The East Asian currency crises: lessons for an early warning system

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Abstract

Is it possible to devise a functioning early warning system for currency crises, and is there a role for the analysis of indicators beyond economic fundamentals? In light of the East Asian crisis, the issue is examined both theoretically and empirically. An analytical framework to detect macroeconomic and structural vulnerability as well as changes in the perception of fundamentals is developed, and a range of leading indicators explored. An exemplary early warning system which includes investors' sentiments is applied retrospectively in case studies of the crises in Indonesia and Thailand in 1997, Mexico 1994 and three other Latin American episodes.

The paper argues that the monitoring of market sentiments has a place along with the analysis of economic fundamentals, structural and political factors. Particularly in the recent East Asian experience, a sudden and dramatic change in the perception of economic fundamentals and expectations regarding future developments was the driving force behind the crisis. A range of promising indicators are identified, some using readily available quantitative data. The challenge lies in the exploration of relevant information outside the traditional realm of economics and the construction of quantifiable indices. The importance of sudden changes in expectations, however, is the very fact that ultimately defeats any attempt to predict currency crises under perfect international capital mobility. Applying the framework suggested in this paper shows that in most cases alarm bells would have gone off some time before the crash; but this result is ultimately due to the benefit of hindsight. The next crisis will always be different. The best any early warning system can do is to give policymakers a clearer indication that problems are brewing.
The East Asian currency crisis: lessons for an early warning system

A sad commentary on our understanding of what drives capital flows is that every crisis spawns a new generation of economic models.

Dani Rodrik (1998)

Introduction

The current East Asian crisis came as a surprise. Economic growth was strong, and the East Asian ‘tigers’ looked set for the continuation of rapid development. Just four years before the crash, the World Bank (1993) published its ‘miracle’ report epitomising the overwhelming optimism regarding the economic prospects of the region. Even the few cautioning voices had not anticipated that a currency crisis in Asia could be so severe and lead to an economic meltdown on the scale experienced in 1997/98, especially in Indonesia (Krugman 1998). The crisis was marked by a sudden and drastic loss of confidence on the part of investors. Given the high degree of capital mobility, this led to immediate capital outflows, causing and reinforcing rapid depreciation.

The question examined in this paper is this: Is it possible to devise a functioning early warning system, and is there a role for the analysis of indicators beyond economic fundamentals? The recent theoretical literature focuses on the self-fulfilling characteristics of currency crises, thus emphasising changes in expectations as determinants of exchange rate collapse and the inherent unpredictability of crisis. The challenge is to integrate the insights of this school of thought with traditional approaches focusing on macroeconomic fundamentals, and develop an applicable system of indicators.

The East Asian crisis is not the first time an economic ‘miracle’ has abruptly ended in a currency crisis. Mexico 1994/95 was in many ways a forerunner of modern ‘emerging market’ crises. Chile 1982 was another case of sudden, unexpected downturn, long before the globalisation of capital markets. At the same times and in the same regions, there were crisis episodes which were more readily anticipated on economic grounds, such as Thailand 1997 and Mexico 1982, and less drastic crises caused mainly by contagion, such as Argentina 1995. While this paper is motivated by the crisis in Indonesia, it looks comparatively at all of these episodes.
The professional investor is forced to concern himself with the anticipation of impending changes, in the news or in the atmosphere, of the kind by which experience shows that the mass psychology of the market is most influenced.

John Maynard Keynes (1936:155)

Theoretical aspects

Crises caused by economic fundamentals
The first-generation theoretical approach to currency crises, pioneered by Krugman (1979), explains the occurrence of speculative attacks when economic fundamentals are incompatible with a particular exchange rate peg. Expansionary monetary or fiscal policy leads to a gradual depletion of reserves, and over time the fixed exchange rate cannot be maintained. The pressure on the exchange rate can also be attributed to domestic economic factors outside the realm of policy, or to international shocks. In traditional models, speculative attacks are the response to macroeconomic inconsistencies, and the timing of the crisis is, in principle, predictable. An early warning system based on this approach consists of macroeconomic fundamentals indicators.

Self-fulfilling crises
In second-generation models (Obstfeld 1986), currency crises are seen as a shift between multiple exchange rate equilibria caused by a self-fulfilling change in investors’ expectations. Even sustainable exchange rate pegs can collapse, and the timing of a crisis is indeterminate. In essence, a crisis occurs if, and only if, speculators expect it to. The crucial point is how expectations are determined and coordinated. Some models allow for ‘…non-attack equilibria where speculators see but do not pursue available profit opportunities. In such a situation, anything that serves to coordinate the expectations and actions of speculators can suddenly cause an attack’ (Flood and Nancy 1998:14). Economic fundamentals are important in that they define the set of possible equilibria, and insofar as they influence expectations, but they do not directly determine the event of a crisis. Instead, there is an important element of market psychology. The choice of indicators for an early warning system based on self-fulfilling models will not be restricted to macroeconomic fundamentals.
Rationality of financial markets
The concept of rationality in economics essentially states that individuals will try to do what they consider best for themselves. Intertemporal decisions are assumed to be based on rational expectations, that is, ‘best guesses’ taking into account all available information. The central feature of financial markets is the processing of information on returns and risks in an intertemporal context. The discussion of irrationality in financial markets does not dismiss the fundamental tenet of individual rational behaviour. Instead, it focuses on problems in the formation of expectations and on collectively irrational outcomes of individually rational behaviour. The fact that financial markets do at times behave in an erratic fashion is undisputed. Kindleberger (1989) provides a rich history of ‘Manias, Panics and Crashes’. The challenge is to find explanations and analytical tools for these apparent bouts of irrationality.

Information, perceptions and expectations
An important step in making the analysis of information in financial markets more realistic is to acknowledge that there is room for the interpretation of information. The notion that the same fact may be assessed differently under changed circumstances or by different individuals will be referred to as the ‘perception’ of information. Differing perceptions can be interpreted as a subset of asymmetric information problems. Expectations, then, are formed not directly on the basis of available information, but on perceived information. Perceptions can be altered by factors unrelated to the issue at stake. Consequently, expectations may change even when the underlying information remains the same. The reevaluation of financial risks can be caused by events which have little to do with the economics of the investment in question, but carry a psychological impact. This chain of argument makes it possible to include ‘mood swings’ of financial markets in the analysis. Such apparently irrational behaviour can then be interpreted as the rational outcome of changes in seemingly unrelated information.

Herd behaviour
A frequently observed feature of capital markets is herding, that is, the fact that individual investors buy when they see others buy, and sell when they see others sell. Herd behaviour is instrumental in bringing about self-fulfilling crises. There are differing explanations for the phenomenon of individually rational, but socially inefficient, herd behaviour in financial markets.

The first relates to the cost of gathering and assessing information. When the cost of being fully informed is higher than the expected losses incurred when running with the crowd, and transaction costs are low, the privately optimal level of information for creditors is below full information, and actions of individual investors can trigger widespread imitation. Such an outcome is individually rational but can be collectively irrational. Drastic reductions in transaction costs and liberalisation of global financial markets have increased the problem over recent years, and developing countries are most susceptible as accurate information is in many cases harder to obtain in developing countries than in industrialised countries. The counter-argument is that it is inconceivable that large funds, investing billions of dollars internationally, should be consciously underinformed. Given the magnitude of capital flows controlled by individual players, the cost of information would have to be implausibly high. The reality is that funds employ country specialists who have access to a great deal of timely information.

An alternative explanation of herding is to analyse the incentive structure for individual fund managers. A simple payoff matrix can illustrate choices and outcomes in the event of an approaching financial panic (Table 1).
The bottom line is that a fund manager can hardly go wrong by running with the crowd, but personally risks a lot by swimming against the tide. McLeod (1998:336) employs a zoological analogy: ‘When a herd of zebra suddenly run off in the same direction, it may be because one of them saw a lion approaching; the zebra who stays put because it has not yet seen the lion with its own eyes runs the risk of going from needing a meal to being one’.

Finally, Krugman (1997) provides some observations on the thinking and behaviour of real-life money managers, which include myopia, being hostage to ‘fashions’ in economic thinking, ‘riding the market’ for extra profits when it is obvious that equities are already overvalued, and the belief that there will always be someone in the market who is slower to jump a sinking ship. On herding, Krugman concludes that money managers are ‘…not a predatory pack of speculative wolves [but] an extremely dangerous flock of financial sheep’.

Types of currency crises
Based on the literature, it is possible to classify financial crises according to their presumed causes. Radelet and Sachs (1998b) distinguish the following.

- **Policy-induced crises.** Domestic credit expansion by the central bank, typically caused by monetisation of fiscal deficits, is inconsistent with the pegged exchange rate.

- **Financial panics.** There are multiple equilibria in financial markets, the outcome depends on creditors’ expectations. During a panic, some short-term creditors withdraw their loans from a solvent borrower, causing others to follow suit. If creditors could coordinate their actions, they would be better off continuing to lend.

- **Disorderly workouts.** Creditors force the liquidation of an insolvent borrower although the borrower has higher net worth if operations continue. Again, the cause of the crisis is a coordination problem among creditors, in this case failing to provide working capital.

- **Bubble collapses.** Financial assets are traded at prices above their underlying value in the expectation of further speculative gains. It is clear that the bubble will eventually collapse, but the timing is stochastic and cannot be predicted.

- **Moral-hazard induced crises.** When bank deposits are guaranteed by the government, banks have the incentive to engage in overly risky lending. The problem of asymmetric information is exacerbated by poor regulation, supervision and undercapitalisation.

In the current debate on the East Asian crisis, individual analysts tend to subscribe exclusively to one of these explanatory categories, to the extent of intellectual ‘camps’ arising. For example, Radelet and Sachs (1998b) argue that the East Asian crisis is characterised by financial panic and disorderly workout, Krugman (1998) is an exponent of the moral hazard/bubbles school, while the IMF, at least initially, subscribed to a policy-based explanation.

The author is attracted to a financial panic explanation along the lines suggested by Radelet and Sachs (1998a) but takes the view that any real crisis is likely to include elements from several of the categories. Exclusive use of one explanatory pattern limits the ability to
see the facts. The theoretical and empirical framework proposed in this paper emphasises perceptions and expectations, thus taking up the ‘rationality of financial markets’ debate, but starting from the analysis of economic fundamentals and structural aspects.

A story of crisis
Presuming there is some truth in each of the explanatory approaches, and with the benefit of hindsight on the events leading up to the recent East Asian crisis, it is possible to put forward a proposition as to how a typical modern currency crisis might arise. Models of self-fulfilling currency crises constitute the theoretical background for the hypothesis that follows. The story underlying the suggested early warning system examined in this paper is in three stages:

**Vulnerability**
- macroeconomic fundamentals are deteriorating and
- structural problems (microeconomic and/or political) exist.

Vulnerability is a precondition for crisis, but the situation of vulnerability may persist indefinitely without a crisis happening.

**Change in perceptions** or re-evaluation of risk (change of ‘sentimentals’)
- re-evaluation or heightened awareness of known facts about fundamentals and/or
- changing perception of political/institutional stability.

At this stage there is a loss of confidence in a country’s economy and currency, posing an immediate threat of capital outflows and subsequent crisis.

**Trigger**
- an event ‘tipping the balance’. Expectations switch to a collapse of the exchange rate equilibrium.

These are self-fulfilling, and a currency crisis results.

This story combines elements from different explanatory patterns, but integrates them within a coherent framework. Vulnerability arising from macroeconomic fundamentals accommodates policy-induced explanations, while the structural indicators can be geared towards identifying financial bubbles and moral hazard in the banking sector. Vulnerability is seen as a necessary, but not a sufficient, precondition for financial panics. Monitoring of ‘change of perception’ indicators is meant to anticipate a sudden loss of confidence which may lead to a panic in the event of a suitable trigger. This pattern of explanation can be said to broadly fit both the Mexican crisis of 1994 and the recent East Asian experience. Greatly increased capital mobility means that changes in investors’ expectations quickly translate into capital movements. Even a temporary loss in confidence can have dramatic consequences.7

The role of an early warning system in this context is to identify the first and second stage of the process, thus sending policymakers a clear signal that preventive action is needed. If the first stage is reached, economic policy should aim to correct the macro and microeconomic imbalances, and economic as well as political stability should take increased importance in order to avoid reaching stage two. At the second stage, a currency crisis may be imminent, and policy should be aimed squarely at influencing investors’ perceptions and short-term expectations.
More than any other branch of economics perhaps, [the branch of forecasting] needs to engage in deep introspection!

