral suasion. We focus on following instruments.

A. Required reserve ratio

From 1984 to 2002, the PBC adjusted the required reserve ratio six times. Due to the gradual modernization of the payment and settlement system in China's banking industry, for the past few years commercial banks maintained relatively low levels of excess reserves; in particular, the SCBs' excess reserve ratios were approximately 4 to 5 percent. Under extreme circumstances, the PBC can adjust the required reserve ratio to drain (or inject) liquidity from (to) commercial banks.

B. Rediscount window

With a peak value of RMB 125.8 billion in December 2000, the turnover through rediscount is quite small in China, and the rediscount window has little influence on base money growth. During the past few years, instead of acting as a monetary policy instrument, the rediscount facility has been utilized actively to guide the development of the commercial paper market. In the hope that small and medium-sized commercial banks would increase their lending to small and medium-sized enterprises, the rediscount window has been operated mainly to cater to small and medium-sized

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[4] Since 1983, the People's Bank of China has utilized 14 monetary policy instruments including the required reserve ratio, excess reserve ratio, rediscount rate, deposits and lending interest rates of financial institutions, benchmark interest rates of the central bank, open market operations (on treasury bonds and foreign exchange), central bank bills (after September 2002), central bank bonds, special deposits with the central bank, assets-liabilities ratio of commercial banks, central bank lending, credit plan(credit ceiling) for commercial banks, currency issuing plan, and a standing facility.

commercial banks after 2000. Nonetheless, the results of the policy have been disappointing.

In recent years the volume of assets discounted by commercial banks has increased swiftly. At the end of 2002, outstanding use of the discount facility reached RMB574.3 billion, with an increase of RMB 224 billion in 2002 alone. Notwithstanding, by the end of 2002, the outstanding balance of rediscount declined to RMB 6.8 billion. Mismatch between discount and rediscount witnesses that it was the rediscount rate, rather than the volume of discount by commercial banks that determined scales of rediscount[5].

C. Central bank interest rates

Central bank interest rates, which consist of interest rates on required reserves and lending rates, constitute an upper limit and a lower limit for the money market interest rate. The interest rate on required and excess reserves marks the lower limit of the money market interest rate, while the PBC lending rate determines the upper limit of the money market rate. Central bank interest rates play important roles in monetary policy as they determine the money market interest rates.

In essence, the interest paid to commercial banks on their deposits in the PBC are huge financial subsidies to commercial banks from the central government, and has greatly influenced the commercial bank's financial condition. For instance, based on the interest rate on required reserves on February 21 2002 (1.89%) and the amount of outstanding reserves by the end of 2002 (RMB 1863.6 billion), the PBC　pays annual interest of RMB 35.2 billion to commercial banks.

D. Central bank lending

As borrowing from the PBC has been needed only by rural credit co-operatives and some small and medium-sized commercial banks since 2000, central bank lending in China has turned into either government subsidies towards rural credit co-operatives

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[5] The central bank rediscount rate should satisfy the condition that the central bank lending rate≥ rediscount rate≥money market interest rate, as is the case for the European Central Bank and Federal Reserve System. Arbitrage opportunities exist if the rediscount rate is less than the money market interest rate.

(as the lending rate is low), or a "lender of last resort" function used to rescue insolvent financial institutions. To deal with non-performing loans of financial institutions, the PBC had lent money to local governments, asset management companies and rural credit co-operatives.

Table 9：Central bank lending (outstanding balance)   in RMB billion

Year	Total amount	Policy-oriented banks	State-owned commercial banks	Asset management Company	Rediscount
1994	1072.086		962.645		
1995	1162.815		692.699		
1996	1463.611		831.756		
1997	1449.251	816.750	576.105		33.090
1998	1252.541	657.376	534.178		33.230
1999	1374.255	679.423	499.530		50.026
2000	1705.487	670.565	168.520	572.500	125.827
2001	1750.680	674.965	177.704	588.737	65.528
2002	1707.675	650.165	179.615	605.737	6.769

Source：Statistics Department, the People's Bank of China.

