

ECONOMIC AND FINANCIAL MONITORING AND SURVEILLANCE

I MONITORING AND SURVEILLANCE: THE THEORETICAL UNDERPINNINGS

INTRODUCTION

Economic and financial crises are not everyday phenomena, but when they come, they inflict untold economic and social costs.¹ The severe economic contraction, widespread bankruptcies, large-scale unemployment, social and political discontent and continued vulnerability to speculative attacks entail a very great burden for any country to bear. As observed in the Asian crisis, the poorest sectors of society tend to be the ones that bear the brunt of the difficulties. The aftermath of the crisis is usually accompanied by intense soul-searching by all affected parties, creditors, debtors, the private sector and policy makers alike. Why did the crisis occur? What could we have done to manage it better? Why was it not spotted in advance? And, perhaps more wistfully, how can a recurrence be avoided?

The Asian crisis has sparked worldwide interest in reform of the international financial system. The main thrust of proposals for a new financial architecture – the buzzword for a reformed system – is to ensure both that the potential benefits of the globalization of markets are realized and that the risks inherent in the process are mitigated. While these objectives are not new, the changing circumstances, including technological advances in communications that underpin financial market integration and the presence of massive and volatile capital flows, give rise to new challenges in managing national and international financial systems. The ideas behind reforms in the financial architecture are multifaceted and include elements of promoting transparency and accountability; strengthening financial systems through better supervision; managing the process of capital account liberalization by better sequencing; ensuring the appropriateness of exchange rate regimes; dealing with volatile capital flows; and involving the private sector in crisis prevention and resolution. The call for improved surveillance (defined to include international cooperation in monitoring and exchange of information and views, as well as the application of peer pressure on policy matters) is an integral part of the overall response to the need to reform the international financial system.

At the global level, there have been some important initiatives by IMF, BIS and the World Bank, as well as by private organizations such as IIF and rating agencies, to revamp and strengthen their information collection and monitoring activities (for a review of these efforts see chapter V). The idea of a regional surveillance or monitoring mechanism, first proposed during the Manila Framework meeting in November 1997,² has gradually advanced to the point where 14 countries have agreed to meet twice a year to review economic and financial development in the region. The ASEAN Finance Ministers Meeting in February 1998 endorsed an ASEAN Surveillance Process³ (discussed in chapter VI).

Designing an effective surveillance or monitoring mechanism is complicated. History is replete with attempts at the international level that failed to take off owing to various constraints. While at the national level the technical challenges to collecting data accurately, on time and with the required frequency, are daunting, it is much more difficult, given political sensitivities, to design and implement monitoring measures at the regional and global levels. In many regions, especially within groupings of developing countries such as ASEAN or SAARC where trade issues have tended to dominate the agenda, cooperation on financial matters is quite novel. Thus, the creation of any regional or subregional initiative necessarily involves a steep learning curve, with many technical and institutional hurdles.

On top of all of this the world is becoming more complex. As the recent experience of the Asian crisis illustrates, policy makers have yet to come to grips with the modalities for operating in an environment of floating exchange rates and free flows of capital, both within the ambit of the expectations and reactions of global markets. Thus, given the possible negative externalities arising from financial crises in either developed or emerging markets, it is in the interest of the world

community, and not just the countries affected by a crisis, to take steps to improve the management of the world financial system.

Background and scope of the study

The members of ESCAP have been reviewing regularly the overall economic situation in the region, including the impact of the financial crisis which hit East and South-East Asia in 1997. The spillovers from the crisis affected many countries in the region and outside negatively. Though the worst predictions did not materialize (see chapter II), all were caught unawares by the force of the crisis. However, such reviews have not been in the nature of what can be considered surveillance, as defined earlier. The Commission, at its fifty-fifth session in April 1999, adopted resolution 55/2 in which, *inter alia*, it requested the ESCAP secretariat to undertake a study on possible regional mechanisms for the exchange of information and early warning systems in relation to the financial and economic situation in the countries of the region, with a focus on crisis prevention and reduction of the vulnerability of countries to economic and financial turmoil. The ultimate objective of the study is to make recommendations for future activities, including ways and means of making regional contributions to the global monitoring and surveillance programmes of IMF and other multilateral entities while complementing, but not duplicating, efforts already made by multilateral financial institutions in this direction.

