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Economic Crises: Evidence and Insights from East Asia

THE EAST ASIAN crisis is only the latest in a series of spectacular economic catastrophes in developing countries. In the past twenty years at least ten countries have suffered from the simultaneous onset of currency crises and banking crises. This has led to full-blown economic crises, in many cases with GDP contractions of 5 to 12 percent in the first year and negative or only slightly positive growth for several years after. Many other countries have experienced contractions of similar magnitude following currency or banking crises.

Financial crises are not strictly exogenous; in many cases the slowdown itself, or the very factors that led to it, have helped to cause a financial crisis. But there is no doubt that the standard features of financial crises, including overshooting exchange rates, withdrawal of foreign capital, failure to roll over short-term debts, internal credit crunches, and the process of disintermediation have also been important.

Crises are also becoming increasingly frequent, at least relative to the post-World War II period. There has been, in Gerard Caprio's memorable phrase, a "boom in bust[s]."¹ Caprio and Daniela Klinge-

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1. Caprio (1997, p. 81).

biel identify banking crises—defined as episodes when the entire banking system has zero or negative net worth—in sixty-nine countries since the late 1970s. The U.S. savings and loan (S&L) debacle would probably not be in the top fifty international banking crises since the early 1980s, although the cost of resolving it was 3.2 percent of GDP, several times more, in real terms, than that of resolving the U.S. banking crisis in the 1930s.² With a less stringent definition, Carl-Johan Lindgren, Gillian Garcia, and Matthew Saal estimate that three-quarters of the member countries of the International Monetary Fund (IMF) experienced “significant bank sector problems” at some time between 1980 and 1995.³ Currency crises have been similarly pervasive. Jeffrey Frankel and Andrew Rose define a currency crisis as a year in which the currency depreciates by more than 25 percent, where this depreciation is at least 10 percentage points higher than depreciation in the previous year. By this definition, at least eighty-seven countries have suffered currency crises since 1975, and currency crises have also become more common recently.⁴

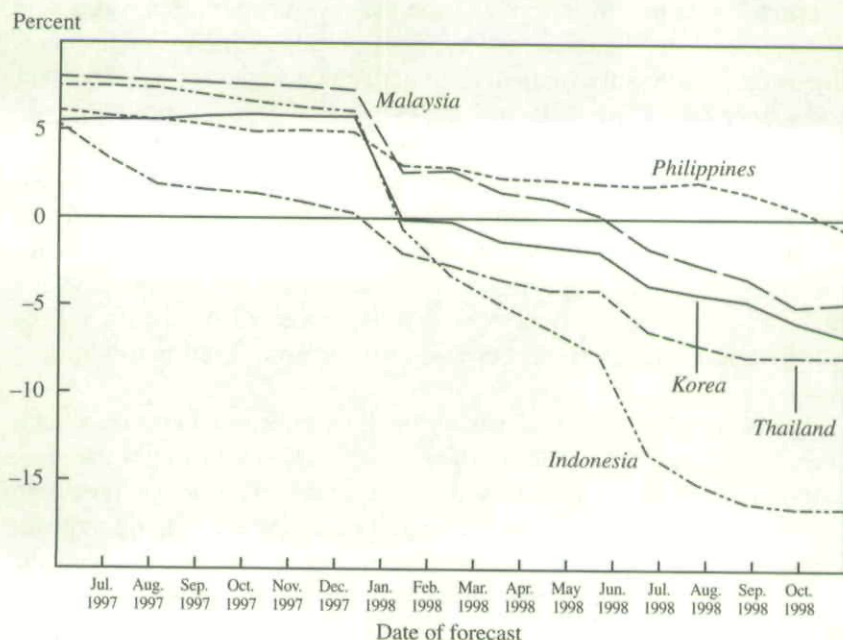
Yet in many ways the East Asian crisis is remarkable. It occurred in the fastest growing region in the world. Many people draw parallels with the “Mexican miracle” that ended in the 1994–95 “Tequila crisis,” but there is no comparison in terms of depth or duration of growth. Mexico’s success in the 1990s is spectacular only in comparison to its dismal performance in the 1980s. Sebastian Edwards discusses “the invention” of the Mexican miracle, pointing out that “between 1988 and 1994, and in spite of the reforms, the performance of the economy was rather modest. Real growth averaged 2.8 percent—significantly lower than Chile (7.1 percent) and Colombia (4.1 percent), for example; productivity growth was almost flat until 1993; export expansion was not overly impressive; real wages barely reached their 1980 level; the real exchange rate appreciated significantly; private savings experi-

2. Caprio and Klingebiel (1996) only cover countries with sufficient data; the S&L debacle in the United States does not make the top twenty-five crises in this list. They estimate, however, that including all of the transition economies of eastern Europe and the former Soviet Union would add at least twenty more crisis countries.

3. Lindgren, Garcia, and Saal (1996, p. 20). They identify “banking crises” in thirty-six countries, or one-fifth of IMF member countries.

4. Frankel and Rose (1996). Using an alternative definition, the International Monetary Fund (1998, p. 77) finds that currency crises were less common in the decade 1987–97 than in the previous decade, 1975–86.

Figure 1. Consensus Forecasts of Year-over-Year GDP Growth, East Asian Countries



Source: Consensus Forecasts, Inc. (1998, various issues).

enced a major decline; and poverty and income distribution continued to be a serious problem."⁵ It is hard to imagine the same being said about Thailand in the years prior to 1997.

Moreover, the largest international rescue packages in history, totaling more than \$100 billion, failed to stem the problem. The depth of the collapse in Indonesia is among the largest peacetime contractions since at least 1960 (excluding the experience of the transition economies of eastern Europe and the former Soviet Union). The East Asian economies continued to deteriorate, even after the initial policy packages were revised. Figure 1 shows that since the initial devaluations, each month has brought downward revisions of the consensus forecasts for growth. In the wake of the Tequila crisis, by contrast, capital flows and economic performance resumed within six months in most countries.

There have already been several comprehensive analyses of the se-

5. Edwards (1998, p. 3).

quence of events leading up to the Asian crisis.⁶ In this paper we do not provide another overview, but address several interrelated questions that emerge from the crisis. We hope that by advancing the understanding of the East Asian experience, we will enhance the ability to prevent and respond to future economic crises.

The magnitude of the East Asian experience requires a fresh look at some old debates, such as the causes of currency and financial crises, the appropriate macroeconomic response, and the costs and benefits of global financial integration. It also makes clear the importance of heretofore unexplored problems, such as the circumstances under which high interest rates are effective in defending a currency and the role of transparency (or lack thereof) in the onset and propagation of financial crises.

We begin with some preliminary methodological remarks on what it means to "cause" a crisis. In the second section we discuss the most salient issue in this regard: how did the East Asian miracle unravel into a deep crisis? We argue that an important change was the pursuit of rapid financial liberalization and capital account opening without the development of sound supervision and regulation. In the third section we discuss the difficulties faced by East Asian policymakers in coping with the inflows of capital that resulted from rapid capital market liberalization, given their commitment to financial market liberalization. In particular, we argue that their ability to undertake preventative macroeconomic policy was severely constrained. But part of the reason why they did not pursue preventative policies is that almost no one expected a crisis. Indeed, it was widely believed that the fundamentals in these countries were, by and large, sound. In the fourth section we suggest that these beliefs were reasonable, when viewed through the lens of the leading financial crisis prediction models. The chief conclusions of this section are that the East Asian crisis differs in significant ways from previous crises; that its most important determinants are not found in the macroeconomic aggregates; and that there is little basis for the argument that it was in some sense inevitable, at least, not in all of the countries nor with such severity.

The failure of the old theories to fit the new data has led to the

6. Those worth noting include Alba and others (1998); Corsetti, Pesenti, and Roubini (1998b); International Monetary Fund (1997); Radelet and Sachs (1998a, 1998b); World Bank (1998b).

introduction of new explanatory variables. One of these is the ratio of short-term debt to reserves, the subject of the fifth section. We argue that the evidence is consistent with the belief that large short-term debt exposure made the East Asian countries vulnerable to a sudden withdrawal of confidence. The other new variable is lack of transparency, the subject of the sixth section. We find that neither theory nor evidence provides much support for the hypothesis that lack of transparency, or corruption, played a large part in causing the crisis, although it may have exacerbated the crisis once it had occurred.

Finally, we look at one of the key issues in responding to currency crises: the use of temporarily high interest rates to change the exchange rate permanently. We try to identify the conditions under which such a policy will be effective, and we assess the evidence from East Asia and other recent experience. Our analysis not only provides an explanation for why these policies failed to stem the fall in the exchange rates but strongly suggests that they were an important factor weakening the economies, with adverse effects that persisted long after interest rates had been lowered again. We also look at the interaction between temporarily high interest rates, longer term reforms such as deficit reduction, and the exchange rate.

Some Methodological Preliminaries

Many discussions of the causes of the East Asian crisis really address the proximate causes, beginning with factors such as the current account deficits or exchange rate misalignments in early 1997. These are themselves the endogenous outcomes of deeper, or at least earlier, factors. We would like to explain how these variables got where they did. Part of the confusion over what caused the crisis is that there is not a clear sense of what is meant by causality. Taken in the conventional sense—a factor that inevitably leads to a given consequence—none of the alleged causes of the East Asian crisis satisfy. Lack of transparency is cited, for example, yet some countries far less transparent than those in East Asia did not have crises, and some of the most transparent countries have had crises in recent years. A broader interpretation looks at the issue from a stochastic perspective: causes are factors that increase the probability of a crisis. In this context, the terms “causes”

and "vulnerability" are often used synonymously. Indeed, the economy can be viewed as constantly bombarded by shocks. An increase in vulnerability means an increase in the probability that these shocks, rather than being absorbed by the economy, will be translated into a systemic downturn: a currency or financial crisis. In either interpretation, there can be multiple causes and interaction effects. That is, a crisis could be caused, in the stochastic or the nonstochastic sense, either by factor A or factor B, or by the interaction of factors A and B.

Still, while a variety of factors may contribute to a crisis, it is important to identify the central factors; in a statistical sense, these are the factors that would have the highest weight in a statistical model explaining the probability or severity of a crisis. And in interpreting the causes of a crisis, one should use Occam's razor: rather than listing every factor that might have contributed to the crisis, one should identify those factors that, by themselves, are large enough to have caused (in a stochastic model, to have led to a high probability of) the crisis. Thus real estate booms, such as that in Thailand, can explain the crisis in a country without further reference to "crony capitalism," weak financial institutions, lack of transparency, and so forth. Around the world, real estate booms are inevitably followed by busts, although one may not be able to predict when the bust will occur—or even whether one is in a bubble, until it bursts. To be sure, real estate bubbles are more likely when financial institutions are weak or base lending on collateral which, in turn, is valued through market prices.

In models that focus on vulnerability, it may not always be possible to explain the shocks. But in some cases, the likelihood of shocks—such as an attack on the currency—may depend on perceived vulnerability. Among the shocks faced by the countries of East Asia (and elsewhere) was a sudden change in the supply function of short-term capital, based on a sudden change in the markets' perceptions of risk. Although such changes can sometimes be related to events within a country or to its policies, often the shocks are almost entirely external. These include not just irrational contagion, for which there is some evidence, but also direct linkages through trade or finance, and common factors facing all developing countries (sometimes called monsoonal effects), such as increases in the interest rates of industrial countries.⁷ Such exogenous shocks can be large and very hard to predict.

7. Studies have had difficulty distinguishing between these effects. Calvo and Rein-

Expectations: Social Psychology and Economic Science

In the stories we tell below (and in most accounts), expectations play a key role in generating a crisis. Explaining expectations is not an easy matter. Within the economics profession there are two distinct traditions: one emphasizing rational expectations, the other, the irrationality of expectations. Keynes's description of the stock market as a beauty contest falls more in the latter category, though it is also consistent with multiple equilibria with rational expectations.

Typically, if there are multiple rational expectations equilibria, theory provides no guidance as to which equilibrium will emerge—if there were systematic factors picking out any one equilibrium, there would not be multiple equilibria. In a sense, then, one cannot explain the movement from one equilibrium to another, other than to say that there was a change of expectations, ratified by the market.

While it may never be possible fully to explain the movement from one equilibrium to another, one can identify exogenous actions—in particular, by the government or international bodies—that might have played a role in such a movement, in effect serving as a coordinating mechanism for the selection of an equilibrium. Accordingly, one interpretation of the East Asian crisis holds that it came to be believed, partly as a result of pronouncements by respected outsiders, that these countries had profound problems. Although some of the problems, such as corruption, had long been recognized, the new emphasis could have led to the belief that they were significantly worse than had been previously realized.⁸ And even if public pronouncements had no direct effect on the beliefs of market participants, the characterization of these problems as the underlying causes of the crisis could have served to coordinate the market on the low-level equilibrium, as each participant believed that others might believe, or act as if they believed, the state-

hart (1996) and Eichengreen, Rose, and Wyplosz (1996) find evidence for "pure contagion" in previous crises.

8. One should not, however, underestimate the difficulty of managing expectations. Those trying to encourage governments to undertake reforms may need to motivate them, possibly by emphasizing the severity of the problems. At the same time, they do not want to scare off markets, should a reform package be adopted. In striking this balance, it should be recognized that investors may find statements about the magnitude of a problem more credible than statements that policy reforms can redress the problems in a relevant time horizon.

ments. While the public diagnosis of the problem might have been grossly off the mark, the prediction that the downturn would continue if certain actions were not taken was self-fulfilling, and thus the expectations of market participants were "rational."⁹

In general, the multiplicity of equilibria may be endogenous; that is, whether there exists a unique equilibrium depends on the value of some economic variable. The literature on currency crises has developed numerous models in which a country with bad fundamentals will definitely suffer a crisis and a country with good fundamentals will definitely not do so. For countries in the middle, the expectations of speculators will be self-fulfilling.¹⁰

Sorting out these alternative hypotheses is not easy. There is considerable evidence casting doubt on the rational expectations hypothesis, including the fact that forward interest rates and exchange rates are not unbiased predictors of future spot rates, asset prices are excessively volatile, and stock prices seem to display mean reversion and other systematic discrepancies from the efficient markets hypothesis.¹¹ However, these are all joint tests of rational expectations and some other hypothesis; failure may in fact indicate that only the other hypothesis is rejected. But even if one does not believe that the market is well described by rational expectations, models using this assumption can help to assess the consistency of model formulations. The assumption of rational expectations is also a useful benchmark against which to evaluate different policies.

If expectations are irrational, one must be circumspect in forecasting the effect of any particular action on beliefs. To be sure, irrationality is not inconsistent with predictability. But while regressions based on past behavior provide insight into the formation of expectations in the past, they provide little assurance that such patterns will continue in the future. Indeed, when there are systematic but irrational patterns and these can be analyzed, there typically will be opportunities for arbitrage. The irrationalities that persist are, by definition, unpredictable.¹²

9. See, for example, Feldstein (1998); Radelet and Sachs (1998a, 1998b).

10. See, for example, Cole and Kehoe (1996); Obstfeld (1996); Sachs, Tornell, and Velasco (1996).

11. For an excellent recent survey, see Campbell, Lo, and MacKinlay (1997), especially chapter 2. See also Poterba and Summers (1988); Shiller (1989); Tyron (1979); Frankel (1980).

12. One often may not be able to reject the hypothesis of rational expectations, given

Economists—and journalists—do not have a particularly good record at predicting market responses to events and policies, especially in relation to such intangibles as market confidence. Will market confidence be enhanced if an economy goes into a deeper recession? Will market confidence be enhanced if economic policies undermine political and social stability? Will market confidence be enhanced if monetary authorities take actions that seem suited to a Latin American crisis, rather than to the specifics of the East Asian economies? What is clear is that different market participants, and different observers of different market participants, have different views on these issues of market psychology. While this paper cannot subject these perceptions to either the psychiatrist's couch or the political scientist's analysis of rival interests, it can address the question of what might have seemed reasonable expectations, by using the economist's standard tool kit of theoretical and econometric analyses.

Miracle versus Crisis

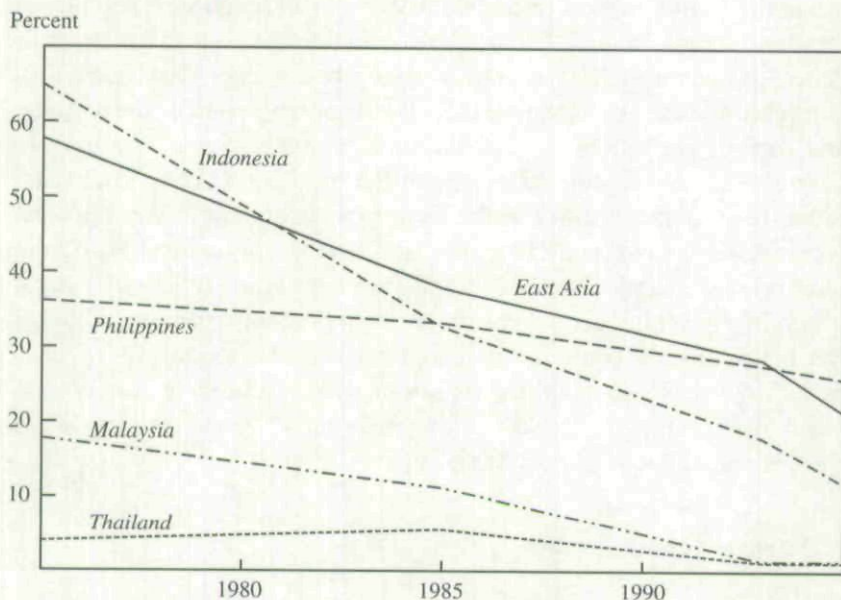
The question of how the widely touted East Asian miracle turned into one of the worst financial crises of this century is not merely of historical interest. It is essential for understanding why some countries are vulnerable to economic crises and what can be done to reduce their vulnerability. Central to our historical analysis is the attempt to explain how East Asia, and the world around it, changed in ways that made the region more vulnerable to crisis. We argue that one of the most important developments was the rapid liberalization of financial markets, both domestic and international, without the corresponding development of proper regulation or supervision.

The Miracle Was Real

The shift in sentiment about the East Asian economies has been remarkable.¹³ Until the outbreak of the crisis, East Asian economies

the paucity of data; typical tests are not very powerful. In many cases, one should be content to identify "consistent" expectations.

13. For a more extensive picture of East Asia's previous successes, see Radelet and Sachs (1998b); World Bank (1998a); Joseph E. Stiglitz, "Sound Finance and Sustainable Development in Asia," speech to the Asia Development Forum, Manila, March 12, 1998 (available on the worldwide web).

Figure 2. Poverty Rates in East Asian Countries, 1975-95^a

Source: Ahuja and others (1997).

a. The poverty rate is defined as the percentage of the population consuming less than \$1 per day (in 1985 PPP-adjusted international dollars).

were widely praised for rapid growth with equity that resulted in large reductions in poverty and increases in longevity. Between 1966 and 1996, per capita income grew at an average annual rate of 4.7 percent in Indonesia, 7.4 percent in Korea, 4.4 percent in Malaysia, and 5.2 percent in Thailand. Growth rates were also very stable: over the same period, real GDP growth was positive in each year for Indonesia and Thailand, and fell in only one year for Korea (1980) and Malaysia (1985). Although most of these countries had experienced financial crises previously, the consequences had been relatively mild and short-lived.¹⁴

This growth, combined with a relatively unchanged income distribution, has resulted in the dramatic drop in poverty rates shown in figure 2. In the region as a whole, poverty rates dropped from roughly 60 percent in 1975 to roughly 20 percent in 1995; in Indonesia, even

14. See Stiglitz and Uy (1996) for a discussion of East Asian countries' responses to earlier crises.

more impressively, from 64 percent in 1975 to 7 percent in 1997.¹⁵ Figure 3 shows a range of recent World Bank forecasts for the poverty rate in 2000 in Indonesia, Malaysia, the Philippines, and Thailand, depending on the change in inequality.¹⁶ The increase in poverty is dramatic. If inequality increases as an economy contracts, the number of people living on less than \$1 a day in the four Southeast Asian countries most affected by economic crisis could rise from 30 million in 1997 to roughly 60 million in 2000. But even the collapse in Indonesia would not come close to fully undoing that country's economic accomplishments since 1975.

Contrasting Perspectives on East Asia's Miracle and Crisis

The success of the East Asian economies—in growth, stability, and poverty reduction—led naturally to the question of its sources. Many observers looked to these economies to understand how elements of their development strategies could be used to promote rapid growth in other parts of the developing world. Among the frequently identified contributors to the miracle were outward orientation, especially with regard to exports; high rates of saving; and effective governments.¹⁷

In the wake of the crisis, the East Asian economies have been castigated for mismanaged exchange rate policies, badly regulated financial markets, lack of transparency, wasteful investment, current account deficits, and inadequate corporate governance. Listing these real and alleged problems has led many analysts to believe, in hindsight, that the crisis was inevitable—in spite of the fact that these countries had

15. This statistic for Indonesia has been challenged in Marcus W. Brauchli, "Speak No Evil: Why the World Bank Failed to Anticipate Indonesia's Deep Crisis," *Wall Street Journal*, July 30, 1998, p. A1. However, these numbers are derived from an extremely well-designed household survey that measures income, the value of consumption, the quantity of consumption, and local prices. Falsifying such survey results, as charged in the article, would be very difficult. As with all poverty statistics, there is some debate about technical issues, including the appropriate prices to use, which affect the measurement by a few percentage points. Also, in Indonesia, as in many developing countries, a large number of people have incomes just over the standard international poverty measure of \$1 a day. But these qualifications do not affect our assessment of the magnitude of Indonesia's accomplishment.

16. World Bank (1998a). These numbers are based on a reasonable estimate of the contraction in GDP and the historical relationship between GDP, income distribution, and poverty.

17. See, for example, World Bank (1993); Page (1994); Stiglitz (1996).

weathered earlier storms, such as the oil crises of the 1970s, as well or better than supposedly less vulnerable economies.

Remarkably, many of the issues that were identified as key to East Asia's success have now been labeled the key causes of its failure. Even the mere semantic shift from "business-government coordination" to "crony capitalism" has changed the way people view East Asia. The following informal table lists the contrasting interpretations of such issues.

<i>Positive</i>	<i>Negative</i>
Business-government coordination: improved performance through superior handling of information.	Business-government relations: collusion and political cronyism.
Open to international markets.	Economies closed in important ways that must be addressed.
Macroeconomic stability, including low inflation and fiscal prudence.	Poor macroeconomic policy; institutional changes needed.
Government-promoted competition, especially in exports.	Lack of competition and presence of large conglomerates.
Strong financial markets: large quantities of savings mobilized and allocated efficiently to investment.	Weak financial markets.

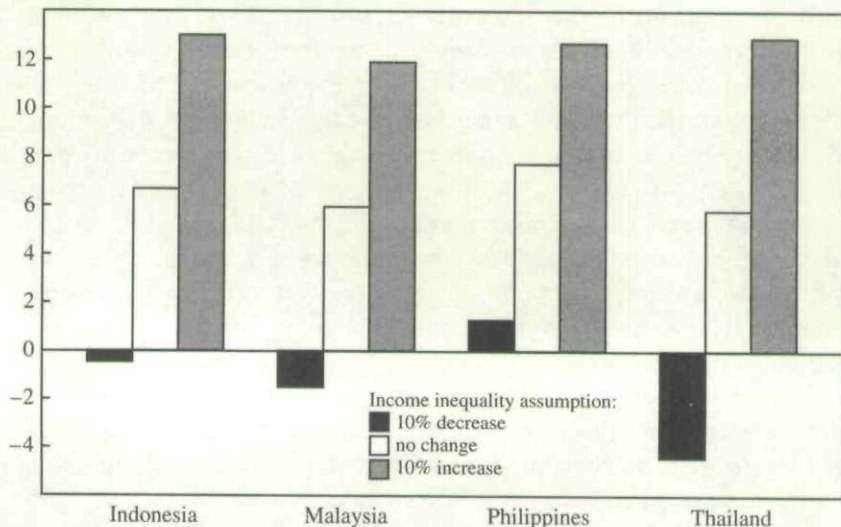
Some of the contrast between positive and negative interpretations comes from the fact that they refer to different countries within the region: Taiwan has more vigorous competition than Korea, and Hong Kong is much more open than Thailand.¹⁸ And some of the criticism follows from ideology: many of those who are generally suspicious of the role of government have been quick to blame government intrusion for the crisis, although they were previously reluctant to give government credit for the successes of the preceding three decades.

Any explanation of the East Asian crisis must deal jointly with the crisis today and the region's remarkable growth and stability in the past. Given their past record, it does not make sense to characterize the East Asian economies as *inherently* vulnerable to crisis, despite their recent experiences. One must therefore identify change, either in the East Asian economies themselves or in the world around them.

18. While it is also possible that certain changes have made the positive interpretation more apposite to the earlier period of growth period and the negative interpretation more apposite today, our discussion below suggests that, for the most part, no such changes have in fact occurred.

Figure 3. Poverty Rate Effects of a 10 Percent Reduction in GDP, Selected East Asian Countries^a

Percentage point increase, 1997–2000



Source: Unpublished estimates by Shahou Chen and Martin Ravallion, using the methodology described in World Bank (1998a).
 a. Poverty is defined for Indonesia and the Philippines as consumption of less than \$1 dollar per day; for Malaysia and Thailand, less than \$2 per day. Measures are in 1985 PPP-adjusted international dollars.

Reconciling the Crisis with the Miracle

There are three arguments that would potentially reconcile the East Asian miracle and the region's past stability with its present crisis: (1) the so-called East Asian system was ill suited to cope with changes in the world around it, especially the increased integration of international capital markets, which increased vulnerability; (2) policies that worked well at an earlier stage of development were ill suited to a more advanced situation; and (3) the East Asian economies abandoned the policies that had served them so well in the past. The most plausible explanations rely on some combination of these three hypotheses.

In regard to the first hypothesis, larger capital flows and greater correlation of movements across markets places enormous strains on economies. Several papers have linked external factors, particularly industrial country interest rates, to the rate of capital flows to devel-

oping countries and the probability of banking and currency crises.¹⁹ The huge change in investor sentiment—both in the perception of risk and the willingness to bear it—reflected in interest rate spreads, not only for emerging market securities but also for “high yield” (that is, risky) corporate securities in developed countries, had profound effects on several developing countries in late summer and fall of 1997. Although it is difficult to assess the change in this phenomenon over time, it is likely that as investors from industrial countries increasingly diversify their investments, these swings in sentiment would become larger and have a greater impact on developing economies—regardless of the degree of capital account liberalization in the developing countries, so long as they are open at all. But clearly the more open a country is, especially to highly volatile short-term capital flows, the greater is the impact of such swings.²⁰

The second, and related, hypothesis also has some credibility. In particular, policies that provide effective insurance against certain risks may work when an economy is small and there are relatively few firms in the manufacturing sector, but become impractical when the economy grows larger and more complex. For instance, Korea deliberately pursued a policy of maintaining high debt-to-equity ratios to leverage greater investment. Some analysts see this high leveraging as an important component of East Asia’s success.²¹ But it also left Korean corporations vulnerable to a growth slowdown. In the past, the government had played a complementary role by absorbing shocks through directed credit and other mechanisms, thereby mitigating much of the risk associated with high debt-to-equity ratios. As a result, Korea experienced very consistent growth and was not seriously affected by the global economic shocks of the past twenty-five years. As Korea has moved toward a market economy, with a more limited role for govern-

19. See, for example, Calvo, Leiderman, and Reinhart (1993); Frankel and Rose (1996); Eichengreen and Rose (1998); Milesi-Ferretti and Razin (1998).

20. With highly diversified portfolios, investors become more risk neutral; with different securities close to perfect substitutes for each other, slight changes in beliefs concerning expected returns (or slight changes in the opportunity cost of funds) can have huge effects on portfolio allocation. Moreover, improved transparency may produce greater similarity in beliefs, leading to greater price adjustments in response to certain exogenous events. We discuss these issues more fully below.

