
Tight Money in a Post-Crisis Defense of the Exchange Rate: What Have We Learned?

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Critics of the tight monetary policies pursued by some of the countries hurt by the 1997 Asian financial crisis have questioned the presumption that tight money can help sustain the value of a currency. The issue is actually an empirical one because theory does not unambiguously predict the effect of tight money on the exchange rate under the circumstances faced by the crisis countries. This article reviews the empirical research and shows that the evidence does not yet support strong statements about post-crisis links between monetary policy and the exchange rate. Proposed deviations from a sustainable medium-term monetary policy stance should thus be viewed with skepticism.

The policy advice given by the IMF during the 1997 Asian financial crisis has generated much controversy. Several aspects of the IMF's policy advice have been called into question, but a main focus has been its advocacy of tight monetary policy in countries experiencing recessions and banking crises. This policy prescription seems to run counter both to the standard countercyclical role that monetary policy plays during recessions in industrial countries and to the traditional role of the central bank as lender of last resort in a confidence-driven banking crisis.

The IMF originally advocated a tight-money policy stance to prevent exchange rate depreciation from being "passed through" excessively to domestic prices and to limit the "overshooting" of exchange rate depreciation, thereby mitigating the adverse effects of depreciation on the net worth of domestic financial institutions and firms (see Lane and others 1999). Because many firms and banks in the crisis countries had severe currency mismatches on their balance sheets, the IMF feared that an excessive depreciation of the currency would exacerbate the danger to their solvency, thereby potentially magnifying the economic dislocations and output losses associated with the crisis.

Critics of this policy prescription assail it on two grounds. First, they claim that even if tight money had been successful in sustaining the value of the currency above what it would have been with a looser monetary policy, the high domestic real interest rates implied by this policy would themselves have probably brought about the adverse real effects the policy sought to avoid. Thus even if it had achieved its goal with respect to the exchange rate, the policy would have been suboptimal (see Krugman 1999).

Second, critics question whether tight monetary policy can ever be successful in defending the value of a currency in crisis circumstances. They argue that because high interest rates imperil the solvency of firms and banks, they reduce the likelihood that domestic agents would be able to service their external debts. Because of their adverse effects on credit risk, high domestic interest rates actually reduce the attractiveness of acquiring claims on the domestic economy and consequently may actually result in a depreciation of the currency.

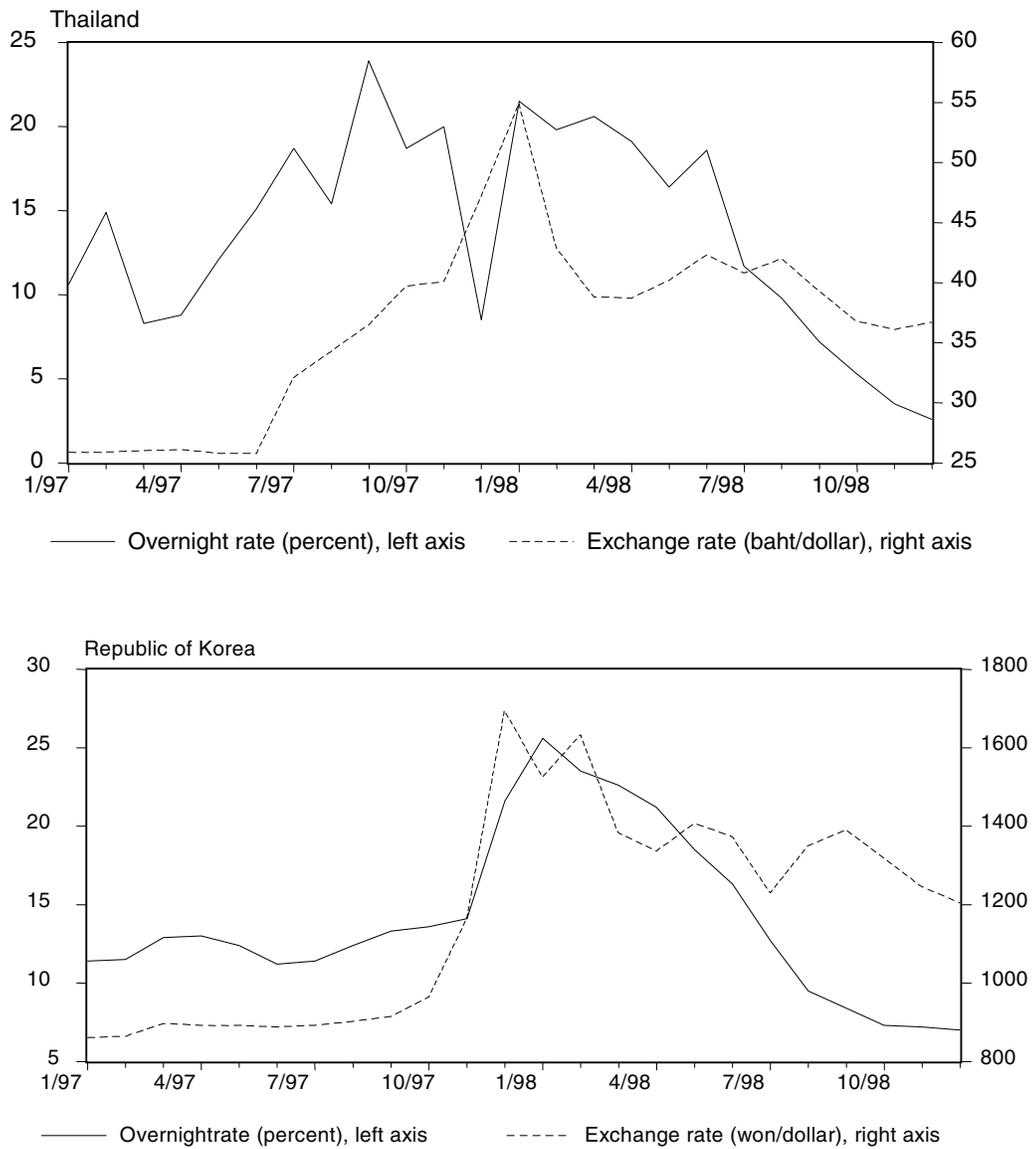
To see the empirical appeal of this view, consider the monthly time-series data for interest rates and exchange rates for the Republic of Korea and Thailand during 1997–98 (figure 1).¹ Both countries are acknowledged by the IMF to have attempted a tight-money defense of the exchange rate in the wake of the Asian crisis. The data suggest why the second criticism may be difficult to dismiss. Interest rates and exchange rates appear to have been positively correlated in Thailand during the second half of 1997 and after the spring of 1998, whereas in the Republic of Korea the positive association seems to have held over almost the entire two-year period around the time of the crisis.

