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Ramon Moreno
Research Department
Federal Reserve Bank of San Francisco

and

Reuven Glick
Research Department
Federal Reserve Bank of San Francisco

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Center for Pacific Basin Monetary and Economic Studies
Economic Research Department
Federal Reserve Bank of San Francisco

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Ramon Moreno
Senior Economist
Research Department
Federal Reserve Bank of San Francisco

and

Reuven Glick
Center for Pacific Basin Monetary and Economic Studies
Research Department
Federal Reserve Bank of San Francisco

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Center for Pacific Basin Monetary and Economic Studies
Economic Research Department
Federal Reserve Bank of San Francisco
101 Market Street
San Francisco, CA 94105-1579
Tel: (415) 974-3184
Fax: (415) 974-2168
http://www.frbsf.org

Is money still useful for policy in East Asia?

Ramon Moreno and Reuven Glick*

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Abstract

Since the East Asian crises of 1997, a number of East Asian economies have allowed greater exchange rate flexibility and abandoned monetary targets in favor of inflation targeting, apparently because the perceived usefulness of money as a predictor of inflation, i.e. the information content of money, has fallen. In this paper, we discuss factors that are likely to have influenced the stability of the relationship between money and inflation, particularly in the 1990s, and then assess this relationship in a set of East Asian economies. We focus on (1) the stability of the behavior of the velocity of money; (2) the ability of money growth to predict inflation as measured by tests of Granger causality, and (3) the contribution of money to the variance of the forecast error of inflation. We find evidence that, with a few exceptions in which capital flows were particularly large, velocity remained generally stable, as did the relationship between money growth and inflation. However, the contribution of money to inflation forecast errors fell considerably in the 1990s, reducing its value as an information variable to monetary authorities.

* Respectively Research Advisor and Vice President, International Studies and Center for Pacific Basin Monetary and Economic Studies, Economic Research Department, Federal Reserve Bank of San Francisco. This paper was prepared for the 14th Pacific Basin Central Bank Conference, hosted by the Bank of Korea, Seoul, Korea, November 14-17, 2001. We thank, without implicating, our discussant, Amara Sriphayak, and conference participants for helpful comments and Jen Huang for research assistance. The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System or the Federal Reserve Bank of San Francisco.

1. Exchange Rate and Monetary Policies in East Asia

Monetary policy in many East Asian economies has traditionally involved some combination of monetary and exchange rate targeting. In 1996, just before the crises in East Asia, Indonesia, Korea, the Philippines and Thailand all targeted a monetary aggregate. Korea and Thailand targeted broad money, while Indonesia and the Philippines each set a floor for foreign reserves and a ceiling for net domestic assets, in effect targeting base money. (Not all countries targeted monetary aggregates, however. For example, Singapore set an exchange rate target to successfully attain its goal of low inflation.)

A number of countries simultaneously sought to stabilize the exchange rate under managed float or basket peg arrangements. Frankel and Wei (1994), and more recently Moreno (2001), and Hernandez and Montiel (2000), have shown that East Asian countries managed their exchange rates in a manner that historically resemble pegs to the U.S. dollar, or what McKinnon (2000) has described as an "Asian dollar standard".

This approach to monetary and exchange rate policy in East Asia posed a dilemma. Given the growing openness of the capital account, the restriction known as the "impossible trinity" (see Moreno and Spiegel, 1997) implied that it was not feasible to target simultaneously the money supply and the exchange rate (at least over the long run). Reflecting this restriction, money supply tended to grow rapidly during periods of capital inflow surges (Glick and Moreno, 1995). Furthermore, one explanation for the recent crises in East Asia was that money supplies and exchange rate targets were incompatible.

In the aftermath of the recent currency crises in East Asia, policymakers in the region with open capital accounts appear to have resolved the problem posed by the "impossible trinity" by abandoning exchange rate targets in favor of more flexible currency arrangements (Hernandez and Montiel, 2000).[1] At the same time, however, a number of countries have abandoned monetary targeting. By 2000, Korea, the Philippines, and Thailand had explicitly adopted an inflation targeting framework. Rather than focus on meeting a money growth target to achieve a desired inflation outcome, policymakers in these countries adjust the policy instrument (typically an interest rate) to respond directly to deviations of anticipated inflation from the target, as well as deviations of output from some potential or trend level. Singapore has also described its policy as an inflation targeting policy, in which the exchange rate is an instrument. (For descriptions of alternative policy reaction functions under inflation targeting see, for example, Clarida, Gertler, and Gali, 1998.)

In this connection, we may ask why money growth targets are being abandoned, and whether there is no longer any role for money in the formulation of policy in the region. In this paper, we attempt to shed light on these questions by assessing the stability of the relationship between money and inflation or output. If this

[1] Malaysia is a notable exception; after September 1998 it imposed capital controls and pegged the exchange rate.

relationship has weakened or become unstable, the usefulness of money in policy formulation would be reduced. However, if the relationship has remained stable, or has changed for reasons that can be modeled, money can still play a role in policy formulation, even for those countries that have decided to switch to inflation targeting. For example, it may improve forecasts of anticipated inflation used in policy reaction functions, or perhaps be useful as an additional target to be smoothed.