21. See, for example, Wade (1990). This policy can be justified on the basis of a scarcity of entrepreneurs and a limited supply of equity capital. Critics would argue that government policies may have contributed to the latter.

ment, the government has shown greater reluctance to engage in massive bailouts. Indeed, the increased openness of the economy—and the foreign debt accumulated by Korean companies after liberalization—have made such a bailout difficult at best.²²

Evidence of the third hypothesis is seen most clearly in the case of financial market liberalization. Before the crisis, several papers and books documented, usually with approbation, the significant steps taken by the East Asian economies toward liberalization of their financial systems.²³ Historically, these countries' financial systems were all highly regulated, with caps on interest rates, directed credit to allocate the scarce supply of credit, limitations on asset holding by financial institutions, limitations on foreign entry into the banking systems, and restrictions on foreign direct investment and foreign borrowing. Over the past decades, many of these restrictions have been eased. Rapid financial liberalization without a commensurate strengthening of regulation and supervision contributed significantly to the crisis. We illustrate with brief discussions of Korea and Thailand; developments in Indonesia and Malaysia were similar.

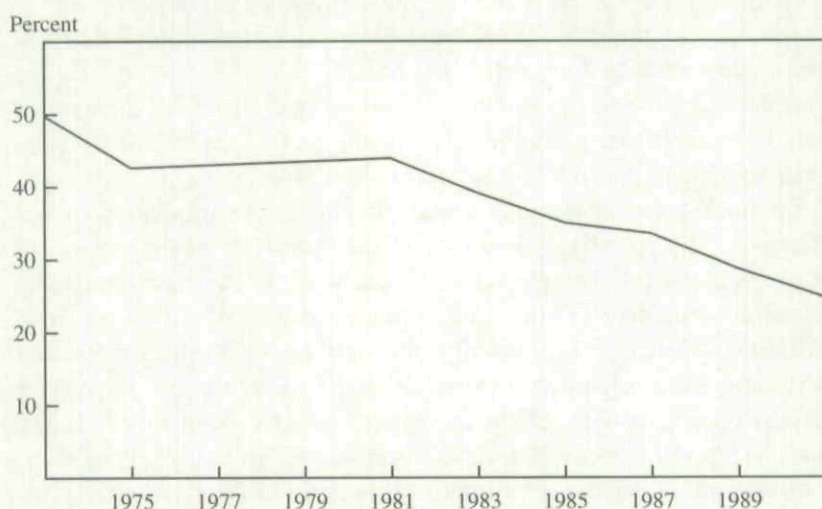
In Korea, some of the problems with the previous system became apparent in the overcapacity in the chemical industries and its role in the economic crisis of 1980. In response, the government adopted a series of progressive policies to loosen the regulations on bank lending, sold its shares in banks, increased restrictions on links between banks and *chaebol* (industrial conglomerates), and decontrolled interest rates. The result, shown in figure 4, was that the share of policy-based loans decreased steadily from 49.3 percent in 1973 to 24.9 percent in 1991. At the same time, Korea progressively freed its exchange market, first for current account transactions and later for capital account transactions, including relaxing and lifting restrictions on foreign direct investment and borrowing abroad.

Thailand has also witnessed rapid financial liberalization over the past decade. Restrictions on interest rates for many types of borrowing and lending were eliminated in the early 1990s. At the same time, banks

22. Wade and Veneroso (1998) have stressed the complementarity of high debt-to-equity ratios and other supporting policies; they place much of the blame for the crisis on the removal of the latter, rather than on the former.

23. See Fry (1995), Patrick and Park (1994), and Ito and Krueger (1996), among others. Much of the discussion that follows benefits from these sources.

Figure 4. Policy-Based Loans as a Share of Domestic Credit in Korea, 1973-91



Source: Park (1996).

were given greater scope in decisionmaking for loans, through the relaxation of mandates in favor of certain types of lending (for example, to agriculture) and the elimination of restrictions against other types of lending (for example, to real estate). In 1991 reserve requirements were reduced, and the scope of permissible capital market activities by banks was expanded to include activities such as financing equity purchases on margin. In addition, by relaxing regulations and increasing incentives, the government promoted a series of financial innovations, including greater use of securities markets and increased access to offshore borrowing and derivatives. Furthermore, the number of nonbank financial institutions expanded dramatically.

The Risks of Rapid Financial Liberalization

The experiences of dozens of developed and developing countries over the past decade clearly illustrate the risks posed by rapid financial liberalization unaccompanied by significant strengthening of supervision and regulation. This observation is confirmed by several systematic empirical studies and explained by well-developed theory.

The case of the developing countries is most striking. Twenty years ago, most developing countries had highly repressed financial systems, in which banks faced little competition for funds and relatively few choices in the disposal of those funds. Liberalization found many banks in a relatively weak position, unable to compete against innovative newcomers. Moreover, the erosion of the franchise value of banks (the present-discounted value of future profits) has created an incentive to take more risk.²⁴ Where these incentives were not offset by better supervision and regulation, serious problems have emerged or are likely to emerge. Experience shows, however, that it is much easier to get rid of restrictions than it is to create prudential oversight and regulation. Indeed, while the process of liberalization puts more demands on regulators and supervisors, it is often accompanied by the erosion of their capabilities, as the newly liberalized private sector bids the best personnel away from the public sector.

Furthermore, banks and other financial institutions often have only a limited ability to cope with the greater choice opened up by liberalization. In a highly protected environment, bank managers lacked incentives to invest in credit assessment or risk-monitoring skills. Rapid liberalization has made these skills necessary, but they cannot be learnt overnight. The increasing prevalence of derivatives and other complex financial instruments have further taxed the often limited expertise of bankers and supervisors.

There is overwhelming evidence that financial liberalization increases the vulnerability of countries to crises. It includes case studies of several countries, both developing and developed, beginning with the path-breaking analysis of Chile's 1982 crisis by Carlos Diaz-Alejandro.²⁵ A recent study of banking crises points out that "in 18 of the 26 banking crises studied . . . the financial sector had been liberalized during the preceding five years, usually less."²⁶ Furthermore, Asli Demirgüç-Kunt and Enrica Detragiache have found systematic cross-country evidence that financial liberalization, as measured by the

24. See Caprio and Summers (1996); Hellman, Murdock, and Stiglitz (1997).

25. Diaz-Alejandro (1985). For the contribution of financial liberalization to crises among the Scandinavian countries, see Steigum (1992) and Kiander and Vartia (1996); for an alternative view, see Drees and Pazarbaşıoğlu (1995).

26. Kaminsky and Reinhart (1998, pp. 10–11).

relaxation of controls on interest rates, increases the probability of a banking crisis.²⁷

The East Asian countries also pursued capital account liberalization, another source of increased risk. This risk was manifested in the \$109 billion reversal of net private capital flows (more than 10 percent of GDP) to the region between 1996 and 1997, with most of the adjustment in the last half of 1997.²⁸ Although the volatility was to some degree endogenous, several other countries with reasonably open capital accounts also experienced great volatility in capital flows and risk premiums during 1997. If virtually all developing countries become vulnerable when they open up their capital accounts, the presumption is that the problem is capital account convertibility (given the constraint that macroeconomic policy is never perfect), not macroeconomic policy. This volatility, with its potential long-run cost for economic growth, is probably part of the reason that cross-country studies have not found any relationship between capital account convertibility and economic growth.²⁹

Coping with Capital Flows

The financial and capital account liberalization of the 1980s left the East Asian countries with fewer tools to cope with the strains imposed by the surge of capital inflows in the 1990s, itself partly a result of the liberalization. Large inflows of capital pose challenges for an economy, especially when exchange rates are fixed. This is all the more so when the flows come in the form of unhedged short-term debt, as was the case for much of East Asia (we discuss this below). Furthermore, particular characteristics of East Asia, especially the high saving rates, reduced the benefits of capital inflows and exacerbated the difficulties.

But dozens of other developing countries around the world have also had to address large increases in capital flows over the past decade.

27. Demirgüç-Kunt and Detragiache (1998b).

28. Institute of International Finance (1998, p. 4). According to these estimates, 76 percent of the reversal was accounted for by commercial banks loans. It is also noteworthy that foreign direct investment to the five most affected East Asian economies—Indonesia, Korea, Malaysia, the Philippines, and Thailand—is estimated to have remained essentially unchanged.

29. See, for example, Alesina, Grilli, and Milesi-Ferretti (1994); Rodrik (1998).

And several of them are currently facing many of the dilemmas faced by East Asian policymakers in the years leading up to the crisis. They need answers to two questions: First, what is the best macroeconomic policy stance to avoid a crisis? And second, what other policies can broaden the set of macroeconomic policies consistent with avoiding a crisis? Although the answers clearly depend on particular circumstances, some general principles emerge from our analysis of the East Asian experience.

At the time, it was far from obvious what were the best policies to cope with the capital flowing into East Asia. Virtually every possible course was fraught with potential problems. There is no doubt that macroeconomic mistakes were made. In many cases, current account deficits were too large, real exchange rates were appreciating, and investment was being concentrated in the nontradable sector. In retrospect, Thailand's fixed exchange rate was unsustainable and probably should have been adjusted, but this was not apparent, especially in the earlier period when an adjustment would have been less costly. Nor is it clear that floating the baht, or adjusting the exchange rate, would in fact have averted the crisis.

Also in retrospect, Thailand's current account deficit of 7.9 percent of GDP in 1996 was unsustainable. At the time, even this was not obvious. The current account deficit was used to fund an increase in investment over and above the high and rising domestic saving rate. The expected returns to this investment, based on past growth, appeared to be high. Fundamentally, the fact that the current account deficit was mostly financed by private-to-private capital flows means that the market believed that these funds would yield higher expected returns than what would be required to service them.³⁰ Moreover, because they were private flows, there was not the issue of capturing the returns, which sometimes arises in the case of sovereign borrowing with high social returns.

There is a consistent economic rationale for describing large *government* deficits or large current account deficits fueled by public borrowing—problems faced by many countries in the 1980s—as inefficient macroeconomic imbalances. There is no general presumption that pol-

30. Except to the extent that market participants were counting on a bailout. The fact that a bailout occurred made such beliefs rational. So far, the international community has not devised a credible way to foreclose that option.

icy decisions will maximize social welfare and many reasons to believe that they will not. The case for the inefficiency of a 7.9 percent current account deficit that is largely due to private borrowing is more difficult. To the extent that one believes in the rationality and efficiency of markets, governments in the region should not have been concerned. The deficits should have been sustainable simply because they were used to finance investments that *should* have yielded returns in excess of the interest charged. And that is the key mistake: governments should have been aware of the systemic risk that these private actions imposed on the economy as a whole.

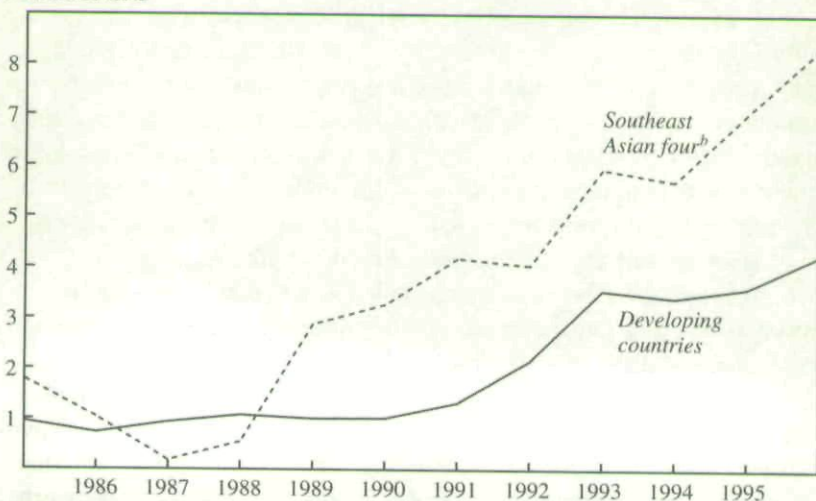
There are several reasons for the discrepancy between private and social risk in decisions about accumulating, for instance, short-term, foreign-currency-denominated debt. First, individual borrowers do not take into account the credit risk they impose on the economy as a whole. In part, this derives from the peculiar institutional feature of the "sovereign ceiling," whereby no firm can receive a higher credit rating than the country in which it is based. Second, to the degree that short-term debt increases the probability of a crisis, which is a gigantic market failure with severe aggregate consequences, it clearly represents an externality. Third, private debt accumulation may increase the probability of a bailout; or even if owners are not bailed out, may lead the government to incur large fiscal costs in resolving the banking problems. Finally, to the degree that the market expects a bailout, regardless of whether one takes place, there is a distortion. It would have been difficult for the East Asian governments to make credible commitments not to engage in domestic bailouts; to commit the international community not to conduct a bailout would have been virtually impossible.³¹

These externalities show that Thailand's 7.9 percent current account deficit should have been worrisome. The standard policy prescription is to address this sort of problem with macroeconomic tools, monetary or exchange rate policy and fiscal policy. We argue that in the case of East Asia, all the standard policies had severe drawbacks. But the discrepancy between private and social returns that made this current account deficit a potential problem in the first place also provides a rationale for using domestic and international financial restraints to

31. Even if investors (or lenders) had been made to pay the full costs of the externality they generated, the problem would have been only partly solved—the ex post incentive distortions (that is, the moral hazard problem) would remain.

Figure 5. Net Long-Term Private Capital Flows to Developing Countries, 1985-96^a

Percent of GNP



Source: World Bank (1998b).

a. Developing countries are defined as those with 1996 per capita GNP below current U.S. \$9,635.

b. Indonesia, Malaysia, the Philippines, and Thailand.

address the problem. In East Asia, the implementation of such restraints was circumscribed by strong belief in the need to pursue financial liberalization. As a result, the set of "good" macroeconomic policies was extremely small. Mild financial restraint could have extended this set and made it substantially easier to conduct macroeconomic policy.

The Sources of Capital Flows to East Asia

Net private long-term capital flows to Indonesia, Malaysia, the Philippines, and Thailand increased from 3.3 percent of GNP in 1990 to 8.3 percent of GNP in 1996. As can be seen from figure 5, these were part of a wave of capital flows to developing countries, which increased more than six-fold between 1990 and 1997: from 1.0 percent of developing country GNP to 4.1 percent. Nearly four out of five middle-income countries saw the net flow of long-term private capital increase between 1990 and 1996, by a substantial amount in the majority of cases.

One of the greatest difficulties faced by policymakers during capital inflow episodes is to assess whether the inflows are temporary or permanent. In general, there are three possibilities. First, the high level of inflows could represent the beginning of a permanent, or long-lasting, trend toward higher capital inflows. Second, they could represent a permanent adjustment in the stock of capital, and thus a temporary period of high inflows followed by no net flows. Third, they could represent a completely transitory phenomenon, which is likely to be reversed by capital outflows. Each of these possibilities has very different implications for macroeconomic policymaking.

In assessing the future course of capital flows, one important consideration is whether the increased capital inflows are caused by internal policy changes or external developments. Relatively early in the recent wave of private capital flows to developing countries, Guillermo Calvo, Leonardo Leiderman, and Carmen Reinhart observed the high correlation of capital flows across countries, noting that flows resumed strongly to all major Latin American countries in the early 1990s, despite the fact that some had initiated reforms much earlier and others had barely begun. They documented the importance of external factors in explaining between 30 to 60 percent of the variance in their proxy for monthly capital flows to these Latin American countries.³² In general, foreign factors can include fundamentals such as U.S. interest rates, balance of payments developments, or growth; institutional innovations that lead to greater global integration; changes in sentiment toward different regions (or emerging markets as a whole) or reductions in the degree of "irrational" home bias in investment; and overall changes in the market risk premium.

In addition, changes in domestic policies can lead to large surges in capital flows. Capital account liberalization can lead to stock adjustment that implies huge transitory flows, as can policies that are conducive to international capital or to particular types of money. An example of the latter is the Bangkok International Banking Facility, which was established by Thailand in 1993 to attract short-term money.

Most developing countries are small relative to the pool of foreign capital, and such capital inflows can place very large strains on them.

32. Calvo, Leiderman, and Reinhart (1993). See Fernández-Arias (1996) for an overview of the "push versus pull" debate, which concludes that external factors played a key role in the surge of capital flows to developing countries in the 1990s.

And as the above discussion indicates, without a single good explanation for the flows at the time or even in retrospect, it is difficult to assess future prospects. The policy implications of believing that capital flows fall and rise with U.S. interest rates are very different from the implications that derive from the belief that they are the result of a secular trend in global integration.

The Fixed Exchange Rate Bind

If a country has a flexible exchange rate, capital inflows will increase the demand for the local currency and lead to a real appreciation of the exchange rate. In a country with a fixed exchange rate, the upward pressure on the nominal exchange rate is averted by the accumulation of reserves by the central bank. To prevent this process from translating into an increase in the domestic money supply, and thus higher inflation and a real appreciation of the currency, policymakers sterilize the money growth by a variety of means. In the process, domestic interest rates rise.³³ In Thailand in 1996, for example, short-term money market rates rose 400 basis points above comparable U.S. interest rates. This, together with the belief that the exchange rate peg would last—justified by the fact that for thirteen years the exchange rate had largely drifted in a narrow band between 25 and 27 baht to the dollar—led to a shift in the composition of capital flows toward unhedged short-term debt. Interest rate spreads were similar in other East Asian countries, after adjusting for expected or actual depreciation in 1996, with similar consequences for capital flows.³⁴

In addition to leading to changes in the composition of capital inflows, the surge in capital flows boosted domestic demand and, because the supply of nontradables is more inelastic than the supply of tradables, raised the relative price of nontradables, encouraging the allocation of investment to the nontradable sector. This led to booming asset prices and perhaps contributed to the real estate bubble—although the real

33. For a simple model of this process, see Calvo (1991).

34. If one believes in interest rate arbitrage, the difference in interest rates is illusory: the lower foreign interest rates are paid for by expected depreciation in the currency. But most market participants do not believe that the market works perfectly, so they think (and act as if) they can save money by borrowing abroad. This is not arbitrage, however, as borrowers found out so painfully in East Asia in 1997, and again in Russia in August 1998.

estate bubble may, in turn, have helped pull capital in. The result was that the ability to repay the short-term foreign-currency-denominated debt was largely tied to the long-term performance of the nontraded sector: a situation of serious currency and maturity mismatch. Thus although the buildup of vulnerability was the result of private decisions, by both foreign lenders and domestic borrowers, the macroeconomic policies pursued by the East Asian governments may have helped to create incentives for these decisions.³⁵

Could the East Asian Governments Have Altered Their Exchange Rate Policies?

What could the East Asian governments have done differently to avoid these strains? One possible approach would have been through exchange rate policy, either adjusting the pegged (or quasi-pegged) exchange rates or abandoning them altogether by moving to a managed float, or even a pure float. Changing or widening the pegs would likely have accomplished little. Market forces were pushing for greater appreciation in the nominal exchange rate, which would have led to greater real appreciation, together with a larger trade deficit and even larger capital inflows.³⁶

Many observers think that abandoning the pegs altogether would have reduced the incentives for unhedged borrowing. This conventional wisdom needs to be qualified. Most of these incentives for hedging are also present in fixed rate systems, and it is not obvious that they would have been greatly strengthened by floating the exchange rate. Historically, fixed exchange rates systems have frequently been attacked, resulting in large discrete changes in the exchange rate. Rational investors should have taken this possibility into account. Risk-averse borrowers should have obtained cover. That they did not do so must be viewed as a market failure: borrowers either believed that they knew better than the market, or were inhibited from obtaining insurance by the associated transaction costs.³⁷

35. This point is emphasized by Alba and others (1998).

36. Unless it raised expectations of a devaluation in the future.

37. Note that to the extent that the "market" believes the exchange rate can be sustained, the price of insurance will be lower. Failure to purchase insurance in an economy with a well-functioning insurance market cannot be blamed on the formal exchange rate regime or the history of exchange rate movements.

Even if abandoning pegs would have reduced unhedged borrowing, possibly by signaling the intentions of the government, the reluctance of the East Asian countries is understandable, given the scant historical experience of successful transitions away from pegged exchange rates. In addition, policymakers were adamant about avoiding even a relatively small increase in inflation, although this might mean that the expansion of domestic demand was channeled into a rising current account deficit and a higher probability of a major crisis. While an appreciation of the currency would have had deflationary effects, this may have been more than offset by the lower interest rates. Another important objection to letting exchange rates float was that the real appreciation that would likely have followed would have further distorted the structure of the economy, adversely affecting the export sector, which had been the engine of growth of these economies for two decades.

Moreover, to the degree that one believes in irrational swings in investor moods (manifested as excess volatility in exchange rates), there is a very plausible story by which, given the circumstances of the East Asian economies, a floating exchange rate would have exacerbated the problems. Consider the following thought experiment. Foreign investors' expectations that the real estate bubble will continue remain robust, even as the government allows the exchange rate to float. To be sure, investors might be a little more reluctant to enter, since there is no guarantee of the exchange rate (though with rational expectations, they should have realized there never really was a guarantee). But it is equally plausible, with irrational expectations, that the flow might increase: as investors see the exchange rate increase, they might extrapolate the change, so that investing in, say, Thailand looks an even better deal, with the huge real estate returns plus an appreciating currency. The increase in the exchange rate discourages exports, and thus allows internal macroeconomic balance to be achieved at a lower interest rate than otherwise. There is no problem in financing the trade deficit; indeed, the flow of funds into the country is what "caused" the trade deficit. But suddenly one day the real estate bubble bursts, just as every other bubble has burst, whether in an open or a closed economy, with fixed or flexible exchange rates. In the process, capital flows reverse, and the exchange rate plummets. This floating-cum-bubble scenario would lead to greater real appreciation, greater resource real-

location to the nontradable sector, and smaller reserves, as compared with the fixed rate scenario, and thus would result in a larger exchange rate crash and more economic disruption.

This thought experiment makes clear that flexible exchange rate regimes would not necessarily have insulated the East Asian economies against the ravages brought on by a sudden change in expectations in a world with no restrictions on capital flows. Our point is not that the East Asian countries conducted their exchange rate policies perfectly, nor that every exchange rate regime is equally good (or bad). The point is just that there was no obvious exchange rate policy that strictly dominated the others, or that would, by itself, have insulated the countries from the volatility of investor sentiment. Furthermore, only in Thailand was there any strong reason to believe that the exchange rate policy was unsustainable at the time. And when this became obvious, in the first half of 1997, the risks of changing the policy were even larger, because of the extreme sensitivity of markets to signals about Thailand's health and the commitment of policymakers to maintaining the exchange rate.

The Limitations of Monetary and Fiscal Policy

Given the constraints on exchange rate policy, the traditional instruments for responding to the capital inflows were monetary policy and fiscal policy. Under fixed exchange rates and perfect capital mobility, monetary policy is completely endogenous. In the reality of the East Asian economies, instead of leading to infinite adjustments of reserves as in the Mundell-Fleming model, monetary policy leads to finite adjustments of reserves and is thus sustainable for a time. But monetary policymakers faced a quandary. Higher interest rates may have reduced investment, and thus the need to borrow from abroad, but they may also have created additional incentives to finance investment through unhedged short-term foreign borrowing. Moreover, the higher interest rates (like the real appreciation) distorted the economy, constraining investment in potentially more economically efficient sectors to make room for those sectors favored by foreign investors, such as commercial real estate.

The problems with using monetary policy to cope with capital inflows are well known and have led to the standard prescription that countries

should deal with capital inflows through tighter fiscal policy. This strategy increases national saving, lowers the current account deficit, and reduces the pressures on the economy. The East Asian countries followed this prescription as capital flows rose in the 1990s, eliminating the often modest deficits that they had run in the 1980s and shifting into surplus. As a result, the ratio of public debt to GDP fell to 24.1 percent of GDP in Indonesia, 8.6 percent of GDP in Korea, and 3.6 percent of GDP in Thailand. Several observers have argued that the East Asian countries should have pursued even tighter fiscal policy. According to Pedro Alba and others, "the fiscal impulse (the change in the fiscal stance) turned positive at a time when these economies were experiencing overheating pressures," contributing to the crisis.³⁸

Whether or not this analysis is correct, it would be hard to describe East Asian fiscal policy as a mistake. First, it is important to remember that fiscal stance is very difficult to fine tune, or even to measure.³⁹ In all countries, spending and (even more so) revenues are very erratic and depend on factors beyond the control of policymakers. Even the structural deficit, which nets out the effect of economic fluctuations, is very influenced by unpredictable factors. Second, and more important, it is very hard to fault a government running a surplus of 2 percent of GDP and government debt below 10 percent of GDP, as was Thailand. There were strong medium- to long-term arguments against running a larger surplus. Public investment was one of the major bottlenecks to future East Asian growth. Public infrastructure was not up to the demands of the modern economy; and in Indonesia, Malaysia, and Thailand education, which earlier had led the growth, had fallen behind. Cutting back public spending would simply have meant agreeing to the diversion of investment from schools and roads toward shopping malls and office towers. Alternatively, the government could have increased its surplus through higher taxes. The result (assuming that Ricardian

38. Alba and others (1998, p. 21).

39. In fact, it is not obvious that fiscal stances were positive in the five most affected East Asian countries: Indonesia, Korea, Malaysia, the Philippines, and Thailand. Actual budget surpluses rose in Indonesia, Korea, and Thailand in 1995 (a year of rising growth rates) and then fell in all five countries in 1996 (a year of declining growth rates for all except the Philippines). Although a careful analysis of the numbers may indeed provide evidence that the net fiscal stance was positive in these countries, the ambiguities involved in this calculation emphasize that one should not underestimate the difficulty of making macroeconomic policy in the context of rapid capital inflows.

equivalence does not hold) would have been that consumption, which had been falling as a fraction of GDP, would have been reduced still further. Again, it is not obvious that this would have been desirable, given the already high—by many accounts, overly high—saving rate.

Financial Regulation and Restraints

If one accepts the pegged exchange rates and open capital accounts, the final policy instrument available was domestic microeconomic policy. Would better financial regulation, along the lines of the Basle standards, have prevented East Asia's crisis? Although good financial regulation is clearly desirable, both for growth and stability, one should not overestimate its ability to overcome macroeconomic incentives. Financial regulation might have succeeded in reducing bank exposure, but the incentives for foreign borrowing would have shown up directly in the corporate sector. Restraints on lending—for example, to commercial real estate—might have been a more successful way to cope with the surge of capital. It was apparent that there was a significant amount of nonproductive speculative real estate lending; imposing sharp restrictions on this lending would have simultaneously dampened investment and strengthened the banking system.

What would have happened if the government had maintained the same misguided foreign exchange policy but had a better-regulated financial sector? In this case, regulators would have limited banks' ability to borrow short in foreign currency and lend long to buy nontradable assets. But the expected constancy of the exchange rate and the differential between foreign and domestic interest rates, which was increased by the partial sterilization of capital inflows, would have created the same incentives to borrow short-term money from abroad. The result could have been that corporations or nonbank financial institutions would have accessed international markets directly, instead of via the banks. This is what happened in Indonesia, where roughly two-thirds of the external debt to banks reporting to the Bank for International Settlements (BIS) was incurred by the nonbank private sector, among the highest proportions of any country in the world. No country can or does regulate individual corporations at the level of detail that would be required to prevent the foreign exchange and maturity mismatches that arose.

In contrast to the other Southeast Asian countries, Malaysia's central bank adopted much more prudent policies on short-term foreign borrowing, so that at the end of December 1996 its ratio of short-term debt to reserves was 0.4, compared with 1.2 for Thailand.⁴⁰ Malaysia did not suffer as much from the failure of foreign creditors to roll over short-term loans, and thus did not face the imminent threat of default that brought Korea and Indonesia to the brink. Despite this fact, Malaysia's crisis, whether measured by the depreciation of its exchange rate or by its expected growth in 1998, has been just as severe of that of Korea or Thailand. Taiwan had strong financial institutions, sound macroeconomic policies, and an exchange rate that was widely believed to be reasonable: its exchange rate depreciated gradually by *only* 20 percent.⁴¹

Well-designed bank regulations—such as risk-adjusted capital adequacy standards and risk-adjusted deposit premiums—might have gone some way toward reducing financial market vulnerabilities. For instance, banks could have charged higher interest rates to borrowers with large uncovered foreign exchange exposures and very high debt-to-equity ratios, to reflect the greater risk. The threat of higher interest rates would have provided a disincentive for firms to have risky financial positions.

