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Examining the role of monetary aggregates in China

José R Sánchez-Fung
Kingston University London, UK

Abstract

The paper examines the relative significance of monetary aggregates and interest rates in China using the information approach to monetary policy. The analysis reveals the superiority and robustness of a narrow monetary aggregate in contributing information about future movements in inflation.

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Contact: José R Sánchez-Fung - j.sanchez-fung@kingston.ac.uk.

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1. Introduction

Monetary policy making involves exploring the past, present and potential future states of the economy using a range of economic models and indicators.Academic interest in the topic goes back at least to Milton Friedman's endorsement of monetary aggregates and includes recent efforts at extracting information from large datasets. But deciding exactly what role, if any,an indicator of aggregate economic conditions ultimately plays in designing and implementing monetary policy is an ongoing source of debate in the literature (Woodford, 2008; McCallum and Nelson, 2011).

The investigation contributes to the debate by examining the potential role of monetary aggregates in China using the information approach (e.g. Friedman and Kuttner, 1992). The paper seeks to answer the following question: Do monetary aggregates, contending alongside interest rates, contain useful information about future inflation in China? The approach seems potentially fruitful for a fast-growing economy with an unconventional and evolving monetary policy framework.And examining non-interest rate measures of monetary policy appears sensible in the light of the balance-sheet policies of many central banks around the world following the crises starting in 2008.

Since 1998 the People's Bank of China has shown a commitment to pursuing a market-based approach to monetary policy and in that context a variable like the interest rate is expected to be central for maintaining macroeconomic stability (e.g. Goodfriend and Prasad, 2007). China's reforms are extensive and well-documented, and include efforts towards improving the functioning of the money market. So there is no rationale for excluding interest rates from analyses on monetary policy in China on the basis that they do not reflect market conditions.

There is no investigationseeking to ascertain the competing relevance of money and interest rates for future inflation using the information approachas the rationale for the modelling;the closest investigation is Xie (2004). Xie computes regressions using quarterly data on monetary aggregates (M0, M1 and M2) and inflation and finds a significant association. However, the analysis does not consider an interest rate variable alongside monetary aggregates and therefore misses a potentially critical element for understanding China's evolving monetary policy.

This paper focuses on investigating the roles of monetary aggregates and interest rates as potential information variables for monetary policy in China. Information variables can be used by an optimizing central bank to learn about initial conditions and decide on open market operations, as discussed by Kareken *et al.* (1973). The approach is likely to be relevant in the presence of stochasticshocks affecting key relationships,and if there are concerns about model, parameter or data uncertainty. It is important to distinguish at the outset the information approach from using monetary aggregates as intermediate targets for which money demand analysis is criticalor as instruments in a policy rule (see McCallum and Nelson, 2011). Both approaches demand a more reliable statistical link between money and inflation than the information approach (e.g. Estrella and Mishkin, 1997).

2. Empirical modelling

The motivation for the empirical modellingis the information approach to monetary policy. The paper's strategy involves using money and an interest rate together to explain movements in inflation.Decisions about using monetary growth or an interest rate alone within a monetary policy framework are prone to suffering the pitfalls deriving from trying to measure the natural rate of interest, or from financial innovation and money demand instability. Furthermore, signals about the monetary policy stance derived from the interest rate alone can be misleading as illustrated by McCallum and Nelson (2011) for the USA economy.

Testing the information approach seeks to ascertain if there is statistically significant information in money and interest rates that is not already contained in inflation[1]. Causality is not relevant in the context of the approach.The analysis runs a battery of autogressions using three monetary aggregates and two interest rates

$$\Delta_{12} p_t = \lambda + \sum_{i=1}^{12} \delta_i \Delta_{12} p_{t-i} + \sum_{i=1}^{12} \beta_{mi} \Delta_{12} m_{t-i} + \varepsilon_t \,, \tag{1}$$

$$\Delta_{12} p_t = \lambda + \sum_{i=1}^{12} \delta_i \Delta_{12} p_{t-i} + \sum_{i=1}^{12} \beta_{ri} \Delta_{12} r_{t-i} + \xi_t \,, \tag{2}$$

$$\Delta_{12} p_t = \lambda + \sum_{i=1}^{12} \delta_i \Delta_{12} p_{t-i} + \sum_{i=1}^{12} \beta_{mi} \Delta_{12} m_{t-i} + \sum_{i=1}^{12} \beta_{ri} \Delta_{12} r_{t-i} + u_t \,. \tag{3}$$