ESCAP is not about to set up its own economic and financial surveillance mechanism, operating in parallel with current or new international, regional or subregional mechanisms. Rather, the intention is to explore ways in which ESCAP could complement and support these mechanisms with a view to enhancing the effectiveness of such activities for crisis prevention for the benefit of ESCAP members. This study, which responds directly to resolution 55/2, first looks at what constitutes monitoring, surveillance and early warning systems and the experience with these systems in terms of the ability to predict a crisis. This is followed by a brief review of the existing mechanisms in IMF, BIS, IIF and the rating agencies in terms of the process followed, the technical aspects of the approach and new activities initiated since the crisis. In chapter VI, an effort is made to explore how some regional/subregional approaches could help fill the gaps identified in the review of existing mechanisms, these approaches being of varying degrees of formality and catering for the needs of different groups of countries depending on the degree of their current involvement in world financial markets. The last chapter presents some suggestions for further action, particularly by ESCAP, to assist the countries in the Asian and Pacific region in identifying and coping with vulnerabilities to economic and financial crises.

SURVEILLANCE AND MONITORING

The logic of international cooperation

The growing interdependence among the economies in the world has stepped up the need to engage in international economic cooperation. As economies become more interdependent, spillovers become more important and developments in one economy affect the welfare of other economies in the world. The more extensive the trading and investment links between countries, the deeper are the spillovers. Spillovers or externalities can be either positive or negative. For instance, a high economic growth rate in a country implies a healthy demand for imports from trading partners, whereas a recession in one country can have a negative effect on the performance of the export sector of its trading partners. The main objective of economic cooperation is thus to exploit the positive externalities and minimize the negative ones. Cooperative efforts, such as policy coordination, are intended to ensure that the external effects on partner countries are taken into account adequately in the decision-making calculus of a national government.

The public goods aspect of overall economic stability at the international level provides another motive for international economic cooperation. A stable international trading and financial system may be considered a public good in that all countries benefit from it, whether or not they have contributed to it. Public goods may be supplied by a government agency at the domestic level, such as a central bank that oversees the financial and economic stability of a country, but there is no comparable institution at the international level.⁴ Without modalities for coordination, countries may be tempted to seek the benefits of stability without assuming their share of the burden (free rider problem). The public good of stability may thus be undersupplied. International cooperation aims to instil in countries an understanding of their responsibilities in contributing to a stable economic and financial environment in the world. In addition, it would be impossible for the national institutions of a single or a small number of countries, however important, to ensure the stability of the global trading and financial system.

While there exist various reasons to promote the positive externalities, very often the avoidance of negative externalities provides the most compelling motivation for cooperation. For example, an upsurge in protectionist measures may be resisted in a country because of the beggar-thy-neighbour behaviour to which such a move could give rise. Cooperation can help minimize the prospect of competitive devaluations. Another important dimension to negative spillovers occurs when the policy mix pursued by a country is unsustainable and, in all likelihood, will be reversed in the near future. Sharp policy reversals have implications for the domestic allocation of resources and therefore carry domestic costs. Moreover, this introduces instability, imposes reallocation on the rest of the world, especially on trading partners, and generates negative international spillover effects. Cooperation can help avoid both the initial disturbance and the policy reversal.

Today an additional reason for international cooperation arises from the growth of open capital accounts and highly integrated capital markets of various sorts. Financial markets, by nature, are inherently prone to instability, owing to the fractional reserve system on which they are based. Weak financial systems at the national level can have long-lasting and insidious macroeconomic implications that are naturally of concern to central bankers; monetary stability and financial stability are two sides of the same coin. With integrated markets, financial instability is unlikely to remain contained within national borders. All financial disruptions are likely to have an international dimension because the three pillars of a domestic financial system, financial institutions, financial markets and payment and settlement systems, are increasingly international. The fact that financial transactions can be made, as well as market information disseminated, instantaneously and at almost no cost around the globe increases the probability that shocks in individual countries will be propagated elsewhere, even when such contagion might not be warranted by underlying economic fundamentals. The crises are increasingly coming in waves; they tend to be regional in scope and, even though they have more severe effects within the region of origin, no region is spared.