To the degree that better financial regulation would have been helpful, three observations are in order. First, countries with more advanced institutions have found it difficult to develop regulatory frameworks that insulate them from financial crises. Even banks in the supposedly well-regulated advanced economies made loans not only to Korean banks, but also directly to the *chaebol*, which had high debt-to-equity ratios. As a practical matter, no government has imposed a good system of capital adequacy. One important lacuna is that while credit risk typically is recognized, though gauged imperfectly, market value risk associated with changes in interest rates or risk premiums is not. Furthermore, regulations do not examine total portfolio risk, including the correlations among market risks and between market risk and credit

40. Other aspects of Malaysia's situation were comparable to other countries in East Asia, for instance, the level of nonperforming loans. Even this may be misleading, however, because Malaysia required larger reserves against losses, so that its banks were in better financial positions.

41. Its trade-weighted effective exchange rate depreciated by a similar amount.

risk. Even the United States has deliberately shied away from fully transparent risk adequacy standards based on modern risk analysis. It is unreasonable to expect such mechanisms of indirect control to work effectively in developing countries.

Second, derivatives and off-balance-sheet items have complicated the problems of designing an appropriate regulatory structure. And the problems are all the more difficult for developing countries, because they are likely to face a shortage of good regulators and because they face greater risks. In both Indonesia and Korea, some firms and banks thought they had covered positions, but the bankruptcy of the parties providing the hedge left them exposed.⁴² To ferret out these problems would require assessing the credit risk of innumerable firms. That is why regulators in more developed countries are switching to evaluation of risk management systems, rather than monitoring individual transactions or even portfolio positions. It is likely to be some time before the financial institutions of developing countries can put into place highly sophisticated risk management systems. There is some concern that the Basle standards, by setting up a regulatory framework that does not deal adequately with these broader and more relevant aspects of risk, may give banks (and their depositors and investors) undue comfort, and may actually lead to excessive risk.

Third, given these limitations, there are arguments for a whole variety of lending restrictions: not only sectoral limits, but also speed limits and restrictions on the liability structures of the firms to which banks lend. Greater financial sector restraints might have gone some way toward changing the composition of capital inflows (by raising the implicit cost or lowering the benefit of short-term borrowing) and their use (by inhibiting the investment in real estate). Broad restraints on international capital flows, especially short-term flows, justified by the externalities imposed by such flows, could potentially have complemented these policies, lengthening the duration and reducing the risk of the inflows.

The intent of the Basle standards—to establish a “level playing field” so that banks throughout the world would face similar standards—has come to be questioned, because different circumstances

42. Dooley (1998). The recent bailout of Long-Term Capital Management in the United States is a reminder that such challenges face even highly sophisticated institutions.

may in fact necessitate different standards for different countries. There is a basic conflict between the principle of a level playing field and the idea that banks should face comparably low default probabilities. More fundamental, the thrust of financial market liberalization, which has focused on capital adequacy standards to the exclusion of broader constraints, such as "speed limits" and restrictions on lending to real estate, appears misguided. How countries that wish to maintain a robust domestic banking system should respond remains an open question.

Summary

We have used several thought experiments to ask what East Asian governments should have done differently in the 1990s. The answer, at least so far as macroeconomic policy goes, is not obvious. Macroeconomic policymakers in East Asia faced many of the same challenges as their counterparts elsewhere. One was the difficulty of ascertaining whether capital flows were temporary or permanent, and if they would be reversed; each of these cases implied different policy. The second problem was that these governments were trying to use relatively few instruments—fiscal policy, monetary policy, and exchange rate policy—to achieve multiple objectives, which included not only achieving output, current account, and inflation targets, but also changing the composition of demand and of capital inflows. The chosen instruments were not sufficiently rich to achieve these goals simultaneously. The fear of a moderate rise in inflation and the ideological predisposition toward deferring to the market, except in the determination of the exchange rate, may have contributed both to creating the problem and to undermining the development of effective solutions. The East Asian countries faced hard choices and approached these challenges within a framework which, at the time, seemed reasonable. There was no Pareto-dominant strategy that would have unambiguously reduced risks, for example, and increased long-term growth prospects.

Perhaps the most important policy lesson is this: one should not design policies—most notably, financial and capital account liberalization—that only work when other policies, including macroeconomic policy, are conducted flawlessly. Just as nuclear power plants are designed to take into account human fallibility, so too should economic systems. It is even more crucial that economic policy regimes be robust, because they must

withstand the reality that policy decisions reflect a diversity of legitimate interests and concerns, and may therefore result in policies that are far from optimal in terms of standard macroeconomic precepts.

Furthermore, as is widely recognized, capital account liberalization greatly increases the risk of capital surges, investment distortions, crises, and collapses, especially in countries that lack robust financial systems. We have tried to emphasize just how difficult it is to eliminate distortions and build a robust financial system. Most banking systems have encountered significant problems in the past decades, and although our understanding of how to design a better banking system is improving, so is the complexity of the job. Some distortions, such as the expectation of an international bailout, are virtually impossible to eliminate or price properly. As a result, there is no general theoretical presumption that eliminating any particular distortion will be welfare improving. This is not to say that liberalization is always bad, only that the case for it must rest on pragmatic grounds: it must be shown that liberalization can be welfare enhancing even when private decisions can lead to inefficient macroeconomic imbalances. The case for financial liberalization cannot rest on a blanket faith in the efficiency of markets.

Did the East Asian Crisis Follow the Pattern of Previous Crises?

The contention that the East Asian countries were pursuing "reasonable" macroeconomic policies in the years prior to the crisis is central to the arguments in the previous section. The best way to test this theory is to ask whether, given the knowledge at the time, the East Asian countries should have been able to see the problems coming. Following the European exchange rate crises in 1992–93 and the Mexican crisis in 1994–95, there was a large outpouring of theoretical and empirical research on how to explain and predict currency crises, and also a few papers on the prediction of banking crises. This literature can be used as a measure of knowledge at the time.

We examine whether the leading prediction models for currency or banking crises would have predicted the East Asian crisis in 1997. In addition to the question of whether policymakers should have been worried, this exercise can help to address two other issues. First, it provides a useful out-of-sample test of models that are increasingly

Table 1. Central Government Budget Balances in East Asia, 1990-96^a

Percent of GDP

Country	1990	1991	1992	1993	1994	1995	1996
Indonesia	0.4	0.4	-0.4	0.6	0.9	2.2	1.2
Korea	-0.7	-1.6	-0.5	0.6	0.3	0.3	0.1
Malaysia	-2.1	-1.1	-0.4	1.3	4.5	2.3	2.1
Philippines	-3.5	-2.1	-1.2	-1.5	1.0	0.6	0.3
Thailand	4.5	4.7	2.8	2.1	1.9	2.9	0.3

Source: World Bank (1998c).

a. A positive number indicates a surplus.

being examined, and even used, by financial institutions, governments, and international organizations. Second, it offers a way to assess systematically the East Asian fundamentals in the years leading up to the crisis. Some observers have argued that the fundamentals were very sound, pointing to budget surpluses, low inflation, and sustained economic growth. Others emphasize the rapid growth of credit to the private sector, real exchange rate appreciation, and, except in Malaysia, the buildup of the ratio of short-term debt to reserves. No one has made a convincing case as to whether the good fundamentals outweighed the bad or vice versa. In this section we test this by asking whether these factors added up to a crisis, using the leading prediction models.

Theoretical Models

Before discussing the empirical models, a brief discussion of the theoretical models is warranted. Several papers have noted that the East Asian crisis does not fit very well into either "first generation" or "second generation" models of currency crises.⁴³ The first generation models view a currency crisis as the inevitable and predictable result of a persistent budget deficit that led to declining reserves.⁴⁴ Table 1 presents central budget balances in East Asia from 1990 to 1996. The East Asian economies were in fact running substantial budget surpluses and had increasing reserves, due to the inflow of capital.

Many of the second generation of currency models were motivated by the collapse of the European exchange rate mechanism in 1992 and

43. See, for example, Corsetti, Pesenti, and Roubini (1998a); Krugman (1998).

44. See Krugman (1979); Flood and Garber (1984).

the Mexican crisis of 1994–95.⁴⁵ The most important feature of these models is that governments did not have to devalue (the unique equilibrium of the first generation models), but were tempted to devalue, often in order to temporarily boost aggregate demand and lower unemployment. The costs and benefits of devaluing as opposed to maintaining the pegged rate depend not only on the current rate of unemployment but also on the market's expectation of the probability of a devaluation. The strategic interaction between policymakers and market expectations can lead to multiple equilibria, depending on the model and the value of the fundamentals. If the market expects a peg to fall, speculators will attack, and thus make it too costly for the government to maintain the peg. If the speculators expect that it will be maintained, they will not attack and the peg will be maintained.

The essential insight that currency attacks can be self-fulfilling is consistent with the East Asian experience. But these particular models do not explain why the East Asian countries were vulnerable to a self-fulfilling withdrawal of confidence, for at least three reasons. First, from the perspective of aggregate demand, the East Asian countries did not face an especially large temptation to devalue. The unemployment rate in Korea (the only country for which we have reliable data) was around 2 percent until the crisis struck, and GDP growth was strong in all of these countries. Second, the second generation models emphasize the (possibly transitory) benefits of a devaluation. East Asia's corporations and banks had substantial foreign exchange exposure, however, and the banking sector was relatively weak. As a result, the option of devaluation had a large potential—and subsequently, actual—cost in terms of weakening the financial system, leading to a collapse of credit and a large fall in aggregate demand. Third, the East Asian countries had little choice about devaluation.

Should Crises Be Unpredictable?

Dozens of empirical models have been developed to predict currency crises, and a few to predict banking crises. These models are typically motivated by the theories discussed above. Before we examine whether these models predict the East Asian crisis, it is important to ask whether

45. See Obstfeld (1994, 1996); Eichengreen and Wyplosz (1993); Jeanne (1997); Cole and Kehoe (1996).

models should be able to predict crises in general. It is often argued that the efficient markets hypothesis, which says that stock prices should be unpredictable, also implies that currency crises should be unpredictable. Accordingly, if one figured out how to predict currency crises they would take place earlier and more smoothly, and the relationship between the predictors and the crisis would disappear as soon as it was observed. The reason why this argument is wrong is that one is not trying to predict the expected change in the exchange rate, but the probability that a dramatic change will take place.⁴⁶

A simple example can illustrate this point. Suppose someone developed a model that predicted, based on several observable variables, that a currency would with certainty devalue by 25 percent next month. This would provide a massive profit opportunity that would either bring the crisis earlier or, when the model became known, erase the relationship between those observable variables and currency crises. But none of the standard crisis prediction models predict crises with certainty. Instead they say, for instance, that there is a 10 percent chance that the peg will not hold, in which case the currency will devalue by 25 percent. If this were widely known, the interest rate in the country would rise to the point that the expected return to holding the currency was equal to the expected return to holding, say, dollars. As a result, making the prediction would not necessarily bring the crisis any earlier or undo the effectiveness of the observed relationships in the future.⁴⁷

In our assessment of forecasting models we focus on four that are among the most cited and span the methodological range: those due to Jeffrey Sachs, Aaron Tornell, and Andrés Velasco; Graciela Kaminsky, Saul Lizondo, and Reinhart; Frankel and Rose; and Demirgüç-Kunt and Detragiache. The first three deal with currency crises; the last, with banking crises. All were developed and estimated before the East Asian

46. In other words, one is not forecasting expected returns, which by the efficient markets hypothesis should be unpredictable, but volatility, which may be predictable. Indeed, the large literature estimating ARCH-type (that is, autoregressive conditional heteroskedasticity) models of asset markets is based on the premise that volatility is systematically predictable.

47. In Krugman (1979) crises are predictable with complete certainty because they do not entail any capital gains or losses. At the date of the speculative attack, speculators buy all of the central bank's reserves and the exchange rate floats, drifting down over time. Because the exchange rate does not jump, there is no profit opportunity. A model that implies that no one makes or loses money, however, seems to miss the most salient feature of a crisis.

crisis. In the text we present only the most important results of this exercise; we describe the models and our estimations in more detail in appendix A.⁴⁸

Real Exchange Rate Appreciation in East Asia: A Digression

One thread that runs through many of the theoretical and empirical models of currency crises in developing countries, including the three that we assess, is the real appreciation of the exchange rate relative to its equilibrium value. Since the outbreak of the East Asian crisis, many observers have sought to fit it into the mold of the "normal" crisis, by emphasizing the appreciation of real exchange rates in all the affected countries, with the exception of Korea. Before evaluating the models, it is worthwhile to evaluate this one variable.

The general relationship between real appreciations and economic crises has been widely analyzed, most notably by Edwards and by Rudiger Dornbusch, Ilan Goldfajn, and Rodrigo Valdés.⁴⁹ The argument is that real appreciation, which often results from the use of a fixed nominal exchange rate as a nominal anchor to bring down inflation, leads to growing current account deficits, increasing financial strain, and costly financial crises. Goldfajn and Valdés follow up on the latter point in a study which finds that only 10 percent of countries with a 25 percent real appreciation have returned without a nominal exchange rate crash, and no country with a real exchange rate appreciation of 35 percent or more has managed this transition successfully.⁵⁰

In the context of the East Asian crisis, many observers have noted that the dollar rose 50 percent against the yen between 1995 and 1997.⁵¹

48. Sachs, Tornell, and Velasco (1996); Kaminsky, Lizondo, and Reinhart (1998); Frankel and Rose (1996); Demirgüç-Kunt and Detragiache (1998a). Note that both of the models published in 1998 were estimated using pre-1997 data, and neither differs very much from the working paper versions written before the outbreak of the crisis; thus the experience of 1997 provides a legitimate out-of-sample test for both. Berg and Pattillo (1998) performed an analysis of the predictive power of the three currency crisis models simultaneously with ours, and their assessment is very similar.

49. Edwards (1989); Dornbusch, Goldfajn, and Valdés (1995).

50. Goldfajn and Valdés (1996).

51. China's 50 percent devaluation in 1994 is sometimes cited as an explanation for this effective real appreciation. The devaluation only covered the official exchange rate, however; roughly 80 percent of exports were covered by the "swap market" exchange rate, which remained essentially unaffected. As a result, the effective devaluation was

Those countries with *de facto* dollar pegs, including Malaysia, the Philippines, and Thailand, thus saw their trade-weighted real exchange rates rise. In contrast, Indonesia allowed its exchange rate to depreciate with its inflation rate and saw a relatively small real appreciation, and Korea, which pursued an even more flexible exchange rate policy, actually saw a real depreciation.

This trough to peak comparison is potentially misleading. In 1995 the dollar was at an historic low relative to the yen. Given that the Thai baht and the other currencies had been effectively pegged to the dollar for some time, a portion of their rise *vis-à-vis* the yen in the following years would simply have been correcting this imbalance. When the real exchange rates are compared with earlier values, the real appreciation is substantially smaller.

To assess real exchange rate misalignment requires a measure of the actual real exchange rate and a method for estimating the equilibrium real exchange rate. Since both of these are very contentious, the most prudent course is to use a variety of estimates together with subjective judgments about the direction of change of the equilibrium real exchange rate. The most significant effort to do this for East Asia is due to Menzie Chinn, and we rely on his estimates along with our own.⁵²

Table 2 shows four estimates of the degree of real exchange rate misalignment in selected countries. The first column is an estimate based on purchasing power parity (PPP), using the average real exchange rate over 1989–91 as the base period. The choice of this base is motivated by the fact that, at least for the East Asian economies, real exchange rates were virtually flat in this period, which was also marked by relative tranquillity in terms of major macroeconomic events.⁵³ Any

only 7 to 8 percent. Furthermore, China's real (trade-weighted) exchange rate in mid-1997 was substantially appreciated relative to its value before the exchange rate unification in 1994. See World Bank (1998a, p. 24).

52. Chinn (1998).

53. This column is based on an unpublished multilateral trade-weighted real exchange rate index that uses the consumer price index (CPI) and is calculated by World Bank staff, based on IMF data. Various other measures of the real exchange rate—including bilateral U.S. dollar using CPIs, bilateral U.S. dollar using wholesale prices, multilateral trade with Organisation for Economic Co-operation and Development (OECD) countries, and the J. P. Morgan effective exchange rate index—are all very similar to these. In the case of Thailand, for instance, alternative measures of the appreciation for the first half of 1997 relative to the 1989–91 average range from 3 percent to 11 percent.

Table 2. Measures of Real Exchange Rate Misalignment for Selected Countries
 Percentage from equilibrium value

Country	Methodology			
	PPP-1 ^a	PPP-2 ^b	Per capita GDP, adjusted ^c	Monetary model ^d
	(Jan.-June 1997)				(May 1997)	(1996)	(May 1997)
Indonesia	6	-5	-16	0
Korea	-5	-9	1	-12
Malaysia	12	8	-41	2
Philippines	37	19	-16	-24
Thailand	11	7	-18	2
Taiwan	-2	-3	...	8
Singapore	20	-6	-18	35
Argentina	65	...	34	...
Brazil	33	...	33	...
Mexico	3	...	-18	...
South Africa	-4	...	-17	...
United States	4	...	-30	...

Source: PPP-1 and adjusted per capita GDP are authors' calculations based on the PPP series in World Bank (1998c) and a multilateral trade-weighted real exchange rate from unpublished World Bank staff estimates using IMF data. PPP-2 and the monetary model are estimated by Chinn (1998).

a. Percentage change between real exchange rate average over 1989-91 and average over January to June 1997.

b. Overvaluation of the real exchange rate in May 1997 relative to Chinn's estimate of the PPP exchange rate over 1975-96.

c. Percentage difference between actual real exchange rate in 1996 and the predicted rate for that year based on the fitted values from the regression of the real exchange rate on per capita GDP measured in PPP dollars. The actual real exchange rate is the ratio of the PPP rate to the dollar exchange rate in 1996, as calculated by the World Bank.

d. Overvaluation of real exchange rate in May 1997 based on Chinn's sticky price monetary model of the exchange rate.

base period is necessarily ad hoc. The second column shows an alternative measure of purchasing power parity misalignment calculated by Chinn, which essentially uses the average from the period 1975-96 as the equilibrium real rate. The third column compares real exchange rates (in this case, the PPP adjustment factors used by the World Bank, which capture the relative price of tradables and nontradables) in 1996 with the value that would have been predicted by a regression on the level of per capita GDP, a measure that is based on the Balassa-Samuelson effect.⁵⁴ The fourth column is Chinn's estimate of real misalignment derived from fitting a sticky price monetary model.⁵⁵

Two results emerge from this analysis. First, and most striking, if

54. Balassa (1964); Samuelson (1964).

55. Chinn (1998) essentially estimates a system with a money demand equation, an uncovered interest parity equation, and an adjustment process for prices. These equations are adjusted to reflect the Balassa-Samuelson effect.

real exchange rate appreciation is defined as the critical variable affecting the likelihood of a crisis, the countries that actually experienced crises would seem not to have been the most vulnerable. Second, the degree of real misalignment is very sensitive to the measure used. Compared to their stage of development, the East Asian countries actually had real exchange rates well below what one would have expected.⁵⁶

There are several other developments that could have changed the relationship between equilibrium exchange rates and actual exchange rates in ways not captured by the above theories. For instance, Korea saw its terms of trade decline by 20 percent in the three years up to June 1997. Indonesia, Korea, Malaysia, and Thailand reduced tariff rates on imports between 1990 and 1996–97.⁵⁷ Even more significant steps were taken on the capital account to open up to capital inflows and to encourage certain types of inflow. Taken together, however, these various effects are not likely to have a large quantitative impact on the results in table 2.

It is almost a tautology that countries with vastly overvalued exchange rates are more likely to experience a crisis, that is, a large decline in their exchange rates. But as a practical matter, determining the magnitude of the overvaluation *ex ante* is not easy. Different methodologies yield not only different magnitudes but different signs. The exchange rates of some of the countries that suffered crises were somewhat overvalued, although perhaps less so even than is indicated by the relatively modest rise in actual real exchange rates. Nor are their actual overvaluations very large compared with many other countries that did not suffer crises. In contrast, by the same measures Korea probably had an undervalued exchange rate. Based on this variable alone, there is no reason to think that the adjustment process could have been much smoother, either through gradual exchange rate changes or price changes. Also, the analysis of the real exchange rate makes it very difficult to explain nominal devaluations well in excess of any estimate of real overvaluation.

56. From the perspective of cross-country fit, the rate adjusted for per capita GDP is by far the best, with an R^2 of 0.82.

57. For Indonesia, Korea, and Malaysia, see World Bank (1998c); for Thailand, see the more recent data and analysis in Martin (1998).

The Unpredictability of the East Asian Currency Crisis

We look first at the model of Frankel and Rose, which predicts the probability of a currency crisis as a function of (possibly lagged) macroeconomic and financial variables.⁵⁸ They define a "currency crash" as an event where the annual exchange rate vis-à-vis the U.S. dollar drops by more than 25 percent in a single year; this drop is at least 10 percentage points greater than that of the previous year, to exclude high inflation cases; and there have been no crises within a three-year window, to exclude counting the same crisis more than once. By this definition, currency crashes occurred 7.0 percent of the time in our sample of 104 countries over 1980–96 (see appendix A). Thus a very simple model is that crises are idiosyncratic events that occur with probability of 7.0 percent in any given year, independent of the past history of crises or the values of any other variables.

Presumably, however, one would be able to do better by looking at the data on East Asia. Frankel and Rose attempt this approach by estimating a probit model based on pooled data from a large sample of countries and periods. They include a wide range of explanatory variables, the most robustly significant—in terms of increasing the probability of a crisis—of which are a low share of foreign direct investment as a fraction of total debt, a low reserve-to-import ratio, high domestic credit growth, low GDP growth, and high foreign interest rates. They find little evidence for the importance of short-term debt, overall debt, the government budget deficit, or overvaluation of the exchange rate.

We fit the full Frankel and Rose model to data from crises during 1980–96 and then construct fitted values for the probability of a crisis in 1997 using the 1996 values of the right-hand-side variables (data sources and regression results are given in appendix A).⁵⁹ Table 3 shows the predicted probabilities of a crisis according to this model; boldface indicates that a country suffered a crisis under the Frankel-Rose definition.⁶⁰

58. Frankel and Rose (1996).

59. When 1996 data are unavailable, we use 1995 data. When neither year is available, the predicted probability is omitted.

60. There is a very strong correlation between having insufficient data with which to fit the crisis probability and suffering a large devaluation: of the eleven countries with

Table 3. Predicted Probabilities of a Currency Crisis in 1997 Using the Model of Frankel and Rose^a

<i>Probability of crisis^b</i>	<i>Countries^c</i>
Greater than 12 percent	Venezuela, South Africa
Between 9 and 12 percent	Panama, Jordan, Argentina, Cameroon
Between 6 and 9 percent	Trinidad and Tobago, Tunisia, Belize, Mexico, Costa Rica, Turkey, Peru, Mauritius, Madagascar, Philippines
Between 3 and 6 percent	Thailand , Poland, Malaysia , Pakistan, Sri Lanka, Indonesia , Dominican Republic, El Salvador, Uruguay, Seychelles
Less than 3 percent	India, Fiji, Nicaragua, Guatemala, St. Vincent and the Grenadines, Chile, Bolivia, China, Botswana, Nepal

Source: Authors' calculations using the model of Frankel and Rose (1996), based on data from World Bank (1998b, 1998c), *International Financial Statistics*, and the real exchange rate series described in table 2.

a. See appendix A for details.

b. The unconditional probability of a crisis is 7.0 percent. Predicted probabilities for the East Asian countries in 1997 are: the Philippines, 6.1 percent; Thailand, 5.8 percent; Malaysia, 4.8 percent; Indonesia, 4.5 percent.

c. Within categories, countries are listed from highest probability to lowest. Countries in boldface suffered a crisis based on the definition of Frankel and Rose.

Given the data and the model, we would revise down the probability of a crisis in East Asia to below the 7.0 percent prediction of the idiosyncratic crisis model. In all four of the East Asian crisis countries for which we have sufficient data, the predicted probability of a crisis is well below 7.0 percent. Thus to the extent that past patterns continued to hold in 1997, one would have been quite sanguine about East Asia's prospects in 1997.

This exercise has implications not only for the Frankel and Rose specification, but for models based on macroeconomic aggregates more generally. One can treat the Frankel and Rose regression as a very general reduced form for predicting crises based on the values of several variables, rather than considering these authors' specific underlying structural model. From this perspective, its failure creates the presumption that most models based on historical relationships between macroeconomic aggregates, capital flow data, and currency crises would not have predicted the Asian crisis. From the experience of the past two decades, the economic indicators in the East Asian economies simply were not very worrisome.

exchange rate data that show a currency crash in 1997, only four have sufficient 1995 or 1996 data to form the estimated probability.

The Unpredictability of the East Asian Banking Crisis

There are very few systematic prediction models for banking crises. Among these, that of Demirgüç-Kunt and Detragiache is one of the few to be essentially completed prior to the East Asian crisis.⁶¹ Like Frankel and Rose, these authors use a limited dependent variable framework, but estimated using a logit model, with a pooled data set of the probability of a banking crisis as a function of some of the standard macroeconomic and financial variables, along with an index of the quality of law enforcement. They find that the most important predictors of banking crises are macroeconomic factors (low GDP growth and high inflation), high real interest rates, vulnerability to capital outflows, domestic financial liberalization, and ineffective law enforcement.⁶² Some of these factors—high real interest rates, domestic financial liberalization, and vulnerability to capital outflows—were present in the East Asian countries that experienced a crisis, but many were not: growth was strong, inflation was low, and according to the *International Country Risk Guide*, the quality of law enforcement was high.

In the model, the unconditional probability of a banking crisis is 4.7 percent. In a subsequent paper, the authors assess the model's ability to predict the crisis in East Asia; the fitted probabilities of a crisis are given in table 4.⁶³ As with the Frankel-Rose model, each of the forecasted probabilities is below the unconditional probability of a crisis. Again, a simple prediction that one out of every twenty years brings a crisis would have done better in East Asia than a prediction that took account of the data. Strikingly, even if one had predicted the macroeconomic crisis in 1997, including the extent of exchange rate depre-

61. Demirgüç-Kunt and Detragiache (1998a). Eichengreen and Rose (1998) present a very similar model and similar findings, with the additional result that lower growth rates in the OECD and higher interest rates in major OECD lending countries increase the probability of a crisis. In assessing their model's predictive power for the East Asian crisis, they claim some success for detecting Thailand's problems, although "other cases like Indonesia and South Korea are more difficult . . . to reconcile with our results" (p. 30). Note also Goldstein and Turner (1996); Honohan (1997).

62. Interestingly, they find no evidence that depreciation of the currency increases the probability of a banking crisis. One explanation is that while there is no reason why banks should maintain unhedged currency positions, as maturity transformers they cannot completely hedge against unexpected changes in real interest rates.

63. Demirgüç-Kunt and Detragiache (1998c). Note that the probabilities using forecasts of 1997 data are almost exactly the same as those using actual values of 1996 data, which is the procedure we used to assess the other models.

Table 4. Predicted Probabilities of a Banking Crisis in 1997 Using the Model of Demirgüç-Kunt and Detragiache^a

Percent	
Country	Probability of crisis ^b
Indonesia	2.7
Korea	1.8
Malaysia	2.0
Philippines	3.5
Thailand	3.6

Source: Demirgüç-Kunt and Detragiache (1998c).

a. Note that these probabilities are based on a slightly different model than the same authors' model discussed in the text.
 b. Estimated using Consensus Forecasts (1998) or the forecasts from International Monetary Fund (1997) for 1997 values of the right-hand-side variables. The unconditional probability of a banking crisis is 4.7 percent.

ciation and slowdown in growth, one would have been very worried about banking crises only in Indonesia and Thailand.⁶⁴

Did Leading Indicators Sound the Alarm?