E. Open market operations on treasury bonds.

From 1998 to 2002, the yearly withdrawal of base money through open market operations on treasury bonds was RMB -70.1, -192, 81.7, 29.6 and 102.1 billion, respectively. On a weekly, monthly or yearly basis, open market operations on treasury bonds (especially short-term repos) had little impact either on commercial banks' excess reserves ratios or their liquidity, or on base money and monetary aggregates. For the period 2000-2002, commercial banks possessed bonds of RMB 2.5 trillion and their monthly average excess reserves ranged between RMB 540 billion and 660 billion. the counterpart of open market operations on treasury bonds is the commercial banks' excess reserves; in essence, open market operations affect the interchange between banks' excess reserves and bonds holdings. Compared with the huge amounts of commercial banks' excess reserves and bond holding, the turnover of open market operations was very limited; monthly net withdrawal or injection of liquidity amounted to only about RMB 40 to 60 billion. Outcomes on liquidity adjustment and base money control through open market operations were

insignificant.

The principal role that open market operation on treasury bonds had played in China was steering the money market interest rate; however, this function had not been well fulfilled.

F. Central bank bills

As mentioned above, to sterilize the rapid expansion of foreign reserves, the PBC had issued central bank bills with the amounts RMB 193.7 billion and 545 billion respectively in September 2002 and in the period between April 22 and September 23, 2003. On the one hand, central bank bills can sterilize the excessive injection of base money induced by the quick expansion of foreign exchange purchases; on the other hand, the interest rate of central bank bills can serve as a reference rate in setting the money market interest rate. Nevertheless, central bank bills might create "substitution effects" and "crowd-out effects" on treasury bonds, both in terms of quality and interest rate, which will in turn restrict the development of the treasury bonds market.

V. Results of Interest Rate Policy

As mentioned in section II, China has cut its interest rate eight times since 1996. Based on monthly data from January 1996 to December 2002, we explore the policy effects of interest rates cuts on saving deposits, consumption, bank loans and investment.

A. Policy effects on saving deposits and consumption

1. Interest rates and saving deposits

As shown in Table 10, the correlation coefficients between the interest rates on deposits and increments of saving deposits are not significant.

Table 10：Correlation coefficients between deposit interest rates and increments of deposits

Correlation coefficient	Increments of saving deposit	Increments of saving deposit（+2）
Nominal one-year deposit interest rate	0.065	0.066
Real one-year deposit interest rate	-0.146	-0.142

Household saving deposits increased sharply after 2001, its rapid expansion can be attributed to the following factors: first, as the economic reform advances, the uncertainties on household expenditure increase. To prepare for future expenditures on education, housing, medical treatment and retirement, households have enlarged their saving deposits. Second, as functions of bank cards and demand deposit accounts have been extended, both households and enterprises have increased their demand deposits in commercial banks and reduced their cash holdings. Third, there are limited investment instruments to choose from for households. Compared with other asset forms, saving deposits are safer, can more easily be inherited, and more convenient for tax evasion. Table 11 shows that saving deposits are the principal asset for China's households.

Table 11：Urban household financial asset in 2001   in RMB and %

Asset Items	Household average （Yuan）	Share (%)
Total asset：	73706	100
Saving deposit	51156	69.41
Stock (A share)	7374	10
Government bond	3210	4.36
Insurance	3094	4.20
Balance of accumulation fund	3036	4.12
Cash	2730	3.70
Loan	2512	3.41
Other securities	359	0.49
Others	235	0.32

Source：State Bureau of Statistics and "Shanghai Securities Daily"(September 27,2002).

2. Interest rates and consumption

With a correlation coefficient of -0.41, the real interest rate and the growth rate of real consumption[6] were negatively connected, which indicates that the "substitution

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[6] Growth rate of real consumption equals nominal growth rate of retail sales minus consumer price index.

effect" dominates the "income effect" after interest rate adjustment. Assuming constant household income, consumption will decrease as saving deposits increase. As the nominal interest rate currently has almost nothing to do with saving deposits, there should be no significant relationships between nominal interest rate and consumption.

The moderate connection between the real interest rate and consumption also suggests that changes in consumption can be attributed to changes in the price level, as the real interest rate is determined by inflation.

B. Policy effects on bank loans and investment

Table 12 shows the correlation coefficients between the commercial bank lending rate and of the increase in bank loans, and between the lending rate and investments in fixed assets.

Table 12: Correlations of commercial bank lending rate with bank loans and investment growth

Correlation coefficients	Increment of bank loans		Growth rate of investment on fixed asset	
	Increment of bank loans	Increment of bank loans (+2)	Real growth rate of investment	Real growth rate of investment（+t）
Nominal one-year lending interest rate	-0.269	-0.209	-0.341	-0.368（+1）
Spread between one year lending rate and saving deposit rate	0.229	0.179		
Real one-year lending interest rate			-0.211	-0.216（+3）

Note: real growth rate of investment equals nominal growth rate minus price index of investment goods.（+t）means move later than interest rate t months.

