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What Has Driven Chinese Monetary Policy Since 1990? Investigating the People's Bank's Policy Rule

Richard C.K. Burdekin and Pierre L. Siklos

Dr. Richard Burdekin is currently an East-West Center Visiting Senior Fellow and the Jonathan B. Lovelace Professor of Economics at Claremont McKenna College in Claremont, California. His primary research interests are monetary policy, inflation and deflation, and the Chinese economic reforms. He has published in a variety of professional journals. His most recent book *Deflation: Current and Historical Perspectives* (co-edited with Pierre L. Siklos) was published by Cambridge University Press in 2004. His current book project on *"China's Monetary Challenges in the Open Era: Past Lessons and Future Prospects"* is supported by a 2005-2006 Chiang Ching-kuo Scholar Grant. Dr. Burdekin received his Ph.D. from the University of Houston.

Dr. Pierre Siklos is Professor of Economics at Wilfrid Laurier University in Waterloo, Ontario, Canada and Director of the Viessmann Research Centre on Modern Europe. He is also co-editor of the North American Journal of Economics and Finance, serves on the Advisory Board of the Department of Finance and Capital Market Theory at the European University Viadrina, and is a Fellow of the European Business Cycle Network. Part of the research on this paper was performed while Dr. Siklos was a Visiting Scholar at the Bank of Finland. He specializes in macroeconomics with an emphasis on the study of inflation, central banks and financial markets. Dr. Siklos' research has been published in a wide range of international journals. His research has been funded by domestic and international agencies. Dr. Siklos received his Ph.D. from Carleton University.

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Richard C. K. Burdekin and Pierre L. Siklos*

Claremont McKenna College and Wilfrid Laurier University

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Abstract

Post-1990 Chinese monetary policy is modeled with a McCallum-type rule that takes into account the People's Bank of China's emphasis on targeting the rate of money supply growth. People's Bank policy appears responsive to the gap between target and actual nominal GDP as well as to external pressures. Additional cointegration analysis yields estimates of the gap between estimated money demand and actual money supply that appear to track the inflationary trends evident over our sample period. Chinese inflation and monetary policy outcomes seem reasonably captured using a standard monetary approach, therefore, without the need to appeal to China-specific "structural" factors.

Contact: Richard C. K. Burdekin, Jonathan B. Lovelace Professor of Economics, Claremont McKenna College, 500 E. Ninth Street, Claremont, CA 91711. E-mail richard.burdekin@claremontmckenna.edu; fax (909) 621-8249; 'phone (909) 607-2884.

There has been an outpouring of recent research on the question of the exchange rate between the US dollar and the Chinese renminbi, with a number of economists making a case for much larger renminbi revaluation than the initial 2% shift announced on July 21, 2005. Notwithstanding any external effects this policy move may have, allowing some freedom from the fixed exchange rate constraint promises to increase the People's Bank of China's scope for effective monetary control. Ba Shusong, deputy director-general of the Finance Institute of the State Council's Development Research Center, for example, emphasized that the fixed exchange rate had "jeopardized" the independence of Chinese monetary policy.[1] In this study we find a consistent monetary policy response to real output that is combined, however, with apparent sensitivity to external pressures. The movement away from the fixed exchange rate policy may well reflect the Chinese authorities' awareness of the benefits for monetary policymaking rather than necessarily representing a response to foreign demands for exchange rate adjustment.

In recent years monetary policy analysis has been increasingly dominated by the estimation of the "Taylor rule" (Taylor, 1993), whereby central bank interest-rate setting is related to the gap between inflation and its target value and the gap between actual real GDP and its potential level. When interest rates are already very low, a problem with the Taylor rule is that it may call for negative interest rates that cannot be delivered in practice, however. In such cases as Japan, therefore, McCallum's (1988) alternative rule based on explaining movements in the monetary base as a function of GDP and velocity growth may be more applicable (see also McCallum, 1993; 2003). In this paper we consider how this same "McCallum rule" may also be applied to China. Estimation of a Taylor rule would not be sensible here as not only does the People's Bank of China not have a target interest rate as such but also loan and deposit rates are still largely administratively determined. Only recently has any movement from the specified interest rates been permitted. And, when the People's Bank of China announced a rise in loan

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[1] Quoted in *People's Daily Online*, July 25, 2005.

and deposit rates on October 28, 2004, there was still no scope provided for exceeding the basic deposit rate laid down in the communiqué (People's Bank of China, 2004a).

Given that the People's Bank's money supply targets have generally emphasized broad money (M2), we consider the behavior of M2 as a dependent variable in our empirical work in addition to the monetary base series originally suggested by McCallum (1988). We consider the 1990-2003 period, thereby including the 1993-1994 inflation spike, the subsequent anti-inflationary policy, the attempts to reflate the economy after the 1997-1998 Asian financial crisis, and the more recent pressures for renminbi appreciation that emerged after 2001. Our analysis of Chinese monetary policy relative to the McCallum rule suggests that monetary policy was typically too tight until around 2001. We also find that, if we augment the basic McCallum rule, there is a significant monetary policy response to the rate of change of foreign exchange reserves that suggests less than full sterilization, as well as a significant shift that appears to coincide with the onset of deflation at the time of the Asian financial crisis. Our analysis concludes with a forecasting exercise that points to the central bank loosening policy too much in 2003-2004. Whether inflation will continue to rise crucially depends, however, on the People's Bank's response to this situation -- as well as the effects of changes in the exchange rate regime. As they stand, our results already imply, based on a forecast that updates information as it is received, that inflation may well show signs of moderating in the near future.

1. Overview of the Post-1990 Monetary Landscape in China

In 1992-1993 China faced its second inflation spike in five years with consumer price inflation peaking around 24% in 1994. The ensuing monetary tightening brought inflation down to single digits without apparent severe negative output effects until the economy was hit by the initial effects of the Asian financial crisis in 1997. While most other Asian currencies depreciated against the US dollar at this time, in many cases dramatically so, China's scope for domestic monetary loosening was limited by its

continuing commitment to the fixed exchange rate with the US dollar. Despite using fiscal "pump priming" to support the real economy and keep economic growth rates high enough to avoid large-scale unemployment, deflation set in and persisted until 2002. Deflation in consumer prices remained quite mild (around 1% in the first half of 2002, for example) but was more pronounced for commodity and raw material prices, which fell by nearly 5% over the same period. The seemingly close relationship between Chinese inflation and M2 money growth after 1990 is apparent in Figure 1.