Indeed, the prospect of financial contagion argues for greater consultation and cooperation. The integration of the capital markets across the globe brings efficiency benefits in terms of competitive cost of funds, diversification benefits etc. However, there are also attendant risks associated with notions of contagion and systemic risks. There are at least three important characteristics of today's capital markets that raise different perspectives on risk.

First, a multiplicity of channels characterizes the transmittal of financial strains from one system to another. Traditionally, trade and investment links are considered to be the main transmission mechanism of disturbances across boundaries. It is now apparent that the transmission mechanism is wider and can include a sell-off instigated by a reassessment by the creditors of a country who become exposed to a previously ignored weakness in another country. The herd mentality of investors who pull out of a region composed of both crisis and non-crisis countries in one sweep on the basis of margin calls, internal risk-management guidelines, or plain panic provides another mechanism for contagion. A series of competitive devaluations in response to a similar action initiated by a country that faces an imminent currency crisis constitutes another channel for the propagation of contagion in a region.

Second, today's capital market is marked by the extremely high speed of transmission of information and transactions. Thus, any change in expectations could trigger massive fund transfers from one system to another and the loss in confidence by investors in a country can result in large and rapid capital outflows with very significant changes in asset prices, which could trigger a financial crisis. The implications of the speed of operations for the reaction time of policy makers in responding to a crisis are that they no longer enjoy the luxury of having a long time to analyse or to determine the appropriate policy response to the initial disturbance.

The third characteristic involves asymmetries in size, particularly between the financial resources available to the private capital market participants and the liquid assets of the official financial sector, and between the size of private capital flows and that of the domestic financial system of an emerging market. Private capital markets far exceed official assets, and international capital flows dwarf the size of the stock markets of almost all emerging markets. One implication of these disparities is that the speed and size of private flows, particularly short-term flows, can significantly destabilize the financial markets of emerging markets. Another implication is that speculative pressure arising from the markets can be very powerful and easily destabilize the asset markets and the exchange rate regimes.

The aforementioned realities impose several challenges on the task of promoting global financial stability. Any such strategy must begin by recognizing two facts: the pace of change in modern financial markets is extraordinary, ongoing and irreversible and financial transactions are becoming increasingly complicated and opaque, involving an ever-widening and changing cast of actors. Thus the system which policy makers aim to stabilize is both difficult to define at any moment in time and rapidly mutating. Moreover, new participants such as pension funds, mutual funds and hedge funds are not likely to behave in the same manner as traditional banks, implying new uncertainties about how the international financial system will react during periods of stress.

Key elements of economic policy cooperation

Economic relations among national governments can be viewed as ranging along a spectrum from open conflict to integration, where governments set policies jointly in a supranational forum to which they have ceded a large measure of authority. At the midpoint of the spectrum lies policy independence, in which governments simply take the policies of other governments as given, attempting neither to influence them nor be influenced by them. Between independence and integration lies coordination – joint problem identification and pursuit of mutually beneficial ways of achieving national objectives. There are a variety of forms of cooperation, such as information exchange, consultation and mutual encouragement to adopt certain strategies or policies. Consultation lies closer to independence than true coordination; it is more informal, less binding and essentially involves sharing views and information without actually tying policies to formally agreed norms.

In the light of the spillover effects where part of the benefit or cost arising from the policy decision of one country affects others, there is a felt need in today's increasingly integrating world for governments to consult with each other and attempt to coordinate their actions to take these linkages into account. In theory, they should then be better off than if they had acted independently. This argument becomes even more compelling in the light of recent rapid advances in information technology and the integration of financial markets discussed earlier.