The majority of the crisis prediction models developed in the past year, especially those used by practitioners, have relied on a leading indicators approach. In part, this flurry of interest in leading indicator models has been driven by the perceived partial success of Kaminsky, Lizondo, and Reinhart's model.⁶⁵

Kaminsky, Lizondo, and Reinhart define a crisis as an attack on the currency, whether successful or not.⁶⁶ They select several potential leading indicators of currency crises and then use past data to obtain percentile thresholds for each indicator that maximize the signal-to-noise ratio. For real exchange rate misalignment, for instance, they estimate a percentile threshold of 90 percent. That is, when a country's

64. This is somewhat unfair. Because Demirgüç-Kunt and Detragiache use annual data, these events do not show up very strongly, especially for Korea, where the crisis occurred late in the year. A monthly version of the model would probably have done much better. Yet to the extent that financial crises cause economic slowdowns, the use of contemporaneous data makes it even harder to interpret the results as indicative of causation.

65. Kaminsky, Lizondo, and Reinhart (1998).

66. Specifically, in defining a crisis Kaminsky, Lizondo, and Reinhart take the weighted average of the one-month nominal depreciation (with respect to the dollar) minus the one-month percentage change in reserves. The weights are set to equalize the variances of the two series. Their cutoff for a crisis is when this index rises three standard deviations above its mean for that country. We consider a crisis in any month of 1997 as a crisis for 1997.

real exchange rate is within the highest 10 percent of its experience of overappreciation, it signals the possibility of a crisis; otherwise it does not.

This approach has several theoretical drawbacks. Most serious, in the context of assessing the model's predictions of the East Asian crisis, is the fixed effects specification. Rather than adopting a common threshold for each country (for example, when the current account deficit is over 8 percent), they designate a common percentile threshold (for example, when the current account deficit is in the worst 10 percent of its historical range). But if a country has consistently run a current account deficit of 8 percent of GDP, that does not necessarily mean that this "normal" level is not worrisome. Furthermore, many of their indicators are rates of growth; for example, growth in the ratio of M2 to reserves or in the ratio of domestic credit to GDP. As a result, even if there should be fixed effects in levels, they would not be needed when using growth rates.

Take the case of real appreciation. Based on the ninetieth percentile cutoff for a warning indicator, which is common to all countries, the numerical threshold would be a 33 percent overappreciation in Argentina, 26 percent in Brazil, 19 percent in Mexico, 13 percent in the Philippines, 11 percent in Korea, 7 percent in Indonesia, and only 6 percent in Malaysia and Thailand. Thus even a very modest real appreciation would show up as a crisis signal for the East Asian countries. Analogous results hold for most of the other indicators. Therefore this fixed effect means that the indicators will overpredict crises in countries with good histories (like those in East Asia) and underpredict them in countries with bad histories. This particular flaw clearly biases the model in favor of being able to predict the East Asian crisis.

Implicit in their framework is the hypothesis that a country that has experienced relatively little change in a variable in the past is more prone to a crisis than other countries if that variable changes only modestly. Although this may contain a grain of truth, the actual danger thresholds that it implies in practice seem unreasonably low for countries with good past behavior.

Kaminsky, Lizondo, and Reinhart identify twelve indicators that have predictive content for currency crises.⁶⁷ Based on these variables

67. One of the variables, "excess M1 balances," is impossible to construct from

Table 5. Potential Currency Crises in December 1996 by Warning Indicators, Using the Kaminsky, Lizondo, and Reinhart Model^a

<i>Number of indicators^b</i>	<i>Countries^c</i>
5	Bulgaria
4	South Africa
3	Brazil, India, Kenya, Korea, Malaysia, Thailand, Pakistan
2	Argentina, Bangladesh, Chile, Colombia , China, Czech Republic, Indonesia , Lithuania, Morocco, Nigeria, Philippines , Poland, Russian Federation, Taiwan, Turkey, Venezuela
1	Egypt, Ghana , Israel, Jamaica, Jordan, Mexico, Slovak Republic, Slovenia, Sri Lanka, Tunisia, Zimbabwe
0	Botswana, Côte d'Ivoire, Ecuador, Mauritius, Peru, Trinidad and Tobago

Source: Authors' calculations using model of Kaminsky, Lizondo, and Reinhart (1998), based on data from *International Financial Statistics* and the real exchange rate series described in table 2.

a. See appendix A for details.

b. Out of a total of eleven. Note that not all indicators exist for every country.

c. Countries in boldface suffered a crisis based on the definition of Kaminsky, Lizondo, and Reinhart.

and the thresholds that these authors identify, the main warning indicators for the East Asian countries in December 1996 were real appreciation of exchange rates (Indonesia, Malaysia, the Philippines, and Thailand), rapid domestic credit growth rates (Indonesia, Korea, and the Philippines), falling stock markets (Korea and Thailand), slowing export growth rates (Thailand), rising M2 multipliers (Malaysia), terms of trade (Korea), and real interest rates (Malaysia). Although real appreciation, M2 multiplier growth, domestic credit growth, and real interest rates were all worrisome relative to the East Asian economies historically, they appear more normal in comparison with those of other developing countries.⁶⁸ Table 5 compares countries in terms of the number of indicators signaling a crisis; countries that suffered crises in 1997 according to the Kaminsky, Lizondo, and Reinhart definition are shown in boldface.

Overall, the Kaminsky, Lizondo, and Reinhart framework would have done better in predicting the East Asian crisis than the two other

the information they provide. We omit it in table 5, but it is unlikely that its inclusion would change the results very much.

68. In contrast, Thailand's domestic credit growth was the one indicator that signaled vulnerability compared with other developing countries, but not relative to its own history.

models discussed above. We have three important caveats: there are a lot of noisy signals; the East Asian countries did not seem too bad in most of the relevant variables; and most important, the construction of the model makes it much more likely to predict—and generally to overpredict—crises in regions which, like East Asia, have a history of good fundamentals.

It is also important to realize that even if the indicators approach were consistently successful in predicting crises, these indicators may not be causing the crisis. This may limit the direct policy relevance of this approach. For instance, a falling stock market may anticipate a crisis because it reflects market expectations, rather than playing any causal role in the onset of the crisis. If the government took steps to stop the decline in the stock market, it would not be addressing the underlying cause of the crisis. Besides, reversing the market's decline might be impossible.

Did the East Asian Crisis Follow the Mexican Pattern?

The three models discussed above for the most part find that the East Asian crisis did not follow the "average" patterns of currency or banking crises over the past two decades. This should not be very surprising. The East Asian economies had virtually nothing in common with the large public sector debt, large deficits, and rampant inflation that characterized many Latin American countries (but not Chile) in the 1980s.

It is harder to argue that the East Asian crisis differed from the Mexican crisis and its spreading effects in 1994–95. Chang and Velasco, for instance, contend that the East Asian "crash is not a new and frightening creature . . . but a *classic financial crisis*, the likes of which we have seen before in so-called emerging markets. Chile in 1982 and Mexico in 1994 provide the clearest, but by no means the only, precedents."⁶⁹ There are many similarities among variables in the run-ups to the Mexican and the East Asian crises, including large capital inflows, budget surpluses, rapid growth of credit to the private sector, real exchange rate appreciation, and, in most East Asian countries, the buildup of ratios of short-term debt to reserves.

However, there are good reasons for thinking that the East Asian economies were different from Mexico. Most important is the East

69. Chang and Velasco (1998, p. 1). Tornell (1998) makes the same argument.

Asian economies' long track record of prudent macroeconomic policies and exceptionally successful macroeconomic performance. Current circumstances were also different. The East Asian countries had a substantially smaller stock of government debt and net external debt than Mexico had at the onset of its crisis. Furthermore, as was widely remarked on at the time, East Asia did not see nearly the same degree of real appreciation as Mexico had earlier.

Once again, the only way to advance the argument about the quantitative significance of the similarities and differences between the East Asian and the Mexican crises is to aggregate them through an accepted empirical model. The most cited model of the Tequila crisis is that of Sachs, Tornell, and Velasco.⁷⁰ These authors seek to explain not the onset of a crisis in the initial country (that is, Mexico in 1994), but its severity and the scope of its spread. They measure severity by the weighted average of the fall in the nominal exchange rate and the loss in reserves, with the weights set to equalize the contribution of each of these measures to the variance of the index.

The model has two key variables: fundamentals and reserve adequacy. Fundamentals depend on real exchange rate appreciation and growth in credit to the private sector as a fraction of GDP, a proxy for weaknesses in the banking system. Reserve adequacy is proxied by the ratio of M2 to reserves.⁷¹ Sachs, Tornell, and Velasco argue that there is no incentive to attack a country with good fundamentals, because in the event of a successful attack its currency will not decline by very much. They also argue that there is no incentive to attack countries with enough reserves to defend their exchange rates. As a result, only countries with both bad fundamentals and inadequate reserves are susceptible to attack.⁷² The severity of the crisis will be proportional to the level of the fundamentals.

70. Sachs, Tornell, and Velasco (1996).

71. The choice of this variable is motivated by the fact that as well as foreign speculation, capital flight has been a key feature of balance of payments crises. With capital convertibility, the entire assets of a country potentially can be converted into foreign currency and moved abroad. Focusing on M2 emphasizes the liquid assets that might most immediately precipitate a balance of payments crisis.

72. They adopt arbitrary and very broad definitions of bad fundamentals and inadequate reserves. According to their definition, a country has bad fundamentals when its real exchange rate appreciation and lending boom are below the lowest quartile of the sample of twenty countries. The cutoff on the exchange rate variable is thus set at a 16

They confirm their hypotheses (including the interaction effects) and test for robustness with several different variants of the model. Most remarkable, in their benchmark specification they find an R^2 of 69 percent and an \bar{R}^2 of 57 percent. Therefore this model provides a very good description of the Tequila crisis in 1994–95. To the degree that it does not describe the East Asian crisis of 1997–98, one could infer that the two episodes are different (or that the fit of the Tequila crisis was spurious).

To test this, we first run the Sachs, Tornell, and Velasco regression for the 1997–98 crisis (regression results are presented and discussed in appendix A). The only meaningful combination of coefficients that is significant and of the correct sign indicates that a lending boom in a country with weak fundamentals and inadequate reserves increases the probability of a crisis. The degree of real appreciation in countries with weak fundamentals and inadequate reserves is also marginally significant, with a p value of 0.12, but of the wrong sign: greater real appreciation reduces the severity of a crisis. The other variables are insignificant. Most important, the R^2 is 5 percent and the \bar{R}^2 is -16 percent. For no specification—removing outliers and using different cutoffs for the dummy variables and the growth of the other variables and different ending periods for the crisis—were we able to get results that were close to those of Sachs, Tornell, and Velasco.⁷³

Second, we use the coefficients from the 1996 paper to form a “predicted index” of the severity of the crises in the East Asian countries in 1997. We then compare these values with the actual crisis values. The correlation between the actual and predicted severity of the crises

percent real depreciation. In other words, any country that has seen its real exchange rate depreciate by less than 16 percent (which includes every country that has witnessed a real appreciation) is, under their definition, potentially subject to a currency crisis. Similarly, the cutoff on the lending boom suggests that virtually any country that has seen credit to the private sector grow more rapidly than GDP will be at risk of a crisis—a very broad definition of vulnerability.

73. Tornell has rerun the Sachs, Tornell, and Velasco regression for the current crisis episode and finds that “the rule that links fundamentals to crises’ severity has been the same in both the Tequila and Asian crises” (1998, p. 1). Between his paper and ours, the regressions differ in the definition and timing of the variables; we stick more closely to the original paper, whereas Tornell includes a number of refinements. Running the specification used in both the original paper and the present paper on the similar but independently developed data set from Corsetti, Pesenti, and Roubini (1998a) yields results similar to ours.

is 0.10 and is statistically insignificant at any reasonable level. This should not be surprising. There is virtually no relationship between the depth of the crisis and the Sachs, Tornell, and Velasco variables when the coefficients are chosen to maximize the fit in this crisis; the relationship using historically determined coefficients will be that much worse. Had policymakers used the Sachs, Tornell, and Velasco model in the summer of 1997, it would not have offered any useful guidance about the depth and scope of the impending crises.

Summary

Our theoretical and empirical analysis strengthens the presumption that the East Asian crisis was a novel event and that, given the knowledge at the time, it probably could not have been predicted. This is not because crises are always, as a matter of theory, unpredictable. Instead, it is because the East Asian experience is not an example of the standard crisis, the inevitable result of declining macroeconomic fundamentals or the temptation to devalue. There is little evidence that real exchange rate appreciation played more than a very small role, if any. The rapid growth of domestic credit and high ratios of short-term debt to reserves clearly resulted in weaker and more vulnerable economies. But as measured by models developed before the crisis, the quantitative magnitudes of these weaknesses do not add up to a crisis.

The above analysis helps to explain why the East Asian crisis was not predicted by the affected countries, by international investors (as evidenced by the falling risk premiums and rising loan volumes leading up to the crisis), or by credit raters. Nevertheless, this failure is disturbing: there is no general analog to the efficient markets hypothesis to say that crises should necessarily be unpredictable. And the growing understanding and experience should make them all the more predictable.

One explanation of this puzzle is that there are a great variety of financial crises, each with different causes and consequences. The East Asian variety was either new or sufficiently rare that it was not predicted.

Another explanation comes from the multiple equilibria stories. Often in these models, countries with good fundamentals are not susceptible to crises, those with very bad fundamentals will certainly suffer from crises,

and those in between will be vulnerable to a given probability of a crisis. On average, therefore, one should be able to predict crises, in a stochastic sense. However, the predictive power is empirically weak. These results could be described as saying that something like three-quarters of countries have fundamentals bad enough that they are vulnerable to a crisis. It is likely that more refined models will do a better job of identifying vulnerable countries, but given current knowledge, there is little basis for claiming that crises are the inevitable punishment (that is, a unique equilibrium) for mismanagement, especially since one cannot define mismanagement in any empirically robust manner.

A third possibility is that the policy response to impending economic problems has a large effect on whether these evolve into large but transitory shocks or serious crises. Had the East Asian countries handled interest rate policy differently, for instance, they might not have seen a crisis of this magnitude. Under this hypothesis, the existence and depth of a crisis are not necessarily determined by the lagged variables—at least, not the ones examined by the standard models.

Finally, conventional interpretations of what it means to be mismanaged have little basis either in theory or in historical experience. For instance, most theoretical models attempting to assess whether a country is likely to encounter troubles focus more on state variables—that is, the level of debt or reserves—than on flow variables, except to the extent that flow variables are the consequence of underlying state variables. State variables are associated with solvency, and flow variables with liquidity. In the presence of market imperfections such as liquidity constraints, the flow variables might matter. But typically, models focusing on flow variables do not identify the source of those imperfections, let alone their consequences or how they might best be addressed. Although theorists have long felt uneasy about the seemingly ad hoc models that policy advisers employ in these contexts, the presumption has been that their insights into the evidence compensate for deficiencies in theory. Our empirical findings cast doubt on that presumption.

The Ratio of Short-Term Debt to Reserves

So far, we have restricted our attention to models that were essentially completed prior to the East Asian crisis. The failure of these

models to explain the East Asian episode has led to a search for new explanatory variables. Perhaps the most frequently mentioned is the ratio of short-term debt to reserves. Although this is often cited as one of the causes of Mexico's crisis in 1994–95, when the short-term debt was primarily public, it is not central to the systematic empirical prediction papers, which rarely consider the composition of capital. One exception is that of Frankel and Rose, who include short-term debt as a fraction of total debt in their currency crisis regressions, but they do not find that it is significant.⁷⁴ Using a similar methodology and data set, Barry Eichengreen and Rose find that a larger share of short-term debt decreases the probability of a banking crisis.⁷⁵ Sachs, Tornell, and Velasco also add the ratio of short-term debt to GDP to their benchmark regression described above and find ambiguous evidence suggesting that it might increase the severity of a crisis.

Predictive Power for Recent Crises

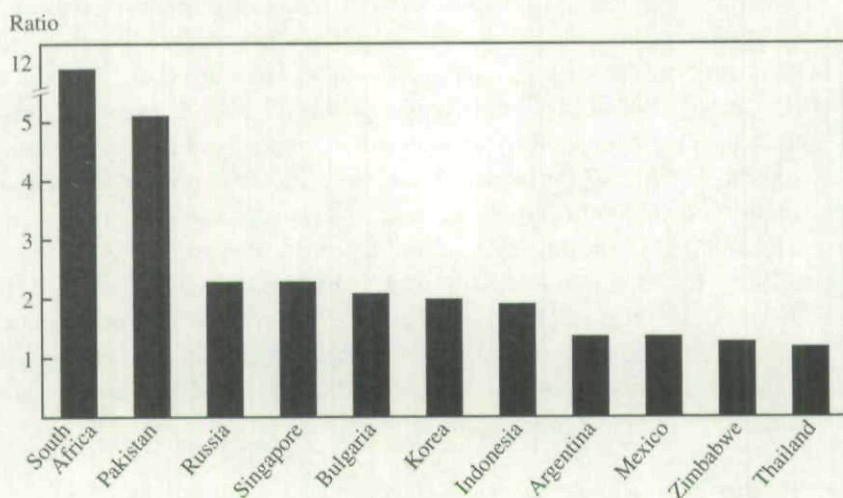
Since the East Asian crisis, short-term debt has assumed new importance in discussions of the onset of crises, and also as a variable in predictive models. The preferred transformation is the ratio of short-term debt to reserves. This indicator emphasizes the fact that virtually any country that has more short-term debt than reserves can suffer a self-fulfilling balance of payments crisis if its creditors refuse to roll over loans.⁷⁶

The ability of this variable, by itself, to predict the crises of 1997 is remarkable. Figure 6 shows that at the end of 1996, eleven of the forty-two developing countries for which data are available had ratios of short-term debt (to BIS-reporting banks) to reserves greater than 1. In addition to Indonesia (with a ratio of 1.9), Korea (2.0), and Thailand

74. Frankel and Rose (1996).

75. Eichengreen and Rose (1998). An explanation for this finding is that short-term capital is like a tight leash, giving the lender an incentive and a tool to influence the behavior of the borrower, and giving the borrower, because of the greater consequences of a crisis, an incentive to act more prudently. It is puzzling, however, that this indirect effect outweighs the direct effect of greater risk.

76. Almost all of the accounts of the East Asian crisis discussed above emphasize short-term debt. Radelet and Sachs (1998a) find that the ratio of short-term debt to reserves is a statistically significant predictor of financial crisis in the period 1994–97. Corsetti, Pesenti, and Roubini (1998a) find that the results from using that ratio as a proxy for liquidity are similar to those from using the ratio of M1 or M2 to reserves.

Figure 6. Ratio of Short-Term Debt to Reserves for Selected Countries, 1996^a

Source: *International Financial Statistics*; Bank for International Settlements (1997).
 a. As of end-December 1996.

(1.2), this group includes several other countries that faced severe financial difficulties in 1997, including South Africa (11.6), Pakistan (5.1), Russia (2.3), Bulgaria (2.1), and Zimbabwe (1.3). The only countries that had ratios of short-term debt to reserves above 1 at the end of 1996 and fared reasonably well in the following year and a half were Argentina (1.4), Mexico (1.4), and Singapore (2.3). On this evidence alone, one might be left with the strong suspicion that short-term debt larger than can be covered by reserves may be sufficient for an economic crisis. But clearly it is not a necessary condition, as evidenced by Malaysia, where prudent policies toward short-term debt did not prevent the spread of the crisis.

Why should the ratio of short-term debt to reserves matter so much? It is not a very good measure of solvency, which depends on the level of external debt and expected future earnings from trade. It is also hard to link it directly to the health of the economy.⁷⁷ Rather, it seems to

77. Singapore illustrates that a high ratio of short-term debt to reserves need not make a country very vulnerable. Note that borrowing decisions are made by firms, reserves decisions by the government; and the typical guidelines for governments in the

matter for four reasons. First, the ratio of short-term debt to reserves does measure liquidity, and thus a country's vulnerability to a Diamond-Dybvig type of bank run.⁷⁸ Second, a high ratio of short-term debt to reserves may signal imprudent macroeconomic or regulatory policies. Although not the most direct measure, the higher the ratio of short-term debt to reserves, the more likely it is that the country is pursuing other problematic policies. This is especially true because it is highly risky to use short-term money to finance long-term investments, and risk-taking investors who engage in such activities may be engaging in other high risk activities. Third, the ratio of short-term debt to reserves is an indicator of the vulnerability of a country to a self-fulfilling withdrawal—or flight—of capital. Finally, it could serve as a "sunspot" that coordinates investors on the bad equilibrium of balance of payments crisis.

While there may be no necessary connection between the ratio of short-term foreign liabilities to reserves and the likelihood of a crisis, it is clear that if a crisis does occur, it will be far more severe if a country does not have reserves to meet these short-term obligations.

The Motivation for Limiting Short-Term Exposure

The fact that greater short-term exposure seems to increase the probability of a crisis, whether for rational or irrational reasons, combined with the systemic consequences of crises—which affect access to credit and its price for all firms in the economy, as well as the probability of a bailout—means that short-term borrowing imposes an externality on the economy. The private decisions of firms regarding the costs and benefits of greater short-term exposure need not result in the optimal short-term exposure for the economy as a whole. Policymakers must therefore assess the desirability of the current level of short-term debt and the policies that can be used to address it.

Two considerations are important in weighing the costs and benefits of short-term capital flows. First, the benefits will depend on the marginal productivity of the extra investment being financed by the short-term capital. In the case of East Asia, where the saving rate was very

past have focused more on "months of imports" than on the short-term foreign indebtedness of corporations.

78. Diamond and Dybvig (1983).

high, the benefits to the extra capital accumulation that followed liberalization may have been relatively low, possibly even negative. This is not just the result of diminishing returns to capital, but also because of the costs and imperfections involved in selecting, installing, and monitoring new investment. Normally, private borrowers and lenders should be able to assess these factors, but it is possible that "hog cycle" effects would lead to myopic, or even rational, overinvestment.

Second, if one believes that countries should keep short-term debt below the level of reserves, additional short-term borrowing must be offset by equal or larger increases in reserves. From a consolidated balance sheet perspective, a developing country is borrowing from industrial countries' banks at high interest rates only to lend that same money to industrial countries' governments at much lower interest rates. Being a financial intermediary with a negative spread is probably not the most profitable line of business!

This may be yet another reason why, as noted above, systematic empirical studies have not found any relationship between capital account liberalization and economic growth.

Policies to Restrain Capital Flows

Two remedies that have often been discussed for the problems posed by the volatility of capital flows, especially short-term flows, are to improve information and to improve financial regulation. We have discussed some of the potentials and limits of increasing financial regulation above, and in the next section we do likewise for information. We argue that such measures may be able to accomplish something, but will not be sufficient. Observation of the East Asian experience suggests two additional general policies toward capital flows.

First, much of the rapid capital inflow into East Asia, especially in the form of short-term debt, was the result of domestic distortions that artificially lowered the price of short-term borrowing from abroad, through either tax incentives or more lax regulations. The most flagrant example is the Bangkok International Banking Facility, but more subtle examples exist almost everywhere: without risk-based capital requirements for banks, for instance, incentives for holding certain assets and liabilities are distorted.

Second, the improvement of financial regulation and information may not go far enough, given that corporate exposure may itself give rise to vulnerabilities. And in Indonesia in end-December 1996, two-thirds of the foreign indebtedness was corporate. The systemic risks of such exposure are ample justification for taking further measures. Among the ideas currently under discussion are inhibitions on capital inflows. In this regard, the Chilean experience offers some useful lessons. Chile has imposed a reserve requirement on all short-term capital inflows—essentially, a tax on short-maturity loans. The overall efficacy of these controls is much debated, but even most critics acknowledge that the reserve requirement has significantly lengthened the maturity composition of capital inflows to Chile, without adverse effects on valuable long-term capital.⁷⁹

Another idea is to use tax policies. For example, one might limit the extent of tax deductibility for interest in debt denominated in or linked to foreign currencies. The problems of implementing such policies may in fact be less than those associated with the Chilean system.

In evaluating these proposals, one must be clear about their objectives. Two seem uncontroversial: to reduce, if not to eliminate, the volatility of flows and the discrepancy between private and social returns. One must also balance their imperfections, the distortions that they create or the fact that they are partially evaded, against the huge costs that the market imperfections and the discrepancy between social and private risk-taking impose on the economy. The key determinants in assessing that balance are the nature of the market—its ability to absorb and share risks, the extent of the automatic stabilizers and other structural features that dampen shocks arising from capital market volatility; the nature of the government—its ability to conduct macroeconomic and exchange rate policy and to implement financial market regulations so that the country is less likely to be subject to capital market volatility and vulnerable to sudden changes in investor sentiment, and the safety nets it provides; and the responses to crises. In

79. Although Chile has reduced the restrictions on capital inflows over the past year, this does not mean that they did not work. The point of the restrictions is to prevent the overaccumulation of short-term debt during a surge in inflows, and so they are less relevant in a period of capital outflows.

East Asia, not only did the economies appear highly vulnerable, but safety nets were weak, and responses brought huge economic costs. It is likely that the risks imposed by capital market volatility may be comparably high in many other developing countries.

Transparency

In this section we consider a potential explanatory variable for the East Asian crisis that has received enormous attention in popular discussion: corruption, or more broadly, lack of transparency. The study of the consequences of corruption has burgeoned in recent years, leaving little doubt that corruption is bad for economic performance.⁸⁰ Inadequate transparency and corruption, however, have received scant attention in the literature on currency or banking crises.⁸¹ We attempt both to assess the experience of East Asia and to sketch some general theoretical considerations about the relationship between transparency and financial stability.

The Political Economy of Transparency

Whenever a crisis strikes, the authorities of the affected country look around for suspects to blame and usually pick on foreign speculators, even though the charges are typically unsubstantiated. The popular discussion of transparency is the flip side of this argument: foreign investors have attempted to shift the blame for their poor investments onto the countries in which they chose to invest. Looking for a scapegoat for their shortsightedness, these investors claim that these countries effectively lied to them, by not disclosing all the relevant information. They were not transparent. The governments of the investor countries and international financial institutions have supported this claim—perhaps it serves their purposes as well, by providing an explanation of the early failure of the interventions. In doing so, they have

80. See Mauro (1995); Johnson, Kaufmann, and Zoido-Lobaton (1998); World Bank (1997).

81. About the closest it gets is Demirgüç-Kunt and Detragiache (1998a), who include a variable on the rule of law in predicting banking crises. The East Asian countries score relatively well on this measure.

helped to advertise the alleged weaknesses in their economies and their societies, further contributing to the downturn.⁸²

Moreover, if lack of transparency is the cause of the crisis, the East Asian countries have only themselves to blame. The international financial markets, and thus the financial and capital market liberalization that some governments and international financial institutions had been so active in promoting, were not responsible.

Beyond shifting the blame, transparency has been attractive as an explanation of the crisis for another reason. To the extent that transparency is a major cause of crises, the international architecture can be preserved with minimal repairs—an important consideration in an era of financial stringency, when national legislatures are loath to provide money for international assistance. All that it requires is that countries wishing to participate in the international capital market become more transparent. There is no need for any change in ideology concerning the virtues of short-term capital flows, nor for large expenditures such as might be associated with establishing a lender of last resort.

Beyond Journalism and Political Rhetoric

In assessing the substantive role of transparency in causing or perpetuating the East Asian crisis, several empirical and theoretical issues arise. We have noted above that these countries had grown faster and with fewer downturns—demonstrating less vulnerability to shocks—than those in other regions. Therefore in order to suggest that lack of transparency was an important factor contributing to their vulnerability, one would need to argue that they had become less transparent; or alternatively, that the need for transparency had increased; or that the market was scared not so much by changes in either the level or the need for transparency, as by the news of the alleged lack of transparency.