The deflationary pressures, and impetus for devaluation of China's currency, were abruptly replaced in the late 1990s by pressures for revaluation, however, in the face of the reversal in the trend of the US dollar against other world currencies since 2000. Whereas, in the late 1990s, downward pressure on the renminbi left little room for expansionary monetary policy to ward off deflation, *upward* pressure on the renminbi later may have impeded the People's Bank's ability to fight inflation. Fueled by surging inflows of reserves (increasing by 40.8% in 2003 alone), money growth rose by 19.6% in 2003 before moderating somewhat to 14.6% in 2004. Attempts to sterilize the effects of these large capital inflows through bond sales seem to have met with only partial success.[2] Moreover, capital inflows into China may well have been fueled not just by any "fundamental" undervaluation based on the real exchange rate but also by speculation on appreciation – and potential capital gains from moving funds into renminbi at the 8.28 exchange rate that was fixed until July 2005.[3] Guo Shuqing, head of the State Administration of Foreign Exchange, had previously voiced the government's concern that the billions of investment dollars flowing into China in 2002-2004 could generate an asset bubble and inflation (see Goodman, 2004).[4]

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[2]Cargill, Guerrero and Parker (2004) point to the importance of interest rate deregulation and other financial reforms in order to facilitate effective open market operations (see also People's Bank of China, 2005).

[3]The relatively small size of the initial adjustment on July 21 itself carried the risk of inducing new speculation on additional exchange rate moves (cf, Goldstein and Lardy, 2005).

[4]Zhang (2005) estimates that speculative inflows accounted for 30-40% of the total increase in foreign reserves over 2002-2004 – that is, as much as $US 120-160 billion. Inflationary pressures would be somewhat offset, however, to the extent that revaluation expectations were boosting money demand (Cargill, Guerrero and Parker, 2004).

Survey evidence from the People's Bank of China also suggested rising inflation fears among urban savings depositors in 2004, with 41.5% of the November 2004 respondents expecting prices to rise further in 2005 while only 7.1% anticipated a decline (People's Bank of China, 2004b, p. 36).

It is unclear to what extent the July 2005 policy shift will be effective in lessening exchange rate pressures for monetary expansion. The People's Bank's freedom to conduct contractionary monetary policy is, in any event, called into question by political concerns about unemployment that might be generated by a cut back in credit expansion. Following the bold initiatives laid out by Jiang Zemin at the 1997 15th Party Congress, the government acknowledged the need for closure of at least some of China's loss-making state-owned enterprises. But, in order to ensure that the workers cast out of these state-owned enterprises are able to find new employment, China's government remained unwilling to accept even a modest reduction in the country's high rates of overall economic growth.[5] The vulnerability of China's banks to any tightening of credit conditions also raises the risks associated with renminbi revaluation (cf, McCallum, 2004) and may help explain the limited nature of the July 2005 exchange rate adjustment. Monetary stringency poses its own risks, therefore, and these must be balanced against the dangers of, through inaction, letting inflation get out of control. The role of the implicit output growth target in monetary policymaking is explored empirically in the following empirical work.

2. The Role of Monetary Policy in China

Prior work has examined money demand in China and tested for causality between money and prices and money and output. Chen (1997) finds a stable money demand function for the monetary base and M2 over the 1951-1991 period – with the inflation rate entered alongside output given that no appropriate interest rate term was available. Cargill and Parker (2004) identify a similarly significant response of

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[5]Bajona and Chu (2004) point to the limited steps actually taken to improve the performance of China's state-owned enterprises – but also identify the potential spur to this restructuring provided by World Trade Organization membership.

money demand to to the inflation rate over the more recent 1985-2002 period. Chen's (1997) additional

identification of a continued decline in velocity as income rose over the sample is a trend that continues

after 1990 (see, for example, Burdekin, 2000) with the Chinese economy becoming increasingly highly

monetized.[6] In the absence of further financial liberalization, however, interest rates continue to be

largely administratively-determined even today --making their influence on money demand hard to

interpret with Zhang (2003), for example, finding the interest rate to be insignificant in influencing money

demand in the post-reform period.

   Recent evidence on the link between money and prices in China is mixed.[7] Both Zhang (2003)

and Sun and Ma (2004) find some support for such a link but Zhang (2003) finds an additional role for

real variables and Sun and Ma (2004) find the money supply to be endogenous with respect to prices. An

accommodative, rather than causal role, for money supply movements in China is also seen by Zhang and

Wan (2004). But Zhang and Wan (2004), while finding a key role for price expectations in influencing

money, prices and output alike, do also point to greater stability in the relationship of M2 (the aggregate

emphasized by the People's Bank) with output and prices and find evidence of a cointegrating

relationship between M2, prices and output.[8]

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[6]Qin (2003) demonstrates how the increased channeling of household savings into bank deposits lies behind China's unusually large, and growing, M2/GDP ratio.

[7]The earlier literature using pre-1990 data generally yielded no clear consensus on the causality issue (see Zhang and Wan, 2004, on this point).

[8]After this paper was written we became aware of Gerlach and Kong's (2005) cointegration analysis that identifies a stable money demand and concludes that inflation in China is indeed a monetary phenomenon over a longer quarterly sample than ours (1980-2004).

There is also the question of structural breaks. Even restricting attention to just the 1990-2002 period, Sun and Ma (2004) find that the effect of the different monetary aggregates (monetary base, M1 and M2) on prices disappears after the onset of deflation in 1998. There are many reasons why monetary policy may become less effective once deflation has set in, including the postponement of non-essential purchases when prices are expected to fall over time (for a review, see Burdekin and Siklos, 2004). In China's case, the more than halving of the M2 growth rate from 34.5% in 1994 to 14.8% in 1998 was accompanied by a 23.7% drop in the (M2) velocity of circulation and a marked acceleration in savings growth relative to consumption (see Xu, 2002). The initial deflation coincided with the onset of the Asian financial crisis, with the decline in the consumer price index itself driven by a sharp drop in food prices that averaged -3.2% in 1998 and -4.2% in 1999 (Wu, 2004, p. 37). Elimination of tariffs as China joined the WTO may also have extended the deflationary trend, as well as helping to account for the fact that wholesale prices dropped so much more than consumer prices in 2001-2002 (Dai, 2002). Although we cannot account for such "structural" factors as WTO accession, we do allow for a parameter shift associated with the onset of deflation in 1998 – and (contrary to Cargill and Parker, 2004) find this effect to be highly significant.