Source：Calculated by data from the People's Bank of China Quarterly Statistical Bulletin (1996-2002): Statistics Department, the People's Bank of China.

Table 12 suggests that bank loans are not sensitive to changes in both the commercial bank lending rate and interest rate spreads, and as far as real growth rate of investments on fixed assets is concerned, a decrease of the nominal lending rate may cause an increase in the growth rate of investment, even though the influence of interest rate on investment was not something decisive. The fact of the matter is that SCBs face a soft budget constraint, and hence are insensitive to interest rate changes.

The private sector's investments are not sensitive to the interest rate either, as it is greatly influenced by the legal environment, especially whether private property rights can be legally protected.

VI. Offsetting Operations on Foreign Exchange Reserve

After 1998, foreign exchange reserves witnessed a rapid increase, and the PBC counterbalanced the excess liquidity injected by foreign exchange purchases through open market operations on treasury bonds, policy financial bonds and central bank bills. As offsetting operations on foreign exchange advances, the outstanding balance of foreign exchange and its share of the total assets of the monetary authority have increased steadily, as shown in Table 13.

Table 13：Share of Components in the Central Bank Assets
(Based on quarter-end outstanding balance, in percentage points)

Quarter	Foreign Exchange	Lending to financial institutions	Claims on Government
1994.Q1	15.81	66.85	11.10
1995.Q1	27.00	59.18	8.83
1996.Q1	33.82	54.79	7.46
1997.Q1	35.96	48.78	5.61
1998.Q1	40.70	45.55	5.09
1999.Q1	43.09	39.84	5.20
2000.Q1	41.58	40.87	4.61
2001.Q1	41.02	46.38	7.43
2002.Q1	39.66	36.93	5.80
2002.Q2	41.30	36.90	5.44
2002.Q3	42.23	35.57	5.32
2002.Q4	43.26	33.41	5.60

Source：The People's Bank of China Quarterly Statistical Bulletin (1996-2002).

To investigate the impacts of net foreign asset on domestic credit and monetary aggregates, from banking survey we have:

DC + NFA + NOI = M2,

Here DC stands for domestic credit, NFA for net foreign asset, NOI for net other items. In first order difference form,

$\varDelta DC + \ \varDelta \mathrm{NFA} + \ \varDelta \mathrm{NOI} = \ \varDelta \mathrm{M2}$,

Judged by levels, from 1994 to 2002, domestic credit, net foreign asset and M2 had grown steadily, with shares of domestic credit, net foreign asset and net other items in M2 amounted to 82 percent, 15 percent and less than 4 percent. Specifically, share of net foreign asset on M2 has reached 15 to 17 percent after 2001, as shown in Figure 5 and Figure 6.
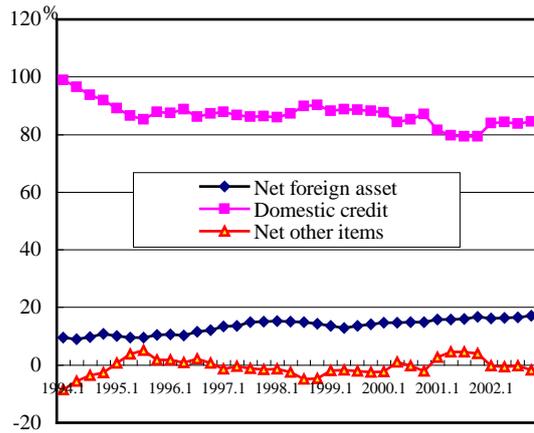

Figure 5: Outstanding balance of items in banking survey (in RMB hundred million)
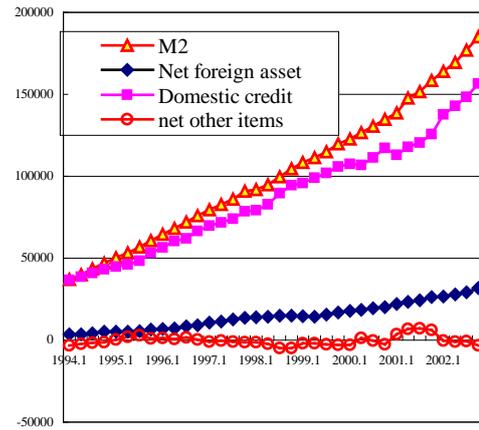
Figure6: Share of each item on M2 (in percent), based on outstanding balance.