More generally, one must subject transparency to the same scrutiny as other variables that allegedly explain crises. One must ask whether there is a systematic relationship between lack of transparency and the likelihood of a crisis; and whether there is a theoretical presumption

82. See Radelet and Sachs (1998b). To the extent that the investors had flat priors, such allegations could have a large effect on their posterior judgment of the desirability of leaving funds in the country; to the extent that the flat priors were due to lack of transparency (see below), and those making the allegations had credibility, the assertion that transparency was at the root of their problems was self-fulfilling.

that better information reduces economic volatility. We look first at transparency within East Asia, and then turn to the broader question of the role of transparency in economic stability.

Lack of Transparency on the Relevant Variables

There is no news concerning transparency that could by itself have instigated the East Asian crisis. As in the case of Mexico in 1994–95, the extent of transparency—both the information regime and the political cronyism—was widely known.

More fundamentally, what information was lacking that would have prevented the crisis? Implicit in the suggestion that transparency caused the crisis is that if investors had only known the relevant information, they would not have put money into the country, and thus would not have pulled it out. But the knowledge that there was eventually going to be a crisis would not have stopped investors from putting their money in. It is true, however, that if they knew that there was going to be a crisis next week, they would pull their money out before that time—forcing the crisis slightly earlier.

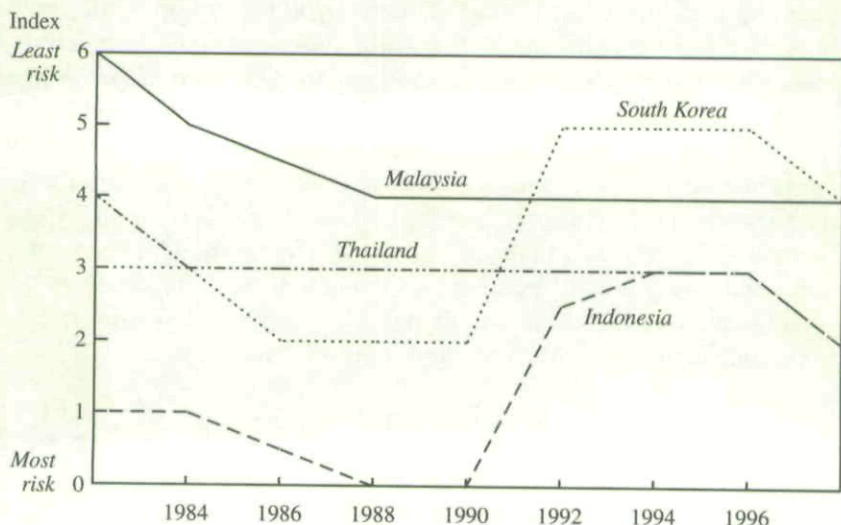
But to the extent that crises are related to fundamentals and information about fundamentals might have affected capital flows, it is natural to ask whether there was a lack of *relevant* information. In the previous section we identified several variables that appear to be systematically related to crises; there is no evidence that there was any significant misreporting on these. Several of the affected countries have statistical services that are far better than the average within the developing world, and data on most of the variables were publicly accessible.⁸³

East Asia

As we have suggested, there is little evidence that news either about the degree of transparency or about fundamental variables that are related to crises played an important role in the case of East Asia. News about the degree of transparency might have been important if there had been a sudden change. It is very difficult to find definitive evidence on whether the East Asian countries had become less transparent over

83. In the case of Thailand, the extent to which reserves had been sold forward was not known. But as has been widely noted in the press as well as in the professional literature, the information problems posed by derivatives are hardly unique to East Asia.

Figure 7. Risk of Corruption, South East Asian Countries, 1982-98



Source: Political Risk Services (various years).

time. There are several measures available that capture different aspects of corruption and transparency, but few offer time series going back more than a few years. For the most part, these measure perceptions of local businessmen, foreign investors, or international risk assessors. Intertemporal comparisons are problematic, because the standard for assessing transparency varies over time and the perception of corruption is often endogenous to circumstances.

The longest time series on corruption is found in the *International Country Risk Guide*'s political risk index.⁸⁴ The "corruption risk" component is measured from 1982 on a scale of 0 to 6, where 0 indicates the greatest risk of corruption. Figure 7 shows these data for Indonesia, Korea, Malaysia, and Thailand. The assessment of the risk posed by corruption was lowered in the 1990s for Indonesia and Korea, but rose after the onset of the crisis in Indonesia, Korea, and Thailand. It is plausible that the assessment of corruption reflected economic performance. Other measures of corruption also indicate that the assessment of corruption in East Asia increased after the crisis, although not nec-

84. Political Risk Services (various years).

essarily its actual extent.⁸⁵ Overall, however, there is little basis for claiming that corruption increased markedly in the run-up to the crisis.

A case can be made that as the world changed around East Asia—most important, through the integration of world capital markets—the demand for transparency grew. Yet the notion that international investors had higher standards of information disclosure and accuracy about forward reserve commitments (in the case of Thailand) or short-term debt (in the case of Korea) is belied by the large increase of capital flows to East Asia and their declining risk premiums. If transparency was unchanged in East Asia but was becoming more important in the world, one would expect this to have been reflected in higher risk premiums than those observed shortly before the crisis.⁸⁶

Comparing East Asian Countries with Others

If transparency is a major cause of crisis, countries with low transparency should have a higher probability of crises and countries with high transparency should have a lower probability. Previous studies have not employed transparency as an explanatory variable of crisis because it has little predictive power, despite its journalistic attraction in the case of East Asia.⁸⁷

This can be seen most simply by asking whether the East Asian countries were significantly less transparent than countries that did not have crises. If less developed countries in general lack transparency, lack of transparency can hardly explain why a crisis occurred in East Asia. If East Asian countries are less transparent than other globally integrated countries that did not experience a crisis, it may be that lack of transparency becomes more important as countries become inte-

85. This is not surprising, given the emphasis laid on corruption by those involved in the rescue operation, both international and domestic. Note, however, that a strong domestic resonance to the concerns about corruption, for example, in Indonesia, does not necessarily indicate that corruption had increased substantially, but only that those within the country who had long been concerned about corruption realized this as an opportunity to address the issue.

86. To be sure, a number of other factors also affect the attractiveness of investment, but there are several reasons why investments in these countries should have been viewed as riskier than elsewhere; for example, the high leverage in South Korea, the speculative real estate boom in much of Southeast Asia, and the exchange rate regimes. Thus the low premiums observed before the crisis represent a low upper bound in market assessments of the importance of transparency.

87. Radelet and Sachs (1998a).

Table 6. Measures of Transparency in East Asian Countries Relative to Other Developing Countries, 1996^aPercentile^b

Country	Measure			
	<i>International</i>			<i>World</i>
	<i>Country Risk</i>	<i>Standard &</i>	<i>Transparency</i>	<i>Competitiveness</i>
	<i>Guide</i> ^c	<i>Poors DRI</i> ^d	<i>International</i> ^e	<i>Yearbook</i> ^f
Indonesia	51	44	74	84
Korea	4	4	26	37
Malaysia	16	10	22	11
Philippines	51	60	70	58
Thailand	51	51	52	63

Source: Political Risk Services (various years); Standard & Poors DRI (various years); International Institute for Management Development (1996); and data from the worldwide web page of Transparency International, Berlin, Germany.

a. Developing countries defined as those with 1996 per capita GNP below current U.S. \$9,635, as in World Bank (1998b).

b. 99 indicates the least transparent. Note that since country coverage varies greatly across series, variations in percentile ranks are due both to different measures and to different samples.

c. Corruption risk, 1996; sample includes ninety-nine countries.

d. Losses and costs of corruption, 1996:3; sample includes seventy-eight countries.

e. Corruption perceptions index, 1996; sample includes twenty-four countries.

f. Existence of improper practices in the public sphere, 1996; sample includes twenty countries.

grated. However, international comparisons are complicated by the same factors as are intertemporal comparisons. In Indonesia, for instance, perceptions prior to 1997 may have understated corruption because economic growth was so strong.

Subject to this caveat, table 6 shows how the East Asian countries ranked in 1996 against other developing countries on various measures of transparency, measured by a percentile scale on which 0 indicates the most transparent.⁸⁸ The *International Country Risk Guide* and the Standard & Poors DRI ratings use large samples; Indonesia, the Philippines, and Thailand fall roughly in the middle. But in the smaller samples assessed by Transparency International and the *World Competitiveness Yearbook*, Indonesia is rated among the most corrupt, and Thailand and the Philippines also fare worse. The smaller group comparisons are probably the more relevant, because they assess corruption among countries attracting high levels of foreign investment. In all of the measures, however, Korea and Malaysia stand out as very transparent. Note that these measures emphasize corruption, rather than

88. Political Risk Services (various years); Standard & Poors DRI (various years); International Institute for Management Development (1996); and data from the worldwide web page of Transparency International, Berlin.

transparency more broadly defined. The difficulty of reading the balance sheet of the typical Korean *chaebol*, for instance, while relevant to the financial crisis, is not reflected in this table.

This comparison between the East Asian countries and others casts doubt on the notion that transparency is sufficient to cause a financial crisis. Indeed, given that the last major financial-cum-currency crises occurred about ten years ago in the Scandinavian countries, which were paragons of transparency, it is not clear that lack of transparency is necessary for a financial crisis.⁸⁹

Some Theoretical Observations on Transparency and Economic Fluctuations

Our analysis has established that there is, at best, a weak empirical link between crises, or vulnerability, and lack of transparency. From a theoretical perspective, the impact of improved information on economic stability has been examined extensively in the literature on the economics of information, which has burgeoned over the past quarter century. It is important to separate the role that transparency plays in causing crises from the role it plays in propagating crises from its more general role in "normal" times in enhancing overall efficiency. Better information should be expected to improve the allocation of resources, but our question is different: does it lead to greater stability, less price or output variability, less likelihood of a crisis, or less credit rationing?

In general, lack of transparency should not affect the mean of people's expectations. Suppose that a set of countries did not publish their monthly reserves numbers or were known to use accounting tricks to inflate these numbers. It is unlikely that, on average, investors' estimates would be much higher than actual reserves. The lack of transparency, however, has a large effect on the variance of people's expectations. It also flattens out their priors. As a result, any information that they do receive has a much larger effect on their beliefs.⁹⁰

89. Or perhaps more accurately, even in the most transparent of economies, there are imperfections in information that, in retrospect, might have been valuable in preventing a crisis. More fundamentally, Hahn (1966) and Shell and Stiglitz (1967) show that bubbles can occur in the absence of markets that extend infinitely into the future, even when information about current variables is perfect.

90. Calvo and Mendoza (1998) have a conceptually similar explanation for why increased globalization could lead to greater contagion, as investors' information about

Lack of transparency did not cause the East Asian crisis, but it may well have contributed to its perpetuation and made recovery more difficult. The large asset price changes associated with an economic downturn increase the riskiness of lending. The less transparent the accounting systems, the less able are lenders and other suppliers of capital to ascertain the financial position of potential borrowers. Thus credit rationing may become more widespread, or credit may become available only with a much higher risk premium, further undermining the financial positions of firms. But although lack of transparency seems to have contributed to the depth of the economic downturn in the East Asian crisis in this way, there is no general theory that says that greater transparency leads to more lending or less credit rationing, or even to less price volatility. Accordingly, one should be wary of putting improved transparency at the center of a reform strategy for a new international financial architecture.

Transparency and Credit Rationing

Credit rationing takes place when lenders are unwilling to lend to certain borrowers, even though they are identical to others who are getting loans and they would be willing to pay higher interest rates. It can occur whenever the expected return to the loan decreases with higher interest rates. Under these circumstances, if the demand for loans at the expected-return-maximizing interest rate is greater than the supply, there will be credit rationing. The equilibrium in the market will have demand greater than supply, but the interest rate will not rise to clear the market, because that would lower the expected return to lenders. In this subsection we discuss how transparency, or lack thereof, can affect the presence and degree of credit rationing.

The impact of lack of information on the expected returns of a lender, and therefore on the lender's desire to make a loan, depends on how

any given country becomes poorer. There may even be an argument that with more possibilities for diversification, the optimal amount of information about any particular investment opportunity becomes less. To our knowledge, no one has developed a theoretical model to explore these issues. However, the hypothesis of nonconvexity in the value of information (Radner and Stiglitz, 1984) suggests a strategy in which investors become well informed about a relatively few securities among which they choose to allocate significant fractions of their portfolios; they diversify the rest of their portfolios widely and obtain relatively little information about these other securities. There is casual empirical evidence that many fund managers behave in this way.

quickly returns increase (or decrease) in the variable about which there is uncertainty—or to be precise, whether the function is concave or convex. Assume, for instance, that there is imperfect information about the size of a firm's indebtedness. Consider a marginal lender making the decision to lend to the firm at the market interest rate r . The firm has total unknown debt of B and invests in a project with a return of R . If the debt is sufficiently low that all lenders can be repaid they get r ; otherwise the firm is liquidated and its returns are divided among the debt holders. The returns to the marginal lender are $\rho = \min \{r, R/B\}$. This function is neither convex nor concave in B . As a result, there is no general presumption that less transparency, which we model as greater uncertainty about B —strictly a mean-preserving spread—will increase the presence or extent of credit rationing. Whether less transparency increases or decreases the expected return depends on the distribution.⁹¹

It is often said that once the crisis had begun, lenders suddenly learned that they had less information than they thought they had. One could model this as the variance of their beliefs after the crisis being greater than the variance of their beliefs before it. To see what this would have done to credit rationing, consider a situation where there is imperfect information about the activity undertaken by the borrower. The borrower has two activities: one yields a return of R_1 with probability π_1 , and R_0 otherwise; the other yields a return of R_2 with probability π_2 , and R_0 otherwise. R_0 , the bad realization, is less than R_1 and R_2 . The second project is assumed to be safer— $\pi_2 > \pi_1$ —and more efficient— $\pi_2 (R_2 - R_0) > \pi_1 (R_1 - R_0)$ —but it has less upside potential— $R_2 < R_1$. In addition, the entrepreneur has initial debt B ,

91. Note that when lenders are constrained in raising the interest rate, either because of adverse selection or incentive effects, the increase in expected returns may result in some categories of borrower gaining access to credit that previously did not; that is, credit rationing is reduced (see Stiglitz and Weiss, 1981). In markets that are not so constrained, by contrast, the increase in expected returns will be reflected in a lower lending rate. Thus for the average borrower, increased transparency is not desirable. But the best firms would find it advantageous to have their low indebtedness known. Therefore while there are market forces at play leading to increased transparency, the market by itself may not arrive at a socially efficient level of transparency. This is another example of a market failure that naive theories of financial and capital market liberalization have not adequately taken into account. See Stiglitz (1975a, 1975b).

and for simplicity it is assumed that $rB > R_0$, so that the firm will be unable to pay its debts in the bad realization.

The firm chooses the technique $i = 1$ or 2 that maximizes $\pi_i(R_i - rB)$; that is, it chooses the safe projects if $r < r^*$, where r^* is given by

$$r^* = \frac{\pi_2 R_2 - \pi_1 R_1}{B(\pi_2 - \pi_1)}.$$

This defines the cutoff interest rate as a function of B : $r^* = r^*(B)$.

The expected return to the lender at \hat{r} depends on the initial debt for two reasons. First, for any given interest rate \hat{r} , borrowers with debt above a certain threshold, defined by the inverse of the equation above, will undertake the more risky project. Second, for any given choice of project, the level of the debt affects the rate of return to the bad realization, which is insufficient to cover the debt and interest. Hence, if the bank chooses to charge interest rate \hat{r} , all those with indebtedness $B < \hat{B}$ —where $\hat{B} \equiv r^{*-1}(\hat{r})$ —choose the safe project. That is,

$$\rho = \begin{cases} \pi_1 \hat{r} + \frac{(1 - \pi_1)R_0}{B} & \text{if } B > \hat{B} \equiv r^{*-1}(\hat{r}) \\ \pi_2 \hat{r} + \frac{(1 - \pi_2)R_0}{B} & \text{if } B < \hat{B} \equiv r^{*-1}(\hat{r}). \end{cases}$$

As figure 8 shows, this function is locally convex within the region $B > \hat{B}$ and $B < \hat{B}$, where these are separated by the difference in the expected return to the lender (evaluated at \hat{B}) between the borrower choosing the safe and the risky projects:

$$(\pi_2 - \pi_1) \hat{r} \left(1 - \frac{R_0 (\pi_2 - \pi_1)}{\pi_2 R_2 - \pi_1 R_1} \right).$$

Overall, however, it is neither convex nor concave.

Thus a mean-preserving increase in uncertainty about B (that is, less transparency) may increase or decrease the expected return, $E\rho$.

If the mean return is increased enough for a particular group of borrowers, then although they may previously have been credit ra-

tioned, they may no longer be.⁹² In a collapse such as in East Asia, the relevant case is probably that in which the mean-preserving spread increases the probability of very high debt but not the probability of very low debt; that is, it may plausibly have taken place entirely in the region $B > \hat{B}$. Yet at the same time, investors revised up their expectations for the mean value of B , leading to more credit rationing.

In short, increased transparency—about critical variables such as the level of indebtedness, for example—does not necessarily result in less credit rationing, or even in lower interest rates, for the typical firm.⁹³

Transparency and Market Volatility

At issue in the concept of transparency, or improved information, is not only the amount of information, but also its timing. For instance, information may become available continuously or in a “lumpy” manner, through occasional disclosures of large amounts of information. The effect of many attempts at secrecy is to make information flows more lumpy. There is a strong presumption that lumpy information results in lumpy asset value revaluations—that is, large discrete changes in asset prices—which contribute to overall economic volatil-

92. These results are not affected by the fact that the market interest rate on safe securities may be increased at the same time. For a group of firms that is not rationed out of the market, the interest rate is the solution to the equation

$$E\rho = r_m,$$

where r_m is the return on the safe asset. This equation defines r , and

$$dr/dr_m = 1 / (\partial E\rho/\partial r) > 0,$$

since if there is no credit rationing, $\partial E\rho/\partial r > 0$. Now let ξ connote a change in transparency, that is, a mean-preserving spread. For a credit-rationed firm, r is chosen to

$$\max_r E\rho \equiv \rho^*.$$

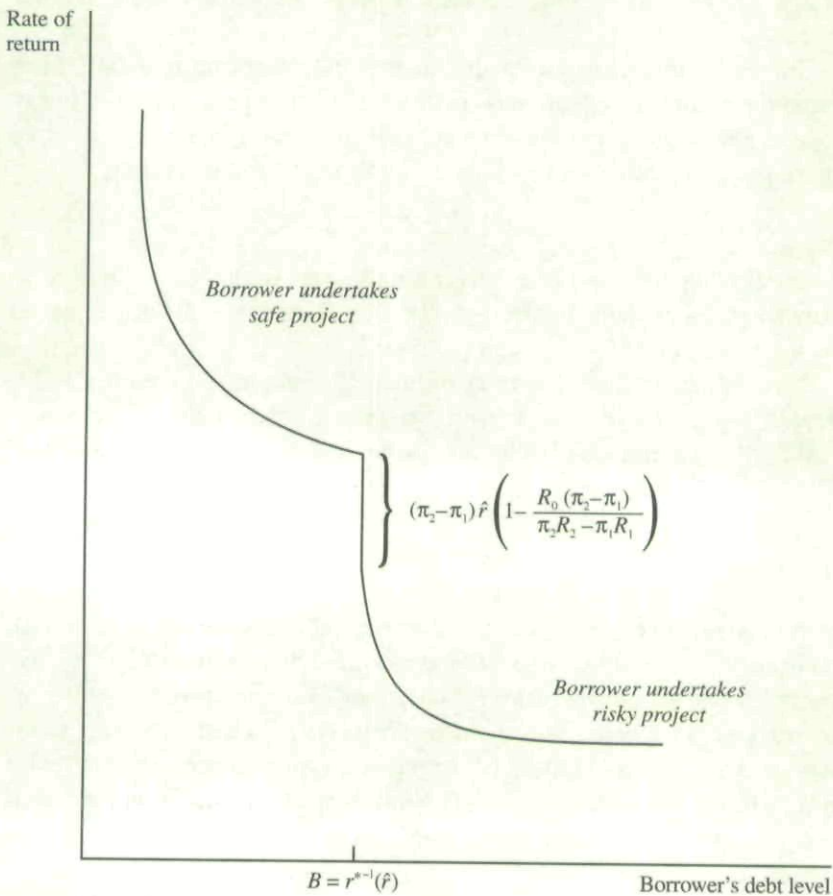
Then

$$d\rho^* / d\xi = (\partial\rho^*/\partial r)(\partial r/\partial\xi) + (\partial\rho^*/\partial\xi).$$

Since $\partial\rho^*/\partial r = 0$, from the above maximization, the change in the optimal return with a change in transparency is $\partial\rho^*/\partial\xi$, the properties of which we have just analyzed in the text.

93. The analysis above assumes risk-neutral lenders. Presumably, if lenders are sufficiently risk averse, increased transparency should have more positive effects; but in well-functioning capital markets, it is hard to see why lenders would be very risk averse. Note, though, that the literature on imperfect information explains why there are in fact a variety of imperfections in capital markets.

Figure 8. Expected Return to Lender for a Given Interest Rate r



Source: Authors' model, as described in text.

ity, just as a lumpy change in exchange rates (under fixed rate systems) may place more stress on the economy than does a continuous adjustment.

But consider an alternative model of lack of transparency. Assume that a firm distributes its crop yield at the end of every year. This yield is a function of the weather in the previous spring and fall, $Y_t = f(Z_t^s, Z_t^f)$. Assume that the weather within any given year may be correlated,

but weather is uncorrelated across years (Z_t is distributed independent of Z_u for any $t \neq u$). Assume also that people cannot observe the weather directly.

Shares of this crop are traded at the end of spring and fall. First consider a nontransparent information revelation process, which only reveals the state of the weather at the end of each year. In this case, share prices at the end of fall are V^* , and at the end of spring,

$$V = E [f(Z_t, Z_t)] + \beta V^*,$$

where β is the discount factor over a half-year. In this case, there is no volatility, other than the predictable movement of share prices based on the proximity of a dividend payment.

Now consider the case when information about the weather is revealed at the end of each season. At the end of fall share prices will still be V^* , but at the end of spring, prices will be given by the stochastic

$$V = E [f(Z_t, Z_t)|Z_t] + \beta V^*.$$

It is clear that there is more volatility in the price with greater information, or more transparency.

Indeed, from the perspective of statistical decisionmaking with risk neutrality, in a rational expectations model where price equals the expected value of the relevant variable (for example, profits), more information must constitute a mean-preserving spread. Two states of nature that were previously confounded are now separated as a result of the information refinement. The value of the information may well not be equal to the cost of the information improvement, even in a partial equilibrium model; indeed, the central point of the Radner-Stiglitz theorem is that under quite general conditions, small refinements are never worth their cost.⁹⁴ With imperfect risk markets, it is easy to construct general equilibrium models in which more information—and hence greater price volatility—leads to lower economic welfare.

Increased transparency may increase price volatility for another reason. It may result in expectations being more similar. With diverse expectations, while some individuals perceive the returns to an asset as decreasing, others may not and may even see it as increasing. Thus the

94. Radner and Stiglitz (1984).

latter are willing to buy the asset as the former are willing to sell it. But if everyone has the same beliefs, any signal will be interpreted by everyone in the same way; prices must fully adjust to reflect that signal, and in fact little trade may occur.

Transparency in Perspective

In developing countries, the absence and thinness of markets exacerbates the information problem; fewer securities are subject to the "price discovery" function of markets, and the accuracy with which those functions are performed is less. Several institutional features of the East Asian economies contributed further to the transparency problem. For instance, because banks in some countries were allowed to invest in securities, their net worth was more volatile. Cross-guarantees may have made it difficult to sort out how one firm was affected by the default of another. The greater risk associated with developing countries implies that even absent these special institutional features, information problems such as those associated with changes in asset values would still be greater.

But although the problem of transparency has been especially identified with developing countries since the East Asian crisis, more developed countries have not gone as far toward disclosure as they could have. We noted above that in the United States and elsewhere bank regulators have resisted pressures from economists for mark-to-market accounting, and have also been slow to use more comprehensive and economically relevant measures—including market value risk, as well as credit risk—in setting risk adequacy standards.

Transparency is also problematic for certain public institutions. Even in more advanced economies, central banks have long had a policy of limiting transparency. Only recently have a few disclosed information concerning their deliberations, and then only with a lag. Evidently, both in regulation and in the control of monetary policy, central banks believe that too much transparency may circumscribe their discretionary ability; for example, to keep alive a bank whose net worth is negative on a mark-to-market basis, even though its future prospects may be good. Indeed, one could argue that greater transparency would have greatly aggravated the banking crisis in the United States in the 1980s, because many major banks would have had to shut down, greatly curtail

their lending, or receive substantial injections of equity. By the same token, the discretion that comes from less transparency can be abused. More generally, if discretion is desirable, surely it should be provided transparently.

Many of the calls for greater transparency concern information about aggregate quantities, such as short-term indebtedness, which would not be required in the perfectly competitive model, where all the relevant information is conveyed by prices. One frequently lauded virtue of the decentralized market is that information can be completely decentralized. The fact of the matter is that there are market imperfections, many related to imperfect information. And once one admits not only that these market imperfections exist, but that they are sufficiently important to require government action in mandating disclosure, one must contemplate other forms of intervention as well.⁹⁵

Moreover, once one recognizes the importance of information imperfections, the entire issue of financial and capital market liberalization takes on a different perspective.⁹⁶ By removing restrictions on lending practices, financial market liberalization has undoubtedly exacerbated the problem of transparency. A central tenet of much of the liberalization movement, that regulators should intervene only through the rigorous enforcement of capital adequacy standards, has no theoretical basis. Regulatory regimes that employ other instruments can be shown to be Pareto superior to those that rely exclusively on capital adequacy standards, even if these are rigorously enforced.⁹⁷

Summary

On theoretical grounds, the effects of increased transparency on price volatility or the volatility of the economy are ambiguous. As an ex-

95. There is no general theorem that says that in the presence of imperfect information, the only government intervention required to attain Pareto-efficient outcomes are disclosure requirements; see Greenwald and Stiglitz (1986). Note that some (for example, Grossman, 1976) have tried to argue that the market provides efficient incentives for information disclosure, but it can be shown that this is not true in general (Stiglitz, 1975a, 1975b).

96. See Stiglitz (1994).

97. See Hellman, Murdock, and Stiglitz (1997). Their analysis assumes that true capital can be monitored without cost but reported capital provides a biased estimate due to accounting practices. There has been some concern that rigorous enforcement of the Basle standards may not only increase the true level of risk-taking but also lower the quality of information.

planatory variable in predicting the crisis, transparency does not seem to be useful. This observation is reflected in the fact that although statements such as "corruption causes financial crises" are the conventional wisdom in some circles, very little of the literature on currency or financial crises has placed much emphasis, either theoretical or empirical, on the various notions of transparency. The link is asserted based mostly on a single data point, rather than on systematic evidence.

At least in the case of Indonesia, there is a plausible case that the exact opposite was true: the crisis may have been due to the expectation that corruption was going to be reduced. A substantial fraction of the profits and value of many companies, including the franchise value of banks and other financial institutions, may have been based on their political connections to the Suharto regime and the favors that followed from them. The worrisome news in the fall of 1997 was not that this corruption and nepotism existed. Rather, it was that these connections or favors might dry up, either because of the increased transparency promised by the reforms or because of the increased likelihood that Suharto's regime would end because of his poor health or political vulnerability.⁹⁸ The costs of this openness for many investors—rather than corrupt practices by the government—may have played a role in the large outflow of capital that was the central feature of the crisis.