We begin our analysis by examining the stability of the behavior of money velocity in East Asia in the 1990s. Then, following the literature on the information content of money (Friedman and Kuttner, 1996, Estrella and Mishkin, 1997), we assess the ability of money to predict inflation (and output) by estimating vector autoregression models and performing (1) Granger causality tests between money and inflation; and (2) variance decompositions that estimate the contribution of money to the variance of the forecast error of inflation.

To anticipate our findings, we find evidence that velocity has generally been stable in East Asia in the 1990s, but the evidence that money aggregates help predict inflation in East Asia is mixed. Granger causality tests generally suggest that some measure of money helps predict inflation, even in the 1990s. However, this does not necessarily mean that money is still very useful in policymaking. The reason is that variance decomposition results indicate that the contribution of money to inflation has fallen sharply since the 1970s. An open question is whether this decline is temporary or may subsequently be reversed.

The remainder of this paper is organized as follows. In section 2 we summarize the behavior of the velocity of money in East Asia. Section 3 discusses whether money (base money or M2) predicts inflation and output, and whether this relationship appears to have changed over time, based on tests of Granger causality. Section 4 examines whether money predicts inflation based on variance decompositions. Section 5 briefly discusses whether broader definitions of money affect our results, and Section 6 concludes.

2. Velocity of money in East Asia

To implement our empirical analysis we collected data from the *IMF International Financial Statistics* (IFS) for Korea, and five ASEAN countries: Indonesia, Malaysia, Philippines, Singapore, and Thailand. We obtained monthly data for CPI (IFS line 64), reserve money or monetary base (line 14), M2 (lines 34+35), quasi-monetary liabilities of other banking institutions (line 45), postal saving deposits for Singapore (45..i) and annual and quarterly data for real GDP (99b.p).[2] Unadjusted data were seasonally adjusted using the X11 procedure of RATS. The monetary data for the Philippines in the mid-1980s and M2 data for Singapore after 1998 should be interpreted with caution. From 1983 to 1986, the *IFS* reports only one annual (end-of-year)

[2] Line 45 was not available for Indonesia, and due to breaks in the series, was not usable in the case of Malaysia. The series is used for robustness checks discussed later in the text. In the case of Korea, we obtained quarterly seasonally-adjusted real GDP data from FAME.

observation of Philippine monetary aggregates and we filled in the gaps by interpolation of the monthly and quarterly series. Singapore reclassified Post Office savings deposits within deposit money banks (putting them in the category of M2) starting in November 1998.

The traditional justification for shifting away from monetary targeting is that the relationship between money, prices and output has broken down. As a first pass at describing this relationship, we examine the behavior of the velocity of money, i.e. the ratio of nominal GDP to money. We use the CPI and real GDP, and alternative measures of money to define velocity. Figure 1 illustrates the log of velocity of the monetary base and M2. Where available, the velocity of a broad measure of money we call M2+ is also illustrated. In most of our discussion we will focus on M2 as it is widely used as a measure of broad money. We discuss the implications of using M2+ in section 5.

While researchers usually focus on the velocity of broader aggregates, such as M2 (a notable exception is Breedon and Fisher, 1993), the monetary base has at times been a policy target. Furthermore, base money most directly reflects the impact of capital flow volatility, which as noted by Glick and Moreno (1995) and Moreno and Spiegel (1997) has complicated the implementation of monetary policy in East Asia. As the monetary base may give independent information on monetary conditions in East Asia, we include both the monetary base and M2 in our analysis.

In East Asian emerging markets, we would expect a long-term downward trend in the velocity of M2, because of the growing monetization of the economy, a phenomenon known as financial deepening. Since the 1970s, the stability of this trend, and the relationship between money, prices and output, may have been affected by the following factors:

(1) *Financial or technological developments that result in the creation of close substitutes for money, inducing unpredictable shifts in and out of money aggregates*. As in advanced market economies, near-bank or non-bank financial intermediaries have played a growing role in a number of East Asian economies. However, the banking sector continues to be the dominant source of financing in most countries in the region, so it is possible that a broad money aggregate like M2, or some variant, would continue to have a stable relationship with economic activity.[3]

(2) *Growing exposure to capital flows in the 1990s.* As shown in Table 1, capital flows to East Asia generally increased significantly in the 1990s, before reversing sharply in 1997-1999 (a notable exception to this broad pattern is Singapore, where the inflow was not as large, and any reversal took place earlier). It is

[3] The importance of banking as compared to other forms of financing is also illustrated by the undeveloped bond markets in East Asia (Herring and Chatusripitak, 2000, Rhee, 2000, Shirai, 2001). For example, at the end of December 1997, the ratio of bank loans to GDP in Indonesia was 60 percent, compared to 1.5 percent for corporate bonds. In Korea, the corresponding ratios were approximately 48 percent for bank loans to 21 percent for bonds, even if the bank loan ratio was unusually low in 1997 due to the unfolding financial crisis.

possible that such volatile capital flows affected the stability of velocity. Periods of capital inflows (roughly the period 1990-1996) were associated with expansionary pressures on the quantity of money and possible increases in money demand, as foreign residents sought to acquire domestic assets and governments intervened in foreign currency markets to prevent currency appreciation. Efforts at sterilizing the monetary effects of intervention were not always fully successful (Glick and Moreno, 1995). During periods of capital inflow, the real exchange rate would tend to appreciate and inflation fall, resulting in declines in velocity. The reverse could occur during periods in which capital inflows reverse (after 1996 in East Asia), resulting in an increase in velocity.