Our application of the McCallum rule for China allows us to examine whether there is evidence of a systematic monetary policy rule over the 1990-2003 period.[9] The focus on money as the policy instrument is consistent with the monetary targeting espoused by the People's Bank itself in recent years and avoids relying upon interest rates that are neither liberalized nor a reliable barometer of the stance of monetary policy. We consider two monetary aggregates: the monetary base suggested in McCallum's (1988) original exposition plus the M2 measure recently emphasized by the People's Bank of China – as in Monetary Policy Director Dai Genyou's (Dai, 2002) stress on the steady growth achieved in broad

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[9]Short-run disturbances in the money-price relationship, as suggested in some recent empirical work on the Chinese case, are, of course, hardly unusual and by no means calls into question the longer-term importance of this link and the potential usefulness of money supply targeting (cf, Deutsche Bundesbank, 2005).

money, in the 14-15% range, over the 1998-2001 period.[10] The later surge in M2 growth to nearly 20%

in 2003 drew attention to the potential importance of fluctuations in the real exchange rate or in foreign

reserve inflows, however. Indeed, these same factors (in reverse) may have been important contributors

to deflationary pressures in the late 1990s and we allow for exchange rate and reserve flow pressures in

the analysis conducted below.[11]

3.   Alternative McCallum Rules for China

The McCallum rule is expressed in terms of nominal GDP growth rather than the decomposition into real

GDP growth and inflation featured on the right-hand side of the more familiar Taylor rule. A velocity

term is added to allow for money supply growth to adjust upward in the face of the money demand

expansion implied by declining velocity of circulation. This is in keeping, for example, with the rationale

for the non-inflationary loosening of Federal Reserve policy in the face of the falling velocity and rising

money demand in the early 1980s. Finally, in the event that nominal output growth is exactly on target

and velocity is constant, the rule allows for a benchmark monetary expansion that is one-for-one with the

target growth rate of nominal GDP. This essentially yields Friedman's famous x% rule for monetary

policy modified to allow for responses to persistent velocity movements and deviations from the

(presumed sustainable) target rate of nominal GDP growth. The basic McCallum rule has the following

form:

$$\Delta m_t = \Delta x^* - \Delta v_t + 0.5(\Delta x^* - \Delta x_{t-1}) \tag{1}$$

where Δm_t is the growth of the monetary aggregate,

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[10]The People's Bank's target for M2 growth was raised from 14% to 17% in the face of continued deflationary concerns in the fourth quarter of 2002, however ("China Still Troubled by Deflation in October," 2002).

[11]After the rapid growth in 2003, the People's Bank of China (2004b, p. 42) forecast that the 2004 M2 growth rate of approximately 15% would be maintained in 2005. The potential impact of capital inflows under a fixed, undervalued exchange is itself perhaps exemplified by an earlier period of Chinese history – the flows from mainland China to Taiwan near the end of the Chinese Civil War (Burdekin and Whited, 2005).

Δx_t is the growth rate of nominal GDP,

Δx^* is the target growth rate of nominal GDP, and

Δv_t is the average growth rate of velocity over the same period.

The money supply data employed in this paper are drawn from the "Great China Database" (http://www.tei.com.tw/greatdb/greatDB.html) and the IMF's *International Financial Statistics*. Nominal GDP data are drawn from China's National Bureau of Statistics, the People's Bank of China, the *China Statistical Yearbook* and *International Financial Staistics* (see Siklos and Yang, 2005, for more details on the construction of this series). Finally, velocity is calculated for each monetary aggregate by dividing the monetary variable into nominal GDP – with the implied growth rate smoothed by taking a moving average.

A key empirical problem is the absence of a regularly-provided official target for nominal GDP growth, however. Chinese officials have at times referred to targeted real growth in the high single digits and, even in the face of the Asian financial crisis, still maintained a 9% target for real growth (Wong, 1998, p. 38). Combining that with single-digit inflation suggests an implicit target nominal GDP growth rate in the range of 10-20%, depending upon exactly how much attempted restraint is to be imposed on inflation. The 2005 targets (People's Bank of China, 2004b, p. 42) of 8% real growth and 4% inflation yield a 12% implied rate of nominal GDP growth. Actual nominal GDP growth rose above 30% in the face of the 1993-1994 inflation spike, however, before dropping to around 10% at the end of the 1990s and then rising again towards the end of our sample period.

In our analysis, the unobservable target nominal GDP growth is modeled based on the trend properties of the raw data, which is both required by the absence of a consistent series of official target values and also is in keeping with the longstanding Friedmanite rationale for linking money growth to trend growth in output. A quarterly 3.75% growth rate, with a stochastic component around this growth

rate, appears to capture the slowdown in GDP growth beginning in the 1ate 1990s.[12] The resulting series,

together with actual GDP, is plotted in Figure 2. With M2 and the monetary base both used as proxies for

Δm_t, the rate of change of the resulting velocity estimates (GDP divided by each money supply measure),

is plotted in Figure 3.

Next, we proceed with two ways to implement equation (1). One approach applyies the rule

exactly as specified by McCallum. The time paths predicted by the rule for M2 and the monetary base are

shown in Figures 4A and 4B. Figure 4A clearly demonstrates that, relative to the indicated McCallum

rule, monetary policy was too loose until about 1996 since actual M2 growth far exceeds predicted money

growth. This is even more strongly evident when base money is used as the monetary aggregate (Figure

4B). Since the peak in inflation ended around 1995 the indicated period of monetary excess corresponds

quite well with the apparent actual stance of monetary policy. When we consider the performance of the

rule after the mid-1990s there is a slight discrepancy between the M2 version of the rule and the base

money version. The former suggests that monetary policy has been persistently too tight since 1997. In

contrast, other than for 1997-98, that is, during the years of the Asian crisis, base money growth has been

more or less in line with the rule's predictions. Different assumptions used to generate Δx_t^* do not

fundamentally change the picture (results available from the authors upon request).