The proposition that tight money can be counterproductive in sustaining the value of the domestic currency under (at least some) crisis conditions directly contradicts one of the most generally accepted tenets of international macroeconomics. For this reason, this contrarian view of events in Asia has spawned a vigorous controversy, and a substantial amount of empirical research has been devoted in recent years to testing this proposition. This article seeks to take stock of what has been learned about this issue as the result of this attention. It focuses on whether the recent systematic empirical research supports the proposition that monetary tightening after the outbreak of the Asian—or any other—currency crisis indeed resulted in currency depreciation.² Given the novelty of the “contrarian” view, the article begins by setting out and evaluating the analytical arguments for this view.

The Contrarian View: Theory

The analytical context in which the controversy over post-crisis monetary policy has arisen is that of a small open economy that maintains a flexible exchange rate.³ The issue under debate has to do with the immediate asset-market response of the ex-

Figure 1. Interest Rates and Exchange Rates in Thailand and the Republic of Korea, 1997–98



Source: International Monetary Fund, *International Financial Statistics*, various issues.

change rate to a change in the stance of monetary policy in such an economy. In other words, it concerns the response of the exchange rate over a relatively short time horizon. A substantial body of open-economy macroeconomic modeling has been devoted to this issue over the 30 years or so since the collapse of the Bretton Woods system.

Conventional models of exchange rate determination are based on an asset-market approach to explaining exchange rate movements—that is, they are derived from a combination of a stable money demand function and alternative versions of an interest-parity condition linking the expected returns on financial assets denominated in domestic and foreign currencies. Such models unambiguously suggest that tighter money strengthens the exchange rate, perhaps even more in the short run than in the long run. To suggest that this association may not hold in the post-crisis context, therefore, one needs to move significantly beyond the standard models. This section reviews the analytical basis for the contrarian view before the evidence is examined in the sections that follow.

Signaling and Credibility

The simplest basis for the contrarian view does not question the relevance of the traditional interest parity conditions that appear in standard models or the analytical link between the domestic interest rate and a floating exchange rate suggested by these models. Instead, it notes that very high domestic interest rates would be required to raise borrowing costs sufficiently to offset the gains arising from near-certain expectations of even a relatively small depreciation of the exchange rate over a short time horizon. Because interest rates at such levels would have destructive effects on the real economy, interest rate defenses are typically mounted with lower interest rates than would be required to achieve this effect.

How could such an apparently inadequate defense be expected to be successful? The expected future exchange rate is simply the probability-weighted average of a range of potential future exchange rate outcomes. Such a defense can be successful if it reduces the probability weight placed by the market on a sharp depreciation of the exchange rate in the near future, thus resulting in an appreciation of the expected future exchange rate relative to what would have happened without the defense. This revision of probabilities could materialize if mounting an interest rate defense signals information to the market about the authorities' resolve not to allow the sharp exchange rate movement that the market expects given the state of the economy. By demonstrating that they are willing to impose high costs on the domestic economy if necessary to make it more expensive to speculate against the currency, the authorities may seek to convey their high level of resolve in defending a particular value of the currency.

This signaling channel for tight-money currency defenses has been emphasized by Drazen (2001). As he points out, however, the effectiveness of a tight-money defense depends critically on what markets actually learn from the signal the authorities send when they mount such a defense. The information the authorities hope to convey concerns their future policy intentions.⁴ But the message the authorities try to send and the one that the market receives may not always be the same. The

government's avowed intentions may simply not be credible. For example, if the domestic economy is weak and the government's political position is precarious, the authorities' announced willingness to inflict pain on the domestic economy to punish speculators may be interpreted by the market as no more than a bluff. This is more likely the more sensitive the domestic economy is to high interest rates (see Bensaïd and Jeanne 1997), as, for example, when leverage is very high and net worth very low among domestic firms and financial institutions. The credibility of a tight-money policy may thus be weakest precisely under post-crisis conditions, when the fragile condition of the domestic economy magnifies the damage that would be done by high interest rates.

In other circumstances, the signal may actually backfire. Assume, for example, that some subset of the fundamentals that drive the value of the currency is unobservable to the market (but not to the government) and the market believes that the government is more likely to adopt an interest rate defense when these fundamentals are weak. Under these circumstances, mounting a defense may send exactly the opposite signal from that intended by the authorities, thus increasing speculative pressures against the currency (see Drazen 1999).⁵

The upshot is that the link between interest rates and the exchange rate is not structural but depends on how markets interpret the signal conveyed by the interest rate defense. This in turn depends on the vulnerability of the domestic economy to high interest rates, the strength of the government's political position, the extent to which the stance of monetary policy reveals information about the economy's fundamentals, and other factors. The implication of the signaling story is that the effectiveness of an interest rate defense depends on the circumstances in which it is mounted.

Default, Risk, and Expectations

A stronger version of the contrarian view argues that a high interest rate policy would be ineffective even if it could credibly be sustained. Proponents of this view argue that the uncovered interest parity condition used in standard models is overly simplified and leaves out some channels through which high domestic interest rates may affect the exchange rate.

To see how this can make a difference in the effects of monetary tightening on the exchange rate, consider how the nexus between the interest rate and the exchange rate works in the standard models. The uncovered interest parity condition is typically expressed as

$$(1) \quad R = (1 + R^*)S^e_{+1}/S - 1,$$

where R and R^* are the nominal interest rates on "safe" domestic and foreign bonds of the same (say, one-period) maturity; S is the current spot exchange rate (units of domestic currency per unit of the foreign currency); and S^e_{+1} is the spot exchange

rate expected to prevail in the next period. In this relation the small-country assumption makes R^* exogenous, and the relation between R and S thus depends on how S^e_{+1} responds to changes in R . Indeed, one of the main functions of traditional exchange rate models is to supply the structure required to make S^e_{+1} an endogenous variable in arbitrage relationships such as condition (1). In the popular Dornbusch “overshooting” model, for example, the expected future spot rate appreciates more than the spot rate that prevails before a monetary shock, making S^e_{+1} a decreasing function of R . It is easy to see that if this is so, condition (1) would immediately imply that increases in R must be associated with decreases in S —that is, tight money must be associated with exchange rate appreciation.