(3) *Lower inflation in the 1990s.* As shown in Table 2, inflation fell in the 1990s in most East Asian economies, compared to the 1970s and 1980s. If this decline was associated with lower inflationary expectations, money demand would tend to increase, tending to reduce velocity.[4] However, there is an offset, as the volatility of inflation also fell. To the extent that this reduced the need for maintaining precautionary balances, it would tend to lower the demand for money and increase velocity.

(4) *Financial crises and capital constraints*. Recent research (Lown, Peristiani, Robinson, 1999) suggests that capital difficulties in U.S. depository institutions during the late 1980s and early 1990s can to a large extent explain why the link between M2 and economic activity broke down in the United States, and specifically why actual M2 was much lower (or M2 velocity higher) than predicted by traditional money demand equations. These capital difficulties are associated with the strengthening of capital requirements on thrift institutions in 1989, in response to the Savings and Loans crisis of the 1980s, and banking sector weaknesses in the early 1990s. To the extent that the recent financial crises in East Asia have constrained bank behavior by reducing available capital, we might observe unusually high velocity in money since the East Asian crises, reinforcing the effect of capital flow reversals cited above. However, an increase in velocity is most likely if firms are able to support economic activity by shifting away from credit constrained banks, i.e. if there are non-bank substitutes for money and credit, as there are in the United States.[5] An alternative possibility is that during a financial crisis, non-bank financial institutions may be even more constrained than banks, prompting a shift in deposits towards banks, resulting instead in a *fall*

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[4] The effect of inflation on velocity is ambiguous. Palivos and Wang (1995) show that in an equilibrium model in which consumption and part of investment spending are subject to a cash-in-advance constraint, higher money growth has two offsetting effects on velocity. It tends to lower velocity by raising inflation, and the cost of holding money, which decreases the net return on capital given the cash-in-advance restriction. It tends to raise velocity because more rapid money growth increases the transactions frequency, requiring less money holdings in equilibrium. They estimate that in the post-1973 period, the second effect dominates in the United States, so faster money growth means higher velocity.

[5] Also see Ragan and Trehan (1998).

in M2 velocity. Velocity may also fall if countries increase liquidity in response to financial sector disruptions, and nominal GDP does not rise proportionately.

To assess the possible importance of these factors in East Asia, we regress the first difference of velocity on a constant and add intercept dummies. One regression allows for a break in the 1990s, which allows us to assess the extent to which factors cited earlier (financial innovation, capital flows, financial sector disruptions) are associated with changes in velocity behavior over a relatively long period. A second regression allows for breaks both in 1990-1996 (a period of surging capital inflows) and 1997-2000 (a period of capital inflow reversals and financial crises). If significant, the timing of the breaks and their direction can give a sense of the plausibility of alternative explanations for velocity behavior. A number of points may be made about this specification.

First, in our empirical analysis, we assume that velocity (the ratio of nominal GDP to money) is difference stationary. While unit root tests suggest that velocity is generally non-stationary in East Asia, these results should be interpreted with caution. Due to the short span of our velocity data set (28 annual observations) tests of this assumption are not entirely reliable due to their low power (i.e. they tend not to reject the unit root null when it is false) in finite samples.[6]

Second, given data limitations we adopt a simple specification, in which the breaks in the data may be interpreted as proxies for certain effects that we do not model explicitly. In some cases, individual circumstances suggest that further refinements in the specification are possible (e.g. the Philippines, where there was an episode of macroeconomic instability in the first half of the 1980s). Theory may also suggest the inclusion of right hand side variables (such as the level or volatility of inflation or the exchange rate) that could improve the specification. To the extent that our specification leaves out variables that explain velocity behavior more precisely, it may tend to find more velocity instability than there actually is. We leave the exploration of these alternatives for future research.

Third, the various factors cited earlier may influence the behavior of velocity in predictable ways. As the financial sector deepens, we would expect the velocity of both base money and M2 to fall over time, implying a negative coefficient on the intercept on the right hand side). However, in the case of base money, this effect is offset by technological improvements, as well as lower reliance on reserves as a source of revenue or as a monetary control instrument, which have tended to reduce reserve requirements, and raise base money velocity. In addition, velocity may be destabilized by the development of close substitutes for money, which may increase velocity or its volatility, reducing the precision of coefficient estimates.

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[6] See Perron (1991). As a result, series such as real GDP or the real exchange rate are found to be difference stationary in short samples, but stationary or trend stationary in levels in long samples.

If volatile capital flows were important, we would expect changes in the behavior of velocity in the 1990s. The precise nature of the change would depend on which effects were dominant. If capital inflow effects were important, we would expect the first half of the 1990s to be associated with a steeper trend decline in velocity. This would be most apparent in base money velocity, to the extent that capital inflow surges lead to foreign asset accumulation, and would also be reflected in M2 velocity unless the M2 multiplier falls. The effects during periods of capital flow reversals and financial crises may vary. On the one hand, the direct contractionary effects on liquidity may raise velocity growth on impact. The capital flow reversal effect would be most apparent in an increase in base money velocity; the financial crisis effects (constraining the supply of credit) would be apparent in an increase in M2 velocity as well if deposits shift away from banks. As noted earlier, an alternative possibility is that M2 velocity will fall if banks are less affected by financial sector disruptions and receive more deposits, or if countries increase liquidity in response to such disruptions.