The above estimates adopt McCallum's assumed coefficient of 0.5 for the gap between target and

actual nominal GDP growth and allow for no other influences on monetary policy besides velocity

changes. Just as many authors have found that estimated Taylor rules do not follow closely the originally

hypothesized parameter values used by Taylor (1993), it seems appropriate to allow the response to the

nominal GDP gap to be determined by the data – as well as allow for other potentially relevant factors.

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[12] Specifically, it was assumed, following considerable experimentation, that
$\Delta x_t^* = 3.75 + .05\varepsilon_t - .07\varepsilon_t^2 - .01\varepsilon_t^3$, where $\varepsilon_t \sim N(0,1)$ was obtained by applying a random number
generator. This expression was then replicated 1000 times. The mean of all 1000 simulated estimates of the resulting
series was used to generate the proxy for target GDP growth. See Scheibe and Vines (2005) for an alternative array
of estimates for China's output gap.

Table 1 reports a series of regressions of the form:

$$\Delta m_t = \beta_0 + \beta_1(\Delta x^* - \Delta x_{t-1}) + \beta_2 \Omega_t + \zeta_t \qquad (2)$$

where Ω_t represents additional covariates used to augment the basic McCallum rule (see below),

ζ_t is an error term, and all other variables are as previously defined.

Even with $\Omega_t = 0$, it is immediately apparent that the estimated value of β_1 differs greatly from

the hypothesized value of 0.5. Indeed, the estimates shown in the first column of Table 1 are in each case

negative and statistically significant.[13] We allowed for the addition of a dummy variable set equal to one

from 1997 on, thereby distinguishing the period following the onset of deflation (at the time of the Asian

financial crisis) from the inflationary period that preceded it (cf, Sun and Ma, 2004). The results in the

second column of Table 1 show that the estimated coefficient on β_1 remains negative but is now

statistically insignificant when base money growth is the dependent variable. However, with both M2

and the monetary base, the deflation dummy variable is highly significant and, as one would expect,

negative. Examining the fitted values of the regression (not shown) suggests that monetary policy was

too tight in 1991-1992 and again in 1998-1999 while the same policy was too loose during 1992-1997.

This suggests the generation of inflationary pressure until the mid to late 1990s, followed by a drop off,

which is precisely in line with what transpired in practice.

The specification of our deflation variable is arguably somewhat ad hoc. Consequently, we next

estimated alternative versions of (2) where $\Omega_t = [\dot{r}_t, \dot{f}_t]$ where $\dot{r}_t$ and $\dot{f}_t$ are, respectively, the rate of

change in the real exchange rate and foreign exchange reserves.[14] The estimates of β_1 continue to be

negative and are statistically significant for both monetary measures. Insofar as the response to nominal

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[13] The results do not change even if we constrain the constant term to be equal to the mean of the simulated value of
$\Delta x_t^* = 14.44\%$.

[14] Using lags of these variables did not affect the conclusions. It was impractical to allow for additional structural
shifts over our relatively short total sample – with other developments including the 1994 currency devaluation and
the more recent gradual moves toward financial liberalization.

GDP is concerned, this implies a procyclical policy response (cf, Zhang and Wan, 2004). The coefficient on the real exchange rate variable is negative and statistically significant, at least at the 5% level, indicating that real exchange rate depreciation led to a negative (countercyclical) monetary policy response, however. Meanwhile, the weaker link between foreign exchange reserves and money growth may be indicative of People's Bank of China success at sterilizing inflows of foreign exchange.

The estimates to date may not accurately reflect the People's Bank of China's true reaction to these variables, however, as the Ordinary Least Squares (OLS) estimates co-mingle the central bank's policy response with the more general economy-wide reactions. This is due to the endogeneity of the right-hand side variables in equation (2). Hence, the final column of Table 1 displays the results arising from estimation via the Generalized Method of Moments (GMM). The constant, deflation dummy, two lags of each of the variables in the equation, and two lags in export growth were used as instruments. One cannot reject that the resulting over-identifying restrictions are correctly specified.

While the results are not greatly affected by this change in estimation approaches, it is notable that the real exchange rate variable is no longer significant in any of the regressions. The coefficient on the foreign exchange reserves variable in Table 1A suggests that M2 growth increases or decreases significantly as reserves are above or below trend – thereby implying that the People's Bank of China is not able to sterilize inflows completely. When the monetary base is the dependent variable (Table 1B), its growth rate falls when foreign reserves rise above trend, however. This may reflect attempted countercyclical policy by the People's Bank of China in offsetting the increase in the foreign component of the base through bond sales and other measures. But the positive response of M2 suggests that such sterilization measures have not been sufficient to prevent the broader money supply from rising as inflows accelerate. Such a pattern seems particularly evident in the 2003 experience in China.

4.   Long-Run Estimates and Inflation Forecasting

While the foregoing results shed some light on the reactions of the People's Bank of China, an alternative approach consists in estimating a money demand function and comparing the estimates with the actual money supply data in order to derive the gap between the actual and predicted values, referred to as the "money gap." As outlined in Adam and Hendry (1999), the money gap has been found to by the Bank of Canada to be a useful indicator of inflationary pressure. Estimation of the money gap proceeds in two steps. In the first stage one tests for cointegration between the variables that form money demand, that is, a monetary aggregate, the price level, real income, and an interest rate. While the short-run relationship between an interest rate and money demand is likely meaningless in the Chinese case, we allow for the possibility that an interest rate belongs in a long-run cointegrating relationship that constitutes a money demand function. In the second stage, a vector error correction model is estimated and the predicted values represent the growth rate in money demand. Finally, the money gap is simply the difference between money demand and actual money supply growth.