Regardless of one's interpretation of the role of corruption in the causation of crises, our analysis has two important policy implications. The first is that countries would do well to improve transparency, even if this does not inoculate them against a crisis. In the East Asian episode, the adverse effects of a lack of transparency are clear: the market observed that some firms were weak, but it could not easily identify those that were. Because of the lack of transparency, the market shut off the supply of capital to all firms, or charged all of them a high risk premium, thus exacerbating the downturn.⁹⁹

98. Some evidence for this view comes from Fisman (1998), who, based on an event study of the reaction of stock prices to news about Suharto's health, concludes that political connections to Suharto were responsible for at least 25 percent of the stock market value of the most "politically dependent" companies listed on the Jakarta stock exchange.

99. This would be the outcome if, for instance, the amount lent is a convex function of "expected" net worth. Then a more refined partition of the information set—that distinguished the different positions of firms more precisely—would lead to more lending overall.

The second policy implication has to do with the desirability of capital market liberalization in the short or medium term. We have observed that those East Asian countries that experienced a crisis, while differing widely in the degree of transparency, were roughly average. There are good reasons to believe that changing the information or political regimes of a developing country will take a long time. Therefore if transparency is necessary for countries that wish to be globally integrated, since without transparency they face the kinds of risks experienced in East Asia, it is clear that they should take a carefully paced approach to global financial market integration. It is ironic that some of the strongest advocates of rapid integration have argued most vehemently for transparency as an explanation of the crisis. But this is perhaps related more to the political economy considerations discussed above than to our empirical evidence or theoretical analyses.

Responding to Crises: The Role of Interest Rates

Whereas the causes of currency and banking crises have been the subject of much theoretical and empirical modeling in recent years, the question of how countries should respond to financial crises has received much less attention. There has been no shortage of opinions about the policy packages adopted in East Asia, but in general they do not rest on a well-supported body of theory or evidence. This is especially true for a central issue in the first months of the crisis: the role of high interest rates policies in stabilizing exchange rates.

The relationship between interest rates and exchange rates in a crisis is crucial. Large exchange rate depreciations can be very damaging. According to the IMF, 71 percent of "currency crashes" between 1975 and 1997 have resulted in output losses relative to trend.¹⁰⁰ Long-lasting increases in real interest rates are also extremely costly, not just for the traditional macroeconomic reasons, but also because of their effect on the health of the banking system. There remain several open questions about the relationship between interest rates and exchange rates: Are there circumstances in which higher interest rates will weaken the economy and lead to currency depreciation? If so, the high-interest-rate

100. International Monetary Fund (1998).

policy is strictly dominated by the low-interest-rate policy. If not, is the trade-off between a stronger exchange rate and permanently higher interest rates, or temporarily higher rates? And if the interest rate hike need only be temporary, what determines the magnitude of the increase and its duration?

In this section we first assess the circumstances under which raising interest rates today will in fact increase the exchange rate today, as claimed by advocates of high interest rates. We then address the stronger and more important claim that temporarily high interest rates will lead to a permanently stronger exchange rate. We develop several models under which this could be true and assess whether they are reasonable descriptions of the East Asian economies. We subsequently turn this claim on its head, showing that when temporarily high interest rates are brought down to normal levels, the result could be a permanently weaker exchange rate. This could be true even if, while the interest rates were high, the value of the currency was maintained or strengthened. Next, we discuss the conditions under which each of these models is likely to be correct. We also present some empirical evidence on the circumstances under which temporarily high interest rates are likely to help or to hurt exchange rates. Finally, we discuss some policy implications of this analysis, in particular, the proper role of monetary policy in exchange rate stabilization.

The Immediate Effect of Higher Interest Rates

Policymakers seem generally to assume that increasing today's interest rate will strengthen today's exchange rate. We show, however, that this belief is only warranted under certain circumstances, using the "uncovered interest parity" framework. While this framework is incomplete, in that it does not provide a solution for the expected future exchange rate, it is very general and can be embedded in virtually any model of the exchange rate.

With risk neutrality, equilibrium in exchange rate markets must balance the expected return from holding domestic currency and, say, dollars. This generates a differential equation for exchange rates that, together with a boundary value condition, determines the exchange rate today. To analyze the effect of a change in the domestic interest rate, one then needs only to analyze the effect on the expected future rate

and solve the differential equation backward. In uncovered interest parity, this is written

$$1 + i_t = \frac{e_{t+1}^E}{e_t} (1 + i_t^*),$$

where e_t is the nominal exchange rate (local currency per unit of foreign currency), i is the interest rate, * denotes a foreign variable, and superscript E denotes the expectation.¹⁰¹

An increase in the interest rate makes it more attractive to invest in the country, and if the expected future exchange rate remains unchanged, today's exchange rate will appreciate. This raises the first problem: monetary policy systematically affects the expected future exchange rate. For instance, if the increase in the interest rate lowers the price level, or the rate of inflation, by purchasing power parity, one will expect a stronger exchange rate in the future. In that case, the change in the boundary value reinforces the dynamic effect, and the exchange rate today strengthens—overshooting its new equilibrium.¹⁰² Alternatively, if confidence in the country weakens, it will be viewed as a less attractive place for investment. At the same time, a restriction of credit could, for a given exchange rate, reduce the supply of exports. Thus the future (and possibly even current) demand for currency falls, and the expected future exchange rate weakens. The dynamic and boundary value effects go in opposite directions, and the movement in the current exchange rate will be ambiguous.

A second problem is that it is not the promised nominal interest rate that matters but the expected return, which must take into account the probability of default, itself an endogenous variable. An increase in the nominal interest rate could lead to a decrease in the expected interest rate, in which case the dynamic effect on today's exchange rate is negative. Although it may be reasonable to neglect this point in examining, say, the relationship between the U.S. dollar and the German mark, it is not at all valid to do so in potential or actual economic crises,

101. In principle, what is relevant is $\lim_{t \rightarrow \infty} e(t)$ at $t \rightarrow \infty$, where e is the exchange rate. Our analysis focuses on a shorter run "boundary value," a time at which the exchange rate has returned to its equilibrium value (say, ten years). Uncovered interest parity is usually interpreted over periods of three months to a year. Arguably, the horizons of investors are even shorter—possibly, even measured in minutes—which may explain why bubbles seem to emerge so frequently.

102. See Dornbusch (1976).

when concern about repayment is usually the central cause of loans not being rolled over and of capital outflow.

A third problem is that the market may be risk averse. Moreover, both willingness to bear risk and perceptions of risk might change dramatically and could be adversely affected by policies that might be seen as inducing a recession, such as an increase in interest rates.¹⁰³

One can combine the second and third effects in a revised uncovered interest parity equation:

$$(1 - \delta)(1 + i_t) - \nu = \frac{e_{t+1}^E}{e_t} (1 + i_t^*),$$

where δ is the probability of bankruptcy and ν is the risk premium. Since these are both increasing functions of i_t , increases in i_t have an ambiguous effect on the left-hand side of the equation, and thus an ambiguous effect on the exchange rate.

In a realistic model, δ and ν would probably also be increasing functions of depreciation, at least, for very large depreciations in economies with unhedged foreign debt. In our analysis, however, we take as given the initial shock—the reduction in demand for Thailand's currency, for example—and ask what the policy response should be. We also take the initial depreciation as given. Thus for our purposes, in these functions depreciation only affects the outcomes through its second order effects and would only strengthen the analysis. If higher interest rates had a sufficiently adverse effect on the economy to lead to even further depreciation, this, in turn, would feed back into still higher probabilities of default and a lower exchange rate; and vice versa if higher interest rates led to a higher exchange rate.

Temporary Interest Rate Increases and Permanently Stronger Exchange Rates

Under the conventional wisdom, the best-case scenario is that higher interest rates will not affect the probability of bankruptcy or the degree of uncertainty. Even in this case, however, the magnitude of the interest rate increases required to prevent or reverse a large depreciation would be huge. If there is no change in the expected future exchange rate,

103. Even if the long-run exchange rate strengthened, this effect could undo the overshooting in the transition path.

defending a currency against the expectation of a 1 percent fall the following day would require an overnight interest rate of 1 percent per day above the international interest rate—that is, an annual rate over 3,678 percent.¹⁰⁴ Furthermore, in the basic model this effect will be almost completely reversed when interest rates are lowered once again to their original level.¹⁰⁵

This is not the policy that most people have in mind. Policymakers typically claim that a period of temporarily higher interest rates will be sufficient to strengthen the exchange rate permanently. Indeed, the fact that higher interest rates are only temporary is publicly announced and universally believed. And it is sometimes claimed that because these rates are temporary, they will not be very costly for the economy. This claim is much stronger than the relationship between today's high interest rates and today's high exchange rates discussed above.

Why should one believe that a temporary increase will lead the stronger exchange rate to persist even after the interest rates have come down? One simple reason could be that the shock to the exchange rate is itself temporary. In this case, the higher interest rates might induce a flow of funds into the country, maintaining the exchange rate at its previous level until the temporary disturbance disappears.¹⁰⁶ The interest rates can then be lowered and the exchange rate will retain its value. But note that although the exchange rate intervention has in some sense succeeded, its benefits are only temporary. Had there not been an intervention, the exchange rate would have fallen, but it would have risen again once the disturbance disappeared. Thus one must compare the benefit of the higher exchange rate in the interim to the cost of the higher interest rate in the interim (as discussed further below).

104. To put this in perspective, between July 1, 1997 and January 30, 1998, the Indonesian rupiah declined at a daily rate of 0.8 percent, some days falling by as much as 18 percent. A risk-neutral investor expecting such depreciation would have kept his money in Indonesia only in exchange for a 1,700 percent annualized return sustained over seven months. A risk-averse investor would have demanded an even higher interest rate.

105. *Almost* completely because the price level will be permanently lower than it would have been as a result of the period of temporarily lower inflation.

106. Note that if the market shares these beliefs and it works well, no government intervention will be required: capital flows will stabilize the exchange rate (unless the source of the disturbance was a change in international interest rates). Thus intervention must be based on the premise that markets are not functioning well, including the possibility that government bureaucrats have better judgment than the market.

However, most policymakers who advocate temporarily high interest rates in defense of the exchange rate argue that these can be effective even in the face of a permanent shock. Assuming standard economic relationships, including rational expectations, there are three models under which this could be the case.¹⁰⁷ The first acknowledges that the effects of the interest rates are only temporary, but argues that they can be used to buy time for other reforms to strengthen the exchange rate. The second says that a movement along a curve—for example, the demand curve for the country's currency—results in a shift of the curve, that is, a permanently greater level of demand for any given interest rate. This is principally explained in terms of "signaling," which conveys information, such as the degree of commitment to the exchange rate target. The third model says that there are multiple equilibria, and that high interest rates may serve to coordinate the economy on one equilibrium rather than another.

BUYING TIME FOR OTHER REFORMS. One commonly stated rationale for temporarily higher interest rates is that they will buy time for the development and implementation of other reforms to strengthen the exchange rate. Note that if the government does in fact make a credible commitment to reform, interest rates do not need to rise. Indeed, raising the interest rate only would make sense if the government, or other parties participating in the design of the policy package, either do not believe that package is credible or do not believe that the market will believe it so. Thus raising interest rates could be viewed as a signal of lack of confidence. More generally, the more credible the promised reforms, the less interest rates have to rise today to defend the currency. This follows from the fact that an announcement about policy measures, if it is believed to raise expectations about the strength of the future exchange rate, will feed back into today's exchange rate through the uncovered interest parity relationship.

How reforms affect the expected future exchange rate is probably as much a matter of psychology as of economics. There is very little basis, however, for making confident predictions about the market's reactions to different reform proposals—and there is little evidence that govern-

107. To be sure, many advocates of these policies implicitly believe that there are irrationalities in the market, and that government intervention is supposed to overcome them. Frequently, these are the very people who argue against government intervention more generally, believing in the efficiency of market mechanisms.

ment officials engaged in designing reform packages are particularly good in predicting market psychology. But from the perspective of economic theory, one is on much firmer ground. Here it is important to realize that not every "reform" will strengthen the future equilibrium exchange rate. We focus on a future sufficiently close that the proposed policies are expected to be still in place.

In an economy which has had prudent fiscal policies, as was the case with the East Asian economies, a fiscal contraction will lead to a more depreciated future equilibrium exchange rate. This result holds in the standard model, essentially because the fiscal contraction raises national saving: thus the need for funds from abroad is reduced or the supply of currency is increased. Furthermore, in an economy with aggregate supply and aggregate demand roughly in balance, as was also the case in East Asia, a fiscal contraction exacerbates the downturn that almost always follows a financial or currency crisis, increasing the probability of bankruptcy and uncertainty about the future. As a result, the attractiveness of investing in and lending to the country will be reduced, contributing to the depreciation of the equilibrium exchange rate.

Similarly, structural reforms will not always strengthen the future equilibrium exchange rate, at least in our short-term horizon—even if they are beneficial for long-run productivity. If these reforms result in the disruption of the flow of credit, a rise in bankruptcy, and an increase in uncertainty about the economy, they may lower the expected short-to intermediate-run return to investing in the economy, and thus the equilibrium exchange rate.¹⁰⁸

SIGNALING. The best case for a high interest rate policy is that it leads to a change in a state variable: beliefs about, for example, the resolve of the monetary authorities to pursue low inflation, which shifts the demand curve. Furthermore, beliefs change in such a way that when the interventions are withdrawn, not only will interest rates fall, but exchange rates will stabilize at a level higher than they would have done without the intervention.

There is well-developed theory to explain how government interventions might change beliefs. For instance, if the government or interna-

108. Thus had the United States eliminated the distortionary tax preferences for real estate in the midst of the S&L crisis—as would have been desirable for long-run productivity—the effects on the banking system would have been disastrous and it is quite likely that the economy would have plunged into a deep recession.

tional agencies have information that is not publicly available, agents in the economy may make inferences about the underlying state of the economy from the nature of the interventions. Strong and painful economic actions, especially preemptive actions taken before signs of crisis are visible, may be interpreted as an indication of serious economic malady. The actions themselves, given a particular appraisal of the economy, may lead to greater optimism; but whether the combined effect of the change in the appraisal and the change in actions is positive or negative is generally ambiguous.¹⁰⁹ This is especially the case when the efficacy of the remedies will be established only in the long run, while the impact of the reappraisals will be felt immediately. Much of this literature is based on rational expectations; when irrationalities are taken into account, the possible adverse effects become magnified.

There is little, if any, research that explicitly models or tests the positive effects of temporary high interest rates as a signal of the resolve of a central bank to maintain or strengthen the value of the currency.¹¹⁰ This hypothesis can, however, be subjected to theoretical and empirical tests. At the theoretical level, the key question is one of internal consistency. A basic tenet of the theory of signaling is that to be effective, signals must be costly: if it were costless to signal that one were a responsible monetary authority by imposing high interest rates, everyone would do so, and thus high interest rates would not be an effective

109. In the context of U.S. monetary policy, Romer and Romer (1996) show that the information revealed by a monetary tightening—that an economy is in the bad state of high expected inflation—more than offsets its direct economic effects, leading commercial forecasters, on average, to revise up their expectations for inflation. This finding begs the question why the Federal Reserve does not release its contemporaneous forecasts, in contrast to the Administration and the Congressional Budget Office, which make public the forecasts underlying their budgetary policies and proposals.

110. There has, however, been extensive work on the importance of signaling in foreign exchange markets. Agnor (1994) provides a theoretical model in which signaling can help to maintain a good equilibrium, although the signals that he describes—"the removal of capital controls, a drastic cut in the budget deficit, the appointment of a 'conservative' central banker, etc." (p. 11)—do not explicitly include high interest rates. Dominguez and Frankel (1993) find that even sterilized interventions can affect exchange rates, and ascribe the majority of this effect to the signaling component of the intervention. Watanabe (1994) finds similar results for Japan. In all of these analyses, foreign exchange interventions are important because they signal the commitment to a stronger currency, implicitly opening up the possibility of further interventions, and possibly even tighter monetary policy. By contrast, when a country uses high interest rates to defend its currency, the announced intention and the economy's expectation are usually that these rates will be lowered over time.

signaling mechanism. One cannot hold simultaneously to the beliefs that there will not be real, adverse consequences (real costs, at least to some groups within the population) and that high interest rates are an effective signaling mechanism.

Another aspect of internal consistency that involves political processes is that if the cost is too high the signal is not credible, because no one will believe that the policy will be sustained.¹¹¹ Even if the current government establishes its credibility, there is overwhelming evidence that economic downturns lead to an increased likelihood of a change in government.¹¹² Although in principle an independent monetary authority might insulate monetary policy from such political pressures, at least for a time, even monetary authorities with a long history of independence recognize their vulnerability: if they push too hard, their independence can be taken away. Paul Volcker put this well when, as chairman of the Federal Reserve, he told a congressional committee that "the Congress created us and the Congress can uncreate us."¹¹³

The costs and benefits of signaling depend on institutional structure and the previous history of the economy. Recall that for signaling to be effective, costs must be borne by the agent. While high interest rates may impose huge costs on the economy in general, and on workers in particular, the more independent the central bank and the less representative its governing board, the lower will be the cost to the central bank of any disruption associated with the higher rates. Thus increasing central bank independence will raise the costs of signaling that are imposed on the economy. These have so far been ignored by advocates of greater independence, who, ironically, often seem implicitly to be relying more heavily on the signaling theory as a justification of high interest rate policies. However, countries where central banks have pursued good macroeconomic policy are likely to receive less benefit from signaling their resolve to address macroeconomic problems. The differences in the costs and benefits faced by countries in different

111. Drazen and Masson provide a nice illustration of this point: "One afternoon a colleague announces to you that he is serious about losing weight and plans to skip dinner. He adds that he has not eaten for two days. Does this information make it more or less credible that he really will skip dinner?" (1994, p. 736).

112. See Alesina and Roubini with Cohen (1997); and in the context of the United States, Fair (1996).

113. Greider (1987, p. 473).

situations provide a set of tests for the signaling model, as discussed below.

Even if temporarily high interest rates do have an effect on beliefs, and therefore on the supply curve of capital, one should still ask whether there are less costly signaling mechanisms—or at least, signaling mechanisms that are less costly to innocent bystanders, if more so to those engaged in risky behavior. Such mechanisms would provide better incentives to prevent future crises, while restoring confidence in the midst of the current crisis.¹¹⁴ This is an especially relevant question for international institutions, which may be in a position to help the market coordinate on a signaling system.

The hypothesis that high interest rates are an effective signaling mechanism can also be subjected to empirical tests. The information contained in the signal would presumably be related to prior information and beliefs. Thus one would expect a high interest rate policy to be less effective in conveying information about a monetary authority that had a long reputation for responsible monetary policy, as evidenced by low inflation, because the revision in beliefs would presumably be smaller. This strongly suggests that even if one believes in the signaling theory, a high interest rate policy would be less effective in East Asia than it was in Latin America. The East Asian experience of currencies continuing to depreciate after initial interest rate hikes seems consistent with this hypothesis, as we discuss below.

Indeed, one might go further if one believed that the underlying problem was not a macroeconomic problem but observed that the monetary authorities were acting as if it were. Then one might rationally infer that the monetary authorities did not understand the issue. Attacking a financial sector crisis with an instrument that is not directly related is not likely to enhance the credibility of the financial authorities or confidence in the economy.

Moreover, information is typically conveyed not only by the level of the interest rate, but also by its duration. Indeed, the standard explanation for the failure of high interest rates is that the countries have not stayed the course. This proposition can also be tested empirically.

114. One possibility is that government interventions imposing Pigouvian corrective taxes on those activities that generated the systemic risks and using the revenues to provide for improved safety nets will, in addition to their direct benefits, send a signal that reform efforts will be politically and socially sustainable.

MULTIPLE EQUILIBRIA. The other major set of models providing a consistent rationale for higher interest rates as a means of stabilizing the exchange rate are those that generate multiple equilibria. Although the results are not in, we doubt that these justifications will stand up under close scrutiny. In such models, government intervention can sometimes help to coordinate the economy to "choose" the good equilibrium. Having intervened to convince market participants which equilibrium would prevail, the government can step aside. In principle, anything can serve to coordinate such sunspot equilibria; and governments should, presumably, choose coordinating signals that do not in themselves have adverse effects in changing the equilibria.

There is a further problem: the coordination signal may be misinterpreted. Rather than restoring the economy to the former, higher exchange rate equilibrium, it may reinforce the movement toward the low exchange rate equilibrium. This is especially likely if there is a belief that the former, stronger exchange rate is no longer an equilibrium, due to the increased interest rate, as the weakening economy saps confidence in the currency and generates capital flight.

Proponents of high interest rates thus have a heavy burden. They need to construct a multiple equilibria model in which high interest rates result in coordination on a "good" equilibrium. They must also devise convincing tests that high interest rates indeed serve as the coordinating mechanism and show that it would be difficult, if not impossible, to establish less costly coordinating mechanisms. The literature is not replete with models that satisfy these criteria.

It is easy, however, to construct multiple equilibrium models in which government intervention in the form of sufficiently higher interest rates eliminates the "good" equilibrium, while the remaining stable equilibrium is discretely lower. Normally, exchange rate depreciation leads to increased exports, and thus a greater demand for local currency. But a very large depreciation can result in a substantially higher probability that firms will default on their foreign-currency-denominated debts. This, together with weaker economic conditions, reduces capital inflows, resulting in a decrease in the demand for the currency that more than offsets the increased demand for local currency to buy exports. Giffen-like demand curves (as well as backward-bending supply curves) can give rise to multiple equilibria. In an intertemporal model, exchange rates today depend on expectations about the equilibrium

exchange rate in the future. Higher interest rates, leading to lower investment and less competitiveness, yield lower exchange rates in the future. More important, the resulting shifts in the demand and supply curves may eliminate the upper equilibrium exchange rate.

Temporary Interest Rate Increases and Permanently Weaker Exchange Rates

In our discussion of the contemporaneous relationship between interest rates and exchange rates, we have emphasized the roles of the probability of bankruptcy and increased uncertainty about the future. Developments in finance-based macroeconomics over the past two decades provide a strong basis for believing that these phenomena may be highly persistent. Thus a period of temporarily higher interest rates may lead to a permanent or long-lived increase in the probability of default. In this case, the conventional wisdom about contemporaneous effects could be correct (the effect of higher interest rates could outweigh the higher default probability in the short run, and thus increase the expected return) and a higher interest rate could still lead to a lower exchange rate. The reason is simple: in the long run, when interest rates return to their original level, the expected return will be lower, because the probability of default will have increased. Even if the intermediate-run exchange rate is unchanged, the exchange rate in preceding periods will have weakened through the standard equations. And the weaker economy might in fact lead to a weaker intermediate-run exchange rate, further weakening the currency in the preceding periods. It is thus possible that today's exchange rate could be weakened, even if today's expected return increased.

To understand why and under what circumstances increasing interest rates today leads to permanently—that is, in the short to intermediate term—weaker future exchange rates, it is important to understand the financial and macroeconomic effects of high interest rates and why they persist. We describe six important channels through which interest rates affect the economy.

NET WORTH. Higher interest rates seriously erode the net worth of debtors, leading them to contract investment, employment, inventories, and production.¹¹⁵ Since it takes time for the depletion of net worth to

115. See Greenwald and Stiglitz (1988, 1993).

be restored, these effects outlast the increase in interest rates. Moreover, increases in interest rates lead to a decrease in asset values, further undermining the value of banks, which cannot avoid having long-term assets and short-term liabilities. Even in a closed economy this has serious adverse macroeconomic effects, because the actions of those who gain (net creditors) typically do not fully offset the contractionary actions of the losers. But in an open economy, with net payments flowing abroad, there is a real wealth effect on the economy as a whole.

PORTFOLIOS AND CAPITAL FLIGHT. Changes in asset values and expected returns caused by higher interest rates lead to portfolio reallocation. While a higher interest rate, by itself, might make it more attractive to hold a country's interest-bearing assets, the attraction will in part be offset by the higher probability of default and the generally perceived higher riskiness. Furthermore, the markedly lower value of net worth will, if there is decreasing absolute risk aversion, reduce demand for risky assets. This will be especially important for domestic investors who, in the face of an impending recession, see the value of their human capital—which is relatively country specific—go down and the variance of its return increase. Since the return on domestic assets is highly correlated with that on human capital, the desire for diversification will lead to a portfolio shift away from domestic assets. Indeed, because domestic investors are better informed about the problems in their own country, they are often the first to move their money out.¹¹⁶ In the East Asian crisis, much of the international diversification by residents of the affected countries involved investing money in other East Asian countries. Subsequent events have shown just how correlated these returns are: further withdrawals of capital from the region result as Koreans, for instance, move their money out of Indonesia and into Mexico or the United States.¹¹⁷ Exacerbating this tendency is the

116. See Frankel and Schmukler (1996, 1997) for evidence from the discounts of closed-end mutual funds holding assets in emerging markets. In surveys of local firms conducted in December 1996, a large fraction of respondents in Korea and Thailand answered yes to the questions "Is a recession over the next year likely?" and "Is the exchange rate in your country expected to be volatile?" By contrast, Indonesian and Malaysian firms did not seem to see the crisis coming any more than foreign investors did. See Kaufmann, Mehrez, and Schmukler (1998).

117. Collier, Hoeffler, and Patillo (1998) estimate that rebalancing portfolios in East Asia will eventually lead to a cumulative outflow of \$80 billion, although they do not predict how long this adjustment will take.

anticipation of the future taxes that will need to be imposed to repay debt, particularly if the government assumes the responsibility, as in Latin America in the 1980s. Together, these factors explain why gross capital outflows by domestic residents—often called capital flight—have played such an important role in past crises, including Mexico in 1994–95 and Indonesia in 1997.¹¹⁸

BANKRUPTCY. Many firms will find their net worth so compromised as a result of higher interest rates that they go bankrupt. Bankruptcy may have severe disruptive effects, even with well-functioning bankruptcy law with some equivalent of chapter 11 of the U.S. Bankruptcy Code. In some cases, bankruptcy has adverse effects on the net worth of a firm's creditors; this is especially true of financial institutions.¹¹⁹ To offset the effects of bankruptcy, new firms will have to be created, and old firms expanded. Neither outcome is typical in the midst of a recession, discouraged by uncertainty about the future, the high fixed costs of investment, and the even higher fixed, sunk costs of starting a new enterprise. Furthermore, the firm's core asset, its organizational capital, dissipates quickly after it is shut down, and it is a lengthy and costly process to rebuild it. This is reflected in the well-known observation that the value of a firm as an ongoing enterprise is far greater than the value of the assets that constitute it. Bankruptcy and net worth effects are likely to be especially large where debt-to-equity ratios are very high, as they have been in Korea.

MORAL HAZARD. In the presence of bankruptcy laws, the decrease in net worth resulting from higher interest rates may lead some firms to engage in gambling or looting behavior.¹²⁰ Such behavior within the financial sector has been credited with exacerbating its problems of that sector and amplifying its losses, for example, in the U.S. savings and loans debacle in the United States. While strong regulatory behavior might be able to reduce the magnitude of this effect, it takes time to develop; in the meanwhile, there are real dangers.

AVAILABILITY OF CREDIT. As financial institutions go bankrupt and

118. On Mexico, see International Monetary Fund (1995); on Indonesia, Dooley (1998).

119. This is so because bankruptcy represents a discontinuity, often with a discrete decrease in value. It is especially apparent when there is a discrepancy between the value of the assets of a company sold as a going firm and those assets sold separately.

120. See Akerlof and Romer (1993).

banks cut back on their lending, credit may become highly constrained. A credit crunch will exacerbate the economic downturn. The severe liquidity constraints imposed by the weakening of the financial system, especially if capital adequacy standards are stringently enforced, make it difficult for firms to find outside financing, and the low level of profits associated with economic downturn make it difficult to finance investment expansions internally.¹²¹ Thus even short-lived interest rate hikes can have persistent negative effects.¹²²

INFORMATION. Because interest rates change asset values, and because information concerning the asset structure of a firm is almost always imperfect, large changes in interest rates increase the imperfections of such information. These adverse information effects exacerbate the constant problems of making good resource allocation (lending) decisions, increase risk premiums, and thereby contribute further to the contraction of the economy. And as shown above, an increase in the imperfection of information can lead to greater credit rationing. Moreover, as banks and firms go bankrupt, there is an enormous loss in informational capital: the specific information that banks have about firms and that firms have about their suppliers and customers.