Table 3 reports the regression results for the velocity of the monetary base and M2 (we discuss the M2+ results, also reported in Table 3, in Section 5). The lagged first difference of velocity was included in the regressions if tests suggest it is significant, otherwise it is dropped. The results suggest four broad conclusions.

(1) *The long run behavior of velocity in East Asia is consistent with financial deepening.* Table 3 (Columns I or II) reveals that base money velocity exhibits no consistent trend. The intercept is not significant, with the exception of Thailand, where it is positive (suggesting less use of base money to support economic activity). In contrast, with the exceptions of Singapore and the Philippines, there is a significant decline in the velocity of M2 in East Asia (Columns III and IV), which suggests financial deepening. As might be expected, the downward tendency is more pronounced in Indonesia (velocity decline of nearly 9 percent a year), where the economy was initially less developed, than in other economies in the region, such as Thailand, Malaysia or Korea (velocity declines of 2 to 3.5 percent a year).

(2) *There is limited evidence of breaks in velocity behavior for the entire period 1990-2000.* (Table 3, columns I and III). Only in Malaysia, and Thailand (base money) is there a steeper decline in velocity. In the case of Singapore (base money), the opposite occurs. We discuss possible interpretations of these breaks below.

(3) *Rising capital inflows in the first half of the 1990s were not generally associated with breaks in velocity behavior*. Columns II and IV of Table 3 allow for two intercept dummies, one for the period 1990-1996 (capital inflow period) and the other for 1997-2000 (capital flow reversal and financial crisis period). In 1990-1996, velocity declines more steeply in Malaysia and Thailand, which is consistent with an increase in base money demand in response to capital inflows. One possible explanation for why these countries experienced a sharp decline in velocity while their neighbors did not is that they experienced much higher

capital inflows, averaging 10 percent of GDP in 1990-1996 (Table 1)[7]. The averages understate the size of the shift. For example, in Malaysia, total capital inflows as a percentage of GDP rose from 2.5 percent in 1989 to a peak of nearly 22 percent in 1993. The associated increase in foreign reserves corresponded to 17 percent of GDP, which tended to expand the base money supply. Inflation did not increase proportionately. It is also noteworthy that the faster declines in base money velocity in the first half of the 1990s in Malaysia or Thailand are not reflected in acceleration in the declines in M2 velocity. One reason may be that measures were adopted, such as higher reserve requirements, to limit the extent to which increases in base money translated into growth in broader money aggregates. Table 3 also reveals a break in Singapore base money velocity, but in this case velocity growth *increased* in the 1990s. Further research is needed to explain the apparent decline in the use of base money in Singapore. Inspection of Table 1 suggests that the timing is not closely related to the pattern in capital flows.

(4) *To the extent that velocity instability is evident in the late 1990s, it appears to reflect liquidity injections or shifts in deposits towards the banking sector, rather than the direct impact of capital flow reversals or shifts in deposits away from banks.* As can be seen in Table 3 (columns II and IV), there was a downward shift in velocity growth in Indonesia and Thailand (base money) and Korea (M2). The base money velocity increases appear to reflect significant increases in liquidity in the aftermath of the crises, that by and large have not been associated with corresponding increases in nominal GDP. (In the case of Indonesia, there was a temporary surge of inflation when liquidity was increased, that was subsequently reversed.) As discussed in more detail in section 5, the M2 velocity increase in Korea appears to reflect a shift towards bank deposits. As for Singapore, after a dip in 1997 that is apparent in Figure 1, base money velocity growth accelerates even more sharply.

To sum up, there is some evidence of breaks in velocity behavior in East Asia in the 1990s. However, the effects in a number of cases appear to reflect the impact of capital flows, raising the question of whether they are temporary or permanent, and whether any evidence of breaks might disappear if the impact of capital flows on velocity is modeled more explicitly.

3. Does money predict inflation and output? Granger Causality Tests.

While our analysis of velocity focuses on annual data, a higher than annual frequency is needed for purposes of stabilization policy, as monetary authorities adjust their policy instrument several times a year. To capture longer data spans (extending back to the 1960s or early 1970s) at a higher frequency, we estimate bivariate models of monthly CPI and money. We also estimate a three-variable model that includes real GDP,

[7] Table 2 indicates that Malaysia and Thailand's experience in reducing inflation in the 1990s was not much better in some of the other economies (Table 2), so this not appear to explain the accelerated decline in velocity.

which is available at a quarterly frequency. However, real GDP in some cases is reported only starting in the 1990s, which is too short for our purposes.

As policymakers are generally interested in inflation and output growth, we follow Friedman and Kuttner (1996), and Estrella and Mishkin (1997) and estimate the models using first-differenced data. However, policymakers may also care about the price level, not just the inflation rate. Furthermore, there may be information about the long run relationship in levels that is lost by first differencing (Dotsey and Otrok, 1994). Thus, a case could be made for estimating the models in levels or in error-correction form. However, given that there is no presumption that money and CPI are cointegrated in our two-variable models, and the occasionally short data span for our three-variable models, we adopt an agnostic approach. We report results for the two variable models estimated in first differences and levels, and estimate the three-variable models in first differences.[8]

To shed light on possible changes in the relationship of money growth to inflation, we estimate two variable models of inflation and money growth for each country over the pre-1990s sample, the pre-crisis sample (up to 1996, which includes the period of large capital inflows), and finally over the full sample (which would reflect periods of capital inflows, reversals and crises in the 1990s, as well as any changes in the evolution of the financial sector in the 1990s). We then look at changes in test statistics and p-values in (Granger causality) tests of the null that lagged money growth does not predict inflation, to assess how the information content of money may have changed in the 1990s, both before and after the recent East Asian currency crises.