The cointegrating relationship that defines the money demand equation is estimated as follows (with standard errors in parentheses):

$$\log M2_t = \underset{(0.32)}{1.54} \ \log CPI_t + \underset{(0.30)}{1.35} \ \log RGDP_t - \underset{(0.02)}{0.06} \ R_t - \underset{(1.01)}{2.14} \tag{3}$$

where   M2 is broad money supply,

CPI is the consumer price index,

RGDP is real GDP, and

R is the People's Bank of China's benchmark lending (discount) rate.

The signs for the long-run elasticities are as predicted by theory. Not surprisingly, however, the sign on the interest elasticity, while negative and statistically significant, is economically small. In contrast, the price elasticity is greater than one and suggestive of rising real balances in the long-run.[15] The income

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[15] The income elasticity is comparable to that reported in Gerlach and Kong (2005) but our price elasticity, estimated over a shorter sample, is considerably larger than theirs. While the implied decline in velocity as real balances rise is evident over most of the 1990-2003 period, there is something of reversal after 1999 (see Figure 3). It is too early to

elasticity is also larger than one and likely reflects the impact of strong economic growth throughout the sample period.

Figure 5 plots the money gap against inflation. Broadly speaking, we once again find that inflation rises when the money gap is positive and falls when it is negative. It is interesting that the surge in the money gap during 1992 directly precedes the 1993-1994 inflation spike. Inflation then somewhat "undershoots" the money gap until the beginning of the deflation period in 1998. The post-1998 period itself offers some apparent support for Sun and Ma's (2004) finding that monetary policy effectiveness declined after the onset of deflation. Even though the money gap begins rising quite sharply by early 2000, no real pick up in inflation occurs until 2003. It is still true, however, that the deflation begins after an extended decline in the money gap and that the absence of any sustained rebound in the money gap in 1998 and 1999 implies a continued relatively tight monetary policy. Capital outflows and the exchange rate constraint may, in turn, help account for the apparent lack of any quick expansionary response to the deflation.

Our last exercise consists in asking how well the inflation equation from the above-estimated vector error correction model (not shown) is able to forecast China's inflation rate out-of-sample, that is, after 2003Q1. To examine this proposition we apply the same coefficients from the previously estimated model to an extended data sets that runs through 2004Q4. The resulting inflation forecast is shown in Figure 6. Clearly, the original coefficient estimates do a good job of capturing the turnaround in inflation after we update with the extra data points. Although inflation overshoots both sets of forecasts in the mid-1990s, and sometimes undershoots in the later part of the sample, these episodes are generally followed by convergence. Note also that when the inflation forecasts do not permit updating for new data during the forecasting period, inflation is expected to rise, suggestive of growing inflationary pressures until 2003. Once the forecasts are adjusted for the arrival of new information, inflation forecasts are seen

tell whether this a manifestation of trends seen in other economies that have gone through a rapid monetization phase

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to stabilize, an indication that monetary policy aimed at stemming rising inflation was showing some signs of success. In general, the inflation equation derived from the vector error correction model provides a useful set of initial inflation forecasts that seem to track the actual course of inflation quite well over the post-1990 period.

5.   Conclusions

This study models Chinese monetary policy from 1990 to 2003 in terms of a McCallum-type rule that takes into account the People's Bank of China's emphasis on targeting the rate of money supply growth. People's Bank policy appears responsive to the gap between target and actual nominal GDP as well as to external pressures. We also find evidence of a policy shift as deflation set in during 1998 following the onset of the Asian financial crisis. Additional longer-run analysis reveals cointegration between the People's Bank's M2 target aggregate and prices, real output and interest rates. Estimates of the gap between estimated money demand and actual money supply appear to track quite well the swings between inflationary and deflationary pressures over our sample period. This suggests that Chinese inflation and monetary policy outcomes can be satisfactorily modeled using standard empirical techniques and are not just a figment of China-specific "structural" factors.

(with falling velocity) followed by a growing financial sophistication phase (reflected in rising velocity), however – see Siklos (1993) and the references therein.

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Table 1

A. Estimates of McCallum's Rule: M2

Variables	Dependent variable: rate of change in M2			
Constant	20.89	25.92	20.99	20.31
	(0.71)*	(0.71)*	(0.68)*	(0.45)*
$\Delta x_t^* - \Delta x_{t-1}$	-0.42	-0.12	-0.45	-0.64
	(0.06)*	(0.05)**	(0.06)*	(0.05)*
Deflation dummy		-10.33		
		(1.17)*		
$\dot{r}_t$			-21.05	-6.47
			(8.76)**	(8.12)
$\dot{f}_t$			0.01	0.11
			(0.03)	(0.02)*
R^2	0.51	0.82	0.57	0.24
F (p)	48.11	103.65	15.60	4.99
	(.00)	(.00)	(.00)	(0.55)[1]

B. Estimates of McCallum's Rule: Monetary Base

Variables	Dependent variable: rate of change in base money			
Constant	26.87	22.15	27.74	31.32
	(2.31)*	(2.00)*	(2.20)*	(1.63)*
$\Delta x_t^* - \Delta x_{t-1}$	-0.008	0.002	-0.009	-0.008
	(0.002)*	(0.002)	(0.002)*	(0.001)*
Deflation dummy		-17.10		
		(3.05)*		
$\dot{r}_t$			28.72	0.67
			(12.82)*	(13.61)
$\dot{f}_t$			-0.10	-0.20
			(0.04)**	(0.05)*
R^2	0.33	0.60	0.46	0.08
F (p)	25.18	36.12	13.25	5.96
	(.00)	(.00)	(.00)	(0.43)[1]