Contrarian critics, such as Furman and Stiglitz (1998), however, argue that condition (1) leaves out endogenous default risk, endogenous risk premia, and endogenous fundamentals. R is the promised (contractual) interest rate on the domestic investment. It corresponds to the expected rate of return on the domestic investment only if the default probability on that investment is zero. However, if the default probability is nonzero, what matters to the investor is the expected return on the investment, given by $\delta(1 + R)$, where δ is the probability of repayment. In crisis conditions, δ may be a decreasing function of R . The effects of tight monetary policy on domestic economic activity (and thus on the profitability of domestic firms, on firms’ borrowing costs, and on the health of the banking system) may adversely affect the probability of repayment. This link may be stronger in post-crisis conditions, when the financial position of firms and banks may be fragile. It is strengthened by interest rate exposure created by maturity mismatches in the balance sheets of firms and banks.

Another criticism of condition (1) is that it assumes risk neutrality on the part of investors. If investors are instead risk averse, a risk premium, ν , would have to be subtracted from the left-hand side of condition (1). Given the expected return on the domestic asset, if under crisis circumstances tight monetary policy increases either the riskiness of the domestic asset (that is, the probable dispersion of asset returns), through its effects on domestic economic activity, or the compensation investors demand for bearing risk, ν may be an increasing function of the domestic interest rate.

The expected future exchange rate may also be affected by current monetary policy through channels other than signaling. A central bank may adopt a tight monetary policy in the aftermath of a crisis to signal its determination to resist future exchange rate movements. Its intention in doing so is to convey information to the market about the government’s intentions, conditional on the economy’s fundamentals (that is, the government’s type), rather than to alter the future evolution of those fundamentals. However, an unintended consequence of tight monetary policy may be to affect the evolution of the fundamentals, thus changing the expected future exchange rate conditional on the government’s actual and perceived type.

The endogeneity of the fundamental determinants of the expected future exchange rate to the stance of monetary policy is not an innovation of the contrarian view, because the standard models essentially add structure to no-arbitrage conditions, such as condition (1), precisely to explain how S^e_{+1} is determined. Contrarian arguments, however, emphasize different channels of influence. For example, Furman and Stiglitz (1998) argue that contractionary monetary policy may cause the expected future exchange rate to depreciate relative to its preshock value. According to them, this could happen if the economy's future export prospects are adversely affected by tight monetary conditions (presumably through reduced credit availability to exporters or bankruptcy of export firms that are highly leveraged with short-term debt). The expected reduction in the future flow of foreign exchange could cause a depreciation in the expected future exchange rate. In that case, S^e_{+1} would be an increasing rather than a decreasing function of R .

Other mechanisms could produce the same result. In their "unpleasant monetarist arithmetic" analysis, Sargent and Wallace (1981) showed that a temporary monetary tightening could actually be inflationary, essentially because the adverse fiscal effects of high interest rates (through government debt servicing costs) may imply higher future seigniorage financing, the anticipation of which could reduce the demand for money sufficiently to raise the current price level.

Applied to an open-economy context, this mechanism would imply a depreciation of the nominal exchange rate, essentially driven by expected future exchange rate depreciation. Indeed, Flood and Jeanne (2000) have relied on just such a mechanism to show that an interest rate defense may actually accelerate the timing of the collapse of a fixed exchange rate. The intuition is that defending a fixed rate by raising the domestic interest rate in effect finances the holding of low-interest reserves with high-interest debt, thereby worsening the government's fiscal position and increasing the stock of government debt outstanding at every instant after the defense is mounted. Because, given the government's post-collapse policies, higher levels of debt cause the "shadow" exchange rate to be more depreciated (to adjust the real stock of debt to the government's post-collapse debt servicing capacity), higher levels of debt cause the collapse to happen sooner. Lahiri and Vegh (2000) have formally demonstrated that this fiscal effect could also cause tight money to depreciate the currency in a flexible exchange rate environment.

Taking each of these three possible channels of influence into account, condition (1) can be rewritten as

$$(1b) \quad \delta(R, \dots)(1 + R) / [1 + \nu(R, \dots)] = (1 + R^*)S^e_{+1}(R, \dots) / S.$$

The left-hand side of this equation can be interpreted as the risk-adjusted expected return on \$1 invested in a domestic asset, where the "promised" return $(1 + R)$ is multiplied by the probability of repayment δ and the required return on the risky

domestic asset has been augmented by the risk premium ν . Both δ and ν are expressed as functions of the domestic interest rate as well as potentially of other variables (indicated by the ellipses).

The right-hand side, representing the expected domestic-currency return on \$1 invested in the foreign asset, remains as in condition (1), except that the expected future exchange rate S^e_{+1} is now expressed as a function of the domestic interest rate, as well as potentially of other variables. The signs under R indicate the direction in which interest rate changes are likely to influence each of the three new functions introduced in condition (1b) according to the contrarian view.

It is easy to see that the potential dependence of each of these components of the uncovered parity condition on the domestic interest rate tends to create a positive association between the interest rate and the exchange rate. Thus each of these channels operates in a direction opposite to the negative link between the interest rate and the exchange rate that would hold in their absence. Taking them into account renders the direction of the link between these variables theoretically ambiguous.

To summarize, the contrarian view of the tight-money defense of the currency suggests that the conventional effect of tight money on the exchange rate may be weak, or even reversed, under the following circumstances.

- The state of the economy and the government's political position are weak, reducing the effectiveness of high interest rates as a signal of commitment to a relatively appreciated currency.
- Market information about fundamentals (such as reserve stocks) is poor, making it possible for an interest rate defense to be interpreted as a sign of desperation.
- The economy is acutely vulnerable to interest rate risk because of high leverage and low net worth among domestic firms and financial institutions.
- High interest rates can be expected to result in a deterioration of fundamentals that depreciates the expected future exchange rate (flows of credit to exporters are imperiled by tight monetary conditions, for example, or monetary tightness imperils the government's fiscal position).

Each of these mechanisms is analytically plausible. In the end, then, the validity of the contrarian view is an empirical issue.

Monetary Policy and the Exchange Rate: Pitfalls in Empirical Testing

Before turning to the empirical evidence, it is worth pausing to consider some methodological issues. The compilation of evidence on the empirical relevance of the contrarian view must overcome some considerable methodological challenges that complicate the interpretation of the evidence and create the potential for conflicting results.

Crisis and Noncrisis Settings

Estimates of the effect of monetary policy on the exchange rate derived from noncrisis environments cannot be used to assess the empirical relevance of the contrarian view because the thrust of that perspective is that the mechanisms that may reverse the effect may operate only in crises. The contrarian view suggests that the empirically estimated effect of monetary policy on the exchange rate should be expected to depend on the economic environment in which it is measured. This means that empirical studies need to address the interest rate–exchange rate link specifically in the context of crisis episodes.