Table 4 reports the results of the Granger causality tests. Once again, we focus in this section on the results for base money and M2. Turning first to the pre-1990s sample, money helps predict inflation in Indonesia (M2), Malaysia (base money), the Philippines (base money and M2), Singapore (base money) and Thailand (base money), but not in Korea (on this more later). As the sample is extended to include the 1990s, we would expect the test statistics and corresponding p-values to fall if the information content of money has declined. However, this is unambiguously the case only in Malaysia, where, as we have noted, capital flows were among the largest in the region. The null that money does not predict inflation in Malaysia cannot be rejected once the sample is extended to include the 1990s. In all cases (with the exception of Korea) base money and/or M2 help predict money even when the sample is extended to include all of the 1990s.

To sum up, Granger causality tests indicate that the 1990s was *not* associated with a consistent decline in the predictive ability of money. One explanation is that the effects of external shocks like capital flows were

[8] In principle, the three variable model could be extended to include the nominal interest rate, thus spanning the variables typically used in analyses of money demand. However, introducing interest rates adds to problems of degrees of freedom. In cases where interest rates are not market-determined, it may also be misleading.

not always large enough to eliminate the empirical relationship between money and inflation. Apart from the case of Malaysia, support of this view is provided by the Indonesian data. As can be seen in Table 3 (columns II and IV) coefficient values and the marginal significance levels fall when the Indonesian sample is extended to include the first half of the 1990s (up to 1996), but then rise again when the crisis period is included. During this latter period, rapid increases in the money supply were followed by a sharp acceleration in inflation. (In the Philippines, the highly significant Granger causality results also reflect the high inflation period of the early 1980s.) In Asia, as elsewhere, the relationship between money and inflation is most apparent when shocks to money are large. We will have more to say on this in the next section.

One limitation of the preceding analysis is that it is based on a two-variable model. A three-variable model involving output would include all the variables that make up velocity, so it may better capture the relationship between money growth and inflation. It also has the advantage of allowing an assessment of the ability of money to predict output, which is of interest to policymakers. We therefore estimate a three-variable model of inflation, real GDP growth and money growth. Unfortunately, the span of quarterly real GDP series is typically too short for most countries in our sample, so we focus on the one country in which the data extend back to the 1970s, Korea.

Table 5 reports the results of tests of whether money growth predicts inflation and output in Korea (we focus here on base money and M2). In contrast to the two-variable model, money growth predicts inflation in the three-variable model of Korea through 1989. The predictive ability of money does not decline when the sample is extended to 1996, but does so when the post-crisis period is included. In addition, money growth (as measured by the monetary base and M2) has a highly significant relationship (at 1 percent) to output in Korea. A comparison of the full sample and sub-sample coefficients and test statistics suggest that this relationship has remained highly significant throughout the 1990s, in stark contrast to the relationship between money and inflation, which appears to have broken down in the most recent period.

4. Variance Decompositions for Money and Inflation

An alternative way of assessing the predictive content of money, and its relative importance in explaining inflation, is to examine the contribution of orthogonalized innovations in money to the variance of the forecast error in inflation. The orthogonalized innovations to prices and money are obtained by applying a Choleski decomposition to the variance covariance matrix of the residuals of the model, with inflation ordered first and money growth ordered second. As we are interested in the contribution of money over longer horizons, we focus on the two-variable models because of the longer sample periods. We find that over the full sample the contribution of money according to this criterion is generally modest: at its peak it only reaches around 20 percent in the cases of Indonesia (for M2) and Singapore (for the monetary base).

To assess the extent to which the contribution of money to inflation might have changed over time, we re-estimate the VAR models from 1970 over rolling 120 month periods, and then recover the contribution of money growth to the variance of the forecast error of inflation at a two-year horizon. The results for M2 and the monetary base are shown in Figure 2 (we do not show variance decomposition results for M2+, which are generally similar to those for M2).

In most cases, the figures suggest that the contribution of money growth to inflation was large in the 1970s (ranging from 20 to over 50 percent) and then declined to very low levels (5 percent or lower) in the 1990s. Some individual cases are worth highlighting. In the case of Korea, the contribution is always small and declining. In the Philippines, interpretation is clouded because there are missing monetary data in the 1980s that have been filled in by interpolations. However, the contribution of money appears to have declined in the 1990s.

Once again, the results for Indonesia are striking. The contribution of money growth to inflation falls from as high as 30 percent in the rolling samples that end in the early 1980s, to less than 5 percent in the sample that ends just before the 1997-1998 crisis and then picks up sharply to close to 30 percent (for M2 growth) in the sample that ends in the post-crisis period. These results highlight the extent to which a fall in the relative importance of money shocks in East Asia have reduced the information content of money, and how quickly this information content may reappear if the shocks to money are sufficiently large, as they were in Indonesia as its financial crisis was unfolding.