The search for leading indicators
The choice of indicators is at the core of any early warning system. This section is devoted to a discussion of some promising indicators, their features and how they might be applied.

Macroeconomic fundamentals as indicators of vulnerability
There now is an empirical literature on leading indicators for currency crises, much of it spawned by the crisis of the European Monetary System in 1992 and the Mexican crisis in 1994. While there is a wide range of samples, indicators used and methods applied, most studies are econometric and use a probabilistic approach, relating changes in time series of economic fundamentals to the incidence of large currency devaluations. Kaminsky et al. (1997:12ff) survey and summarise this literature. Their conclusion is that despite difficulties in comparing the results of the different studies, it is clear that an early warning system should include a broad range of indicators. They judge the most important indicators to be international reserves, the real exchange rate, credit growth, credit to the public sector and domestic inflation, and also find support for the indicators of trade balance, export performance, money growth, M2/reserves ratio, GDP growth and the fiscal deficit. Perhaps surprisingly, the current account balance and indicators associated with the external debt profile do not receive much support as leading indicators in the studies included in the survey.

In comparison, IMF (1998) emphasises the importance of the real exchange rate and some financial indicators, while Radelet and Sachs (1998a) find rising ratios of short-term debt to reserves and private credit to GDP to be the best leading indicators. Key indicators and average lead times are compared in Table 2. The benchmarks used to define critical levels of each variable varies greatly across the studies.

The choice of economic fundamentals to be used as indicators in the framework applied in this paper is partly based on the results shown in Table 2, and partly guided by the ‘story’ of currency crises suggested in the previous section, which in turn is influenced by the events in the East Asian and Mexican crises. The emphasis is thus on financial indicators and proxies for competitiveness; variables from the real and fiscal sector are largely omitted. The indicators chosen are the level of reserves, the real exchange rate, export growth, the ratio of short-term debt to reserves and the ratio of domestic credit to GDP.

International reserves. Declining reserves are a reliable indicator that a currency is under devaluation pressure. A drop in reserves is not necessarily followed by devaluation; central banks may be successful in defending a peg, spending large amounts of reserves in the process. On the other hand, most currency collapses are preceded by a period of increased efforts to defend the exchange rate, which is marked by declining reserves. In the event of a financial panic, the lead time of this indicator may be extremely short. A drop in reserves can be either the cause or the symptom of a currency crisis. Data on reserves by themselves should be interpreted only in respect to changes over time. To make judgements
### Table 2 Leading indicators of currency crises

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<td>Capital account</td>
<td>International reserves</td>
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<td>15</td>
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<td>Current account</td>
<td>real exchange rate</td>
<td>12/10</td>
<td>*</td>
<td>17, (13+)</td>
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<td>current acc. bal.</td>
<td>6/2</td>
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<td>trade balance</td>
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<td>exports</td>
<td>3/2</td>
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<td>ToT deterioration</td>
<td>2/1</td>
<td>*</td>
<td>15, (8)</td>
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<td></td>
<td>current account surplus/GDP ratio</td>
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<td>Inter-national</td>
<td>world or foreign interest rates</td>
<td>3/1</td>
<td>*</td>
<td>(3)</td>
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<tr>
<td>Debt</td>
<td>short-term debt/reserves ratio</td>
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<td>Financial</td>
<td>domestic credit growth</td>
<td>7/5</td>
<td>*</td>
<td>(8)</td>
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<td></td>
<td>money supply</td>
<td>3/2</td>
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<td>M2/international reserves</td>
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<td>(13+)</td>
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<td></td>
<td>change in private credit/GDP ratio</td>
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<tr>
<td>Real</td>
<td>domestic inflation</td>
<td>5/5</td>
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<td></td>
<td>real GDP growth or level</td>
<td>8/5</td>
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<td>16</td>
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<td></td>
<td>unemployment</td>
<td>3/2</td>
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<tr>
<td>Fiscal</td>
<td>credit to public sector</td>
<td>3/3</td>
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<tr>
<td></td>
<td>fiscal deficit</td>
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about their level requires that reserves be put in relation to other variables. Conventionally, this is done in a current account framework, the most widely used indicator being the ratio of reserves to monthly imports. Conversely, in the context of currency crises reserves need to be interpreted in the context of the capital account, as in the ratio of external debt to reserves (Hill 1998:17).

**Real exchange rates.** Real exchange rate indices attempt to capture the effect of differences in the rates of inflation between countries and the change in the exchange rate. The real exchange rate appreciates when domestic inflation is higher than foreign inflation and this differential exceeds the rate of depreciation of the nominal exchange rate. Changes in the real exchange rate alter the relative prices of tradables and non-tradables. A real appreciation causes the price of imports to decrease in comparison to domestically produced goods, and exports to become less competitive. This is a result of an increase in the relative price of non-tradable factor inputs. The real exchange rate can thus be a measure for the change in international competitiveness and a proxy for under or overvaluation.

The difficulty in defining real exchange rate indices lies in the choice of price deflators. The most basic index is a bilateral exchange rate deflated with the consumer price indices (CPI). More sophisticated versions use a basket of foreign currencies, which may be trade-weighted, and deflate exchange rates with wholesale price indices (WPI) or even the price of factor inputs, such as unit labour costs. Another method is to directly measure the price ratio of tradables to non-tradables. Any of these definitions may be justifiable depending on the purpose of the indicator, even though the results vary greatly. Regarding the debate on appropriate real exchange rate indices, Fischer (1994:304) observes that ‘…concentrating on alternative indexes only proves the first law of overvaluation: ‘You know that a country is overvalued when the Finance Minister finds one real exchange rate index according to which the currency is not overvalued’. Constructing complex indices is a daunting task, and the availability of consistent time series covering a range of countries is limited. For consistency and simplicity, this study uses the JP Morgan series of real effective exchange rates, which are trade-weighted indices using wholesale prices as deflators.

**Export growth.** Declining export growth can be an indicator for a loss of competitiveness in international goods markets, possibly caused by an overvalued domestic currency. To this end, a slump in export performance may be a proxy for overvaluation. Alternatively, if export growth slows due to reasons unrelated to the exchange rate, this may cause devaluation pressure. In both cases, declining export growth can be a leading indicator for a large devaluation. Since this variable is part of the real economy, relatively long lead times can be expected.

**Ratio of domestic credit to output.** The extent of domestic credit in the economy is, in a narrow sense, not so much an indicator of vulnerability to crisis but of how bad the impact of a financial crisis on the economy might be. The higher the credit ratio, the larger the share of real economic activity dependent on the functionality of the banking system, and the worse the disruptive effect of a crisis. This means a higher aggregate credit risk, which in turn makes an economy more vulnerable to crisis. An appropriate indicator for the relative exposure to credit risk in an economy is the ratio of domestic credit to GDP. Both level and change are relevant.

**Ratio of short-term debt to reserves.** Analysts of the East Asian crisis widely agree that short-term capital flows were an important or, possibly, the decisive factor. The question is which aspect of ‘hot money’ to focus on, and which indicator to employ. The ratio of short-term debt and portfolio investment to long-term debt and FDI is often used as a macroeconomic vulnerability indicator. However, a high level of long-term obligations does not offset vulnerability arising from short-term capital, so that the ratio of short-term to long-
term obligations can be misleading. In this study, the composition of capital inflows is regarded as a structural rather than a macroeconomic indicator. The indicator that captures the central feature of financial panics is the ratio of short-term debt to reserves. In principle, a creditor run may start when creditors realise that short-term liabilities exceed short-term assets, so that if all creditors demanded their money back, there would not be enough capital to satisfy all claims. The decisive factor is how liquid claims and assets are. A sudden withdrawal of foreign funds can lead to the collapse of a pegged exchange rate if short-term external debt is high relative to reserves. Both a high level and an increase over time may indicate vulnerability to crisis. In the currency crisis models, high ratios of foreign short-term capital to reserves translate directly into high vulnerability, increasing the likelihood of crisis in the event of a potential triggering event. Increases in the ratio may cause a reevaluation of credit risks and so be a factor in the onset of self-fulfilling crises.

**Structural characteristics**

Many indicators of structural weaknesses are hard to quantify. Those which can be quantified tend not to be useful in time series analysis due to their slow rate of change. Empirical work on structural indicators is mostly carried out qualitatively and without a formal framework.

**Structure of foreign debt.** The maturity and sectoral structure of foreign debt as a structural characteristic can provide additional information independent of reserves. An important aspect is the possibility of maturity and currency mismatches. When project length exceeds debt maturity, loans need to be rolled over. This may prove critical if lenders are not willing to enter new agreements or demand higher interest rates. If the currency of a loan and the payout of the corresponding project differ, changes in the exchange rate affect the financial viability of the project. Such maturity and currency mismatches can create or exacerbate vulnerability.

**Banking and financial system.** A weak domestic financial system is prone to external shocks and thus attracts less confidence from investors, and may be subject to considerable moral hazard problems in lending, which is detrimental to the quality of domestic re-lending of foreign capital. Vulnerability to crisis increases on all counts. Financial systems are likely to be weak in the aftermath of liberalisation, if prudential regulation, supervision or publication requirements are inadequate, and if explicit or implicit government deposit guarantees exist. In addition, the share of non-performing loans, reserve requirements and capital–asset ratios can be used to judge the soundness of the banking sector. Due to lack of information and differing definitions, however, it is hard to accurately determine the extent of non-performing loans.

**Institutions.** Institutional shortcomings affect the flexibility of an economy, thus increasing the likelihood of crisis when external pressure arises and exacerbating the negative effects of a crisis. An effective early warning system needs to analyse the legal and administrative system, judging effectiveness, speed and transparency of operations. The functioning of bankruptcy laws is the prime example of institutional aspects of vulnerability. The prevalence of corruption in government administration and business can also shed light on the institutional setting. The quality of institutions is among the hardest aspects to assess in a comparative framework. For want of better methods, this study looks at survey results taken from the *World Competitiveness Report* (IMD various years) and Transparency International (1997) for corruption rankings.

**Market structure and business environment.** The market structure influences the flexibility of an economy, and thus its ability to respond to pressure and crisis. The hypothesis is that if the business environment is characterised by high levels of direct state involvement, market power and barriers to entry and exit, the effects of external shocks will be more
severe, and crisis more likely, as well as of greater consequence. In addition to qualitative evidence, there are a range of quantitative indicators available, including industry concentration ratios and the share of state-owned enterprises.

**Change in expectations and perceptions**

Most indicators that come to mind for this category are of the ‘soft’ variety and are not well suited for a formalised system of analysis. The focus here is on suggesting ways of unifying the measurement and assessment of such qualitative variables, and on identifying quantitative indicators, preferably in time series format, which could be proxies for ‘sentimentals’.

**Asymmetric information between domestic and international investors.** When looking at changes in perception, it is crucial to determine whose perceptions to analyse. The theoretical literature on currency crises and the readily available data tend to concentrate on the movement of foreign equity and currency holdings, neglecting capital movements by domestic residents. When collapse is anticipated, the incentive to move capital out is the same for domestic as for foreign investors. Depending on relative magnitudes of capital flows, domestic capital flight may even be the decisive factor in bringing about a crisis.