Note: Estimates in the first three columns are based on OLS; GMM estimates were used in the last column. [1] indicates *J*-test for over-identifying restrictions. * indicates that the coefficient is statistically significant at the 1% (** 5% level).
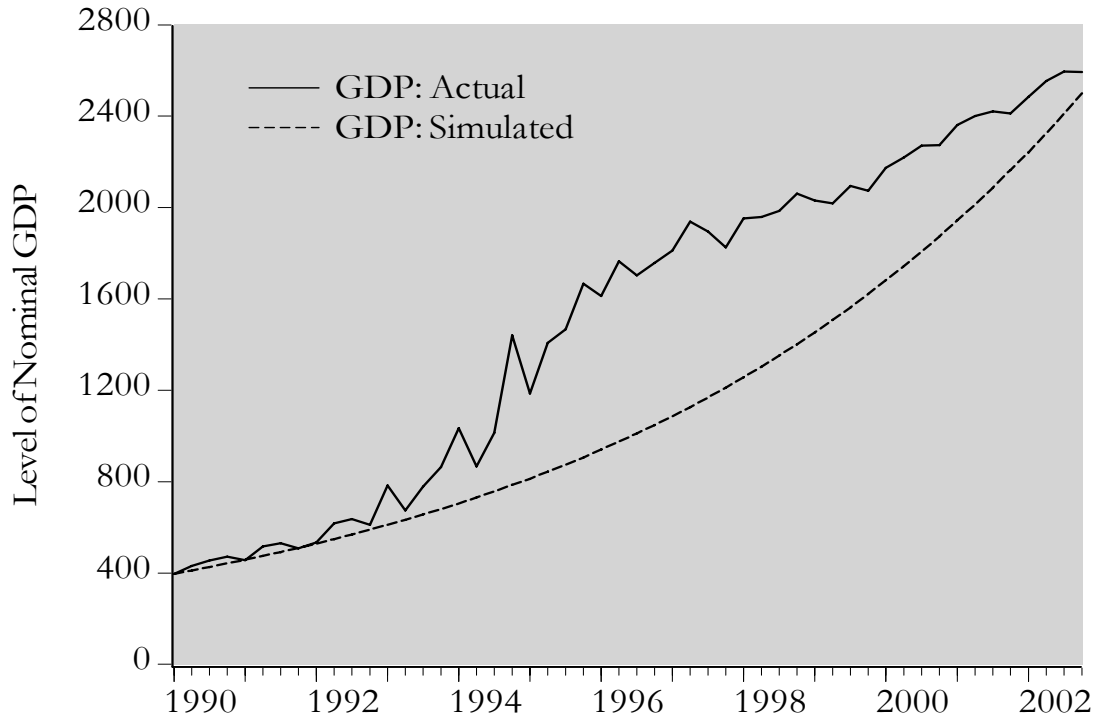
FIGURE 1

Annual Inflation Rate vs. Annual M2 Growth Rate
Quarterly data, 1990Q1 to 2003Q1
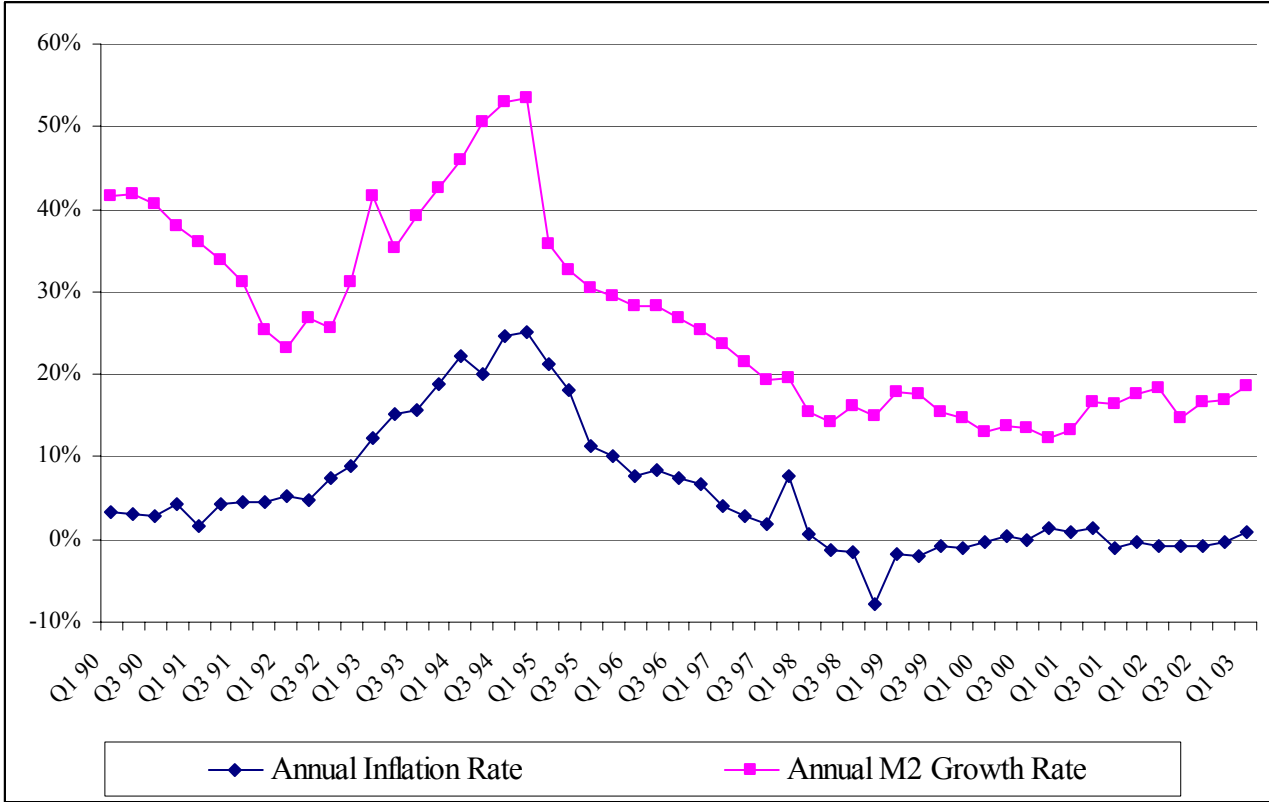
Note: Sources of data and series definitions are given in the main body of the paper. Inflation is measured
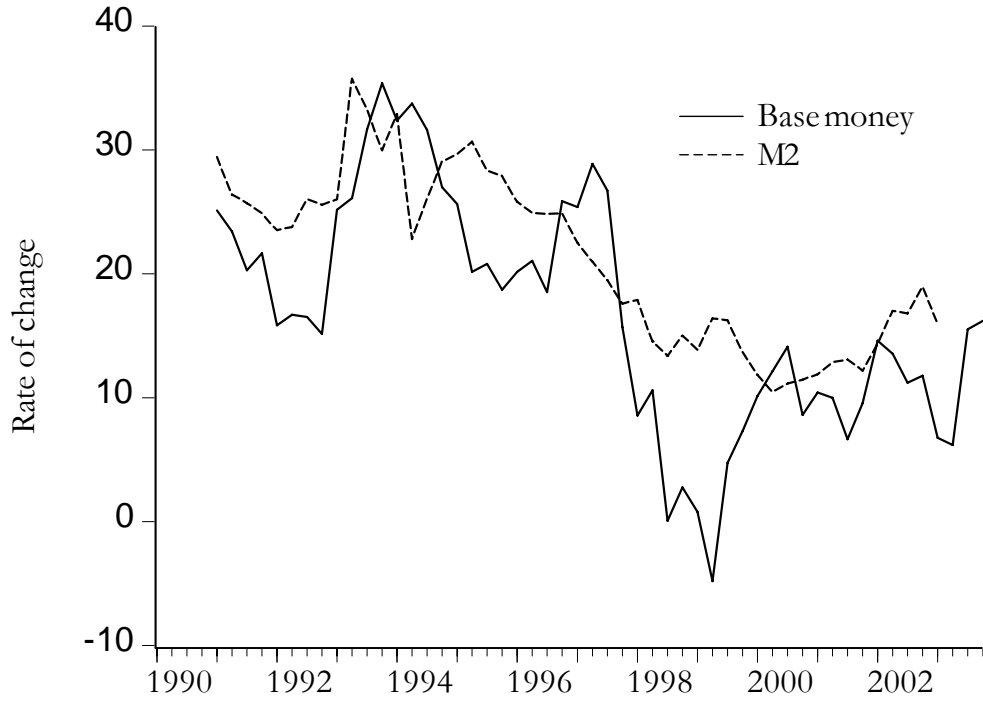by the year over year log difference in the consumer price index.