So far, the models are estimated with the variables in first differences, which may throw out information about the long-run relationship between series in levels. In addition, policymakers may also care about the price level, and not just about inflation. To illustrate how our reliance on first-differenced data may influence the results, we re-estimate the rolling variance decompositions using log level data for the CPI and Money. The results are shown in Figure 3. Inspection of the figure reveals that in most economies (Indonesia, Korea, Malaysia, Philippines and Singapore, but not Thailand) the share of money in the forecast error of CPI declines in the 1990s, reinforcing the impression conveyed by the models based on growth rates. It is also still the case that there is a sharp reversal in this decline in the late 1990s in the case of Indonesia.

However, there are also obvious differences between the results for first-differenced and log level data. The peak estimated contribution of money in the regressions with log-level data is often much higher than in the regressions with first-differenced variables, reaching as high as nearly 90 percent in the cases of Malaysia and Singapore. In addition, the contribution of money to price forecast errors in the log-level regressions remains higher for longer periods than in the growth regressions. Indeed, in the cases of the Philippines and Thailand, and to a lesser extent Korea and Singapore, the reduction of the share of money in price is largely an artifact of the second half of the 1990s. If this reduction turns out to be temporary, East Asian monetary

authorities that care about the price level may still gain from paying attention to the behavior of money aggregates.

5. Does a broader definition of money help?

The preceding analysis reveals that while money appears to maintain a systematic empirical relationship with inflation, the importance of money in explaining inflation has fallen over time. Given the growing importance of near-banks or non-bank financial intermediaries in the region, it could be argued that better results might be obtained if we used a broader definition of money than M2. To investigate this possibility we constructed a broader money series, which we call M2+, defined as the sum of M2 and quasi-monetary liabilities of other banking institutions (line 45 of the IFS) for Korea, Philippines, Singapore and Thailand. In view of the November 1998 Singapore government decision to include postal saving deposits in M2 in Singapore, we include such deposits in our definition of broad money for this country. M2+ was not estimated for Indonesia due to lack of data, nor for Malaysia, because of very large breaks in the quasi-monetary series in that country. While our definition of M2+ attempts to be consistent across countries, in some cases it may not be broad enough to capture possibly important money substitutes. For example, M2+ does not include the liabilities of finance companies in Thailand, which grew to very high levels until 1996.

The share of quasi-monetary liabilities is large in Korea and Singapore, but has been much smaller in the Philippines and Thailand. In Korea, this share peaked at over 45 percent of M2+ in 1996, before falling to around 15 percent in 2000, reflecting the sharp decline in the importance of non-bank intermediaries in the aftermath of Korea's recent crisis. In Singapore, the share of quasi-monetary liabilities peaked at over 50 percent in the second half of the 1980s, but had fallen to around 30 percent by 1998. In the Philippines, the share of quasi-monetary liabilities peaked at around 20 percent in the early 1980s, while in Thailand it has reached recent highs not exceeding 5 percent.

We tested the stability of velocity, and re-estimated vector autoregression models using our broad money series, and found that our main conclusions remained largely unchanged. The following results are worth highlighting.

Turning first to Table 3 (columns IV and VI), the significant decline in M2 velocity in Korea in the 1997-2000 period does not apply to the velocity of M2+ (the intercept dummy for the 1997-2000 period is not significant for M2+ velocity). The reason is that in the aftermath of Korea's financial crisis, Korean depositors shifted their funds from near-banks to banks (whose deposits are covered by the definition of M2). This resulted in an unusually large drop in M2 velocity, but stable behavior in the velocity of M2+. As this effect is the opposite of what we might expect given the findings of Lown, Peristiani and Robinson (1999), it

highlights the possibility that in emerging markets, banks may actually emerge stronger than other financial intermediaries in the aftermath of a financial crisis.[9]

As can be seen in Table 4, there are no qualitative difference in the Granger-causality test results for M2 or M2+. Variance decompositions of inflation (not shown) analogous to those reported in Figure 2 also indicate that the contribution of M2+ growth to the variability of inflation dropped significantly between the 1970s and the 1990s.

Finally, Table 5 reveals that M2+ has generally had a weaker relationship to inflation in Korea than has M2. Granger-causality test statistics and p-values are not significant in the samples up to 1989 and 2000, and are significant only at 10 percent in the sample up to 1996. However, just as for M2, the relationship of M2+ to output in Korea is very strong.

Our analysis of M2+ thus indicates that other than in post-crisis Korea, the extent to which the development of alternatives to money has contributed to instability in the relationship between M2 and inflation in East Asia is not obvious. However, this may reflect data limitations or conceptual difficulties in defining a suitable money aggregate. As noted earlier, our M2+ series may still not be broad enough, or our near money series may need to be weighted differently from our money series, in order to account for the effects of money substitutes.

6. Conclusions

In this paper we have discussed some factors that could have influenced the stability of the relationship between money and inflation in East Asia in the 1990s. We then analyzed (1) the stability of the behavior of the velocity of money; (2) the ability of money growth to predict inflation as measured by tests of Granger causality, and (3) the contribution of money to the variance of the forecast error of inflation. We find evidence that, with a few exceptions in which capital flows were particularly large (and the effects of which may be temporary), velocity remained stable, as did the relationship between money growth and inflation in tests of Granger causality. However, the contribution of money to inflation forecast errors fell considerably in the 1990s, limiting its relevance as an indicator of inflation. In an era of financial development, lower inflation and volatile capital flows, factors other than money appear to be more important contributors to the volatility of inflation. This would partly explain the recent interest in inflation targeting in East Asia.