These six effects of higher interest rates on the economy combine to induce a leftward shift in the aggregate supply curve, which is mutually reinforcing with the leftward shift in the aggregate demand curve that has been the subject of traditional macroeconomic discussions. As firms reduce their employment, aggregate demand is reduced further; as the uncertainty of the reduction in credit availability and the anxiety caused by increased bankruptcies grow, even firms that do not face credit

121. Worse still, the higher interest rates offered on government securities induce banks to hold their assets there—especially if government indebtedness is low, so that the probability of default is low—rather than lending. In response to the observation that some banks are awash with liquidity, naive observers have argued that there is no credit crunch; there is simply not an adequate supply of creditworthy borrowers (clearly, there may be relatively few creditworthy borrowers who are willing to pay the extremely high interest rates being charged). Moreover, they have argued that the government should contract the money supply, since the excessive liquidity represents an inflationary threat. The implicit worry is that circumstances might change quickly and dramatically before monetary authorities could react, so that all the excess liquidity would turn into inflationary spending. In reality, they should be worried that in the attempt to reduce excess liquidity the credit crunch be exacerbated, since both banks that have excess liquidity and those that do not are likely to be affected.

122. See Greenwald and Stiglitz (1993).

constraints may reduce their demand for investment. The reduced demand pushes more firms into bankruptcy, further exacerbating the supply-side effects.

These effects provide the motivation for our claim that the probability of bankruptcy and the increase in uncertainty are increasing functions of the interest rate. But they go further, to argue that a period of temporarily high interest rates could have the persistent effect of increasing the probability of bankruptcy, and thus lower the expected return and the exchange rate long after interest rates have returned to more normal levels.

Comparing the Models

We have discussed several cases in which a speculative attack on a currency is followed by temporarily high interest rates. During the period of high interest rates, the movement of the exchange rates depends on the strength of the offsetting movements in the promised rate of return and the probability of bankruptcy and increase in the risk premium. When the high interest rates are brought down again, in the most basic specification the exchange rate would return to its precrisis levels. The exchange rate could be permanently strengthened if favorable reforms are introduced in the meantime, or the signaling effect is positive, or the economy is coordinated to a new equilibrium. But it could be permanently—or at least persistently—weakened if the period of high interest rates leads to a long-lasting increase in the probability of bankruptcy.

Which of these alternatives prevails depends on two important factors: the degree to which a period of high interest rates signals important information about the monetary authority and the degree to which high interest rates harm the economy. In Latin America, capital markets are highly segmented, so that an increase in, say, a bank's discount rate or the interbank lending rate does not get translated into higher lending rates for most borrowers. The effects are also likely to be limited when firms are not highly indebted or when most debt is long-term debt. That is why increases in interest rates may have worked to stabilize Latin American currencies—although in some cases they entailed substantial macroeconomic sacrifices.

But in East Asia, firms were highly leveraged, banks were very

fragile, capital markets were not highly segmented, and much of the debt was short term. Moreover, aggregate demand and supply were initially roughly in balance. Not surprisingly, raising interest rates had significant adverse macroeconomic effects. These large macroeconomic effects, combined with high indebtedness, led to a large increase in the probability of bankruptcy, lowering expected returns, and thus making investments less attractive in these countries.

In appendix B we prove the general theorem that if there is initially some credit rationing in a country, such adverse macroeconomic effects always increase credit rationing: some loans that would have been rolled over are not. These effects are compounded by capital flight, which will be exacerbated by the increase in interest rates when there are large adverse macroeconomic consequences and a heavy level of indebtedness, some of which is expected to be assumed by the government, and thus reflected in higher taxes.

The situation in East Asia in 1997 was sufficiently different from that of Latin America in the 1980s and mid-1990s that the prospects for higher interest rates stabilizing exchange rates were clearly bleak.

Empirical Evidence

There is remarkably little empirical research on the use of temporarily restrictive monetary policy to defend the exchange rate in a crisis. By contrast, the belief is widespread that this defense will work in a wide range of circumstances. To date, the arguments made in its favor have mostly been stories. It is argued that temporarily high interest rates successfully defended against speculative attacks in several Latin American countries. Yet Korea, Indonesia, the Philippines, and Thailand followed the classic prescription of raising their interest rates to defend their currencies, and all three saw continued depreciations, well in excess of what would be predicted by the currency crisis models examined above or by estimates of the overvaluation of these currencies. In both Latin America and East Asia, many other factors were at work, and one could argue that the exchange rate depreciations would have been even larger in the absence of high interest rates, or equivalently, that interest rates were not raised high enough. And this reasoning could be reversed to undermine the Latin American example: perhaps exchange rates would have stabilized on their own, or with a far

more moderate increase in interest rates. The problem is to establish the counterfactual. This kind of storytelling is useful, in that it alerts one to the possibility—already suggested by our theoretical analysis—that there may be circumstances in which higher interest rates work, and others in which they do not. To go beyond storytelling, one needs empirical research that will confirm or reject the theoretical predictions about the likelihood that such policies will work.

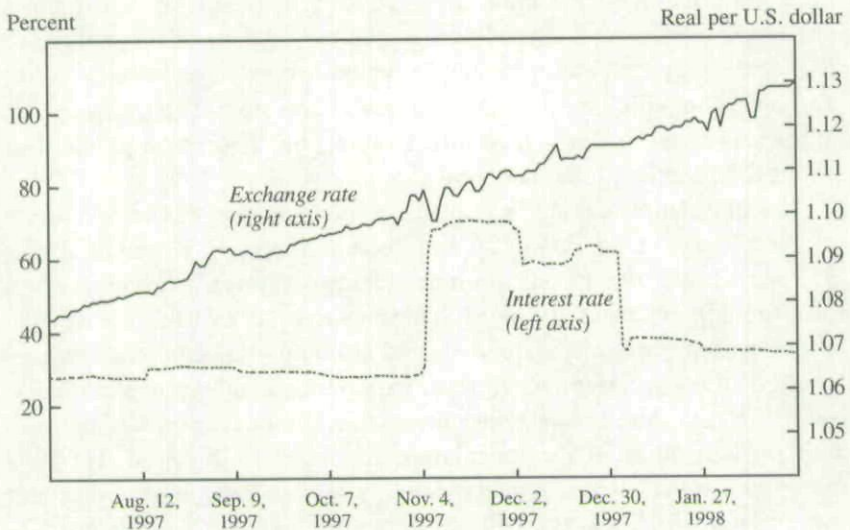
The only empirical studies on this issue of which we are aware are by Aart Kraay and by Goldfajn and Poonam Gupta.¹²³ Kraay identifies 313 speculative attacks on currencies, defined as large drops in reserves or large depreciations in the exchange rate. In 192 of these cases the attack was successfully defended, and although non-gold reserves decreased, the exchange rate did not experience a substantial depreciation.¹²⁴ Kraay then asks whether the stance of monetary policy helps to explain why some of the speculative attacks were thwarted. He finds no evidence that tighter monetary policy, defined as a higher discount rate relative to the United States or slower domestic credit growth, played a role in defending the exchange rate. This result is confirmed in several different samples and specifications, including a more complete model that includes other determinants of crises.

Goldfajn and Gupta look at a large sample of real exchange rate “undervaluation” episodes following crises to assess whether tight monetary policy brings about a recovery in the real exchange rate through a nominal appreciation of the exchange rate. They find that in their total sample, tight monetary policy increases the probability of recovery by about 10 percentage points. But among countries undergoing simultaneous banking and currency crises, as in East Asia, tight monetary policy is associated with a roughly 10 percentage point lower probability of success. Both of these differences are statistically significant.

The advantage of the monthly framework used by these studies is that it can identify a large sample and examine a rich set of variables. The cost, however, is that monthly variables necessarily miss much of the action in currency attacks, which can take place over the course of a few days. Also, the methodology of these studies ignores episodes

123. Kraay (1998); Goldfajn and Gupta (1998).

124. See Kraay (1998) for the precise numerical thresholds and other conditions for successful and unsuccessful speculative attacks.

Figure 9. Exchange Rates and Interest Rates in Brazil, 1997-98^a

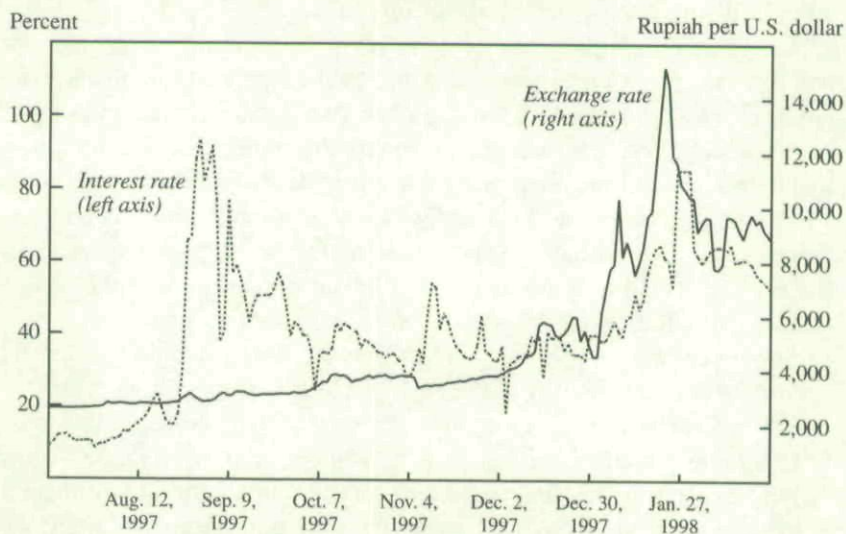
Source: Data are from an electronic database from Datastream International.
 a. Interest rate is the Brazilian Financing Overnight (middle rate).

when high interest rates were sufficient to deter a speculative attack in the first place.

We try to clarify the relationship between temporarily restrictive monetary policy and the exchange rate with two sets of evidence. First, we present a detailed discussion of the contrast between the recent crises in Brazil, where tight monetary policy worked, and in Indonesia, where it did not. Second, we take a more systematic look at episodes of temporarily high interest rates in developing countries.

INDONESIA VERSUS BRAZIL. When speculative pressures on the Brazilian real increased in October 1997, the authorities responded by raising the overnight interest rate from 30 percent to 70 percent, with most of the increase coming in one day. Interest rates stayed at high levels for almost two months, until they were brought down to pre-attack levels by the Brazilian authorities. The exchange rate maintained its upward trajectory even after the rates were lowered. Brazil's exchange and interest rates are portrayed in figure 9.

Indonesia's experience, shown in figure 10, stands in sharp contrast to that of Brazil. In the aftermath of Thailand's devaluation on July 2,

Figure 10. Exchange Rates and Interest Rates in Indonesia, 1997-98^a

Source: Data are from an electronic database from Datastream International.
 a. Interest rate is the Indonesian Interbank CALL (PIPU middle rate).

1997, the rupiah fell by around 7 percent over the course of that month. In mid-August speculative pressures intensified and the rupiah fell by another 10 percent. The authorities responded by raising interest rates from 20 percent to almost 100 percent. After one and a half months, they tried to lower interest rates, only to see the exchange rate slip, so that they quickly raised interest rates again. By late September, interest rates had come down to 40 percent—20 percentage points higher than their precrisis levels—but the exchange rate began to fall sharply.

In both of these cases, high interest rates seemed to prevent the currency from depreciating, but only in Brazil did the exchange rate maintain its value after interest rates were reduced. We have discussed three different models for interpreting this experience. In terms of the first, Brazil was subject to a temporary shock, whereas Indonesia was subject to a much larger permanent shock. Brazil's temporary shock could have been a period of irrational contagion, and the high interest rates would have defended the currency until the market regained its senses. In contrast, the attack on the rupiah was more rational and could

not be defended; when interest rates were reduced, the exchange rate quickly depreciated to its equilibrium value.

Although a definitive counterfactual is impossible, most estimates of real exchange rate misalignment would have suggested that the Brazilian real was more overvalued than the Indonesian rupiah in August 1997. In fact, by the middle of that month the rupiah had already fallen so far that its real exchange rate was more depreciated than in 1989–91. Similarly, based on the standard macroeconomic and financial indicators, one would have expected the real to be in more trouble than the rupiah: Brazil is rated as more vulnerable than Indonesia in all of the crisis prediction models reviewed in the previous section.

The other two models are more promising. Brazil would be a prime candidate for the signaling model. It had a long history of high inflation, which had recently been brought under control with little, if any, cost to aggregate output or unemployment. The period of high interest rates might have provided substantial information about the government's willingness to take costly measures to maintain its exchange rate (a *de facto* crawling peg), and thus its nominal anchor. In contrast, Indonesia had followed a much more prudent monetary policy, keeping the inflation rate under 20 percent for over two decades. The information content in the Indonesian government's signal would have been much less.

Finally, Indonesia's economy was much more sensitive to high interest rates than Brazil's, due to its greater financial fragility and the fact that unlike Brazil's its interest rates tend to move together. As a result, there was a much greater increase in the probability of bankruptcy in Indonesia, and thus the direct economic effect of the interest rate hikes was probably to weaken, rather than strengthen, the equilibrium exchange rate.

THE HIGH INTEREST RATE DEFENSE. The contrast between Indonesia and Brazil can be generalized to the experience of a number of developing countries. We look at periods of temporarily high interest rates, defined as episodes when the average interest rate rises by more than 10 percentage points relative to its starting value for at least five trading days, after which interest rates are reduced again. We use our judgment to determine the precise starting and ending dates of these episodes. The sample is restricted to the countries included in the emerging markets index of the International Finance Corporation (IFC). However,

many of the countries either had no data on short-term interest rates or no usable data; for example, their daily interest rate series were extremely erratic. Data limitations also restrict the sample to the period January 1992 to June 1998, although several countries have even shorter series. Finally, a number of countries have good data but do not have any episodes that match our criteria for a high interest rate defense. This leaves nine countries with at least one episode of temporarily high interest rates: Argentina, Brazil, Czech Republic, Ecuador, Indonesia, Korea, Mexico, the Philippines, and Slovakia. Table 7 presents data about these episodes and the associated exchange rates.

From eyeballing the data, there appears to be a negative relationship between either the magnitude of the interest rate hike or its duration and the eventual outcome for the exchange rate. Our theory, however, predicts that the relationship between interest rates and exchange rates will depend on initial conditions. One natural formalization is to interact the magnitude and duration of the interest rate hikes with a dummy that takes the value of 1 for countries with average inflation rates above 40 percent, and 0 otherwise. In table 8 we regress the change in the exchange rate on the magnitude and duration variables, with and without the degree of real misalignment as a control (columns 1 and 2, respectively). An alternative regression looks at the effect of the cumulative rise in interest rates, the product of the duration and average magnitude of the interest rate hike. This is also shown with and without the degree of real misalignment as a control (columns 3 and 4, respectively).

The results are very consistent across countries. In low inflation countries, each additional day of high interest rates tends to lead to an additional depreciation of roughly 0.3 percent. The sign of the effect of the average level of interest rates during the defense period is also negative, but is not significant. In the high-inflation countries, the point estimates of the effects of both the duration and magnitude of the interest rate hike are also negative, but insignificantly different from zero. The regressions of exchange rate depreciation on the total magnitude of the interest rate hike (that is, its duration multiplied by the average magnitude) yield similar conclusions. In low-inflation countries, the eventual depreciation is increasing in the total magnitude of the interest rate hike. The same result obtains for high-inflation countries, although the effect is substantially smaller. To give some sense of size, if a low-

Table 7. Effect of Temporarily High Interest Rates on Exchange Rates in Selected Developing Countries

Units as indicated

<i>Country and start of episode</i>	<i>Average magnitude of interest rate change^a</i>	<i>Duration^b</i>	<i>Initial misalignment^c</i>	<i>Average inflation, 1985-94^d</i>	<i>Change in exchange rate^e</i>
Argentina					
Nov. 10, 1992	11.7	72	66.1	641	0.0
Dec. 21, 1994	10.0	19	61.2	641	0.0
Feb. 22, 1995	13.6	20	64.4	641	0.0
Brazil					
Mar. 9, 1995	39.8	145	32.0	1089	-6.4
Oct. 30, 1997	32.8	64	33.6	1089	-1.2
Czech Republic					
May 16, 1997	46.5	33	39.1	11	-10.9
Ecuador					
Jan. 25, 1995	60.2	50	27.5	43	-1.5
Oct. 26, 1995	34.9	75	25.7	43	-5.2
July 3, 1996	13.5	8	22.7	43	2.3
Indonesia					
Aug. 12, 1997	30.7	94	4.0	8	-52.3
Korea					
Dec. 2, 1997	10.3	113	-14.2	6	-11.2
Mexico					
Oct. 3, 1995	12.8	115	-10.6	49	-13.3
Jan. 17, 1997	20.6	169	4.3	49	-10.3
Philippines					
Sept. 30, 1997	29.2	23	21.2	10	-0.4
Slovakia					
May 23, 1997	27.1	24	13.0	9	-1.6

Source: Authors' calculations based on data from World Bank (1998c), an electronic database from Datastream International, and the real exchange rate series described in table 2.

a. Percentage points. Average level of interest rates during episode less initial level.

b. Calendar days.

c. Percentage change between the real exchange rate over 1989-91 and its value in the month before the interest rate hike. Positive values indicate appreciated exchange rates.

d. Average inflation rate, measured by the GDP deflator.

e. Percentage points. Measured between beginning of episode and one month after end of episode. Positive values indicate appreciation.

inflation country raised its interest rates by 20 percent for twenty days, it would see a depreciation of 6.0 percent; the same policy in a high-inflation country would lead to a depreciation of 0.9 percent.

So far, we have discussed these results as if they expressed a causal link between interest rates and exchange rates. In reality, this interpretation is fraught with all of the difficulties we described above concern-

Table 8. Regression Results Explaining Exchange Rate Depreciations in Selected Developing Countries^a

Variable	(1)	(2)	(3)	(4)
Constant	7.33 (0.51)	6.20 (0.39)	0.85 (0.84)	3.22 (0.28)
Real misalignment ^b	0.02 (0.89)	...	0.06 (0.44)	...
Average magnitude of interest rate change ^c	-0.27 (0.33)	-0.27 (0.31)	...	...
Average magnitude × high inflation dummy	0.22 (0.44)	0.22 (0.42)	...	...
Duration ^d	-0.29 (0.06)	-0.27 (0.02)	...	...
Duration × high inflation dummy ^e	0.18 (0.17)	0.17 (0.13)	...	...
Duration × average magnitude	...	...	-0.015 (0.00)	-0.016 (0.00)
Duration × average magnitude × high inflation dummy	...	...	0.013 (0.00)	0.013 (0.00)
<i>Summary statistic</i>				
R ²	0.57	0.56	0.80	0.79
$\delta r/\delta r_m$	0.32	0.39	0.74	0.75
N	15	15	15	15
<i>Addendum: F test^f</i>				
Average magnitude	0.83	0.82	...	...
Duration	0.19	0.14	...	...
Duration × average magnitude	...	...	0.08	0.004

Source: Authors' calculations based on data in table 7.

a. *p* values are in parentheses.

b. See table 7, note c.

c. See table 7, note a.

d. See table 7, note b.

e. High inflation dummy is equal to 1 for countries with 1985-94 inflation rate (see table 7, note d) above 40 percent, and equal to 0 otherwise.

f. The null hypothesis is no effect on the exchange rate in high-inflation countries. *p* values are reported.

ing endogeneity. The more important result is that the behavior of the two subsamples is very different. In this sense, it is simply a formal generalization of the Brazil versus Indonesia story.

Also, we call our dummy variable high inflation. We could just as well have called it Latin America, or any other variable that distinguishes Latin America from the rest of the world. With so little data, it would be impossible to test the validity of the various theories about why Latin America is different.

We recognize that these results are not definitive evidence of the effect of tight monetary policy on the ability to defend the exchange rate. But they are consistent with the theoretical models described above, and also with the contrasting stories of Brazil and Indonesia about signaling and the economic costs of higher interest rates. At the very least, they question the presumption that increasing interest rates is an effective mechanism for defending the exchange rate, especially in the case of low-inflation countries, such as those of East Asia.

Policy Implications

If temporarily high interest rates lead to a weaker exchange rate today, the high interest rate policy will be strictly dominated. If they strengthen today's exchange rate but lead to a permanently weaker exchange rate, there will also be little basis for favoring this policy. The tougher case is when higher interest rates do strengthen the exchange rate, today and in the future, but at a macroeconomic cost. How does one evaluate this trade-off?

Many of the factors of the positive analysis also appear in this normative analysis. If, for instance, credit markets are highly segmented, an increase in the policy interest rate may not affect the interest rates faced by many borrowers, and thus it would be relatively costless. By contrast, where leveraging is high, high interest rates will be very costly, in terms of weakening aggregate demand and increasing the number of bankruptcies. Even if the impact of increasing the probability of bankruptcies did not outweigh the higher promised return, so that the exchange rate is strengthened, the cost may be substantially higher than is justified.

In addition, both exchange rate depreciations and interest rate increases create winners and losers, and one needs to look at the distribution of these gains and losses and the net magnitude of their impact. With a weaker exchange rate, exporters and net holders of foreign assets will benefit, while those relying on imports and net debtors in foreign currency will be hurt. In general, it is expected that the consequent rise in net exports will increase overall output, although this need not be the case for very large devaluations, which may increase bankruptcies just as do high interest rates.¹²⁵ Unexpected increases in interest rates

125. See, for instance, the discussion in Agnor and Montiel (1996, chap. 7).

hurt variable rate debtors and fixed rate creditors, while helping fixed rate debtors and variable rate creditors. As a result, they weaken financial institutions. This effect, along with others discussed below, typically leads to lower investment and thus, lower overall output.

The evaluation of these trade-offs will depend on the circumstances. In general, there are three reasons why one might be disposed toward keeping the interest rate down and letting the exchange rate depreciate.

First, from the perspective of avoiding a crisis—and focusing primarily on the likelihood that one will occur—Demirgüç-Kunt and Detragiache find that there should be greater concern about interest rate increases than exchange rate decreases.¹²⁶ This should not come as a surprise. Well-managed firms can usually find cover for their exchange rate risk. But even well-managed firms will have some indebtedness that leaves them exposed to huge increases in interest rates, especially when those increases are associated with an economic downturn.

Their results describe the typical country. Looking more specifically at the East Asian countries, one would expect these to be especially sensitive to increases in interest rates; but in at least some cases, there are reasons to believe that sensitivity to exchange rate risks was at or below average. The foreign exchange exposure of Malaysian firms and banks was very low, for example, partly because of the government's active policies limiting such exposure. Thus it seems likely that a high-interest-rate policy would have been especially misguided. And a recent survey of industrial firms in Thailand shows that much of the foreign indebtedness was held by exporting firms; these firms were at least partially covered, as they would have gained in the value of their exports part of what they lost in the increased value of their liabilities.¹²⁷ To be sure, there were some real estate ventures with large foreign exchange exposures; but given the huge vacancy rate and plummeting real estate prices, these would have gone bankrupt in any case. This observation emphasizes the importance of looking at the marginal impact of policy, for example, on bankruptcy and economic disruption more generally.¹²⁸

126. Demirgüç-Kunt and Detragiache (1998a).

127. Dollar and Hallward-Driemeier (1998).

128. One should also look at the duration of the effects. We have established that even temporarily high interest rates have effects that persist long after these rates have been lowered. What about exchange rate effects? In many cases, the defense of the exchange rate proves to be pointless: there is a lower permanent exchange rate, and the costs of

High interest rates have adverse effects on all firms with short-term debt, including small firms that never gambled by taking on liabilities denominated in foreign exchange. Very high interest rates can bring bankruptcy even to firms with moderate indebtedness.¹²⁹

The second reason is a version of the moral hazard argument. If it is believed that governments will act to stabilize the exchange rate, investors and others will be encouraged to take positions that they otherwise would not—and once they have taken these positions, the government may be forced to support the exchange rate, to avoid large adverse effects. The government must commit to not intervening to stabilize the exchange rate, either directly or through interest rate policies. Any intervention reinforces the belief that the government will be there to help stabilize the exchange rate. While in principle those who take a foreign exchange position could obtain a hedge, the maturity mismatch that characterized the East Asian crisis is an inherent part of all financial markets.¹³⁰ An increase in interest rate volatility might increase the demand for longer term loans, which could have adverse effects on firm behavior. It is also likely to lead to lower willingness to borrow more generally, and this, too, will have an adverse effect on overall economic growth.¹³¹

The third grounds for preferring exchange rate decreases is equity. Why should borrowers in general, workers, and firms, all of whom will be adversely affected by the increase in interest rates, be made to pay the price of speculators' profit?¹³² Only if it were shown, contrary to

delaying adjustment may well exceed the benefits. A temporarily lower exchange rate does have persistent effects. On one side, exporters are better off, as a result of their increased net worth. On the other side, the adverse effect on producers of nontradables depends both on the magnitude of their imports and the speed of adjustment of output prices. Those with foreign-denominated debts are worse off, but only to the extent that during the period of temporarily low exchange rates they had to make payments for which they were not covered. Those with foreign-denominated assets are better off.

129. In the very short run, firms in the nontradable sector that use tradable inputs will be adversely affected by the depreciating currency; but as output prices adjust to their new equilibrium value, the impact is limited to the inevitable disruption associated with the reallocation of resources from one sector of the economy to another.

130. A consequence of a natural mismatch between the longevity of assets and the desire of depositors for short-term liquidity; see Rey and Stiglitz (1993).

131. The lower willingness to borrow will result in less depth in the financial markets. Depth of financial markets has been shown to be significantly correlated with economic growth; for an excellent survey, see Levine (1997).

132. One might argue that successfully defending the exchange rate prevents speculators from making a profit. Our point is that when the government wagers its reserves

our results above, that the economy as a whole will benefit, would an increase in interest rates be desirable.¹³³

Concluding Remarks

As we write, the East Asia crisis has entered a second stage: while financial variables have now stabilized in several countries, all of the affected countries have moved into deep recessions, if not depressions.¹³⁴ This paper is concerned with diagnosing the causes of the East Asian crisis and assessing how appropriate have been the remedies. This is imperative if we are to improve our ability to respond to future crises and to make such crises less likely and, in the event, less deep. While we focus on the circumstances leading up to the crisis and the responses in the months immediately following its onset, many of these issues remain, as the affected countries face the challenge of recovering from deep recession. Recovery will require addressing the problems of insufficient aggregate demand and huge disturbances to aggregate supply. Tackling both sides of this equation simultaneously will require careful attention to financial institutions and the link between the financial and real sectors; and also a deeper understanding of the role of bankruptcy than was manifested in the design of the initial responses.¹³⁵

in defense of the currency, it is often making a one-way bet, where the expected loss is speculators' expected gain. In contrast, if the government does not wager any reserves, the gains of some speculators are simply the losses of others.

133. Given a social welfare function that cares about distribution, the conditions are even more stringent. One needs to show either that the disadvantaged are compensated (which they almost never are) or that the benefits to those who gain are sufficiently large that they offset the losses to others, taking into account the fact that those who are hurt, such as small businesses and workers, typically are poorer than those who benefit.

134. There is no standard definition of a depression as distinct from a deep recession. A depression is sometimes defined as a 25 percent contraction, based on the fact that U.S. GDP contracted by 26 percent between 1929 and 1932. By this definition, many forecasters foresee the possibility of a depression in Indonesia, but not in the other countries in the region.

135. Problems are apparent on both scores. In discussions of capital adequacy standards, forbearance, and the resolution of bankruptcy, insufficient attention has been paid, on the one hand, to the difference between a bankruptcy in a single firm and the kind of systemic bankruptcy currently faced by Indonesia, where an estimated 75 percent of firms are insolvent; and on the other hand, to the difference between lack of capital in a single bank and a systemic financial sector problem.