The Meese-Rogoff Problem

The second issue is a broad philosophical one. The empirical performance of traditional exchange rate models has left much to be desired. The classic references on this issue are Meese and Rogoff (1983a, 1983b), who examined the out-of-sample forecast accuracy of these models compared with simple univariate forecasting methods at various short (up to 12-month) forecast horizons. They found that none of these models could outperform a simple random walk at any of the forecast horizons tested, even when predictions were based on the actual future values of the variables these models use to explain exchange rate behavior. These findings proved to be robust to a variety of modifications of the empirical methodology, sample period, and criteria for forecast accuracy.

The original Meese-Rogoff results applied not just to estimated structural models but also to nonstructural vector autoregressions (VARs) specified on the basis of the explanatory variables identified in these models, including domestic interest rates. These results suggest that even without imposing structural restrictions, the full set of variables identified in standard exchange rate models is jointly unable to provide a very satisfactory explanation of exchange rate movements. These results have tended to hold up well over time, and some recent work has suggested that standard exchange rate models may indeed be able to improve on simple random walks in long-horizon predictability. Still, there is no evidence that they can do so over the short time horizons relevant for the post-crisis interest rate defense of the currency.

Where does this leave empirical tests of propositions about the determinants of exchange rate behavior? One interpretation of the Meese-Rogoff results is that they indicate that there is no satisfactory theory to guide hypothesis testing about exchange rate behavior. In the absence of any such theory, hypothesis testing would be fruitless.

A more sanguine interpretation is that although there is some useful theory, the understanding of exchange rate behavior is incomplete, in the sense that a large frac-

tion of exchange rate behavior cannot be explained. This interpretation complicates but does not preclude hypothesis testing of individual influences on exchange rate movements. Put differently, the viability of an interest rate defense of the currency does not depend on the empirical relevance of any particular structural explanation of how monetary policy affects the exchange rate or on the broad question of whether the variables emphasized by the models can usefully explain exchange rate movements. It depends instead on a much narrower issue: the sign of the reduced-form effect of exogenous changes in monetary policy on the exchange rate. From an empirical standpoint, what one wants to measure is the sign of the partial derivative of S with respect to R in condition (1b), an estimate of the independent effect of an exogenous increase in domestic interest rates on market-determined exchange rates.

Although estimating the sign of this partial derivative may seem to be a less ambitious task than that of explaining exchange rate behavior more generally, it turns out to be a nontrivial matter. It is complicated by the limitations highlighted by the Meese-Rogoff results.

Empirical Identification of Monetary Policy Shocks

The two key challenges in determining the sign of this reduced-form parameter concern identifying monetary policy shocks and controlling for other influences on the exchange rate. Two separate issues are involved in identifying monetary policy shocks: identifying the variable that was actually used as the intermediate target of monetary policy in a particular context and identifying exogenous innovations in that variable within the sample.

Identification of the appropriate monetary policy instrument is crucial. If the researcher identifies the wrong monetary policy target (taking it to be the interest rate when the authorities were actually targeting domestic credit, for example), the chosen indicator of monetary policy will actually be an endogenous variable. Because the chosen variable and the exchange rate are jointly endogenous in this case, the correlation between them will be driven by third factors that are likely to vary from sample to sample, depending on the sources of shocks that prove to be dominant. These correlations would provide no information about the reduced-form effect of monetary policy on the exchange rate.

Once the problem of identifying the appropriate monetary policy variable is solved, the next challenge is to identify exogenous innovations in this variable within the sample. Because previously anticipated monetary policy actions would presumably elicit no exchange rate response, it is necessary to discriminate between monetary policy actions (changes in the monetary policy instrument) and monetary policy shocks (changes in the instrument that could not have been predicted on the basis of

past information). What matters is how exchange rates respond to monetary policy shocks rather than to actions per se. Even if monetary policy shocks can be identified within a sample, it is still necessary to identify their exogenous components. If an innovation in monetary policy, for example, partly responds to contemporaneous movements in the exchange rate, correlations between monetary policy shocks and exchange rate movements may convey little information about the reduced-form parameter that is of concern.

Controlling for Nonmonetary Exchange Rate Determinants

Once the empirical identification of the exogenous monetary policy shock is resolved, the next task is to control for the influence of other variables on the exchange rate to isolate the independent effect of the monetary policy variable. Doing so requires identifying these other potential influences and measuring their effects on the exchange rate. Unfortunately, the Meese-Rogoff problem complicates matters significantly. The fact that exchange rate models do not tend to work very well in explaining exchange rate behavior makes it difficult to identify the additional variables that should be included in empirical exchange rate equations. The upshot is that specification error may bias the sign and magnitude of the coefficients of interest in empirical tests of propositions about the determinants of exchange rate movements.

Though the task is daunting, there is a substantial empirical literature on the reduced-form effect of monetary policy on the exchange rate. For the United States most of this evidence tends to be consistent with the orthodox presumption that tight money results in an appreciation of the exchange rate (see Eichenbaum and Evans 1995). For other countries results have tended to be sensitive to the identification strategy used for monetary policy. Overall, studies that have been careful about this identification strategy—that is, those that have examined movements in policy variables that can plausibly be considered to be exogenous—have also provided support for the orthodox presumption that tight money results in exchange rate appreciation.⁶ Although this research at least suggests that the specification challenges posed by the Meese-Rogoff problem have not been perceived as insuperable, it is not directly relevant to the issue at hand because the bulk of it has been restricted to noncrisis contexts.

The conclusion to be drawn is that empirical tests of the contrarian view face demanding requirements. A credible test of the contrarian view is one that specifically allows for the role that crisis-induced vulnerabilities may play in determining the effects of monetary policy on the exchange rate, takes the identification of exogenous innovations in monetary policy seriously, and acknowledges the unsettled state of empirical exchange rate economics by allowing for a wide range of other potential influences on the exchange rate.

The Contrarian View: The Evidence

A substantial amount of empirical work has been done on this issue, but not all of it has overcome the methodological challenges. This section evaluates the evidence in light of the empirical difficulties described in the previous section.

Bivariate Tests

The most straightforward way to explore the empirical relation between exchange rates and interest rates is to examine the time-series correlation between the two variables in individual country episodes in which monetary policy was tightened and exchange rates were free to respond to market forces. Kaminsky and Schmukler (1998) looked at daily interest rate and exchange rate data in the immediate post-Asian crisis period (the second half of 1997) for the five countries most affected by the crisis (Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand) as well as Taiwan (China). They examined correlations between interest rates and exchange rates within 30-day rolling windows. Not surprisingly, they found that the signs of these correlations were very unstable during the period examined for all of the countries in their sample.