A number of points are worth bearing in mind before concluding that the use of money aggregates should be entirely abandoned by East Asian monetary authorities. First, the experience of Indonesia in the immediate

[9] There are two other differences between M2 and M2+ velocity results. In contrast to M2, the decline in M2+ velocity in the Philippines in the 1990s is significant. This may partly reflect a recovery from the crises of the 1980s that is more clearly reflected in the M2+ series. There is evidence of financial deepening in Singapore when using M2+, as the negative coefficient on the constant is significant.

aftermath of the East Asian crisis suggests that the information content of money may return very quickly if shocks to the money supply are sufficiently large. Both Granger causality tests and variance decompositions indicate a more significant and larger contribution of money to inflation in the late 1990s in Indonesia, when both money growth and inflation accelerated sharply for a period and then fell.

Second, the experience of Korea suggests that even if money ceases to predict inflation, it may still be significant in predicting output. In such a case, it may still be useful to take money behavior into account in policy formulation.

Third, some of our results suggest that declines in the information content of money may reflect large shocks to capital flows or the financial sector. If these shocks are temporary, money may still prove useful in predicting the behavior of the price level or inflation.

Table 1. Capital Inflows, Current Account Deficits, and Foreign Reserves

(Percentage of GDP)

	1985-1989	1990-1996	1997-1999
Korea			
Total Capital Inflows, net	-2.4	2.4	-1.8
Current Account Deficit	-4.3	1.7	-5.7
Official Foreign Reserve Increase	1.7	0.6	3.9
Indonesia			
Total Capital Inflows, net	2.5	3.7	-4.1
Current Account Deficit	2.4	2.5	-2.0
Official Foreign Reserve Increase	0.1	1.2	-2.1
Malaysia			
Total Capital Inflows, net	0.6	10.1	-2.4
Current Account Deficit	-2.4	5.6	-7.7
Official Foreign Reserve Increase	2.9	4.5	5.3
Philippines			
Total Capital Inflows, net	2.3	6.6	-1.5
Current Account Deficit	0.5	4.0	-2.5
Official Foreign Reserve Increase	1.8	2.6	1.0
Singapore			
Total Capital Inflows, net	2.7	-1.6	-17.3
Current Account Deficit	-3.8	-12.5	-23.2
Official Foreign Reserve Increase	6.4	10.8	5.7
Thailand			
Total Capital Inflows, net	5.0	10.2	-11.4
Current Account Deficit	2.1	7.0	-7.0
Official Foreign Reserve Increase	3.0	3.2	-4.5

Note: Capital inflows include errors and omissions.

Table 2. Average Annual Inflation Rates in East Asia

	1970-1979	1980-1989	1990-2000
Korea	13.9	7.8	5.2
	(5.9)	(8.0)	(2.4)
Indonesia	15.2	9.1	12.0
	(9.4)	(3.5)	(11.9)
Malaysia	5.3	3.6	3.4
	(4.4)	(2.9)	(1.0)
Philippines	13.6	13.3	8.0
	(7.2)	(11.2)	(3.3)
Singapore	5.5	2.7	1.9
	(7.4)	(3.1)	(1.2)
Thailand	7.5	5.5	4.5
	(6.5)	(5.3)	(2.1)

Note: Standard deviations in parentheses.

Table 3. The stability of velocity growth in East Asia

	Base Money		M2		M2+	
	I	II	III	IV	V	VI
Korea						
Constant	-0.64 (0.83)	-0.64 (0.84)	-3.58*** (0.01)	-3.58*** (0.01)	-4.71*** (0.00)	-4.71*** (0.00)
Dummy 1990-2000	2.70 (0.60)		-3.28 (0.16)		-1.37 (0.52)	
Dummy 1990-1996		0.14 (0.98)		0.54 (0.82)		-2.90 (0.25)
Dummy 1997-2000		7.18 (0.34)		-9.98*** (0.00)		1.33 (0.67)
Lagged velocity						
Indonesia						
Constant	-2.02 (0.31)	-2.02 (0.31)	-8.60*** (0.00)	-8.60*** (0.00)	n.a.	n.a.
Dummy 1990-2000	-4.07 (0.22)		0.75 (0.78)		n.a.	n.a.
Dummy 1990-1996		-1.22 (0.75)		0.86 (0.79)	n.a.	n.a.
Dummy 1997-2000		-9.1* (0.07)		0.56 (0.89)	n.a.	n.a.
Lagged velocity						
Malaysia						
Constant	-1.71 (0.36)	-1.70 (0.36)	-3.38*** (0.00)	-3.38*** (0.00)	n.a.	n.a.
Dummy 1990-2000	-8.18** (0.02)		-1.36 (0.41)		n.a.	n.a.
Dummy 1990-1996		-9.86*** (0.01)		-1.12 (0.57)	n.a.	n.a.
Dummy 1997-2000		-5.19 (0.25)		-1.77 (0.47)	n.a.	n.a.
Lagged velocity	-0.45** (0.02)	-0.44** (0.02)				
Philippines						
Constant	-1.13 (0.82)	-1.13 (0.82)	-0.69 (0.59)	-0.69 (0.59)	-0.71 (0.60)	-0.71 (0.60)
Dummy 1990-2000	-0.42 (0.96)		-3.91 (0.14)		-6.54*** (0.01)	
Dummy 1990-1996		-2.44 (0.81)		-4.89 (0.13)		-8.05*** (0.01)
Dummy 1997-2000		3.11 (0.80)		-2.49 (0.49)		-3.90 (0.30)
Lagged velocity			0.36** (0.04)	0.34** (0.05)		