Cycles and financial panics have characterized capitalist economies over the past two centuries, and though the duration of expansions has become longer, and that of recessions shorter since World War II, there is no reason to believe that cyclical fluctuations will disappear.¹³⁶ Presumably, good macroeconomic management might be able to lengthen the expansions and both shorten the contractions and reduce their depth. But given the ubiquity of fluctuations, it is hard to attach too much blame to the occurrence of a downturn. The East Asian countries have been remarkable not only for the strength of their growth, but for the infrequency of their downturns. Yet the severity of the current crisis inevitably raises questions about these countries' policies, as well as the evolving international architecture and the international community's response.

In this respect, the paper has several broad themes. First, the crisis was the result of private decisions gone wrong—both those of lenders in industrial countries and those of East Asian borrowers. To understand what caused the crisis, and what could have been done to prevent it, requires a theoretical perspective that integrates the financial sector with the real sector and incorporates market imperfections. Instead, many analysts have relied on an inconsistent model: on the one hand, justifying the advocacy of capital account liberalization on the basis of the efficiency of free markets; while on the other hand, worrying about whether the market valuation of the exchange rate was correct and pushing for the release of more information about quantities (for example, of short-term debt) when these are not required under the perfectly competitive model.¹³⁷

Past experience shows that economic downturns associated with fi-

136. In the United States, the average recession, as dated by the National Bureau of Economic Research, fell from twenty-one months over 1854–1929 to eleven months over 1945–91. At the same time, the average expansion has grown from twenty-five months to fifty months (Joseph E. Stiglitz, "Sound Finance and Sustainable Development in Asia," speech to the Asia Development Forum, Manila, March 12, 1998; available on the worldwide web). Assessment of changes in historical volatility through business cycle dating does not require accurate measures for every subcomponent of GDP and can also employ other, non-GDP data. As a result, it is more robust against Romer's (1986) criticism about spurious volatility in historical GDP data.

137. This justification of capital account liberalization is advanced even though recent literature has established that whenever there is imperfect information and incomplete markets—certainly an apt description of the East Asian countries—markets are not even constrained Pareto efficient; see Greenwald and Stiglitz (1986).

nancial crises are markedly different from those associated with, say, inventory cycles; that they tend to be more severe, with longer lasting effects; that high leverage on the part of firms and high lending in a real estate boom contribute to financial fragility; that bankruptcy has severe consequences, especially in the case of financial institutions, with the associated collapse of the credit mechanism; that large unanticipated increases in interest rates can have severe adverse effects, both in precipitating a crisis and leading to a real economic downturn, as the asset values of banks fall and the net worth of highly indebted firms quickly erodes; and that these adverse effects persist even after the interest rate has returned to more normal levels. Research over the past two decades has not only significantly advanced understanding of financial markets, but has shown how those insights can be integrated into macroeconomic models; macroeconomic models in which financial markets are "summarized" in a money demand equation are of little use—indeed, they are likely to be highly misleading.

Had policymakers placed greater reliance on economic models that integrated finance and macroeconomics and that recognized more fully the complexity of appropriate regulation of financial markets—that reliance on capital adequacy standards may not suffice and in general is not Pareto efficient—they might have been able to mitigate the severity of the current downturn. Such models would have forced a recognition that preventing and responding to crises requires a broad range of instruments, including those that stabilize and ensure the safety and soundness of financial and capital markets. Standard forecasting models, incorporating reasonable assumptions of lags, suggest that the onset of a crisis will be followed by a severe downturn that would be exacerbated by fiscal contraction, such as targeting a zero deficit, even if that deficit only included interest on the financing costs of restructuring the banking system. Policy designs that took more explicit account of dynamics—not only the lags, but the irreversibilities and persistence associated with reduced net worth and bankruptcy—and were based on a Bayesian statistical decision framework would likely have achieved far better outcomes.¹³⁸

138. It should have been obvious that there were risks associated with any policy, and that who bear those risks differed markedly among policies. Thus, the decision about the appropriate policy was not a mere technical decision, to be left to government bureaucrats, either within the country or in international agencies, but an intensely political one.

Second, the research to date has little to contribute to the discussion. The variables typically ascribed to major roles in the crisis do not seem to have high predictive value in a wider sample of countries. And while some have been tempted to fit a model using a single data point, or even four data points, this approach does not advance one's understanding much, and certainly does not prepare one to prevent the next crisis.

Third, in the debate over how to cope with capital inflows and with rapid capital outflows, the disagreements among economists counsel a degree of humility. We do not have all the answers.¹³⁹ In our discussion of macroeconomic policy, we have tried to show that the "correct" answers were far from obvious at the time the decisions were made, and even with the benefit of hindsight. Under these circumstances, blaming the victims while ignoring those who willingly lent to them is unfair at best, and at worst can lead to counterproductive responses.

Finally, it is necessary to reexamine some aspects of the international economic architecture, those that relate to short-term capital flows in particular, to ask whether it exposes developing countries to significant risks without commensurate returns. If a single car has an accident on a road, there is a presumption that the driver made an error; if there are repeated accidents at the same curve, then the presumption should be that the road is badly designed. The key issue is not whether the social risk is equal to the private risk—there can be little doubt that it does not—but whether and how one can design policies whose benefits outweigh their ancillary costs. The international response to the East Asian crisis makes clear that we lack evidence on many crucial issues, and that much more research is needed.

APPENDIX A

Empirical Estimation of Prediction Models

IN OUR EMPIRICAL estimations of the three currency crisis prediction models, we try to stick as closely as possible to their sources and

139. In part the disagreements arise from the paucity of relevant data. But more broadly, to some extent they are based on differences of interests and ideologies. In any case, the fact that the available evidence can be interpreted in such different ways supports the view that economic policy is not just a technical matters, to be resolved by technicians.

definitions. This appendix indicates only the ways in which our data, definitions, and coverage differ; for complete sources and definitions, please see the original papers. We assess the banking crisis model of Demirgüç-Kunt and Detragiache (1998a) on the basis of their own calculations.

Frankel and Rose (1996)

We use the same definitions and sources as in the original paper, except that we use IMF and World Bank staff estimates of the trade-weighted real exchange rate relative to its average value in 1989–91. The left-hand-side crisis variable runs from 1980 to 1996, and the right-hand-side variables are lagged by one year. There are 104 countries in the sample (all the countries for which at least one data point is available), and 766 usable observations out of 1,768 possible observations. The probit regression coefficients, estimated by maximum likelihood, are given in table A1. We use these to calculate the probabilities shown in table 3 in the text.

The variables that reduce the probability of a crisis and are significant at the 0.10 level are similar to those found by Frankel and Rose. In particular, greater foreign direct investment, multilateral debt, reserve-to-import ratio, or per capital income growth reduce the probability of a crisis, while an overvalued exchange rate increases the probability. The one anomaly is that higher foreign interest rates seem to increase the probability of a crisis.

Kaminsky, Lizondo, and Reinhart (1998)

We define the indicators as in the original paper, with the exception of real appreciation, which is defined as the real exchange rate (measured using multilateral trade-weighted real exchange rates from unpublished estimates by World Bank staff, based on IMF data) relative to its average value in 1989–91. We assume that there is no trend in the real exchange rate; the results for the East Asian countries are insensitive to this assumption.

In our updating of the Kaminsky, Lizondo, and Reinhart framework a crisis in 1997 is defined according to the following criteria. A monthly

Table A1. Probit Regression Estimates Predicting a Currency Crisis in 1997 Using the Model of Frankel and Rose^a

Variable	Effect on probability of crisis ^b	Z statistic ^c
Commercial bank debt/total debt	0.06	0.84
Concessional debt/total debt	-0.07	1.48
Variable rate debt/total debt	-0.07	0.91
Short-term debt/total debt	0.02	0.34
Foreign direct investment/total debt	-0.19*	1.64
Public sector debt/total debt	0.02	0.26
Multilateral debt/total debt	-0.12*	1.78
Debt/GNP	-0.03	1.50
Reserves/imports ^d	-0.57*	1.82
Current account surplus ^e	-0.09	0.68
Overvaluation ^f	0.02**	2.46
Government budget surplus ^e	0.06	0.36
Domestic credit growth rate	8.6×10^{-6}	0.04
GNP per capita growth rate	-0.44†	3.43
OECD growth rate	-0.09	0.16
Foreign interest rate	0.66**	2.25
<i>Summary statistic</i>		
Log likelihood	-168.6	...
Pseudo R ²	13.6	...
Number of crisis observations	54	...
Number of tranquil observations	712	...

Source: Authors' calculations using model of Frankel and Rose (1996), based on World Bank (1998b, 1998c), *International Financial Statistics*, and the real exchange rate series described in table 2.

a. Variables and specification are defined in the text and by Frankel and Rose. Significance at the 10 percent level is denoted by *; at the 5 percent level, by **; at the 1 percent level, by †.

b. This is dF/dx , the change in the probability of a crisis for an infinitesimal change in the variable evaluated at the means of all variables.

c. Absolute value.

d. Months.

e. Percent of GDP.

f. Percent.

crisis index is computed as the weighted sum of the change in reserves and the change in the nominal exchange rate (vis-à-vis the U.S. dollar), where the weights are the inverse of the variance of these variables between January 1975 and June 1998. A crisis occurs in any given month if this index rises more than 3 standard deviations above its mean for that country. If there is a crisis in any month in 1997, we say a crisis occurred in 1997.

The percentile rankings of the East Asian countries in December 1996 relative to their own history (1976–96) and to other developing

Table A2. Vulnerability to Crisis for East Asian Countries in December 1996 Relative to 1976-96, Using the Kaminsky, Lizondo, and Reinhart Model
Percentile^a

Indicator ^b	Country				
	Indonesia	Korea	Malaysia	Philippines	Thailand
Real exchange rate ^c (+)	95	55	96	99	99
Banking crisis in previous year ^d	0	0	0	0	0
Export growth (-)	72	87	76	58	91
Stock price growth (-)	15	92	32	49	93
M2/reserves growth (+)	26	38	66	16	57
Output growth (-)	...	...	44	...	...
"Excess" M1 balances	...	...	...	...	...
Reserve growth (-)	26	63	53	16	72
M2 multiplier growth (+)	83	3	97	57	19
Domestic credit/GDP growth (+)	99	99	...	99	80
Real interest rate (+)	75	19	93	67	53
Terms of trade growth (-)	...	98	...	...	...

Source: Authors' calculations using model of Kaminsky, Lizondo, and Reinhart (1998), based on *International Financial Statistics*, and the real exchange rate series described in table 2.

a. A higher percentile indicates greater vulnerability. For some indicators (marked +) this is the percentage of months with values below that for December 1996, for the others (marked -) it is the opposite. Numbers that exceed Kaminsky, Lizondo, and Reinhart's warning thresholds are in boldface.

b. Variables are listed according to their adjusted signal-to-noise ratios, as estimated by Kaminsky, Lizondo, and Reinhart.

c. Our definition differs from that of Kaminsky, Lizondo, and Reinhart.

d. 99 if there was a banking crisis in 1996; 0 otherwise.

countries in December 1996 are shown in tables A2 and A3, respectively. Our sample of developing countries includes the low- and middle-income countries in the IFC's emerging markets index (Argentina, Bangladesh, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Côte d'Ivoire, Czech Republic, Ecuador, Egypt, Ghana, India, Indonesia, Israel, Jamaica, Jordan, Kenya, Korea, Lithuania, Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Russian Federation, Slovak Republic, Slovenia, South Africa, Sri Lanka, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Venezuela, and Zimbabwe) plus Korea and Singapore. For most of the variables, even the December 1996 data would not have been available by the time the crisis struck in July 1997. In this sense, choosing such a late date allows us to assess the causal impact of these variables, but gives an unrealistic picture of how well the model would have predicted the crisis. But anyone who estimated warning signals based on this framework could have formed a reasonable expectation of the Decem-

Table A3. Vulnerability to Crisis for East Asian Countries in December 1996, Relative to Other Developing Countries, Using the Model of Kaminsky, Lizondo, and Reinhart
Percentile^a

Indicator ^b	Country				
	Indonesia	Korea	Malaysia	Philippines	Thailand
Real exchange rate ^c (+)	47	34	53	91	56
Banking crisis in previous year ^d	0	0	0	0	0
Export growth (-)	81	87	73	31	95
Stock price growth (-)	43	97	54	39	99
M2/reserves growth (+)	21	47	59	7	42
Output growth (-)	...	...	25	...	...
"Excess" M1 balances	...	...	...	...	...
Reserve growth (-)	17	70	50	8	67
M2 multiplier growth (+)	83	7	80	59	40
Domestic credit/GDP growth (+)	58	76	...	74	94
Real interest rate (+)	60	24	34	53	51
Terms of trade growth (-)	...	99	...	...	...

Source: Authors' calculations using model of Kaminsky, Lizondo, and Reinhart (1998), based on *International Financial Statistics*, and the real exchange rate series described in table 2.

a. See table A2, note a.

b. See table A2, note b.

c. See table A2, note c.

d. See table A2, note d.

ber 1996 values of many of these variables by the early spring of 1997, at the latest. Thus this reflects something like a three-month-ahead prediction probability.

The higher the percentile, the greater the potential of a crisis. When the vulnerability is indicated by a high indicator (as with the ratio of M2 to reserve growth), the value is positive; when it is indicated by a low indicator (as with export growth), it is negative. Numbers that exceed the optimal thresholds derived by Kaminsky, Lizondo, and Reinhart are indicated in boldface.

Sachs, Tornell, and Velasco (1996)

For the Sachs, Tornell, and Velasco regression, we extend the country sample and update the timing of the variables. We draw our country sample from the IFC's emerging markets index, which represents a reasonable selection of countries that are relatively open to international capital movements. Excluding the European Union countries, Greece

and Portugal, the transition economies, and the countries for which there are insufficient data, we are left with thirty-four countries (fourteen more than in Sachs, Tornell, and Velasco's sample): Argentina, Bangladesh, Botswana, Brazil, Chile, China, Colombia, Côte d'Ivoire, Ecuador, Egypt, Ghana, India, Indonesia, Israel, Jordan, Kenya, Korea, Malaysia, Mauritius, Mexico, Morocco, Pakistan, Peru, Philippines, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Venezuela, and Zimbabwe.

With the exception of the real exchange rate, the data sources and calculation methods are the same as in the original paper, but the timing differs. The right-hand-side variables are as follows:

Lending boom (<i>LB</i>)	Growth in credit to the private sector, 1992–96.
Real appreciation (<i>RER</i>)	Measured using a multilateral trade-weighted real exchange rate index computed by World Bank staff using IMF data. The base period is 1988–92, and the current period is set as the average of January 1996 to June 1997, to avoid the after-effects of the Tequila crisis.
Reserve adequacy	Ratio of M2 to reserves, June 1997.
Crisis index	Weighted average of the percentage change in the exchange rate and reserves between June 1997 and December 1997. Weights are country-specific and equalize the contribution of each component to the variance of the index over the previous decade.
Weak fundamentals dummy (D^{WF})	We use the same <i>numerical</i> cutoffs as the original paper: dummy is 1 if a country has a real depreciation greater than 16 percent or domestic credit growth in excess of 7 percent; otherwise, it is 0. Countries with sound fundamentals include Côte d'Ivoire, India, and Trinidad and Tobago

Inadequate reserves
dummy (D^{LR})

Dummy is 1 if a country's ratio of M2 to reserves is greater than 2.1; otherwise, it is 0. Countries with adequate reserves include Botswana, Chile, Colombia, Ghana, Peru, Singapore, and Venezuela.¹⁴⁰

Sachs, Tornell, and Velasco estimate the following regression:

$$IND = b_1 + b_2(RER) + b_3(LB) + b_4(D^{LR} \times RER) + b_5(D^{LR} \times LB) + b_6(D^{LR} \times D^{WF} \times RER) + b_7(D^{LR} \times D^{WF} \times LB) + e.$$

They hypothesize that the effect of a real depreciation on the severity of a crisis in a country with inadequate reserves and bad fundamentals ($b_2 + b_4 + b_6$) will be significant and negative, and that the effect of a lending boom on a country with inadequate reserves and bad fundamentals ($b_3 + b_5 + b_7$) will be significant and positive. They find these results in most of their specifications. They also hypothesize that these variables will have no predictive power for the severity of a crisis in countries with either adequate reserves or good fundamentals (b_2 , b_3 , $b_2 + b_4$, and $b_3 + b_5$). They find this to be the case in most specifications of their model.

Table A4 shows the results from running the Sachs, Tornell, and Velasco regression with our updated variables for 1997, both for our expanded country sample and for the original country sample. In the larger sample, the only meaningful combination of coefficients that is significant and of the correct sign says that a lending boom in a country with weak fundamentals and inadequate reserves increases the probability of a crisis. The degree of real appreciation in countries with weak fundamentals and inadequate reserves is marginally significant but of the wrong sign: greater real appreciation reduces the severity of a crisis.

Our second exercise with these data is to use the coefficients from the 1996 paper to form a predicted index of the severity of the crisis in

140. Note that the top quartiles of the new sample are very close to the old ones for real appreciation, domestic credit growth, and the ratio of M2 to reserves. Defining the thresholds as the top quartile of the new sample would thus have resulted in the same dummy variables for almost all of the countries. The results are robust to the alternative definition.

Table A4. Regression Results Explaining the Severity of the Crisis in 1997 Using the Model of Sachs, Tornell, and Velasco^a

<i>Independent variable</i>	<i>Full sample</i>	<i>Original sample</i>
Constant (b_1)	20.56 (0.09)	36.95 (0.12)
Real appreciation (b_2) ^b	0.29 (0.58)	1.58 (0.27)
Lending boom (b_3)	-0.032 (0.78)	0.077 (0.62)
Real appreciation \times low reserves dummy (b_4)	-0.64 (0.49)	-2.24 (0.26)
Lending boom \times low reserves dummy (b_5)	0.20 (0.31)	0.36 (0.26)
Real appreciation \times low reserves dummy \times weak fundamentals dummy (b_6)	1.01 (0.10)	1.40 (0.15)
Lending boom \times low reserves dummy \times weak fundamentals dummy (b_7) ^c	0.15 (0.09)	. . .
<i>Summary statistic</i>		
R^2	0.05	0.10
\bar{R}^2	-0.16	-0.22
N	34	20
<i>Addendum: Wald tests</i>		
$H_0: b_2 + b_4 = 0$	0.39	0.30
$H_0: b_2 + b_4 + b_6 = 0$	0.12	0.30
$H_0: b_3 + b_5 = 0$	0.32	0.10
$H_0: b_3 + b_5 + b_7 = 0$	0.04	0.10

Source: Authors' calculations using model of Sachs, Tornell, and Velasco (1996), based on *International Financial Statistics*, and the real exchange rate series described in table 2.

a. Variables and specification are described in the text and by Sachs, Tornell, and Velasco; p values are in parentheses. Note that results reported by Sachs, Tornell, and Velasco include a numerical error: all reported coefficients must be divided by 10 to be consistent with definitions of variables.

b. A negative value indicates a real appreciation.

c. This row is impossible to estimate for the original sample, since it includes only one country with sound fundamentals. But this does not affect the hypothesis tests on the combined values.

1997. We then compare these values with the actual crisis values.¹⁴¹ The results are shown in table A5, where countries are listed in order of the severity of the predicted crisis. The correlation between predicted and actual values is 0.10 and is not significantly different from 0 at any reasonable significance level.

141. Note that the results reported in Sachs, Tornell, and Velasco (1996) include a numerical error: all of the reported coefficients should be divided by 10 to be consistent with the definitions of the variables.

Table A5. Predicted versus Actual Crises in 1997 Using the Model of Sachs, Tornell, and Velasco

Crisis index		
Country	Predicted ^a	Actual ^b
Philippines	56	54
Ecuador	48	12
Egypt	29	0
Côte d'Ivoire	19	1
Argentina	15	-11
Ghana	15	7
Thailand	13	61
Kenya	12	7
Peru	11	-3
Brazil	10	8
Bangladesh	9	4
Turkey	8	26
Malaysia	8	70
Israel	7	0
Indonesia	6	283
Morocco	5	1
Sri Lanka	4	4
Mauritius	3	7
Zimbabwe	3	64
Korea	2	90
Trinidad and Tobago	2	1
Taiwan	1	18
Jordan	1	0
India	0	10
South Africa	-2	8
China	-5	-7
Tunisia	-7	3
Pakistan	-7	9
Botswana	-8	2
Chile	-11	8
Singapore	-11	18
Colombia	-14	18
Venezuela	-22	-6
Mexico	-22	2

Source: Authors' calculations using model of Sachs, Tornell, and Velasco (1996), based on *International Financial Statistics* and the real exchange rate series described in table 2.

a. Fitted value based on regression coefficients reported by Sachs, Tornell, and Velasco, using data prior to the outbreak of the East Asian crisis. Exact definitions and timings of the variables are given in text.

b. Weighted average of the percentage change in the nominal exchange rate (against the U.S. dollar) between June and December 1997 and the (negative) percent change in reserves. Weights are proportional to the inverse of the variances of the monthly values of these two series between 1987 and 1996.

APPENDIX B

The Adverse Effects of an Interest Rate Increase

THE EXPECTED RETURN to a bond depends on the probability of bankruptcy; as that increases, the expected return falls. In this appendix we show that if there is initially credit rationing, an increase in the interest rate will lead to more extensive credit rationing, that is, some existing loans will not be rolled over. More generally, we show that there may be adverse effects on the overall expected rate of return. If investors are not risk neutral, the adverse effects on the desirability of investing funds in the country are even greater, especially if there are adverse effects on assets that are highly correlated, such as human capital.

Standard partial equilibrium models analyze the effect of an increase in the interest rate on the probability of default. Assume the firm's return is a random variable θ . Furthermore, the firm has outstanding debt B , on which it pays a variable interest rate r . Its cash flow will be sufficient to meet its debt obligations if

$$\theta > rB.$$

If θ is distributed with distribution function $F(\theta)$, then the probability of default is

$$F(rB)$$

and the increase in the probability of default as a result of an increase in r is simply

$$dF/dr = B f(rB),$$

where f is the density function.¹⁴²

142. This simple model both under- and overstates bankruptcy: even if its current cash flows are insufficient to meet current obligations, a firm might be willing to make loans to finance the deficit if future expectations are sufficiently positive. Yet its obligations also include loans coming due; if lenders are pessimistic, they will refuse to roll over those loans at any interest rate. That is what happened in the East Asian countries. Note that a refusal to roll over is inconsistent with standard models, in which there is always an interest rate which would induce a lender to roll over. But with the standard models of imperfect information in capital markets there can be credit rationing, so that there is no interest rate at which lenders are willing to roll over. The fact that there is a rollover crisis is thus fully consistent with the models on which we focus and totally inconsistent with the standard model.

Stiglitz and Andrew Weiss (1981) show that in response to the increase in r , firms will in fact change their behavior in such a way as to increase the probability of bankruptcy; that is, F is a function of r . But beyond that, in any "firm-specific" contingency, the return itself depends on macroeconomic conditions. In this framework, we represent macroeconomic conditions by the interest rate on safe government securities, r_m . In general terms, these considerations can be modeled by extending the distribution function of θ to $F(\theta, r, r_m)$ and assuming that $F_1 > 0$, $F_2 > 0$, and $F_3 > 0$.

In this more general specification, the increase in the probability of default as a result of an increase in r_m , which in turn induces an increase in r , is

$$\frac{dF}{dr_m} = \{B F_1 + F_2\} \frac{\delta r}{\delta r_m} + F_3 > 0.$$

An increase in r leads to an increase in bankruptcy on three accounts: the direct effect from the increased obligations (the first term in the equation above), the increased risk-taking that this induces (second term), and the adverse macroeconomic effects that result (third term).

One can now ask whether an increase in interest rates makes it more or less desirable to roll over a loan, or to make a new loan. Consider the expected return to a loan ρ , and assume that if the firm goes bankrupt, it incurs costs of C . To simplify the notation, assume that all possible realizations of θ are larger than C . The expected return to the loan is

$$\rho = r(1 - F) + \int_{\theta_{\min}}^{rB} \left(\frac{\theta - C}{B} \right) dF.$$

The change in this return with respect to a change in r_m , which in turn induces an increase in r , is

$$\begin{aligned} \frac{d\rho}{dr} = \frac{\partial r}{\partial r_m} - \left(F + CF_1 + \int_{\theta_{\min}}^{rB} \frac{rB - (\theta - C)}{B} dF_2 \right) \frac{\partial r}{\partial r_m} \\ - \int_{\theta_{\min}}^{rB} \frac{rB - (\theta - C)}{B} dF_3 \end{aligned}$$

This expression can be interpreted as follows. In a world without

bankruptcy, the expected return would increase one to one with the lending interest rate. But in this more general framework, four different terms (all of which are positive) guarantee that the rate of return will increase by far less than the interest rate. The first term represents the fact that there is a probability of bankruptcy F . The second term is the dissipative cost of bankruptcy (C) multiplied by the additional firms that go bankrupt as a result of the higher lending interest rate (the density function evaluated at $\theta = rB$). The third term represents the moral hazard effect that increases the probability of a lower return. And the fourth term represents the externality from the overall macroeconomic weakening due to the higher market interest rate, which increases the probability of bankruptcy. In general, however, the sign of the derivative as a whole will be ambiguous.

But when firms are credit rationed, an increase in the policy interest rate, r_m , always leads to a lowering of the expected return to private loans if there are adverse macroeconomic effects. This is a simple application of the envelope theorem. To see this, define the maximum return as the highest expected return maximized over the choice of interest rate, $\rho^* = \max_r [\rho]$. Note that the change in the maximum return can be written as

$$\frac{d\rho^*}{dr_m} = \frac{\partial \rho^*}{\partial r} \frac{\partial r}{\partial r_m} + \frac{\partial \rho^*}{\partial r}$$

Recall from Stiglitz and Weiss (1981) that when there is credit rationing, interest rates are set so as to maximize the expected return, where each firm ignores the effect of its actions on the macroeconomy. In this case,

$$\frac{\delta \rho^*}{\delta r} = 1 - \left(F + CF_1 + \int_{\theta_{\min}}^{rB} \frac{rB - (\theta - C)}{B} dF_2 \right) = 0,$$

so that the total effect is just

$$\frac{d\rho^*}{dr_m} = - \int_{\theta_{\min}}^{rB} \frac{rB - (\theta - C)}{B} dF_3 < 0.$$

Thus whenever there is credit rationing, raising the interest rate will lower the expected return, and thus drive capital out of the country.

It is important to emphasize that this result is not general; it requires

that there initially be credit rationing. Therefore it is perfectly consistent with the observation that there have been numerous instances in which raising the interest rate has had the desired effect. In Latin America, for example, firms typically have low debt-to-equity ratios, so that their probability of default is low; and capital markets are highly segmented, so that many borrowers are insulated from the effects of an increase in the interest rate, at least in the short run. Moreover, an increase in the deposit rate in government-insured deposits (where a government provides such insurance or is believed to be providing such a guarantee) may attract capital, even as lenders are pulling out funds from firms that are at risk of default. In that case, the net effect is ambiguous. At the very least, this analysis should warn against the blanket use of the policy of raising interest rates in response to a devaluation, or the threat of one. Finally, to the extent that the debt held outside the country is sovereign debt, the factors influencing default are markedly different from those that have been analyzed in this section.

In response to the above arguments, one might object that if lenders set interest rates to maximize expected returns, an increase in the bank discount rate may have no effect on lending rates. While that is true, the concerns we raise are more serious. There are then two categories of borrower: marginal and inframarginal. For the marginal borrowers, if ρ_{\max} represents the maximum rate of expected return that can be extracted from them, regardless of the rate of interest charged, and if ρ^* is the market rate of return, then $\rho_{\max} = \rho^*$. But it is clear that if macroeconomic conditions deteriorate ρ_{\max} will fall, and marginal groups will accordingly be cut out of the market: the extent of the roll-over problem will increase. Indeed, if the macroeconomic effects are large enough, even inframarginal borrowers will be excluded from the market.

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