FIGURE 2

Actual and Simulated Levels of Nominal GDP

Note: Sources for actual GDP are provided in the text. Footnote 9 details the construction of the simulated GDP series.
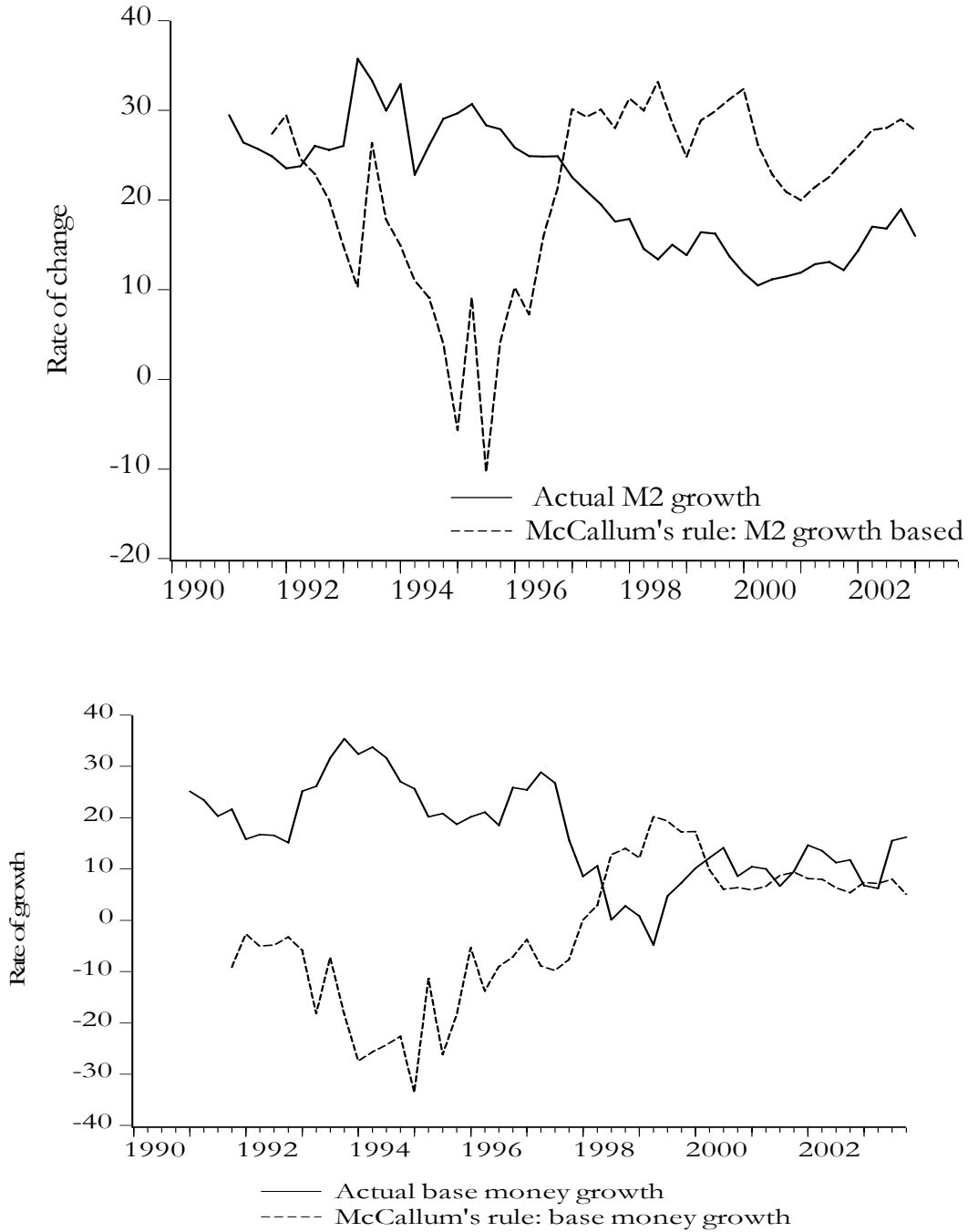
FIGURE 3