	Base Money		M2		M2+	
	I	II	III	IV	V	VI
Singapore						
Constant	-0.79 (0.53)	-0.79 (0.53)	-1.43 (0.35)	-1.43 (0.35)	-2.59** (0.05)	-2.59* (0.06)
Dummy 1990-2000	4.47** (0.04)		-0.86 (0.74)		2.64 (0.23)	
Dummy 1990-1996		2.79 (0.26)		0.60 (0.84)		2.32 (0.38)
Dummy 1997-2000		7.42** (0.02)		-3.41 (0.36)		3.22 (0.32)
Lagged velocity						
Thailand						
Constant	1.78* (0.06)	1.78** (0.05)	-2.13* (0.10)	-2.16* (0.10)	-3.16*** (0.01)	-3.16*** (0.01)
Dummy 1990-2000	-6.36*** (0.00)		-0.93 (0.64)		-1.89 (0.36)	
Dummy 1990-1996		-4.18** (0.03)		-0.59 (0.80)		-0.99 (0.69)
Dummy 1997-2000		- 10.17*** (0.00)		-1.59 (0.60)		-3.45 (0.26)
Lagged velocity			0.31* (0.08)	0.30* (0.10)		

Notes: Entries list coefficient values. P-values in parentheses.

*** Significant at 1%, **Significant at 5%, * Significant at 10%

Lagged velocity growth is included in the regression if found to be significant.

Table 4. Does Money growth Predict Inflation in East Asia?

Tests of Granger-causality Model: Inflation, Money Growth

Variable (Monthly)	Monetary Base	M2	M2+
Korea			
Pre 1990s	0.42	0.79	0.74
(1970:06-1989:12)	(0.96)	(0.66)	(0.71)
Pre-crisis	0.55	0.79	0.95
(1970:06-1996:12)	(0.88)	(0.66)	(0.50)
Full	0.61	0.67	1.05
(1970:06-2001:04)	(0.84)	(0.78)	(0.40)
Indonesia			
Pre 1990s	1.42	2.65***	n.a.
(1970:07-1989:12)	(0.16)	(0.00)	
Pre-crisis	1.58*	2.01**	n.a.
(1970:07-1996:12)	(0.10)	(0.02)	
Full	2.56***	6.49***	n.a.
(1970:07-2000:12)	(0.00)	(0.00)	
Malaysia			
Pre 1990s	2.07**	1.53	n.a.
(1970:01-1989:12)	(0.02)	(0.12)	
Pre-crisis	1.34	1.29	n.a.
(1970:01-1996:12)	(0.19)	(0.22)	
Full (1970:01-2001:04)	0.70	1.04	n.a.
	(0.75)	(0.41)	
Philippines			
Pre 1990s	2.29***	1.62*	1.60*
(1970:01-1989:12)	(0.01)	(0.09)	(0.09)
Pre-crisis	2.75***	1.29	1.18
(1970:01-1996:12)	(0.00)	(0.22)	(0.30)
Full	2.90***	1.69*	1.59*
(1970:01-2001:03)	(0.00)	(0.07)	(0.09)
Singapore			
Pre-1990s	4.44***	1.05	1.12
(1970:07-1989:12)	(0.00)	(0.41)	(0.34)
Pre-crisis	5.20***	0.85	0.97
(1970:07-1996:12)	(0.00)	(0.60)	(0.47)
Full	3.56***	0.63	1.08
(1970:07-2001:04)	(0.00)	(0.81)	(0.38)
Thailand			
Pre 1990s	2.41***	1.07	1.18
(1970:01-1989:12)	(0.01)	(0.38)	(0.30)
Pre-crisis	2.57***	1.57*	1.63*
(1970:01-1996:12)	(0.00)	(0.10)	(0.08)
Full	1.70*	1.83**	1.81*
(1970:01-2001:03)	(0.06)	(0.04)	(0.04)

Notes: Entries list test statistics. p-values in parentheses. *** Significant at 1%, ** at 5%, * at 10%.

Table 5. Does Money growth Predict Inflation and Output in Korea?
Three variable model: Inflation, Real GDP Growth, Money Growth

Variable (Quarterly)	Monetary Base	M2	M2+
	Inflation		
Pre-1990s	2.78**	2.57**	1.53
(1971:02-1989:04)	(0.03)	(0.05)	(0.20)
Pre-crisis	3.14**	3.50***	2.26*
(1971:02-1996:04)	(0.02)	(0.01)	(0.07)
Full	1.38	1.93	1.88
(1971:02-2001:01)	(0.24)	(0.11)	(0.12)
	Output growth		
To 1989:04	2.65**	5.34***	5.48***
	(0.04)	(0.00)	(0.00)
Pre-crisis	3.13**	5.23***	5.17***
(1971:02-96:04)	(0.02)	(0.00)	(0.00)
Full	3.24***	4.55***	6.22***
(1971:02-2001:01)	(0.01)	(0.00)	(0.00)

Notes: Entries list test statistics. p-values in parentheses
*** Significant at 1%, **Significant at 5%, * Significant at 10%

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