In (1) to (3) M is a nominal monetary aggregate (M0, M1 or M2), P is the price level, and R is anominal interest rate -the discount rate (Rd) or the lending rate (Rl). In the equations small caps denote logs; $\Delta 12$is the 12-month difference operator, so the variables are expressed in annual growths rates; $\lambda,\delta,\beta_m$and$\beta_r$are coefficients to be estimated empirically, whileε,ξ and μ are disturbance terms. The frequency of the economic time series is monthly, ranging from 1999 to 2011, and the sourcesare the Federal Reserve Bank of St Louis FRED database on China and the International Monetary Fund's international financial statistics. Table A1 contains further details about the data.Figure 1 displays the variables considered in the modelling that follows: all the series are integrated of order zero according to ADF unit root tests including twelve lags, a constant term, and seasonal dummies[2].

The empirical modelling considers eleven regressions and focuses on the corresponding Fstatistics. The null hypothesis to be tested isthat a subset of coefficients ina given regression is equal to zero, e.g. all the coefficients on a monetary aggregate($\Sigma\beta_m$), say in equation 1,explaining inflation.Table 1 shows the results from estimating the two-variable systems using M0, M1, M2, Rd, or Rl to explain inflation (equations 1 and 2); Table 1a displays the corresponding coefficients alongside heteroscedasticty and autocorrelation consistent standard errors. The Fstatistics, the most relevant statistics given the paper's focus on the information approach, related to the five systems show that only the M1 variable contains significant information about future movements in inflation. None ofthe Ftests in Table 1 is significant at the 5% level excepting the one corresponding to the M1 equation – which is significant at the 1% level.

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[1] China's fixed exchange rate regime alongside binding capital controls has facilitated the implementation of a mostly independent monetary policy. For that reason the analysis is confident about not explicitly considering foreign prices in the empirical modelling.

[2] The sample for the ADF tests is 2001.2-2011.12 and the corresponding statistics are: inflation (-3.76), M0 (-4.16), M1 (-4.41), M2 (-3.15), Rd (-3.90), and Rl (-3.40). All the statistics are significant at the 5% level. It is worth noting that the interest rate variables are non-stationary in their levels.

Table 2 displays the Fstatistics for three-variable systemsanalogous to equation 3; Table 2a shows the corresponding coefficients alongside heteroscedasticty and autocorrelation consistent standard errors. The systems reported in Table 2 include one of the monetary aggregates (M0, M1 or M2) alongside one of the interest rate variables (Rd or Rl). The null hypothesis to be tested isthat a subset of coefficients ina regression is equal to zero. The results confirm the findings from the two-variable modelling displayed in Table 1: only the M1 monetary aggregate contains significant information on inflation (at the 1% level), even when competing alongside any of the two interest rate variables.

The relevance of the findings so far dependson the stability of a given relationship. The stability or otherwise a relationship, in turn, reflects the evolution of the institutional setting in China, the wider economic environment and changes in the practise of monetary policy. The investigation proceeds by estimating the regression containing inflation and M1 (equation 5) using a 37-observationwindow to initialise the recursive modelling process.Figure 2 displays two resulting recursive tests: 1-step-ahead forecast residuals together with two-error fans and the 1-step Chow test alongside the corresponding 1% significance line. Both graphs confirm the stability of the regression, with only two observations appearing barely outside the confidence fans in Figure 1's upper panel.So the two-variable model encompassing M1, the most robust variable for predicting movements in inflation,is stable during the turbulent period including the international financial crisis starting in 2008. That is notable in the light of the substantial build up of credit related to the expansionary policies in China and the impact that the process could have on wider macroeconomic developments including inflationary pressures.