These two investor communities need to be viewed separately when there are differences in information or perception between them. In the case of asymmetric information, changes in expectations of just one group can be enough to cause a self-fulfilling crisis. It is, however, analytically and empirically more difficult to assess for each country which information is available to local investors and what their prevalent perceptions are. This essay, in common with the bulk of the literature, takes the convenient analytical shortcut of assuming that there are no significant asymmetries in information and perception between domestic investors and foreign investors, and focuses on the latter.

**Stockmarket prices.** The stockmarket is the prime quantitative indicator of sentiment on economic prospects. If a devaluation is expected, foreign investors have a strong incentive to sell their equity positions, because the value of their investment in dollar terms falls even if domestic stock prices stay stable. But stockmarket indices have the advantage of also capturing expectations of residents. Domestic capital flight in the face of an anticipated exchange rate collapse will include equities as well as liquid currency. The empirical evidence on share prices as leading indicators is thin and mixed. Kaminsky and Reinhart (1996) find stock prices to be a significant early-warning indicator, with a lead time of 14 months, while the study conducted by the IMF (1998:138) finds significant declines in share prices leading up to currency crises in industrialised, but not developing countries.

**Portfolio investment.** The most volatile component of capital flows, and the one which therefore can be said to reflect changing expectations of foreign investors most clearly, is portfolio investment. When portfolio capital inflows take a sudden drop or even reverse to net outflows, this can be taken as a sure sign of loss of confidence, and may be the immediate cause of exchange rate collapse. Very short lead times are to be expected. Monitoring portfolio investment should thus be at the core of the second stage of the early warning system. Data availability is improving, and the IMF now publishes quarterly data on portfolio capital flows, distinguishing debt and equity securities.

**Bond and interest rate spreads.** The spread of returns on domestic government bonds denoted in US dollars over US government bonds can be used as a proxy for the perceived risk of sovereign debt default. As there is no currency exchange component involved, any differential in yields can be attributed to differences in perceived risk. A sudden increase in a country’s government bond yields relative to US bonds thus reflects a re-assessment of sovereign risk by market participants. In cases where there are no government-issued US
dollar bonds in the market, an average of yields on commercial bonds issued in that country could be compared to the yield of a basket of US commercial bonds. If there are commercial bonds which are widely regarded to be implicitly government-guaranteed, the yields on these could be used as a proxy for government bond yields. World interest rates are a promising indicator if put into relation to domestic interest rates and adjusted for domestic and foreign interest rates. An increase in the ratio of real interest rates is a proxy for increased riskiness of investment.

Country risk ratings. Country risk analysis became widely used following the Latin American debt crisis in the 1980s. A number of commercial services now provide investment risk assessment to institutional investors on a country-by-country basis. There are three sufficient conditions under which such country risk ratings might be beneficially included in an economic early warning system: if they actually provide useful factual information; if the ratings adequately represent market sentiment; and/or if ratings actually influence or determine investors' decisions. It is conceivable that all of these conditions hold at least in some cases or for some investors.

Country risk reports typically appear in monthly intervals and consist of an assessment of political and economic risk factors and economic forecasts for each country. Assessment of risk factors is both qualitative and numerical, using a score system, and a standardised framework is applied across countries and periods. This makes the construction of time series possible. Although there are serious limitations in interpreting such data statistically, sudden drops in ratings may convey useful information. For this paper, however, no time series data were available from any of the commercial services. A more readily accessible source of country risk assessments are the semi-annual ratings by Euromoney. Political and economic risks are assessed by means of an expert survey; overall ratings also include economic forecasts and debt indicators. The publication is widely circulated and likely to be quite influential, which may give its assessment a certain weight. There are methodological caveats regarding surveys and rankings based on scores, but these are unimportant if country risk ratings function as recommendations to portfolio investors and succeed in influencing opinion. In other words, if a sudden change in risk ratings has an effect on the market, it is irrelevant if the method of assessment is flawed.

Political situation. Political uncertainty can play a paramount role in bringing about or worsening an economic crisis, as the recent Indonesian experience shows. If the political situation becomes so critical that there is fear of civil unrest, violent interference by the armed forces or worse, then investors will flee regardless of strictly economic considerations. A drastic deterioration in political stability can therefore be considered a 'stand-alone' leading indicator for currency crises. The fact that this insight has generally not been widely used by economists is partly due to problems in measurement and quantification. It is a mistake to attribute less importance to such factors that do not lend themselves easily to quantification, yet it frequently happens in economic analysis. An early warning system needs to employ some kind of formalised approach to assessing political stability. As for general country risk, the work of agencies specialising in political risk analysis could be used. The International Country Risk Guide, for example, provides monthly estimates of the probabilities of regime change and 'turmoil'. Factors and events that indicate political instability include upcoming elections, impending leadership change, riots, assassinations and terrorist or military activity. In the case studies, the respective political situations and events are discussed briefly and informally.

Media coverage and country-specific events. If one follows through with the characterisation of portfolio investors as fickle and prone to base their decisions on sentiments, then 'bad press' may well be a leading indicator for currency crises. A change in
media coverage, with more negative reporting on economic, business, political and even general issues might reflect or induce a change in investors' assessment of a country. A similar argument can be made be with regard to specific events such as natural catastrophes. Quite apart from their economic impact, these can damage the 'image' of a country and affect investment decisions in an indirect way. Methodologically, media coverage could be quantitatively analysed either by monitoring one or several publications, counting and classifying articles, or by using commercial media monitoring services. Due to the limitations of this study, media coverage is not analysed in the case studies. Cursory mention will be made of country-specific events.

Contagion. Contagion as a cause or trigger of currency crises is the subject of a substantial body of research (see Lowell and Neu 1998 for a theoretical and empirical treatment). The incidence of a currency crisis in one country can greatly increase the likelihood of a exchange rate collapse elsewhere. Possible causes for contagion include

- the crisis in the first country negatively affects economic fundamentals in other countries
- awareness of weaknesses in another country's fundamentals or structure is heightened
- a crisis forces technical realignments of investor portfolios
- a crisis induces herd behaviour elsewhere.\(^{16}\)

For an early warning system, it is crucial to determine if a country affected by crisis is similar enough to others to pose a danger of contagion. The critical aspect for similarity in turn depends on the type of cause for contagion. To cut through this complexity, similarity is usually defined in regional terms. This simplification appears justified by the spread of European currency peg collapses in 1992 and the evolution of the East Asian financial crisis. The 'Tequila effect' in the wake of the Mexican crisis, however, was not confined to Latin America.

Triggers. A trigger can be defined as any of the events listed in this section which 'tips the balance' in expectations and sets off a self-reinforcing process of crisis. There is a wide range of events that may act as triggers and channels through which they take effect. The intensity that any such event needs to have in order to trigger a currency crisis also varies with the specific situation. For example, international contagion can act as a very powerful trigger, setting off a crisis even when fundamental vulnerability and change in perceptions are not extreme. Exploring the nature of triggers in detail is beyond this paper, since a triggering event can by definition only be identified when it is too late to avoid a crisis.

A framework for an early warning system
Combining the above indicators yields an early warning system oriented along the lines of the 'story' of a currency crisis outlined in section two. An overview of the framework and suggestions for the detection and measurement of individual indicators, along with data and information sources is presented in Table 3. The choice of sources is largely determined by ease of access and evaluation, however, much more sophisticated proxies for the indicators could be developed and applied. This is particularly true for the structural and perception indicators. Many of these are 'soft' indicators lending themselves well to qualitative analysis. A consistent and reliable early warning system, however, would benefit from formalisation of measurement and, wherever possible, quantification of indicators.

A crucial point to be addressed is the definition of threshold levels at which alarm bells go off at each stage, and the analysis of interaction between variables. Benchmarks would need to be established for absolute values and rates of change of individual indicators,
as well as for combinations of indicators. A thorough discussion of these issues is well beyond the scope of this paper.

**Table 3 Framework for an early warning system**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Measurement/detection and data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vulnerability: macroeconomic fundamentals</strong></td>
<td></td>
</tr>
<tr>
<td>Foreign reserves decline</td>
<td>IMF - International Financial Statistics (IFS)</td>
</tr>
<tr>
<td>Real exchange rate appreciates</td>
<td>JP Morgan real exchange rate series</td>
</tr>
<tr>
<td>Export growth declines</td>
<td>IMF-IFS</td>
</tr>
<tr>
<td>Ratio of domestic credit to GDP is high and/or increases</td>
<td>IMF-IFS</td>
</tr>
<tr>
<td>Ratio of short-term debt to international reserves is high and/or increases</td>
<td>World Debt Tables</td>
</tr>
<tr>
<td><strong>Vulnerability: structural characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Maturity and sectoral structure of foreign debt: high proportion of short maturities and loans to the private sector</td>
<td>IMF-IFS Bank for Int. Settlements (BIS)</td>
</tr>
<tr>
<td>Banking and financial system is weak</td>
<td>recent liberalisation regulation/supervision non-performing loans</td>
</tr>
<tr>
<td><strong>Institutional weaknesses</strong></td>
<td></td>
</tr>
<tr>
<td>inefficient bureaucracy, weak legal system, corruption</td>
<td>World Competitiveness Report Transparency International</td>
</tr>
<tr>
<td>uncompetitive business environment: barriers to entry, market power, inflexibility</td>
<td>importance of SOEs, cronyism industry concentration ratios</td>
</tr>
<tr>
<td><strong>Change in perceptions/Re-evaluation of fundamentals and investment risks</strong></td>
<td></td>
</tr>
<tr>
<td>Share prices drop, especially for financial sector stock</td>
<td>stockmarket indices (Datastream)</td>
</tr>
<tr>
<td>Portfolio capital inflows decrease</td>
<td>IMF-IFS</td>
</tr>
<tr>
<td>Spreads for government bonds over US bonds increase real interest rate differentials rise</td>
<td>JP Morgan</td>
</tr>
<tr>
<td>Country risk ratings drop</td>
<td>Euromoney and commercial services</td>
</tr>
<tr>
<td>Media coverage (‘bad press’) Country-specific events</td>
<td>The Economist or media analysis services</td>
</tr>
<tr>
<td>Political uncertainty: Domestic political disturbances, change of government likely</td>
<td>‘political risk’ (International Country Risk Guide) political events</td>
</tr>
<tr>
<td><strong>Contagion</strong></td>
<td>crisis in ‘similar’ country</td>
</tr>
<tr>
<td><strong>Trigger</strong></td>
<td>any significant event</td>
</tr>
</tbody>
</table>
Just as the silence of the Baskerville hound alerted Sherlock Holmes to the real culprit, the fact that the financial markets did not signal alarm helps us to understand the real nature of the current crisis. All signs point to a very recent and dramatic shift in expectations.

Steven Radelet and Jeffrey Sachs (1998b) on the East Asian crisis

Empirical application

In this section, the proposed early warning system is retrospectively applied to six currency crises to explore which indicators and combinations of indicators would have been useful for prediction. The emphasis is on the analysis of time series data for the fundamentals and some ‘perception change’ indicators. The case studies are not meant to be full applications, but rather illustrations of the framework. To properly test the system, counterfactual examples would have to be included, namely countries and episodes without crises. The main focus is on Indonesia as the country worst hit by the 1997/98 East Asian crisis, and the episode that surprised economists the most. Thailand is included as a significantly different episode in the same region and at the same time. The recent East Asian experience is compared to several Latin American crises, with emphasis on the Mexican crisis of 1994/95. Argentina 1995 is included as an example of a financial crisis that did not evolve into a currency crisis. The 1982 crises in Mexico and Chile are referred to, but analysed in less depth.

To set the scene, the key features of the six episodes are outlined. The movements of nominal exchange rates, each for a period of one year, beginning just before the crises are plotted in [Appendix Figures 1a–1f]. The overviews of the unfolding of the crises aim to establish just how differently crisis situations can evolve, owing to second-round effects, policy response and circumstances. The remainder of the empirical analysis concentrates on individual aspects during the time leading up to the crises.