Because such simple bivariate correlations fail to take into account any of the empirical problems mentioned, they can provide suggestive evidence at best. Nonetheless, Kaminsky and Schmukler's results at least rule out the possibility that the post-crisis sample period in these countries was characterized by purely exogenous interest rate shocks in the context of orthodox links between monetary policy and the exchange rate. Something else must have been happening to explain the instability of these correlations.

In the wake of the Asian crisis, Goldfajn and Baig (1998) conducted one of the first empirical examinations of the nexus between interest rates and exchange rates that attempted to dig a little deeper. Like Kaminsky and Schmukler, they looked at the correlation between nominal interest rates and exchange rates in the immediate aftermath of the Asian crisis (though in the longer period from July 1997 to July 1998) for the five Asian countries most affected by the crisis. They went beyond Kaminsky and Schmukler, however, by attempting to identify innovations (that is, unpredictable shocks) in interest rates as well as to allow for richer dynamic effects of such innovations on exchange rates. To do so, they estimated bivariate VARs for first differences in daily interest rates and exchange rates and focused on the associated impulse response functions. They found little evidence that innovations in interest rates had any effect on subsequent exchange rate behavior in either direction during the crisis period (that is, the response of exchange rate changes to innovations in the domestic interest rate did not prove to be significantly different from zero).

The two equations of the VAR system estimated by Goldfajn and Baig can be interpreted as condition (1b) solved for the exchange rate S as a function of current and lagged interest rates, together with a monetary policy reaction function that sets the interest rate partially as a function of lagged exchange rates. The key problems with this approach are the ex ante identification of interest rate innovations with exogenous changes in monetary policy (as opposed to, say, changes in the risk premium) and the potential bias in estimates of the VAR parameters that would arise from the omission of other relevant variables from both the exchange rate and interest rate equations.

Other researchers who have examined the bivariate relation between interest rates and exchange rates have reasoned that there is no particular reason to expect that the contrarian view should have emerged only in the context of the Asian crisis. They have thus attempted to exploit the broader international currency crisis experience to shed light on the issue.

Goldfajn and Gupta (1999), for example, examined a broad sample of crisis episodes, including 80 currency crisis episodes (identified on the basis of the occurrence of large exchange rate depreciations) between 1980 and 1998. They usefully note that one of the factors that may influence the effects of monetary policy on the exchange rate is the position of the economy's real exchange rate relative to its long-run equilibrium level. They reason that if a country's real exchange rate differs from its long-run equilibrium value, the equilibrium real exchange rate must be restored through some combination of nominal exchange rate adjustment or inflation differentials relative to partner countries. In this context, the role of monetary policy is to determine the extent to which adjustment takes place through nominal exchange rate changes or inflation differentials. Because adjustment through prices may be asymmetric, however, the influence of monetary policy on the composition of real exchange rate adjustment (and consequently on the nominal exchange rate) may depend on whether the currency is initially overvalued or undervalued. To control for this possibility, they consider instances in which the depreciation of the exchange rate following the crisis significantly overshoot its equilibrium rate, investigating the role of tight money in causing the overshooting to be reversed through nominal exchange rate appreciation rather than differentially high domestic inflation.

Defining a success as an instance in which at least 50 percent of the overshooting was eliminated through nominal appreciation, Goldfajn and Gupta found that the probability of success conditional on the adoption of a tight monetary stance (defined as a domestic real interest rate above a given threshold) was significantly larger than either the unconditional probability of success in the sample or the probability of success conditioned on monetary policy that was not tight by their definition. This led them to conclude that consistent with the orthodox view, tight money tended to be associated with a more appreciated nominal exchange rate.

It is difficult, however, to determine the extent to which these results were driven by monetary policies actually undertaken in the post-crisis period. It is possible, for example, that in countries that had previously established monetary credibility, private agents did not expect a return to equilibrium real exchange rates through an acceleration in domestic inflation. This would have made it less costly for the central banks in those countries to adopt a restrictive monetary stance post-crisis. It would suggest that in cross-section, causation would run from low inflation (and thus more nominal appreciation) to tighter monetary policy rather than vice versa. However, the authors' results were supported by a fixed-effects panel regression in which deviations of the real exchange rate from its equilibrium value were regressed on real interest rates in a panel containing all the undervaluation episodes. The estimates, which exploit the time-series dimension of the data, indeed indicate that higher real interest rates tended to be associated with smaller gaps between the real exchange rate and its equilibrium value—that is, with smaller undervaluation. The implication is that the association between tight money and real appreciation in these episodes is not merely a cross-section artifact of previously established monetary credibility.

These results are clearly favorable to the orthodox view. However, there is no presumption that the selection of crisis episodes from the international data on the basis of the magnitude of exchange rate depreciation would serve to identify cases in which contrarian results are likely to hold. Indeed, consistent with the vulnerability argument of the previous section, Goldfajn and Gupta also found that the probability of choosing a tight monetary policy during a post-crisis period of undervaluation was significantly lower when the country was simultaneously faced with a banking crisis. Moreover, their results also indicated that if tight money was nevertheless chosen under such circumstances, it was less likely to succeed than in the absence of banking sector fragility.

Other researchers have also obtained mixed results in studies based on international currency crisis experience. Kraay (1998), for example, examined whether interest rate policy was instrumental in permitting countries to defend successfully against speculative attacks. Presumably, if the channels of influence emphasized in the contrarian view were important, they would tend to undermine the role of interest rate policy in defending against speculative attacks by increasing the cost of an interest rate defense. Thus although not directly focused on the problem of the feasibility of a post-crisis tight-money defense of the currency, this evidence bears indirectly on the issue.

Kraay used a sample of monthly data from 75 countries over the period 1960–99. In his sample he identified 105 successful attacks (defined as episodes in which a nominal depreciation of at least 10 percent was preceded by a period of relatively stable exchange rates) and 203 failed attacks (episodes in which monthly reserves declined more than 20 percent, interest rates rose more than 5 percent, or both). The central monetary policy instrument used in the study was the real central bank dis-

count rate, but Kraay also considered real domestic credit growth and reserves of deposit money banks as alternative measures of the monetary stance. He examined the change in these variables in the month before the attack relative to the previous month.