3. Conclusion

The paper investigates the potential role of monetary aggregates in China using the information approach to monetary policy. The analysis considers three definitions of money and two interest rates. The modelling reveals the superior performance of the M1 monetary aggregate, alone and contending alongside interest rates, in providing information about future movements in inflation. Therefore theinvestigationcontributes empirical evidence endorsing thecase for using monetary aggregates to inform monetary policy in China.

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Table 1
Ftests for the monetary aggregates and interest rates in the inflation equations 2001-2011
Systems with two variables
The dependent variable is inflation($\Delta_{12}p$)

Equation number	Variables included in the equation	F tests
4	$\Delta_{12}m0$	0.36
5	$\Delta_{12}m1$	**0.00****
6	$\Delta_{12}m2$	0.19
7	$\Delta_{12}rd$	0.34
8	$\Delta_{12}rl$	0.30

Notes: Each OLS regression (corresponding to equation 1 or 2 in the text) includes 12 lags of inflation and 12 lags of a monetary aggregate (M0, M1, or M2) or an interest rate (Rd or Rl), plus seasonal dummies. The second column displays probability values for the Ftests generated by each of the five equations (4 to 8). The null hypothesis is that a subset of coefficients in a regression is equal to zero ($\Sigma\beta_{m0}$=0, $\Sigma\beta_{m1}$=0, $\Sigma\beta_{m2}$=0, $\Sigma\beta_{rd}$=0, and $\Sigma\beta_{rl}$= 0). **denotes significance at the 1% level.

Table 1a
Coefficients and HACSE for the auto regressions in Table 1
The dependent variable is inflation ($\Delta_{12}p$)

Lags	**Equation 4** $\Delta 12m0$	**Equation 5** $\Delta 12m1$	**Equation 6** $\Delta 12m2$	**Equation 7** $\Delta 12rd$	**Equation 8** $\Delta 12rl$
-1	0.010 (0.017)	**0.188 (0.040)**	0.047 (0.056)	0.021 (0.013)	**0.052 (0.017)**
-2	0.017 (0.012)	-0.068 (0.046)	-0.014 (0.072)	**-0.029 (0.013)**	-0.031 (0.023)
-3	**0.030 (0.013)**	-0.037(0.051)	**0.137 (0.064)**	0.017 (0.012)	0.003 (0.026)
-4	0.014 (0.011)	-0.022 (0.037)	-0.097 (0.065)	-0.015 (0.025)	-0.015 (0.039)
-5	0.018 (0.012)	0.019 (0.055)	0.007 (0.069)	-0.002 (0.027)	-0.008 (0.037)
-6	0.001 (0.011)	0.042 (0.035)	-0.013 (0.077)	-0.003 (0.009)	-0.014 (0.019)
-7	-0.008 (0.012)	-0.097 (0.050)	0.059 (0.061)	0.002 (0.008)	0.022 (0.019)
-8	0.006 (0.008)	-0.038 (0.044)	-0.074 (0.063)	-0.001 (0.008)	-0.026 (0.022)
-9	0.001 (0.010)	-0.007 (0.045)	-0.079 (0.072)	0.012 (0.012)	0.032 (0.024)
-10	0.004 (0.015)	0.054 (0.039)	0.102 (0.060)	-0.012 (0.008)	-0.040 (0.024)
-11	0.011 (0.009)	-0.017 (0.048)	0.018 (0.062)	0.004 (0.008)	0.031 (0.026)
-12	-0.004 (0.012)	0.025 (0.042)	-0.036 (0.048)	0.005 (0.007)	-0.003 (0.018)

Notes. –**HACSE:** heteroscedasticity and autocorrelation consistent standard errors displayed inside parentheses. Cells in bold denote a t-ratio greater than 2.