Indonesia and Thailand 1997

Beginning in 1996, there was mounting exchange rate pressure on the Thai currency, caused by weakening economic fundamentals, financial sector problems and political uncertainty. On several occasions, especially in May 1997, the fixed exchange rate was successfully defended against speculative attacks, but pressure rose. After losing a total of up to US$15 billion in reserves over the course of the year, the Bank of Thailand switched to a managed float on 2 July, which in effect set off the East Asian crisis. The baht depreciated quickly and soon other regional currencies came under devaluation pressure. Thailand called in the IMF at the end of July, resulting in the signing of agreements and the announcement of rescue packages in August. However, implementation of the measures to clean up the financial sector was slow initially, and the depreciation caused a further liquidity squeeze. The baht continued its gradual slide amidst the lack of government resolve and growing regional economic instability.

In November, the government was forced to resign, and this change in leadership proved to be the turning point. The new administration embraced reform, and after a period of accelerated depreciation, the baht began to appreciate in January. By mid March, the exchange rate had reached 40 baht per US dollar, about 60 per cent below its pre-crisis peg,
the level at which it appears to have stabilised. The short and medium-term economic outlook is subdued, largely due to the regionwide downturn, but there is little doubt that by late 1998 the immediate crisis situation had subsided.

In Indonesia, the crisis took a drastically different course. The economy appeared to be stable right into the second half of 1997, and a continuation of high growth was expected. Following the baht devaluation, there soon was selling pressure on the rupiah, causing Bank Indonesia to intervene on 21 July. After further interventions, the Indonesian authorities decided not to try to stem the tide and floated the rupiah on 14 August, avoiding the loss of reserves. The exchange rate fell around 15 per cent below the pre-float level, dropping and stabilising again in October. Academic assessment then was generally still positive, expecting a beneficial shake-up of economic policy in the region, and ‘cautious optimism’ (Hill 1998) prevailed.

The government sought IMF advice early in October. Consultations immediately became negotiations, and the first agreement was signed on 31 October, providing a massive US$43 billion standby loan. The day after, a number of banks were liquidated. But rather than restoring confidence, these measures were taken to indicate that the problems were worse than hitherto thought, which fuelled the panic and accelerated capital flight. The rupiah dropped further as Korea got into trouble and as concerns over Indonesia’s short-term debt increased and spiralled in December amidst rumours that President Suharto had serious health problems. The situation drastically worsened again in January 1998. An unrealistic budget was introduced, an overambitious second IMF agreement was signed after a public rift with the IMF, and Habibie was nominated vice president. Each of these events further eroded confidence. A massive contraction of the real sector had set in, the effects of a prolonged drought hit, and the exchange rate reached 5 times its pre-crisis level. By this time it was clear that Indonesia, not Thailand, had been hit hardest by the crisis. The stand-off with the IMF continued over the proposed introduction of a currency board.

During the first half of 1998, economic policy issues subsided into the background when the issue of presidential succession became ever more pressing. Opposition grew stronger and was suppressed by the military. Thousands of lives were lost in the violence preceding Suharto’s resignation in May, and in the aftermath dreadful facts on systematic violence against the ethnic Chinese emerged. In late 1998, the economic situation was catastrophic, and a turnaround was not in sight. It was impossible to foresee that things would go so wrong for Indonesia. The interaction of regionwide crisis, policy mistakes, and, most importantly, extreme political uncertainty, led to a uniquely deep and persistent crisis.

**Mexico and Argentina 1994/95**

Mexico’s economic prospects looked bright at the beginning of 1994. The government had implemented far-reaching structural reform, including comprehensive internal and external liberalisation, and had just signed the North American Free Trade Agreement (NAFTA). The economy was widely judged to be in excellent shape. There was concern about the large external deficit and real appreciation, but agreement that these were not threatening problems, given the fundamental soundness of the economy.¹⁹ However, the fragile domestic banking system did not cope well with substantial capital inflows, and amidst growing political uncertainty the pressure for devaluation of the peso increased. For political reasons, the currency peg was maintained at the cost of substantial reserves losses, and the extent of the problem was covered up both by Mexican and US authorities through most of 1994.²⁰

The crisis broke out in December when a political event caused renewed selling pressure and the central bank finally had to float the peso. The currency dropped from 3.5 to 5.8 pesos/US dollar in just three weeks and reached its new equilibrium rate of around 7
pesos/US dollar by March 1995. Given these rates, depleted reserves and strong capital outflows, the Mexican government could not roll over its short-term debt, especially the dollar-denominated tesobonos. The United States and the IMF were fast to mobilise massive financial support, which helped to restore confidence. Within the space of a year, the worst of the crisis was over.

The Mexican crisis, however, sent a shock wave through financial markets, dubbed the 'Tequila effect'. In the wake of the plunge of the peso, investors scrutinised other economies for signs that they might also succumb to attack. Early in 1995, self-fulfilling panics on varying scales occurred in a number of countries, including Argentina. The Argentine economy was doing well prior to the crisis, and the exchange rate had been fixed at US dollar parity since the introduction of a currency board system in 1991. The peso crisis caused immediate selling of Argentinian financial assets, including equities, bonds and currency holdings. The banking system ran into liquidity problems because of withdrawals by domestic residents, and some banks became insolvent by March 1995. The Argentinian case is special in that there was no currency devaluation. Sticking to the US dollar parity was the main policy response to the financial crisis. From December 1994 to March 1995, the central bank spent around US$6 billion, more than one third of its total reserves. This policy was successful in that it avoided a self-reinforcing devaluation process and so limited the disruptive effect of the crisis.

**Mexico and Chile 1982**

Under military government since 1973, Chile had embarked on a comprehensive program of economic liberalisation. The economy did pick up and, right into the 1980s Chile was hailed as an economic miracle. In 1979, the exchange rate was fixed to the US dollar in order to fight inflation. The nominal peg was the pillar of the government's macroeconomic policy and was not adjusted despite moderate to high inflation, leading to rapid real appreciation. Beginning in 1981, Chile experienced recession, domestic interest rates and the trade deficit rose, and owing to the lack of restrictions on offshore borrowing, private sector debt became a major problem. Faced with declining reserves and a loss in competitiveness, the peg was abandoned in June 1982, and more devaluations followed. This marked the beginning of serious economic decline, with the economy contracting by 15 per cent in 1982 alone. Chile remained in a deep recession until 1985.

Similar to Chile, Mexico had a fixed exchange rate regime and inflation above 20 per cent annually, leading to steep real appreciation. Like 1994, 1982 was an election year. Fundamental economic problems which already existed were exacerbated by political economy induced expansionary policies. Again for political reasons, the government 'chose to do too little too late' (Dornbusch et al. 1995:232). The 68 per cent devaluation of the peso in February 1982 proved insufficient and was followed by much more drastic devaluations in the years to come. International confidence was quickly eroded in the face of populist policies, including bank nationalisations, and a moratorium on debt repayments. The Mexican currency crisis marked the beginning of the Latin American debt crisis, and Mexico itself did not emerge from recession for years.

**Defining the start of the crises**

In the empirical literature on currency crises, it is customary to define episodes of crisis by movements of a certain magnitude in an index of 'exchange market pressure', typically comprising the nominal exchange rate and international reserves (Kaminsky et al. 1997:15ff). Pinning down the start of a crisis is not always straightforward, however, and in many cases there remains an element of arbitrariness in defining a specific date. For the purpose of this study, a relatively simple approach is used. The time of crisis is defined either by the decision...
to float the currency or the first large devaluation. In the case of Argentina, which did not abandon the dollar parity, it is defined by the first large drop in reserves (Table 4). These dates for the start of the crises are used to define t=0 in all comparative charts and tables.

### Table 4  Start times for crises

<table>
<thead>
<tr>
<th>Country</th>
<th>Start of crisis (t=0)</th>
<th>Event/reason for choice of that date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>14/8/97</td>
<td>float</td>
</tr>
<tr>
<td>Thailand</td>
<td>2/7/97</td>
<td>float</td>
</tr>
<tr>
<td>Argentina</td>
<td>1/95</td>
<td>drop in reserves</td>
</tr>
<tr>
<td>Mexico</td>
<td>21/12/94</td>
<td>float</td>
</tr>
<tr>
<td>Mexico</td>
<td>2/82</td>
<td>devaluation</td>
</tr>
<tr>
<td>Chile</td>
<td>6/82</td>
<td>devaluation</td>
</tr>
</tbody>
</table>

### Comparative exchange rate movements

For best comparability of the unfolding of the crises, the relative exchange rates are rebased on their value in t=−1, that is, the last period before the start of each crisis, and presented on a unified time scale. The depreciation of the baht and the rupiah after the float were gradual and on a very similar scale for the first four months after the float, and then radically different. While the baht continued its steady depreciation to reach its lowest level 30 weeks after the float, the actual collapse of the rupiah only began 20 weeks after the float. The divergence started in December 1997. The Mexican peso in 1994 underwent a comparatively sudden and large deprecation, reaching its lowest level just three months after the float. The Argentinian exchange rate did not change from its parity to the US dollar because the currency board system introduced in 1991 was retained. The only episode comparable to Indonesia in the magnitude and persistence of currency deprecation is Mexico 1982, where the exchange rate also reached more than four times its pre-crisis level. The largest drop did not occur until six months after the crisis began, which is similar to the Indonesian experience.

### Macroeconomic fundamentals

#### Reserves

Appendix Figures 3a–3c show pairwise absolute levels of reserves in the lead-up to and during crisis episodes. Thai reserves had a slight downward trend throughout the first months of 1997 and started dropping sharply in May when the Bank of Thailand attempted to defend the currency peg. Reserves continued to fall after the managed float. Reserves fell from US$36 billion at the end of April to US$25 billion at the end of August. Indonesian reserves did not drop during the lead-up to and the beginning of the crisis, due to the decision of the central bank not to follow the Thai example of wasting reserves in an unsuccessful bid to stem the tide. Rather, the Indonesian government made the decision to float the rupiah at an early stage.

The most pronounced fall in reserves occurred in Mexico 1994, and this is also the most interesting case regarding public information on reserves. Reserves dropped sharply in March and April and again in November and December. From February to April, reserves went down by almost US$12 billion, or 40 per cent. This drastic loss of reserves eight months
before the crisis should have been a strong warning sign. The fact that it was not widely recognised at the time sparked a retrospective debate about ‘who knew what and when’.

Reserve figures were traditionally published only three times a year, and there have been additional accusations that Banco de Mexico was deliberately slow to report figures during 1994 (Edwards 1997:20). On the other hand, Gil-Díaz and Carstens (1997:180) argue that financial observers were able to accurately estimate reserves, and back up this assertion by a list of estimates on reserves in the Mexican press at various times in 1994. It was also claimed that information favoured domestic residents, the informational asymmetry causing Mexican investors to start selling equity and currency holdings weeks before foreign investors began getting out (IMF 1995). Conversely, Edwards (1997:1) concludes that ‘the US Treasury was fully aware of what was going on, [but] most private sector analysts were unaware of the seriousness of the situation’. For an early warning system in the Mexican case, the discussion of opaqueness and asymmetry of information on reserves is central as it would have been the one indicator to give a clear warning sign.

Argentinian reserves began to decrease in January 1995 as the ‘Tequila effect’ brought the US dollar parity under pressure. Before that, reserves had been stable. In Mexico 1982, reserves had dropped sharply in the month before the crisis, however, there were several large fluctuations in the previous eight months. In Chile, there was a slight but continuous downward trend in reserves beginning ten months before the crisis. In either case, it is not clear if a warning sign would have been recorded.

Real exchange rates

Real exchange rate time series, using JP Morgan data, are presented pairwise in Appendix Figures 4a–4c. Additionally, Appendix Figure 4d presents rebased RER indices on a unified time scale for Indonesia, Mexico 1994 and Chile 1982, illustrating the differences in magnitude and timing of real appreciation.