Kraay found that conditional on attacks having failed, the probability that monetary policy was tightened in the month before the attack was not statistically different from 0.5 for the real discount rate or real credit growth. Conditional on a tightening of monetary policy, the probability that a speculative attack failed was far below unity. Indeed, tightened monetary policy and failure of speculative attacks were essentially uncorrelated (or marginally negatively correlated) across episodes. These results held across a variety of robustness checks, including within subsamples that controlled for the stage of financial development, for various conditions that might affect the probability of resisting a speculative attack, and for the endogeneity of the monetary policy response to the strength of the speculative attack. Finding that tight money was not successful in defending speculative attacks and did not weaken the currency, Kraay concluded that it is unrelated to the probability that an attack will be successful.

Overall, then, the evidence based on simple bivariate associations is inconclusive. In individual country studies the issue of the identification of monetary policy shocks has not been confronted, and the studies have failed to control for the roles of non-monetary factors in driving movements in exchange rates. In the multicountry studies these problems have been compounded by country heterogeneity with respect to the conditions under which tight monetary policies may have been implemented. Indeed, a consistent interpretation of the results of Goldfajn and Gupta (1999) and Kraay (1998) is that when it comes to the association between monetary variables and exchange rates, country circumstances matter.

Multivariate Tests

A second group of studies has attempted to deal with the potential influences of initial conditions and nonmonetary factors. Furman and Stiglitz (1998) examined the effects of 15 episodes of high interest rates in nine countries during 1992–98. To control for the country characteristics they considered relevant, they focused on the possibility that both real exchange rate misalignment (as in Goldfajn and Gupta) and the country's previous inflationary history may determine the response of the exchange rate to monetary tightness.

They considered the change in the exchange rate between the beginning of the high interest rate episode and one month after the end of the episode. They regressed the change in the exchange rate on the average magnitude of the interest rate hike during the episode, its duration (measured in days), and the interaction between these variables as well as their interaction with a high-inflation dummy (on the grounds that high interest rates may provide more useful signals of a new anti-inflation de-

termination in formerly high-inflation countries), with and without controls for pre-episode real exchange rate misalignment.

They found that all of the variables associated with a high interest rate defense were associated with a subsequent depreciation of the nominal exchange rate, although the effect was far more pronounced for low-inflation than for high-inflation countries. Their interpretation was based on the signaling mechanism described earlier. They argue that in low-inflation countries periods of high interest rates may be of little value as a signal of future anti-inflationary resolve, implying that the adverse effects of high interest rates on the real economy (that is, a deterioration of fundamentals) would exert the dominant influence of high interest rates on the exchange rate. In contrast, in high-inflation economies the deterioration of fundamentals would be somewhat counteracted by a positive signaling effect. Furman and Stiglitz do not indicate how representative they believe their rather small sample to be.

Other recent studies have focused more narrowly on the experience of individual countries and taken more seriously the challenge of controlling for effects other than domestic monetary policies. All of these studies take condition (1b) as their point of departure and then add structure to the model to account for other influences on the exchange rate in an attempt to isolate the independent effect of monetary policy.

Basurto and Ghosh (2000) focused on testing one of the channels identified by Furman and Stiglitz: the potential dependence of the risk premium on the domestic interest rate, as captured by the function $\nu(R, \dots)$ in condition (1b). They begin from the observation that the variables causing movements in the exchange rate can be classified into two groups: changes in the risk premium ν and everything else. Their strategy is to account for the component of exchange rate movements that can be explained by “everything else,” thus isolating the effect of changes in the risk premium, and then to see whether changes in domestic real interest rates are related to the implied behavior of the risk premium. That is, they want to determine whether the function $\nu(\cdot)$ indeed depends on the domestic interest rate, as stipulated in condition (1b).

To identify the factors to be controlled for as everything else, they adopt one of the traditional models of exchange rate determination—the “flexprice” monetary framework—but provide a role for risk premia in the model by replacing condition (1b) by

$$R = R' = (1 + R^*)S_{+1}^e/S(1 + \nu) - 1,$$

which in log terms becomes

$$(1c) \quad R = R^* + (s_{+1}^e - s) + \nu,$$

where ν is the Furman-Stiglitz risk premium and $s = \log(S)$.⁷ Solving the risk premium-augmented monetary model for the exchange rate permits the current exchange rate

to be expressed as the sum of two terms, one that contains the current and anticipated future values of the standard variables identified by the flexprice monetary model and one that depends on current and anticipated future values of the risk premium ν . The implication is that any variables that affect the risk premium—such as the domestic real interest rate—would be expected to exert an influence over the exchange rate over and above that contributed by the standard monetary variables.

Basurto and Ghosh essentially tested whether the domestic real interest rate exerted such an independent influence. To do so, they noted that the augmented monetary exchange rate model suggests that the current exchange rate is a function of the actual and expected future values of the monetary variables and the risk premium. Agents' expectations of the future values of these variables are presumably based on their current and lagged values, as well as on other information not observed by the econometrician but that would be reflected in the actual exchange rate. These expectations can be estimated on the basis of projections derived from an estimated VAR containing the exchange rate and the monetary variables. If the domestic real interest rate affects the risk premium, it represents a part of the relevant information set and thus should be included in the VAR. The empirical test thus consisted of estimating VARs containing the exchange rate, the monetary variables, and the real interest rate and conducting tests of exclusion restrictions on the real interest rate.

Basurto and Ghosh conducted this test for Indonesia, the Republic of Korea, Thailand, and Mexico (as a comparator), using monthly data for the 1990s as well as a sample restricted to the post-crisis period. They found that after “contagion” variables were included in the VAR, the null hypothesis that the real interest rate does not belong in the information set could not be rejected for any of the countries. Their results thus shed doubt on at least one channel of influence emphasized in the contrarian view.

Gould and Kamin (2000) took a complementary approach. They attempted to eliminate the effects of variations in the risk premium and default probabilities from the exchange rate and to determine whether doing so made it possible to detect the orthodox channel from interest rates to exchange rates in the data. They reasoned that since the default and risk premium functions— $\delta(\cdot)$ and $\nu(\cdot)$ —in condition (1b) may depend on factors other than the domestic interest rate, the potential influence of such factors may make it difficult to detect the sign of the partial effect of tight money (as reflected in the interest rate R) on the exchange rate in simple bivariate tests. By controlling for the influence of these other factors, they could hope to isolate the sign of the reduced-form effect of R on S .