Table 2
Ftests for the monetary aggregates and interest rates in the inflation equations 2001-2011

Systems with three variables

The dependent variable is inflation($\Delta_{12}p$)

Equation number	Variables included in the equation	F tests	
		Monetary aggregate	Interest Rate
9	$\Delta_{12}m0, \Delta_{12}rd$	0.44	0.42
10	$\Delta_{12}m0, \Delta_{12}rl$	0.41	0.35
11	$\Delta_{12}m1, \Delta_{12}rd$	**0.00****	0.17
12	$\Delta_{12}m1, \Delta_{12}rl$	**0.00****	0.26
13	$\Delta_{12}m2, \Delta_{12}rd$	0.31	0.47
14	$\Delta_{12}m2, \Delta_{12}rl$	0.10	0.16

Notes: Each OLS regression (corresponding to equation 3 in the text) includes 12 lags of inflation,12 lags of each of the two additional variables (M0, M1, or M2, and Rd or Rl), plus seasonal dummies. The third and fourth columns display probability values for the F tests generated by the six different specifications(equations 9 to 14) and show if a subset of coefficients in a regression is equal to zero ($\Sigma\beta_{m0}$=0, $\Sigma\beta_{m1}$=0, $\Sigma\beta_{m2}$=0, $\Sigma\beta_{rd}$=0,and$\Sigma\beta_{rl}$=0). **denotes significance at the 1% level.

Table 2a
Coefficients and HACSE for auto regressions in Table 2
The dependent variable is inflation ($\Delta_{12}p$)

Lags	Equation 9	Equation 10	Equation 11	Equation 12	Equation 13	Equation 14
	Δ12m0		*Δ12m1*		*Δ12m2*	
-1	0.007 (0.014)	0.012 (0.016)	**0.206 (0.052)**	**0.194 (0.054)**	0.050 (0.062)	0.068 (0.070)
-2	0.014 (0.013)	0.016 (0.014)	-0.038 (0.047)	-0.048 (0.047)	-0.006 (0.075)	-0.057 (0.082)
-3	0.027 (0.015)	**0.031 (0.015)**	-0.031 (0.045)	-0.024 (0.056)	0.109 (0.069)	**0.125 (0.062)**
-4	0.010 (0.011)	0.003 (0.014)	-0.001 (0.043)	-0.016 (0.038)	-0.107 (0.075)	-0.062 (0.066)
-5	0.015 (0.014)	0.019 (0.015)	0.041 (0.059)	0.035 (0.065)	0.007 (0.083)	0.024 (0.083)
-6	0.005 (0.012)	-0.008 (0.015)	0.009 (0.043)	0.025 (0.041)	0.010 (0.079)	-0.018 (0.083)
-7	-0.003 (0.013)	0.001 (0.011)	-0.069 (0.055)	-0.084 (0.051)	0.089 (0.067)	0.120 (0.076)
-8	0.013 (0.010)	-0.007 (0.010)	-0.053 (0.049)	-0.052 (0.054)	-0.084 (0.073)	-0.104 (0.064)
-9	0.009 (0.010)	0.016 (0.011)	-0.020 (0.040)	-0.029 (0.046)	-0.086 (0.070)	-0.040 (0.062)
-10	0.005 (0.018)	-0.001 (0.016)	0.058 (0.046)	0.047 (0.043)	0.114 (0.075)	0.059 (0.065)
-11	0.016 (0.009)	**0.024 (0.011)**	-0.040 (0.055)	0.001 (0.054)	0.038 (0.069)	0.076 (0.077)
-12	-0.001 (0.012)	-0.006 (0.016)	0.045 (0.052)	0.035 (0.043)	-0.063 (0.058)	-0.067 (0.052)
	Δ12rd	*Δ12rl*	*Δ12rd*	*Δ12rl*	*Δ12rd*	*Δ12rl*
-1	0.022 (0.014)	**0.051 (0.018)**	0.021 (0.011)	0.040 (0.023)	0.020 (0.012)	**0.072 (0.019)**
-2	**-0.030 (0.015)**	**-0.049 (0.024)**	-0.018 (0.011)	-0.022 (0.024)	**-0.029 (0.013)**	**-0.057 (0.025)**
-3	0.018 (0.011)	0.035 (0.031)	0.008 (0.015)	-0.006 (0.028)	**0.021 (0.010)**	0.019 (0.026)
-4	-0.013 (0.027)	-0.038 (0.054)	-0.005 (0.017)	0.004 (0.028)	-0.007 (0.021)	0.001 (0.035)
-5	-0.001 (0.028)	0.018 (0.048)	0.006 (0.018)	0.009 (0.032)	-0.011 (0.028)	-0.023 (0.040)
-6	-0.001 (0.011)	-0.032 (0.028)	0.004 (0.013)	-0.014 (0.018)	-0.005 (0.011)	-0.015 (0.022)
-7	-0.002 (0.009)	0.035 (0.023)	0.001 (0.009)	0.014 (0.019)	0.012 (0.009)	0.039 (0.020)
-8	-0.001 (0.008)	-0.047 (0.025)	0.009 (0.010)	-0.001 (0.024)	0.001 (0.011)	-0.019 (0.027)
-9	0.012 (0.012)	0.046 (0.030)	0.014 (0.013)	0.034 (0.027)	0.010 (0.014)	0.017 (0.033)
-10	-0.010 (0.009)	-0.046 (0.026)	-0.012 (0.009)	-0.026 (0.019)	-0.014 (0.010)	-0.028 (0.025)
11	0.006 (0.008)	0.043 (0.028)	0.004 (0.009)	0.003 (0.025)	0.008 (0.009)	0.029 (0.024)
-12	0.006 (0.007)	-0.005 (0.020)	0.001 (0.008)	-0.008 (0.019)	0.003 (0.007)	0.001 (0.021)