The time series of Indonesian and Thai RERs are almost identical. Both experienced a modest real appreciation of around 10 per cent in the two years leading up to the crisis, but there was no compelling evidence of overvaluation, as the indices were on the 1990 level in the beginning of 1996. Warr (1998) shows that in the case of Thailand, calculating the RER index by using traded/non-traded goods price ratios results in higher estimates of real appreciation. Mexico experienced a 20 per cent real appreciation from 1991 to the beginning of 1994, which then eased due to gradual, managed nominal devaluation. Again, different indices provide different results. Dornbusch and Werner (1994) provide a detailed discussion of different real exchange rate indices and their implications for Mexico 1994. The peso was overvalued to some degree, but this was not seen as a great danger, and was firmly denied by the government. Retrospectively, the overvaluation view is supported by the fact that the effect of the crisis was a permanent devaluation of the peso by around 50 per cent. With regard to Argentina, the RER had stayed almost constant since 1991 due to the low inflation and the fixed exchange rate.

Both the earlier episodes were characterised by significant real appreciation leading up to devaluation. The Mexican crisis of 1982 was preceded by a steady real appreciation, totalling 30 per cent from early 1977. In Chile, real appreciation was more rapid. From mid 1978 to mid 1981 the index rose by 70 per cent before easing off in the immediate lead-up to the crisis. Real exchange rates thus perform well as an indicator with a long lead time for some episodes, while in others the conclusions depend heavily on the statistical methods employed. In the recent episodes, devaluation was much more severe than what could have been expected by way of corrections for real appreciation. Such extreme overshooting suggests that overvaluation is only part of the story.
Export growth
The value of exports fluctuates strongly from month to month, [Appendix Figures 5a–5c]. This seasonality necessitates the calculation of moving averages for monthly export growth [Appendix Figure 6a–6c]. For Indonesia, there was a slight downward trend in export growth rates beginning in early 1996. This may have been overlooked ex ante because there were upward movements within the overall downward trend. The case of Thailand is much clearer, with a steep and continuous decline beginning two years before the crisis. The turning point, however, was in October 1996 and from then on export growth slowly recovered. In a short-run oriented early warning system, the alarm bells might already have been turned off again by the time the crisis hit.

Mexico experienced a clear increase in export growth in the three years prior to the 1994 crisis. Export growth became much stronger after the devaluation, which suggests that exports prior to the devaluation grew less rapidly than they might have, but this is another fact that was only known ex post. Argentina had an even stronger increase in export growth in the 18 months leading up to the crisis, the general upward trend in export growth having begun as early as 1991. In both cases, exports would have been a misleading indicator.

Mexico and Chile 1982 are the best examples supporting exports as a relevant indicator. Real appreciation was accompanied by sharp declines in export growth. Mexican export growth took a dramatic drop from 80 per cent in August 1980 to -20 per cent in February to April 1982. The devaluation had a very short-lived effect on exports, with growth rates beginning to drop again later in 1982. Chilean exports took a similar dip, falling from 70 per cent in March 1980 to its lowest point of almost -30 per cent in June 1981. Export contraction eased but continued until April 1982. As in the case of Mexico, devaluation did not significantly improve export growth in the medium term. This fact may be attributed to the prolonged adverse effects of the financial crisis on the domestic economy, or to an atypically long ‘J-curve’ effect.

Ratio of domestic credit to output
Thailand is the outstanding case of a very high and rapidly rising ratio of domestic credit to GDP, rising from 0.81 in 1993 to 1.27 at the end of 1997 [Appendix Figure 7a and Table 5]. A look at monthly data reveals that credit expansion was especially rapid after July 1997 (Appendix Figure 7a, inset). In Indonesia, the ratio also rose, but more slowly and at a lower level than in Thailand. The ratio was 0.48 in 1993 and 0.60 in October 1997. Both levels and rates of change would have indicated that vulnerability was high for Thailand and medium for Indonesia. The fact that Thailand’s credit ratio was so much higher would have suggested that a disruption of the financial system would have caused greater trouble in Thailand than in Indonesia. Ironically, the opposite turned out to be the case. In each of the Latin American episodes, there was a sudden increase in the ratio in the year of the crisis (Appendix Figure 7b). Increases in the years leading up to the crises were negligible for Mexico and Argentina 1994/95, but sizeable in the case of Chile. The pre-crisis levels were all around 0.5 or below and thus not alarmingly high. The exception is Thailand. On the basis of the domestic credit to output ratio, early warning signs would have been recorded for the Thai and Chilean episodes.
Table 5  
**Ratios of domestic credit to GDP**

<table>
<thead>
<tr>
<th>t=0:</th>
<th>Indonesia 1997</th>
<th>Thailand 1997</th>
<th>Mexico 1994</th>
<th>Argentina 1995</th>
<th>Mexico 1982</th>
<th>Chile 1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time before crisis in years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td>0.46</td>
<td>0.71</td>
<td>0.44</td>
<td>0.45</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td>0.46</td>
<td>0.74</td>
<td>0.46</td>
<td>0.45</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td>0.48</td>
<td>0.81</td>
<td>0.44</td>
<td>0.23</td>
<td>0.44</td>
<td>0.41</td>
</tr>
<tr>
<td>-3</td>
<td>0.51</td>
<td>0.91</td>
<td>0.45</td>
<td>0.22</td>
<td>0.44</td>
<td>0.41</td>
</tr>
<tr>
<td>-2</td>
<td>0.52</td>
<td>0.97</td>
<td>0.46</td>
<td>0.24</td>
<td>0.44</td>
<td>0.45</td>
</tr>
<tr>
<td>-1</td>
<td>0.54</td>
<td>1.01</td>
<td>0.47</td>
<td>0.24</td>
<td>0.49</td>
<td>0.51</td>
</tr>
<tr>
<td>0</td>
<td>0.60</td>
<td>1.27</td>
<td>0.58</td>
<td>0.26</td>
<td>0.64</td>
<td>0.88</td>
</tr>
</tbody>
</table>

**Source:** IMF, various years. *International Financial Statistics,* from International Economic Database, The Australian National University, Canberra.

**Ratio of short-term debt to reserves**

Ratios of external debt with maturities of less than one year to foreign exchange reserves are presented in Table 6. Data are available in yearly intervals. For easier comparison of the time series, the time scale is unified with t=0 the year of the crisis.

Table 6  
**Ratios of external short-term debt to reserves**

<table>
<thead>
<tr>
<th>t=0:</th>
<th>Indonesia 1997</th>
<th>Thailand 1997</th>
<th>Mexico 1994</th>
<th>Argentina 1995</th>
<th>Mexico 1982</th>
<th>Chile 1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time before/after crisis in years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td>1.55</td>
<td>0.71</td>
<td>1.79</td>
<td>5.83</td>
<td>3.21</td>
<td>3.06</td>
</tr>
<tr>
<td>-5</td>
<td>1.73</td>
<td>0.72</td>
<td>1.63</td>
<td>2.27</td>
<td>3.62</td>
<td>2.88</td>
</tr>
<tr>
<td>-4</td>
<td>1.60</td>
<td>0.92</td>
<td>1.63</td>
<td>2.26</td>
<td>2.85</td>
<td>1.33</td>
</tr>
<tr>
<td>-3</td>
<td>1.60</td>
<td>0.99</td>
<td>1.23</td>
<td>1.62</td>
<td>3.94</td>
<td>0.94</td>
</tr>
<tr>
<td>-2</td>
<td>1.89</td>
<td>1.14</td>
<td>1.30</td>
<td>0.63</td>
<td>5.46</td>
<td>0.86</td>
</tr>
<tr>
<td>-1</td>
<td>1.77</td>
<td>1.00</td>
<td>1.44</td>
<td>0.50</td>
<td>6.13</td>
<td>0.95</td>
</tr>
<tr>
<td>0</td>
<td>6.26</td>
<td>0.71</td>
<td>31.35</td>
<td>1.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.21</td>
<td>0.67</td>
<td>2.59</td>
<td>1.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Short-term debt = external debt with maturities under one year; reserves = total reserves minus gold, end-of-year data.


In Indonesia, the level of the ratio was high but had no discernible trend in the lead-up to the crisis. In Thailand, the ratio was lower but had risen continually until 1995. In the suggested early warning system, vulnerability would have been indicated for Indonesia and
possibly for Thailand. In Mexico, the ratio of short-term debt to reserves in the years leading up to the 1994 crisis was relatively high but had a downward trend until the year before the crash. The exceptionally high ratio for 1994 is due to the fact that year-end data, and thus an extremely low value for reserves, are used. The ratio for Argentina was very high until four years before the crisis but then dropped dramatically and to very low levels. Vulnerability might have been indicated for Mexico, but certainly not for Argentina. Mexico 1982 is the epitomy of very high and rising ratios of short-term debt to reserves in the lead-up to a crisis. From 1978 to 1982 the nominal volume of Mexico's short-term debt increased fivefold without a matching rise in reserves, and alarm bells would have gone off in 1979. The ratio for 1982 again reflects very low reserves, while the dramatically lower ratio for 1983 is due to reductions in debt. By 1995, nominal short-term debt was back at its 1978 level. The development of the ratio for Chile was ambiguous, with levels falling until two years before the crisis but still not reaching low levels.

Summary: performance of macroeconomic fundamentals indicators
The performance of the macroeconomic fundamentals indicators, including approximate lead times, is summed up in Table 7 using four categories for the conclusions that would have been drawn from each indicator. Estimated lead times are given where appropriate. The results show that there is no single universal leading indicator. In each category, vulnerability would have been detected only for some episodes. Based on the combination of the economic fundamentals indicators, vulnerability would have been obvious in the case of Thailand, Mexico 1982 and also Chile. At the other end of the spectrum, none of the indicators would have raised an alarm in the case of Argentina. The picture is mixed for Indonesia and Mexico 1994. Alarm bells might have rung for Indonesia if the emphasis had been on debt and competitiveness indicators, and for Mexico 1994 on the grounds of sharply diminishing reserves.

In most cases, there was a marked deterioration in at least some macroeconomic fundamentals, demonstrating that the indicators chosen can be useful. Still, the cases of Indonesia and Mexico 1994, and especially Argentina, show that this set of macroeconomic indicators is not sufficient to determine whether a country is vulnerable to a currency crisis. Another issue is interactive effects between indicators. It is conceivable that some combinations of variables cause higher vulnerability than others. This has not been adressed much in the literature and appears to be an important topic for further research.
### Table 7: Performance of macroeconomic fundamentals indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Country/episode</th>
<th>Performance* and approximate lead time (months)</th>
<th>Indicator</th>
<th>Country/episode</th>
<th>Performance* and approximate lead time (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>macro-economic fundamentals indicators overall</td>
<td>Indonesia (+)</td>
<td>Export growth slowing</td>
<td>Indonesia (+) 18</td>
<td>Thailan ++</td>
<td>Thailand (++) 24</td>
</tr>
<tr>
<td></td>
<td>Thailand ++</td>
<td></td>
<td></td>
<td>Mexico 94 (+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico 94 (+)</td>
<td></td>
<td></td>
<td>Argentina -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico 82 ++</td>
<td></td>
<td></td>
<td>Mexico 82 ++ 18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chile +</td>
<td></td>
<td></td>
<td>Chile ++ 24</td>
<td></td>
</tr>
<tr>
<td>Foreign reserves declining</td>
<td>Indonesia o</td>
<td>domestic credit/ GDP high or rising</td>
<td>Indonesia o</td>
<td>Thailan ++ level and change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thailand ++ 2</td>
<td></td>
<td></td>
<td>Mexico 94 o</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico 94 ++ 9 and 1</td>
<td></td>
<td></td>
<td>Argentina o</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Argentina o</td>
<td></td>
<td></td>
<td>Mexico 82 (+) 8 and 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chile (+) 10</td>
<td></td>
<td></td>
<td>Chile + change</td>
<td></td>
</tr>
<tr>
<td>Real exchange rate appreciating</td>
<td>Indonesia (+) 24</td>
<td>short-term debt /reserves high or rising</td>
<td>Indonesia + level</td>
<td>Thailand (+) level change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thailand (+) 24</td>
<td></td>
<td></td>
<td>Mexico 94 (+) level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico 94 + 36</td>
<td></td>
<td></td>
<td>Argentina -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Argentina o</td>
<td></td>
<td></td>
<td>Mexico 82 ++ 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico 82 ++ 48</td>
<td></td>
<td></td>
<td>Chile ++ 36 level and change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chile o</td>
<td></td>
<td></td>
<td>Chile o</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** * ++: strong signal, +: signal, o: no signal, -: wrong signal, (): with qualification.
Structural characteristics

Foreign debt

The short-term and non-guaranteed private sector debt is plotted as a share of total external debt in Appendix Figures 8a–8e. The snapshot picture before each crisis episode is shown in Table 8.