Gould and Kamin based their work on weekly post-crisis data (through the end of July 1998) for the five most affected Asian countries and Mexico. Their proxy for country risk premia was the spread on dollar-denominated government bonds over

U.S. Treasuries with similar maturities. Their estimation strategy was based on writing condition (1c) in real terms, as

$$r = r^* + (e_{+1}^e - e) + \nu,$$

where r and r^* are the domestic and foreign real interest rates and e is the real exchange rate. Solving this equation for e , we have

$$e = (r^* - r) + e_{+1}^e + \nu.$$

Gould and Kamin observe that according to this equation, the expected future real exchange rate should depend on the expected future values of the real interest rate differential and the risk premium. They then estimate an error-correction specification that relates the change in the real exchange rate to past changes and levels of the real interest rate differential (decomposed into nominal interest rates and inflation) as well as of their proxy for the risk premium. Their test is based on the signs and statistical significance of the estimated coefficients of the nominal interest rate terms in this equation. Under the orthodox interpretation of the link between tight money and the exchange rate, these coefficients should be negative.

They found that, although their proxy for ν tended to be significantly related to exchange rate movements, neither nominal interest rate nor inflation differentials had systematic effects on the exchange rate. This was true even after relatively parsimonious specifications were chosen, restricting the number of parameters to be estimated, and after adding aggregate domestic stock returns and bank stock returns to the regression to improve the credit risk proxy. They concluded that their results could provide little support for either the orthodox or the contrarian view. If monetary policy exerts any influence on exchange rates, they concluded, it probably does so over a longer time horizon than could be identified in their study.

Cho and West (2001) adopted a methodology that is very similar conceptually to that of Basurto and Ghosh but includes an alternative approach to identifying “everything else”—that is, factors other than risk premia that may affect the exchange rate. In terms of condition (1c), the methodology of Basurto and Ghosh can be interpreted as solving for the log of the exchange rate s in terms of R , s_{+1}^e , and ν , and then using the monetary model to identify the factors that determine the endogenous variables R and s_{+1}^e . After accounting for the effects of these factors, the remaining variation in s can be attributed to variation in ν as well as random elements.

Cho and West use a monetary policy rule in which the domestic interest rate for the current period is set as a function of the exchange rate that the authorities rationally expected in the previous period to prevail in the current period. Their model consists of condition (1c), a linear function relating the risk premium ν to the domestic interest rate, and the monetary policy reaction function. This model has the sensible property that if the relation between ν and R is nonpositive, interest rate and exchange rate movements are positively correlated (recall that an increase in the exchange rate

is a depreciation) if the sample is dominated by shocks to the risk premium and negatively correlated if it is dominated by shocks to the monetary policy rule. (The relation between ν and R is nonpositive in traditional monetary exchange rate models, in which there is no relation, and under a signaling interpretation in which tight money sends a favorable signal about risk, in which the relation is negative.) In contrast, if the relationship between ν and R is positive, as in the contrarian view, the correlation between interest rates and exchange rates is positive even if the sample is dominated by monetary policy shocks.

Cho and West's empirical procedure was to estimate the parameters of their model directly to detect the sign of the dependence of ν on R in condition (1c). Their estimates are based on weekly interest rate and exchange rate data from the Republic of Korea, the Philippines, and Thailand for a 53-week period beginning 2 weeks into the immediate post-crisis exchange rate regime. Their estimates of the dependence of ν on R for the three countries are very imprecise, but they are negative for the Republic of Korea and positive for the Philippines and Thailand. In the Philippines the positive influence of the interest rate on the risk premium was sufficiently weak that stabilizing the exchange rate in response to an expected depreciation would nevertheless require monetary tightening. That is, although the contrarian channel was present, it was too weak to dominate the orthodox channel. In Thailand the influence of the domestic interest rate on the risk premium was much stronger, suggesting that consistent with the contrarian view, resisting depreciation would actually have called for loose monetary policy.

Summary and Conclusions

What conclusions can be drawn from the research on the effect of monetary tightening on exchange rates in the aftermath of currency crises in emerging markets? The short answer seems to be that the contrarian view is plausible on analytical grounds, but too little is still known to determine how important the mechanisms associated with this view have been in actual crisis episodes.

Consider the analytical issue first. The basic uncovered interest parity condition—on which the orthodox presumption that tight money results in a more appreciated exchange rate rests—is one of the fundamental building blocks of open-economy macroeconomics. But even within the confines of conventional open-economy models, extracting a theory of exchange rate determination from it requires supplementing it with a model that explains the behavior of the two endogenous variables it contains: the domestic interest rate and the expected future exchange rate. The traditional exchange-rate models used to perform this function all generate the orthodox prediction that monetary tightening should be associated with a more appreciated exchange rate, other things being equal.

However, the claims that form the analytical basis for the contrarian view—that what should matter for uncovered parity is the expected rate of return on domestic assets rather than the promised interest rate and that the relation needs to include a risk premium—are unassailable. The key additional argument that default probabilities, the risk premium, and the expected future exchange rate may all be positively affected by domestic interest rates also appears to be unobjectionable in principle. These factors are particularly likely to be relevant in crisis situations in which both domestic firms and banks find themselves with precariously low levels of net worth, especially if maturity mismatches leave both types of agents severely exposed to interest rate risk. The bottom line is that the contrarian perspective cannot be dismissed on theoretical grounds in post-crisis situations.

The issue, then, is empirical. The challenge is to isolate the independent effect of monetary policy on the exchange rate in a context in which exogenous innovations in monetary policy are hard to identify and in which many other relevant factors are known to be changing at the same time. This challenge has to be met under some rather serious handicaps. The state of knowledge does not permit researchers even to confidently identify the set of relevant factors they need to control for, many of the factors that need to be controlled for are very hard to measure, and parameters may differ not just across countries and episodes but over time.

The empirical literature on the post-crisis tight-money defense has begun to deal with some of these challenges. Recent multivariate studies improve on earlier bivariate work by attempting to control for the influence of everything else. But the range of other potential influences on the exchange rate considered in these studies remains relatively restricted, and none of the recent studies has faced up to the challenge of identifying exogenous innovations in monetary policy in the crisis countries.

Under these conditions it is perhaps not surprising that the empirical work on this issue does not speak with one voice. If there is one theme that runs consistently through the empirical work it is the absence of strong results not just for or against the contrarian view but also for the view that monetary policy has any consistent and systematic effect on the exchange rate in post-crisis situations. Progress in this area will require more careful attention to identifying exogenous monetary policy innovations and the potential role of influences on the exchange rate other than monetary policy, if only by assessing the robustness of empirical results to alternative approaches to these problems.

Empirical studies have also failed to condition the response of the exchange rate to tight monetary policy on the presence and severity of domestic financial fragility. In principle this could be done by interacting monetary policy variables with indicators of fragility, for example, or using switching regressions to discriminate among effects that obtain under alternative fragility regimes.