Judged by first order difference, increments of domestic credit, net foreign asset, net other items and M2 are quite volatile; correspondingly, shares of domestic credit, net foreign assets and net other items on M2 are unstable. In particular, the share of net other items in M2 is even more volatile. For the period 2000 to 2002, the share of net foreign asset increments in M2 increments was about 20 percent.

Correlation coefficients (for levels) of M2 with net foreign assets, domestic credit and net other items are 0.64, 0.70 and -0.17 respectively, implying that besides domestic credit, net foreign assets is an important factor that affects M2.

Under the system of foreign exchange purchase-and-sale via foreign-exchange-designated banks, China's exchange rate is *de facto* pegged to the US dollar, and China's balance of payments is endogenously determined while China's net foreign assets cannot be controlled by the central bank. According to the Mundell-Fleming model, China's offsetting coefficient of net foreign asset on

domestic credit was estimated to be 0.18, or equivalently, when domestic credit decreases by one unit, net foreign assets will increase by 0.18 unit. Compared with other countries', China's offset coefficient is relatively low, which means that under the current exchange rate regime, adjustments to monetary aggregates can be realized only through modulation on domestic credit.

VII. Conclusions

This paper has reviewed China's monetary policy between 1998 and 2002, and we are particularly interested in the following.

First, effectiveness of China's intermediate targets. Monetary policy issues concerning intermediate targets in China attract warm discussion. Xia and Liao (2001) contended that the monetary aggregates (M1 and M2) were no longer suitable as intermediate targets, because the money multiplier is unstable and the monetary aggregates are uncontrollable by the monetary authority. Dai (2002) argued that at present, monetary aggregates are closely related to output and inflation and the PBC can adjust monetary aggregates via interest rate policy, central bank lending and open market operations, and therefore China needs to continually target the money supply. The results of this paper show that to some extent, monetary aggregates are endogenously determined and have tenuous connections with monetary policy. Empirical research provides little support for the idea that there exist significant interactions between base money and money supply. In the long run, money supply is neutral to output; nonetheless, monetary aggregates affect inflation remarkably closely in both the long-term and short-term.

Second, pros and cons on monetary policy instruments. Central bank lending has been transformed into an instrument either for rescuing insolvent financial institutions or for providing quasi-fiscal subsidies to rural credit cooperatives and policy-oriented financial institutions. Open market operations on foreign exchange purchase and treasury bonds have evolved into the principal channels to inject and withdraw liquidity, while the rediscount window needs further development. Under the current

foreign exchange administration regime, the PBC needs more instruments to sterilize foreign reserves that are endogenously determined and out of the control of the monetary authority. The preferred policy is for the PBC to transform its claims on government, including the existing overdraft by the central government, claims on the Agricultural Development Bank and on the asset management companies, into government bonds. This transformation can on the one hand, explicitly define the government's liabilities to the central bank; on the other hand, it would enhance the PBC's instruments for open market operations. Usually, central bank assets in developed countries consist of net foreign assets, government bonds and claims on financial institutions through repos. An international comparison reveals that among the total assets of the PBC, the share of net foreign assets (45%) is moderate, while the share of government bonds is extremely low. By the end of 2002, the share of government bonds in total assets of the PBC was only 6.6 percent (of which 2.5 percent are treasury bonds and 4.1 percent are policy financial bonds); the corresponding shares amounted to 88 percent, 60 percent and 85 percent for the central banks of the US, Japan and Canada.

Third, the policy results of interest rate adjustments. The effects of interest rate cuts on saving deposits, consumption, bank loans, and investment growth are all insignificant. Therefore it may be fair to argue that at present, the interest rate is unqualified to be a target of monetary policy operations.

Fourth, offsetting on foreign reserves. Considering the relatively low level of inflation at present, whether China needs to offset foreign exchange purchases deserves further investigation. Above all, money supplies are mainly determined by domestic credit, and the effect of offsetting foreign reserve accumulation on M2 is insignificant. Moreover, when inflation rises, the PBC can drain liquidity from commercial banks by raising the required reserve ratio.

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