<table>
<thead>
<tr>
<th>Table 8</th>
<th>Short-term and private external debt shares (as a percentage of total debt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short-term debt</td>
</tr>
<tr>
<td>Indonesia 1996</td>
<td>25.0</td>
</tr>
<tr>
<td>Thailand 1996</td>
<td>41.4</td>
</tr>
<tr>
<td>Mexico 1994</td>
<td>28.1</td>
</tr>
<tr>
<td>Mexico 1981</td>
<td>31.9</td>
</tr>
<tr>
<td>Argentina 1994</td>
<td>9.3</td>
</tr>
<tr>
<td>Chile 1981</td>
<td>19.4</td>
</tr>
</tbody>
</table>

Note: Short-term debt = external debt with maturities under one year.

In Indonesia, the shares of both short-term and private sector debt began to increase in 1988/89 and were at moderately high levels in 1996. The increase in private debt was more rapid. A look at the sectoral and maturity structure of debt to foreign banks only (Appendix Tables 7 and 8) confirms that private sector debt was probably the bigger problem: 68 per cent of all external bank loans were to private debtors, compared to an average of 44 per cent for all countries. The share of short-term maturities in loans from foreign banks was, perhaps surprisingly, not much above world average. Radelet (1995) provides an in-depth analysis of Indonesian foreign debt until 1993. Thailand is the most extreme case of short-term and private sector exposure. The proportion of loans in both categories began rising sharply at the end of the 1980s, and was very high in 1996 at around 40 per cent. External bank debt statistics confirm that in 1997, Thailand had an abnormally high proportion of short-term and private sector loans compared to world averages.

Currency mismatches also played an important role in the East Asian financial crises. A high proportion of loans in foreign currencies used to finance domestic revenue-creating projects were unhedged, because debtors were relying on implicit government guarantees to uphold the quasi-fixed exchange rates while taking advantage of lower foreign interest rates. According to McLeod (1998:337), in 1997 83 per cent of Indonesian private sector foreign debt was unhedged.

In Mexico, the short-term debt share rose from 5 per cent in 1987 to 28 per cent in 1994, which should have caused alarm. Private sector debt also rose, but was still at a relatively low level at the time of the crisis. Argentina's debt structure looked troublefree. It had a rising, but low share of private sector debt and had experienced a sharp fall in the short-term debt share. In the years preceeding the Mexican crisis of 1982, short-term debt had risen sharply. At 32 per cent in 1981, the share was higher than in 1994. Private-sector debt was relatively low and stable. By contrast, the proportion of short-term debt in Chile was
stable at around 20 per cent, but private loans increased sharply from 12 per cent of total external debt in 1975 to 52 per cent in 1981.

**Banking and financial systems**

Indonesia had brought in wide ranging banking sector deregulation in 1983 and 1988, introducing stronger prudential regulation only in 1991. Thailand by comparison tightened prudential requirements in the 1980s and deregulated the financial system in the mid 1990s, a sequence more in line with conventional wisdom. Capital–asset ratios were above the internationally recommended 8 per cent.

Although sophisticated systems of prudential regulation were in place in Thailand and Indonesia, according to Fane (1998:1) controls ‘clearly proved to be inadequate’. This was partly due to inadequate enforcement, and partly to the regulation being too complex and non-transparent. Reisen (1998) points out that government-directed bank lending and low accounting standards also contributed to financial vulnerability. No formal deposit guarantees were in place in either country, but in practice there was implicit government backing as the governments were generally expected to bail out financial institutions. When banks were actually closed, this was not perceived as a step to a healthier financial system but resulted in a massive loss of confidence, fuelling financial panic and capital flight.

Mexico had a very weak domestic financial system in both episodes. In the first half of the 1990s, problems were due mainly to recent financial sector liberalisation which included hasty bank privatisation in the 1991–92 period and the elimination of bank reserve requirements. Banking supervision was weak and bank deposits were fully government-backed, resulting in moral hazard problems. Gil-Díaz and Carstens (1997:189ff.) argue that these financial sector weaknesses, exacerbated by drastically increasing inflows of short-term foreign capital, were the key to the 1994 crisis. The situation was starkly different from 1982, when Mexico was among the examples of fully fledged financial repression (Edwards 1995:203ff). Banking accounted for almost all of the financial sector, and there was pervasive direct state involvement, including the prescription of interest rates and sectoral allocation of credit. Prudential regulation and supervision were practically nonexistent, information disclosure was minimal and auditing uncommon. Moral hazard was compounded by implicit government guarantees regardless of the quality of loans.

Argentina’s financial system was reformed and liberalised after the introduction of the currency board in 1991 Edwards (1995:218ff). Banking sector reform however was not comprehensive, and the privatisation of badly run state banks stalled. Prudential regulation was in place, but controls were poor, mainly because the supervisory agency was not able to keep up with the financial sector growth. Among domestic residents there was widespread distrust of the banking system Lowell and Neu (1998:39ff). In Chile, sweeping financial sector reform began in 1975 as part of the general liberalisation drive. Banks were privatised, reserve requirements reduced, directed lending and interest rate controls abolished. The supervisory framework, however, did not keep pace with the reforms and was weak until the mid 1980s (Edwards 1996:5).

Non-performing loans were a clear indicator only in the case of Mexico 1994, as a result of the steep increase in their share. In Indonesia, the share was high at around 10 per cent but declining, as was the case in Argentina. On the basis of the available data on non-performing loans, the Thai banking system looked least unhealthy. The Thai data for the end of 1997 already reflect the impact of the crisis. A caveat is in order regarding these data as there are is no consistent definition of non-performing loans, and the treatment of ‘problematic’ loans varies between countries and possibly over time. For instance, it is not clear how loans to ‘cronies’ in Indonesia should have been (or were) classified.
Table 9  **Non-performing loans** (percentage of total loans)

<table>
<thead>
<tr>
<th>Year</th>
<th>Indonesia</th>
<th>Thailand</th>
<th>Mexico</th>
<th>Argentina</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>4.5</td>
<td>9.7</td>
<td>2.3</td>
<td>16.0</td>
</tr>
<tr>
<td>1994</td>
<td>12.0</td>
<td>7.5</td>
<td>10.5</td>
<td>8.6</td>
</tr>
<tr>
<td>1995</td>
<td>10.4</td>
<td>7.7</td>
<td>14.4</td>
<td>12.3</td>
</tr>
<tr>
<td>1996</td>
<td>8.8</td>
<td>n.a.</td>
<td>12.5</td>
<td>9.4</td>
</tr>
<tr>
<td>end-1997</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Summing up, financial sector weaknesses were important in each of the crisis episodes. Instabilities in all but the Mexican episodes were due to problems in implementation of fairly recent deregulation or changes in regulation, and to inadequate supervision. Such problems however are easily overlooked because they do not show up in quantitative indicators. Weaknesses in both Mexican episodes were more obvious, in 1994 because of underregulation and explicit deposit guarantees, in 1982 because of financial repression.

**Institutions**

The *World Competitiveness Report* (IMD various) compiles yearly assessments of countries’ competitiveness from a business perspective and includes a range of proxies for the quality of institutions. It provides both statistical indicators and a survey of foreign executives in the countries. The results suggest that the business environment before the crisis was much worse in Indonesia than in the other countries. It is interesting to note that both Indonesia and Thailand dropped in the ranking from 1994/95 to 1996. On the other hand, as a time series indicator, the rankings are clearly lagging, as can be seen in the plunges Mexico took in 1995, and Thailand in 1998. Rankings based on the aggregation of scores are methodologically questionable. In devising an early warning system, however, it may be more worthwhile to ‘mine’ the rich data set of individual indicators provided by the *World Competitiveness Report*.

Table 10  **World Competitiveness Report overall ranking**

<table>
<thead>
<tr>
<th>Year</th>
<th>Indonesia</th>
<th>Thailand</th>
<th>Mexico</th>
<th>Argentina</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>31</td>
<td>23</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>1995</td>
<td>33</td>
<td>26</td>
<td>44</td>
<td>28</td>
</tr>
<tr>
<td>1996</td>
<td>41</td>
<td>30</td>
<td>42</td>
<td>32</td>
</tr>
<tr>
<td>1997</td>
<td>39</td>
<td>29</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>1998</td>
<td>40</td>
<td>39</td>
<td>34</td>
<td>31</td>
</tr>
</tbody>
</table>

**Source:** International Institute for Management and Development, various years. *World Competitiveness Report*, IMD, Lausanne.

With regard to corruption, the Transparency International (TI 1997)) ranking gives an indication of the relative magnitude of the problem. The index is in effect a ‘poll of polls’ on
corruption. Indonesia has consistently been ranked near the bottom of the list. In 1996, it was ranked 45th out of 54 countries, while Thailand, Mexico and Argentina occupied ranks from 35 to 38. Corruption is a problem in all four countries, but particularly in Indonesia, a conclusion in line with common knowledge on the prevalence of ‘corruption, collusion and nepotism’ (KKN) in Indonesia. For the beginning of the 1980s, only scores are available. These show corruption to have been a major problem in Mexico, but not in Chile. Looking at trends in the rankings, it appears that there was a decline in the quality of institutions in both Indonesia and Thailand.

**Summary: performance of structural indicators**

In summary, using the above indicators, weak institutions appear to be connected to vulnerability, but less clearly so than indicators on the banking sector and debt structure. In all of the episodes but Argentina, there were strong indications of vulnerability caused by structural weaknesses. Notably, all crises examined took place in countries with weak financial sectors, and the structure of foreign debt appears to have played an important role. However, we should not infer too much from this empirical result, because the sample is restricted to developing countries. The choice of this subsample of currency crisis episodes could be the underlying reason for the existence and detection of structural problems.

**Table 11  Performance of structural indicators**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Country/episode</th>
<th>Presence of condition</th>
<th>Indicator</th>
<th>Country/episode</th>
<th>Presence of condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>structural indicators overall</td>
<td>Indonesia</td>
<td>+</td>
<td>Banking and financial sector weak</td>
<td>Indonesia</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>+</td>
<td></td>
<td>Thailand</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>+</td>
<td></td>
<td>Mexico 94</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>o</td>
<td></td>
<td>Argentina</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Mexico 82</td>
<td>+</td>
<td></td>
<td>Mexico 82</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>+</td>
<td></td>
<td>Chile</td>
<td>+</td>
</tr>
<tr>
<td>Foreign debt: high proportion of short maturities and private borrowers</td>
<td>Indonesia</td>
<td>+ (sectoral)</td>
<td>Institutions weak or inflexible</td>
<td>Indonesia</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>++ (maturities)</td>
<td></td>
<td>Thailand</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>+ (maturities)</td>
<td></td>
<td>Mexico 94</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>- (mat.) o (sect.)</td>
<td></td>
<td>Argentina</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>Mexico 82</td>
<td>+ (maturities)</td>
<td></td>
<td>Mexico 82</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>+ (sectoral)</td>
<td></td>
<td>Chile</td>
<td>o</td>
</tr>
</tbody>
</table>

**Notes:** +: condition very clearly detected; +: condition detected; o: no detection; -: contrary situation
Changes in perceptions and expectations

The analysis in this section concentrates on foreign (as opposed to domestic) investors’ perceptions, assuming that they determine if and when a crisis occurs. This assumption is problematic but necessary for the analysis to remain manageable. Little information on ‘perception’ indicators is available for the earlier episodes, so they are omitted.