M2 and Monetary Base Velocity

Note: Sources of data and series definitions are provided in the main body of the paper. Rates of change are annualized.
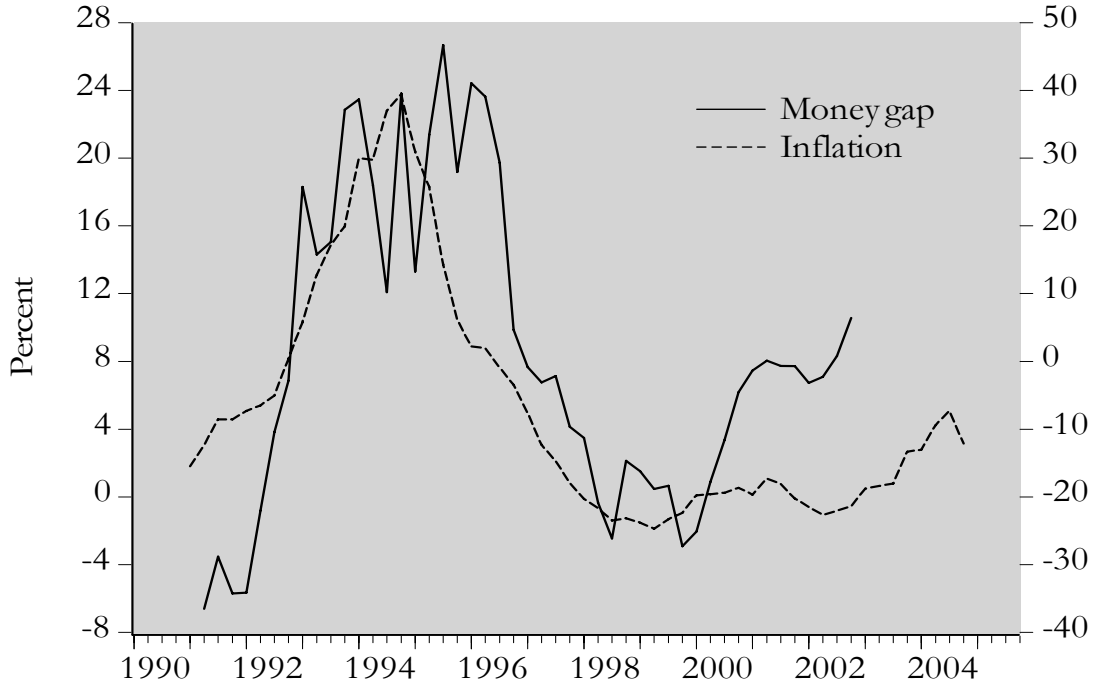
FIGURE 4

McCallum's Rule: Simulated Values

Note: See text for estimation details and Table 1 for coefficient estimates.
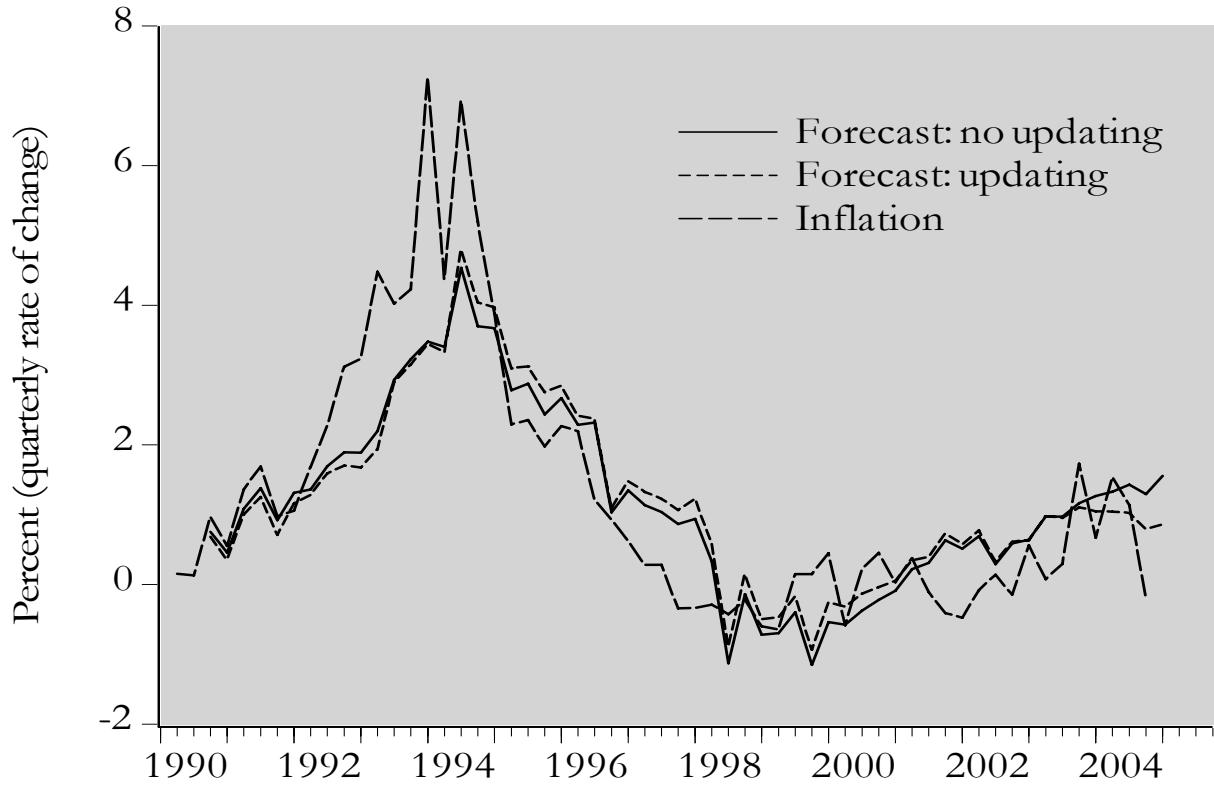
FIGURE 5

Money Gap Versus. Inflation in China

Note: Four quarter moving average of quarterly inflation and money gap shown. The left hand scale is for inflation, the right scale is for the money gap.

FIGURE 6

Out of Sample Inflation Forecasts

Note: Updating refers to the addition of new data as they become available. The no-updating case uses information from the estimated sample only. See text and Table 1 for additional details, sources and definition of series.