Inconclusive empirical results on a contentious and important policy question suggest a strong need for additional research. In the meantime, the state of knowledge on

this issue suggests a need to tone down the rhetoric on both sides of the debate. It is not obvious that tight money is called for in the aftermath of crises because of, say, the presence of currency mismatches because tight money may not help prevent further depreciation of the currency. Nor is it clear that reliance on tight money under such circumstances is an obvious policy mistake because of its destructive effects on the real economy. If such effects are present, they may not have been strong enough to reverse the orthodox direction of influence of monetary policy on the value of the currency. In short, the state of knowledge on this issue calls for humility in *ex post* policy analysis.

The effects of monetary policy in post-crisis situations should be considered very uncertain. The standard prescription in the face of uncertainty of this type is that policy instruments should be used with caution. In a post-crisis environment proposed deviations—in either direction—from a sustainable medium-term monetary policy stance should thus be viewed with a strong dose of skepticism.

Notes

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1. In figure 1 the exchange rate is defined as the domestic-currency price of foreign currency, so that an increase in the exchange rate represents a depreciation. Lane and others (1999) present the IMF's view of the extent to which a tight-money defense was actually attempted in crisis countries with IMF-supported programs.

2. This article does not evaluate the normative question of whether or not tight money is optimal in a post-crisis situation. Clearly, monetary tightening could be suboptimal even if the currency does not depreciate as a result (see Krugman 1999). The question of optimality is, of course, substantially broader and more complicated than the one addressed here and has received much less formal attention from researchers. For recent research on this issue, see Krugman (1999), Lahiri and Vegh (2000), and Cespedes and others (2000, 2001).

3. The flexible exchange rate regime is, of course, the post-crisis successor to the fixed exchange rate regime overthrown by a successful speculative attack.

4. In standard exchange rate models, consistent with the traditional link between tight money and the exchange rate, the authorities' intentions are typically assumed to be known.

5. The policy could also backfire if the fundamentals are themselves endogenous to an interest rate defense.

6. See Zettelmeyer (2000) for evidence on Australia, Canada, and New Zealand.

7. This is just a special case of condition (1b) with the repayment probability δ set equal to unity.

References

The word *processed* describes informally reproduced works that may not be commonly available through libraries.

Basurto, G., and A. Ghosh. 2000. "The Interest Rate-Exchange Rate Nexus in Currency Crises." International Monetary Fund Working Paper WP/00/19. Washington, D.C.

- Bensaid, B., and O. Jeanne. 1997. "The Instability of Fixed Exchange Rate Systems When Raising the Nominal Interest Rate Is Costly." *European Economic Review* 41(8):1461–178.
- Céspedes, L. F., R. Chang, and A. Velasco. 2000. *Balance Sheets and Exchange Rate Policy*. NBER Working Paper 7840. Cambridge, Mass.: National Bureau of Economic Research.
- . 2001. "Dollarization of Liabilities, Net Worth Effects, and Optimal Monetary Policy." Paper presented at National Bureau of Economic Research Conference on Crisis Prevention, Islamorada, Fla., January 2001.
- Cho, D., and K. D. West. 2001. "Interest Rates and Exchange Rates in the Korean, Philippine, and Thai Exchange Rate Crises." Paper presented at National Bureau of Economic Research Conference on Management of Currency Crises, Monterey, Calif., March 2001.
- Drazen, A. 1999. "Interest Rate Defense Against Speculative Attack under Asymmetric Information." University of Maryland, Department of Economics, College Park, Md. Processed.
- . 2001. "Interest Rate Defense against Speculative Attack As a Signal: A Primer." University of Maryland, Department of Economics, College Park, Md.
- Eichenbaum, M., and C. L. Evans. 1995. "Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates." *Quarterly Journal of Economics* 110(4):975–1010.
- Flood, R. P., and O. Jeanne. 2000. "An Interest Rate Defense of a Fixed Exchange Rate?" International Monetary Fund Working Paper WP/00/159. Washington, D.C.
- Furman, J., and J. E. Stiglitz. 1998. "Economic Crises: Evidence and Insights from East Asia." *Brookings Papers on Economic Activity* 2. Washington, D.C.: Brookings Institution.
- Goldfajn, I., and T. Baig. 1998. "Monetary Policy in the Aftermath of Currency Crises: The Case of Asia." International Monetary Fund Working Paper WP/98/170. Washington, D.C.
- Goldfajn, I., and P. Gupta. 1999. "Does Monetary Policy Stabilize the Exchange Rate Following a Currency Crisis?" International Monetary Fund Working Paper WP/99/42. Washington, D.C.
- Gould, D. M., and S. B. Kamin. 2000. "The Impact of Monetary Policy on Exchange Rates During Financial Crises." International Finance Discussion Paper 669. Board of Governors of the Federal Reserve System, Washington, D.C.
- International Monetary Fund. Various issues. *International Financial Statistics*. Washington, D.C.
- Kaminsky, G., and S. Schmukler. 1998. "The Relationship between Interest Rates and Exchange Rates in Six Asian Countries." World Bank, Development Economics and Office of the Chief Economist, Washington, D.C.
- Kraay, A. 1998. "Do High Interest Rates Defend Currencies against Speculative Attacks?" Policy Research Working Paper 2267. World Bank, Development Research Group, Macroeconomics and Growth, Washington, D.C.
- Krugman, P. 1999. "Balance Sheets, the Transfer Problem, and Financial Crises." Massachusetts Institute of Technology, Department of Economics, Cambridge, Mass. Processed.
- Lahiri, A., and C. A. Vegh. 2000. "Should Interest Rates Be Raised to Fight Currency Depreciation?" University of California–Los Angeles, Department of Economics. Processed.
- Lane, T., A. Ghosh, J. Hamann, S. Phillips, M. Schulze-Ghattas, and T. Tsikata. 1999. *IMF-Supported Programs in Indonesia, Korea, and Thailand: A Preliminary Assessment*. Occasional Paper 178. International Monetary Fund, Washington, D.C.
- Meese, R.A., and K. Rogoff. 1983a. "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics* 14(February):3–24.
- . 1983b. "The Out-of-Sample Failure of Empirical Exchange Rate Models: Sampling Error or

- Misspecification?" In Jacob Frenkel, ed., *Exchange Rates and International Macroeconomics*. Chicago: University of Chicago Press.
- Sargent, T. J., and N. Wallace 1981. "Some Unpleasant Monetarist Arithmetic." *Federal Reserve Bank of Minneapolis Quarterly Review* 5(fall):1-17.
- Zettelmeyer, J. 2000. "The Impact of Monetary Policy on the Exchange Rate: Evidence from Three Small Open Economies." International Monetary Fund Working Paper WP/00/141. Washington, D.C.