Stockmarket prices

Relative stockmarket indices on a unified time-scale are shown in Appendix Figure 10 (individual time series are plotted in Appendix Figures A9a–A9d). The stockmarket index could be regarded as a clear leading indicator for a currency crisis in only one case, Thailand. The Bangkok index began an uninterrupted decline about 18 months before the crisis. The price index for financial sector shares declined even more steeply over the same period. This suggests that investors had started pulling out of Thai equity long before the crisis, and that there was particular awareness of financial sector problems. Immediately following the float of the baht, the stockmarket index went up and was stable through most of July 1997 before falling again in August. This reflects initial optimism regarding the measures taken to stem the financial crisis, followed by the realisation that a substantial international crisis was underway.

The Indonesian stockmarket index, by comparison, showed a slight general upward trend during 1996 and the first half of 1997. There was a share price slump in March 1997, but the market quickly recovered and began a significant decline only when the exchange rate started depreciating. Financial sector share prices moved in line with the general index before the crisis, but then plunged more steeply without making a recovery.

In Mexico, there was no discernable trend in the stock exchange index over the year preceding the crisis. The index started to weaken in September 1994, possibly reflecting growing concerns about the economic outlook, but the slump was much less pronounced than the one earlier in the year. As in the case of Indonesia, drastic falls in equity prices occurred only after the currency crisis had begun. The financial share index was virtually identical to the overall index before and into the crisis, deviating only in that recovery was slower. Frankel and Schmukler (1996) use an elegant method to determine divergent expectations quantitatively, comparing Mexican country fund equity prices on Wall Street to the prices of the same bundle of shares in Mexico City. Their conclusion is that there were differences in information and expectation, and that Mexican investors turned pessimistic before international investors did. This means that an effective early warning system should have focused on domestic investors. As mentioned above, there is a strong argument for the explicit inclusion of domestic expectations in an early warning system, since financial panic and capital flight often begins ‘at home’.

The Argentinian stockmarket index went into a strong decline more than four months before the crisis hit, losing a third from September 1994 to January 1995. Given the relatively strong Mexican stockmarket and the fact that the Argentinian crisis is widely regarded to have been due to contagion by Mexico, this is surprising. It is puzzling why equity markets would have anticipated problems in Argentina, but not in Mexico.

Portfolio investment

The magnitudes of quarterly portfolio investment inflows, broken down into equity securities and debt securities are plotted in Appendix Figures A11a–A11d. These time series illustrate just how volatile portfolio investment is.

In Indonesia, portfolio capital inflows were positive in each quarter, with a rising trend. Inflows rose from a total of US$1.8 billion in 1993 to US$5 billion in 1996. The peak inflow
occurred in the fourth quarter of 1996 (US$2.1 billion). The first quarter of 1997 saw a sharp drop to less than half this. The relative drop in equity securities was more pronounced than that in debt securities. In the second quarter of 1997 capital inflows in equities dropped again, while debt equity inflows rose slightly and were stable in the third quarter. In the third quarter of 1997, at the beginning of the crisis, there was for the first time a net outflow of foreign portfolio capital in equities. The fourth quarter saw a massive net outflow of US$5.4 billion in equity capital, equal to total portfolio capital inflow from the third quarter of 1996 to the third quarter of 1997. The slowdown in equity capital inflow in the first quarter of 1997 can be seen as a genuine early warning sign, particularly as the Jakarta stockmarket index continued to rise until the end of February.

In the case of Thailand, total portfolio capital inflows started to drop in the second quarter of 1996, over one year before the crisis. Total inflows were US$1.4 billion in the first quarter of 1996 and just US$260 million in the first quarter of 1997. Interestingly, capital inflows, driven by equities, picked up strongly after this and surged to US$2.1 billion in the third quarter of 1997 before dropping again in the last quarter. An explanation for this pattern might be that stock indices rose in the third quarter, making Thai equity attractive given the currency devaluation. In Thailand, as opposed to the Indonesian case, it was capital inflows in debt securities that took the more significant plunge. However, both broken-down and total changes in portfolio inflows before the crisis were much less pronounced than the plunges in both 1993 and 1994.

Mexico 1994 exemplifies the case of sudden reversals of portfolio capital flows. Inflows dropped from US$8.6 billion in the first to US$1.4 billion in the second quarter of 1994, recovered slightly in the third quarter and then reversed to outflows of US$5.5 billion in the fourth quarter. Outflows reached their peak in the first quarter of 1995—at the height of the crisis—and reverted to inflows again in the fourth quarter of 1995. Looking at disaggregates, it is notable that inflows in equities took a sharp drop in the first and second quarter of 1994 and then remained at relatively low levels until well after the crisis. The reversal in flows was due almost entirely to debt securities. Inflows in this category began dropping sharply in the second quarter of 1994, and while there still was an inflow of US$2.9 billion in the third quarter, the fourth quarter saw an outflow of US$5.1 billion. Recovery, however, was swift, with a new record level of inflows in the third quarter of 1996.

In the case of Argentina, the first quarter of 1995, coinciding with the crisis, brought an outflow of US$600 million in portfolio capital, a sharp reversal from the US$2.2 billion inflow in the period before. There is no clearly interpretable trend in portfolio capital movements in the lead-up to the crisis. The most outstanding feature of the time series is its apparently arbitrary volatility, including a spectacular US$25 billion inflow in the second quarter of 1993, over ten times the average of inflows in the periods since.

Summing up, portfolio capital inflows could have served as short-term leading indicators in three out of four cases examined. Disaggregation into debt and equity would have been useful in the cases of Mexico and Indonesia, where significant drops in equity capital inflows began three and two quarters, respectively, before the crises.

**Bond spreads**

The most detailed work using yield spreads between domestic government US dollar bonds and US treasury bonds as a ‘risk premium’ indicator has been done on Mexico 1994 (Edwards (1997:20ff)). The ratio of return on US dollar denominated tesobonos to US treasury bills fell from 2 in January to below 1 in February 1994 and then jumped up to over 3 in March, then slowly decreased again to around 2 late in the year. A drastic jump did not occur until mid December, after the crisis had begun. The movement of bond spreads can be
interpreted as a reassessment and heightened awareness of risk following the uprising in the
Ciapas region and the assassination of the presidential candidate Colosio. After that, market
expectations gradually turned more optimistic again, without any foresight of what was to
happen at the end of the year. The sudden increase of the spread nine months before the
crisis would clearly have been picked up in an early warning system, but the gradual
decrease after that might then have caused a false ‘all clear’.

**Euromoney country risk ratings**
The semi-annual *Euromoney* country risk ratings include survey results on economic
forecasts and political risk, assessments by credit ratings agencies as well as debt and
financial indicators. Key results and a note on methodology are presented in Appendix Table
A12.

In the case of Asia, the rating system must be credited with astonishing foresight.
Indonesia’s ranking started to slide in the in March 1996 after being stable for years.
Thailand’s began dropping in September 1996, reversing the earlier upward trend. Looking at
the survey indicators for the two countries, both economic projections and political risk
assessment began to worsen significantly in September 1996. Political risk assessment for
Indonesia had taken an earlier drop in 1995. The *Euromoney* article interpreting the
September 1996 results was titled ‘Asia’s economies start to slip’, and pointed out that
‘South-East Asian economies—and even Japan—are looking riskier, as debt ratios worsen
and monetary instability spreads’.

The reverse is true for Latin America. The rankings of both Mexico and Argentina
improved during 1993 and 1994. In the case of Mexico, both survey indicators took a sharp
drop from September 1993 to March 1994, but had recovered by September 1994. This
confirms that there was concern in the beginning of 1994 which then subsided right until the
crisis began.

It is worth noting that credit ratings agencies consistently had it wrong. In each of the
episodes, sovereign ratings went up in the lead-up and down only after the crisis had begun.
In summary, the findings based on *Euromoney* ratings suggest that country risk assessment
may play an important role in gauging market sentiments. The early downgrading of
Indonesia is impressive, but the Mexican case brings home the point that the system is not
cleverer than the market itself.

**Politics**
Political events played the central role in the development from financial crisis to economic
catastrophe in Indonesia. The issue of presidential succession took centre stage when
President Suharto fell sick in December 1997 and was the cause for the turmoil that shook
the country in the first half of 1998. The first and only leadership change after the end of
colonial rule had taken place in the tragedy of 1965/66. The memory of these events certainly
compounded the decision of foreign investors to abandon the country. The uncertainty about
who would follow Suharto, and under which circumstances, also was a key factor in capital
flight of domestic residents. Indonesia parted company with other crisis-affected countries
when it became clear that a major political turning point was being reached, the outcome of
which was completely unpredictable. Widespread rioting and increasing mob violence against
ethnic Chinese compounded the sense of chaos. The government and the military were not
effective in controlling the spread of violence, and there are suspicions that ethnic hatred may
have been incited and fanned by the authorities. In addition to accelerating the exodus of
domestic capital, the tragedy of the ethnic Chinese certainly played a significant part in
Indonesia being practically abandoned by international financial markets during the first half of
1998.
While it is obvious that the dramatic worsening of the Indonesian crisis was to a large extent caused by politics, the role of the political situation in the onset of the crisis is less clear. Opposition had increased and was suppressed in 1996. This may have influenced the perception of stability of the New Order regime, which then looked less solid than ever before. By mid 1997, however, Suharto was firmly in control. There is the possibility that opinion in financial markets at some point started to turn against stability in the old framework, because of ever-increasing economic dominance of the president's family and cronies, and the tendency of backsliding in economic policy. However, there is no evidence for this hypothesis.

Thailand, in contrast to Indonesia, has been notorious for its rapid succession of governments, which on the whole did not impinge on the continuity of sound economic policy. Therefore, while there was anticipation of an impending leadership change, political uncertainty is not likely to have contributed greatly to the loss in confidence preceding the crisis.

1994 was an election year in Mexico, and this had a strong bearing on economic policy leading up to the crisis. Transformation of power in Mexico traditionally is abrupt, complete and surrounded by considerable uncertainty. Political aims were behind the staunch defence of the currency peg throughout the year, eventually resulting in a situation worse than it might have been. One reason was that most outgoing presidents had quit office on a low note, and President Salinas was eager to avoid this fate by ‘finish[ing] his term in a blaze of glory’ (Smith 1997:39). Currency devaluation was traditionally seen as an admission of defeat. In addition, NAFTA presumed a strong peso, and opponents of the free trade agreement had long argued that the peso was overvalued. Devaluation was therefore out of the question for political reasons.

In January 1994, the Zapatista rebellion in the Chiapas region came as a surprise and was the subject of great international attention. Smith (1997) argues that maintaining the pegged exchange rate was one of the ways the Mexican government sought to appease worried international investors. Two political assassinations, among them the murder of a presidential candidate, contributed to growing political uncertainty. The ongoing political trouble in Chiapas was covered up for most of the year, so that news of a renewed uprising on 18 December had a devastating effect on confidence, triggering the crisis.

To summarise, politics can be the decisive factor in currency crises. The relationship between the political system per se and the incidence of crisis is hard to determine, so an economic early warning system will be confined to an attempt to identify political uncertainty. Still, the East Asian crisis has brought home the point that economic openness needs to be matched by democratisation and good governance (Soesastro 1998). While not a cure-all, moving to a more open society is necessary if economic stability in interconnected world markets is to be achieved.

Country-specific events and the media
An event originating in Indonesia can serve as a case in point for the importance of ‘bad news’ in bringing about a change in perception. The country was gripped by a drought in the second half of 1997, with severe implications for food production. The event that received much more media attention at the time, though, were the massive forest fires raging in Kalimantan and Sumatra. For months, large parts of Southeast Asia were covered under a thick blanket of haze. The ‘Asia on fire’ story was highly publicised and soon became a symbol for public perception of the region. The prime image associated with Asia was suddenly no longer a tiger but a breathing mask.