Notes. - **HACSE** = heteroscedasticity and autocorrelation consistent standard errors displayed inside parentheses. Cells in bold denote a t-ratio greater than 2.

Table A1
Data appendix

Series descriptions	FRED codes
Consumer price index: All items for China (P), 2005 = 100, NSA	CHNCPIALLMINMEI
Discount rate, percent per annum (Rd), NSA	INTDSRCNM193N
Lending rate, percent per annum (Rl), NSA	92460P..ZF... (IMF code)
M0, national currency, NSA. M0 comprises currency issued by the PBC less the amount held by banking institutions.	MYAGM0CNM189N
M1, national currency, NSA. M1 comprises currency in circulation plus demand deposits in national currency of resident non-bank non-government sectors with the PBC and banking institutions. Currency in circulation refers to notes and coins by the PBC less the amount held by banking institutions.	MYAGM1CNM189N
M2, national currency, NSA. M2 comprises M1 plus time and savings deposits in national currency of resident non-bank financial corporations and non-bank non-government sectors with the PBC and banking institutions.	MYAGM2CNM189N

Notes: NSA = not seasonally adjusted.Source: Federal Reserve Bank of St Louis FRED China database and IMF international financial statistics.

Figure 1
Inflation, monetary aggregates and interest rates in China
Annual growth rates, 2000-2011

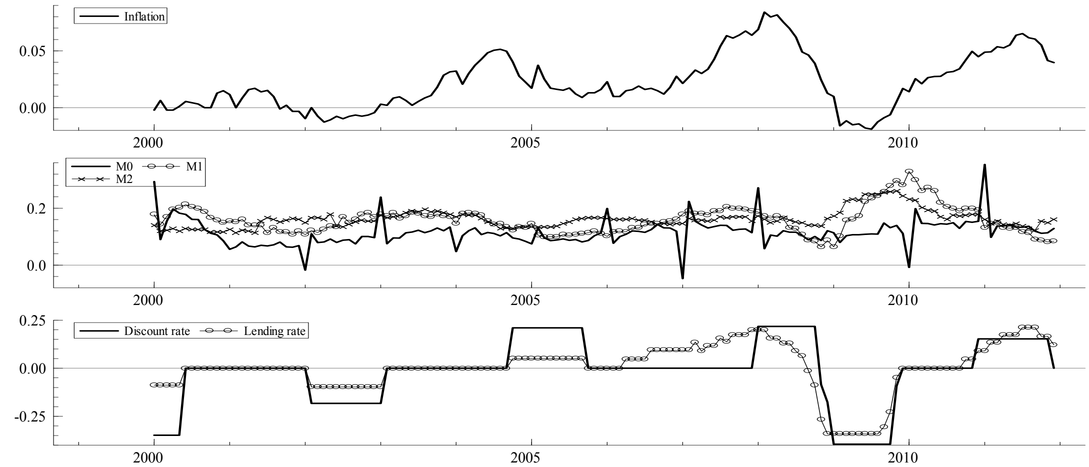

Figure 2
Recursive tests for the residuals of the inflation and M1 regression (equation 5)