In the Mexican case, it can be argued that the Chiapas rebellion should be included in this category also. The uprising was prominent in the world media and showed Mexico in a
different light from the officially promoted image. The rebellion never posed a serious political or economic threat (Smith 1997:40); perception was what mattered in December 1997. However, Mexico’s glamorous image had prevailed in public throughout the year, so that ‘bad press’ could, if at all, be considered a trigger rather than an early-warning sign.

Contagion
The analysis of contagion as a cause for a change in perception is straightforward in the cases considered. Thailand and Mexico were cases that caused contagion. In both cases, there were no preceding currency crises elsewhere that might conceivably have been connected. It can be argued that corporate failures in South Korea earlier in 1997 had a negative impact on Thailand by heightening investors’ awareness of overborrowing in the region, but this can hardly be classified as contagion. Regarding Indonesia, there is widespread consensus that the domestic economic crisis would not have happened, or at least would have been much less drastic, without the Thai crisis. Contagion is likely to have occurred through all of the channels discussed in the third section of the paper. The case of Argentina was even more clearly one of contagion (Lowell and Neu 1998).

Triggering events
The trigger in the case of Indonesia was the exchange rate collapse in Thailand, causing a change in expectations regarding the whole region’s economic future and a sudden withdrawal of capital. For Thailand, it is much harder to locate a single triggering event. In retrospect, Thailand was for some time headed for a financial crisis, and in 1997 it did not take much to bring it about. Immediately preceding the decision of the Bank of Thailand to stop defending the peg was the suspension of 16 banks on 27 June. In Mexico, although deterioration of economic fundamentals was nowhere near as bad as in Thailand, the crisis was waiting to happen through most of 1994. It was only the determination of the authorities not to allow a devaluation of the peso, and their readiness to spend substantial amounts of reserves defending the peg, which postponed the outbreak. The trigger was news of political unrest, namely renewed uprisings in Chiapas.

Summary: performance of ‘change of expectations’ indicators
In the East Asian crisis, a change of expectations and reevaluation of investment risks was at the heart of the matter. In the case of Thailand, signs of a mood swing began appearing early in 1996. With regard to Indonesia, expectations changed much later and more drastically. It can be argued that a mood swing was decisive for the dramatic worsening of the economic situation in late 1997 and early 1998, but that confidence in the Indonesian economy was still considerable when the crisis began in August. Mexico also is a clear case of a sudden loss of confidence. However, the change in expectations was not easy to see at the time. This was due to the success of the Mexican and US governments in patching up investor confidence after the situation had begun to look bad early in 1994, the readiness to spend reserves and the withholding of potentially damaging economic information. During the rest of the year, there appears to have been a creeping change in expectations, erupting in December. Expectations regarding the Argentine economy and exchange rate regime changed substantially, but only as a result of contagion by the events in Mexico. An early warning system would have been of least use in the Argentinian case.
### Table 12: Performance of ‘change of perception’ indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Country/episode</th>
<th>Performance* and lead time (months)</th>
<th>Indicator</th>
<th>Country/episode</th>
<th>Performance* and lead time (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>change of perception indicators overall</td>
<td>Indonesia</td>
<td>+</td>
<td>Country risk ratings drop</td>
<td>Indonesia</td>
<td>+ 15</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>+</td>
<td></td>
<td>Thailand</td>
<td>++ 12</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>(+)</td>
<td></td>
<td>Mexico 94</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>(o)</td>
<td></td>
<td>Argentina</td>
<td>-</td>
</tr>
<tr>
<td>Stock market indices drop</td>
<td>Indonesia</td>
<td>(-)</td>
<td>Political situation more unstable</td>
<td>Indonesia</td>
<td>++ (December 97)</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>++ 18</td>
<td></td>
<td>Thailand</td>
<td>(o)</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>o</td>
<td></td>
<td>Mexico 94</td>
<td>++ 12</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>+ 4</td>
<td></td>
<td>Argentina</td>
<td></td>
</tr>
<tr>
<td>Portfolio investment inflows decrease or revert</td>
<td>Indonesia</td>
<td>++ 6</td>
<td>Country-specific events, ‘bad news’</td>
<td>Indonesia</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>(+) 12</td>
<td></td>
<td>Thailand</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>++ 9</td>
<td></td>
<td>Mexico 94</td>
<td>(+) (trigger)</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>o</td>
<td></td>
<td>Argentina</td>
<td></td>
</tr>
<tr>
<td>Bond spreads increase</td>
<td>Indonesia</td>
<td></td>
<td>Contagion</td>
<td>Indonesia</td>
<td>++ 2</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td></td>
<td></td>
<td>Thailand</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>Mexico 94</td>
<td>(++) 9</td>
<td></td>
<td>Mexico 94</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td></td>
<td></td>
<td>Argentina</td>
<td>++ 1</td>
</tr>
</tbody>
</table>

**Notes:** * ++: strong signal, +: signal, o: no signal, -: wrong signal, (): with qualification.*
Capital-account convertibility will leave economic policy in the typical 'emerging market' hostage to the whims and fancies of two dozen or so thirty-something country analysts in London, Frankfurt, and New York.

Dani Rodrik (1998)

Conclusion

In light of the theoretical considerations and the case studies of currency crises in Indonesia, Thailand and four earlier Latin American episodes, the answer to the questions posed in the introduction is twofold: yes, an early warning system for currency crises needs to take into account indicators beyond economic fundamentals; but no, it will not be possible to devise a reliable early warning system.

A framework along the lines suggested in this paper appears well suited for the analysis of recent crises. In order to identify vulnerability, a number of useful macroeconomic and structural indicators have been identified, and ways to detect changes in the perception of those fundamentals have been explored. Vulnerability would have been indicated on the basis of macroeconomic variables in the lead-up to all but one of the crises. No single indicator, however, was reliable in all episodes. A combination of indicators capturing exchange rate overvaluation and inadequacy of foreign exchange reserves performs well. As for structural indicators, the empirical results emphasise the importance of the health of the financial sector and the structure of foreign debt. More research is needed on the interactions between macroeconomic variables, the development of indicators for institutional and political aspects, and the definition of threshold levels for individual and combinations of variables.

It has been shown that the monitoring of market sentiments has a place along with the analysis of economic fundamentals, structural and political factors. Particularly in the recent East Asian experience, a sudden and dramatic change in the perception of economic fundamentals and expectations regarding future developments was the driving force behind the crisis. A range of promising leading indicators has been identified in this paper, some using readily available quantitative data. The challenge lies in the exploration of relevant information outside the traditional realm of economics and the construction of quantifiable indices. The importance of sudden changes in expectations, however, is the very fact that ultimately defeats any attempt to anticipate currency crises under perfect international capital mobility. Applying the framework suggested in this paper shows that in most cases alarm bells would have gone off some time before the crash; but this result is ultimately due to the benefit of hindsight. The next crisis will always be different. The best any early warning system can do is to give policymakers a clearer indication that problems are brewing.

Prediction is the part of economics which performs most poorly, and can never be a substitute for intelligent policy. Sound macroeconomics, a favourable microeconomic and structural environment, and political stability are all necessary to achieve lasting stability in an increasingly open world economy. In light of the East Asian currency crises, an internationally coordinated attempt to stabilise global financial markets seems in order. Measures to avoid similar crises in the future should include, but may well go beyond, the implementation of sophisticated early warning systems.
Notes

1 In most models, speculative attack is at the heart of currency crises. However, the results easily carry over to a less malevolent view of international capital markets.

2 If currency crises were perfectly self-fulfilling, the idea of an early warning system becomes absurd. A credible system would become endogenous to the system, a prediction of impending exchange rate collapse coming true by definition.

3 See also Wyplosz (1998) on informational aspects of globalised financial markets.

4 See Keynes (1936, Chapter 12), 'The State of Long-Term Expectations', providing some valuable insights into investment market psychology.

5 Scharfstein and Stein (1990) laid the theoretical foundations for microeconomic analysis of herd behaviourTheir model is geared towards investment decisions influenced by managers’ reputation in the labour market.

6 The matrix draws on Krugman (1997).

7 Interestingly, general equilibrium modelling of the Asian crisis supports the argument for the overriding importance of changes in expectations. McKibbin (1998), attempting to re-create the crisis by subjecting a GE model to various external shocks, shows that a sudden and drastic re-evaluation of investment risks produces the results most alike to the observed behaviour of several variables.

8 Of the indicators featured in the Kaminsky et al. (1997) survey, only those which appear in at least three studies are included.

9 In simple algebraic terms: RER=ER(p/p*).

10 See Hargreaves (1994) for details on the construction of the index.

11 An example would have been bond issues by Indonesian companies owned by the Suharto children.

12 International banks typically use country risk rating to determine country limits of investment exposure. Euromoney (1992). This means that a downgrading of a country risk assessment can directly cause the selling of financial assets.

13 This description is based on the International Country Risk Guide, New York, which focuses on actual political factors and Political & Economic Risk Consultancy, Singapore, which covers mainly Asian countries. Other ratings include those by the Economist Intelligence Unit, Institutional Investor and JP Morgan. See Krayenbuehl (1988) for an introduction to the concept of country risk.

14 A case in point for the quality of the data is a regression analysis by Melvin and Tan (1996), finding highly significant correlations between ICRG ratings and foreign exchange bid-ask-spreads using panel data.

15 As in the case of country risk ratings, time series data has to be purchased and was not available for this study.

16 See Lowell and Neu (1998:30ff.).

17 Some of the many useful references are APEG (1998), Radelet and Sachs (1998b), Montes (1998), Warr (1998) and, for a definitive account on Indonesia, Soesastro and Basri (1998). In addition, there are numerous internet sites providing factual accounts and analysis. See especially Roubini (1998) and the detailed chronology of events there.


19 The discussion after the event was as if the Mexican crisis was indeed ‘a chronicle of death foretold’ Calvo and Mendoza (1996), with all warning signs in plain sight but still unnoticed.

20 Edwards (1997) gives a detailed account of what he calls ‘the invention of the Mexican miracle’ by Mexican and US officials as well as the World Bank and the IMF, fostered by the media and eagerly taken up by financial markets.

This included the refusal to report reserve data to a World Bank delegation in June 1994. The handling of key economic data by the Mexican authorities in the lead-up to the crisis caused the IMF to introduce more stringent data publishing requirements. (Edwards and Naim 199);25

There was a discussion on the overvaluation of the peso at the annual Brookings Panel conference in May 1994. Dornbusch and Werner (1994) argued then that the peso should be devalued by 20 per cent.

Data is taken from the World Bank World Debt Tables (now renamed Global Development Finance). Short-term debt data in the World Bank series is comprehensive, but of variable quality (World Bank 1998:x). For the compilation of short-term debt data series, the World Bank relies both on debtors’ information and on creditors’ data provided semi-annually through the Bank for International Settlements (BIS). The same applies to the data on private nonguaranteed debt.

For details on the data, see the footnote above.

Radelet (1995:41) examined the possibility of a debt crisis, concluding that Indonesia was not headed for an immediate crisis. However, he warned of rapidly growing short-term debt as a potential problem and predicted that ‘a severe debt service problem is possible by the end of the decade, given a combination of poor investment decisions, strong external shocks, and an uncharacteristically weak or counterproductive macroeconomic policy response’. Such wariness was unusual in the general optimism regarding East Asia at the time.

Radelet (1995) details the reasons why foreign loans were so attractive to the Indonesian private sector.

In Indonesia, this belief was confirmed on several occasions in the 1990s.

The ranking is based on on 2:1 weighting of statistical to survey indicators. For Mexico and Argentina, there are no comparable rankings before 1994.

Data for financial shares only was unavailable for Argentina.

Equity securities include ‘shares, stocks and similar documents’, debt securities cover ‘bonds, debentures, notes, etc.; money market or negotiable debt instruments; and financial derivatives or secondary instruments, such as options’. (IMF-IFS, June 1998:xxi); for Argentina, data is available only for total flows.

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