There are several steps needed for effective international cooperation:⁵

- A common understanding of the objectives that are being pursued
- An appreciation of the nature of the economic environment within which national economies interact
- An analytical framework for assessing the international impact of the economic policies and the performance of individual countries
- A set of procedures that allow international considerations to be taken into account properly in framing national policies

In the Group of Seven (G-7)⁶ framework for economic cooperation, which is one of the more long-lasting and developed systems,⁷ there are three main steps:

- Surveillance, using statistical (also called "objective") indicators for the projection of the effects of economic policies and for measuring actual performance, to assist in assessing the emergence of internal and external disequilibria
- Policy objectives and guidelines developed in the light of existing knowledge about the linkage between goals and policies, against which the member countries' economic performance can be appraised and remedial changes recommended, if necessary
- Adoption of recommended policy changes

Surveillance thus has an important role to play in international economic cooperation, but it is only one element. In the G-7 framework, for instance, surveillance is the first step in a coordination process that should end with the adoption of policy changes. In less ambitious cooperative efforts, the surveillance indicators are used to give focus to the process of exchanging views. Without these objective elements that provide a common starting point, there is the attendant risk that such consultations will be unfocused and therefore ineffective. The process of surveillance itself contains several elements, including the selection of indicators which measure economic performance as well as provide an early warning of the emergence of unsustainable trends. In the G-7 context, there are two kinds of indicators: the target indicators and their actual values; target indicators reflect domestic policy objectives, such as growth of real incomes, low inflation and full employment.

Monitoring is the process of comparing the target variables against actual performance. Therefore, one must necessarily undertake monitoring when performing surveillance, that is, monitoring is an essential component of surveillance.

Determining the targets for these variables or their paths can be done using quantitative projection methods. Sometimes, on top of the target variables, the set of instruments that countries use to achieve their targets, such as open market operations, public-sector expenditure and tax rates that are controlled by monetary and fiscal authorities, may be quantified and monitored. In many cases targets include intermediate variables such as interest rates and exchange rates, nominal income and growth of monetary aggregates. International targets may refer to what in the domestic economic context would be intermediate variables, such as reduction of current account deficits, stabilization of

exchange rates, or reduction of protectionist pressures. Monitoring is used to provide policy analysis of why targeted paths were successfully attained or not or to give an early warning of a potential crisis situation. Adequate monitoring can lead to improvements in the ability of governments to recognize warning signals early and to act swiftly.

Monitoring can and should take place at different levels of policy-making as economies are made up of several subsectors: real, financial, fiscal etc. The implications of the interrelationships between these subsectors for the overall economy also need to be considered. Thus a monitoring hierarchy may consist of at least two levels: monitoring at the level of the sectors and at an overarching economy-wide level.

In the aftermath of the recent crises, as domestic policy makers, IMF and other multilateral institutions came to grips with the apparent failure of surveillance to foresee them, there has been a movement towards countries adopting internationally developed codes or standards in a number of areas affecting the operation and supervision of financial markets. The most developed of these so far is the Basel capital adequacy standard, although standards or codes on transparency, fiscal, financial and monetary policies, stock markets, accounting systems, bankruptcy etc. are being developed. Such codes and standards can provide clear parameters for monitoring exercises in the financial sector.

An important element in a successful economic coordination framework is a set of policy guidelines developed to conduct surveillance of members' policies and performance and to identify the need for remedial action. The G-7 practice has been to make policy commitments and exchange rate objectives public through communiqués issued at ministerial meetings. In this exercise, exchange rate commitments are analysed first, together with the measures that were used for comparing commitments with actual performance; this is followed by an analysis of the norms that were used in judging the need for changes in macroeconomic policies.

The third element of successful coordination is to find means to encourage remedial policy action once the need for it has been identified. In theory, this can involve peer pressure from other countries, bargaining to accomplish linkage with other desired objectives, or retaliation for failure to take the remedial action. From the above, it is clear that the ultimate effectiveness of any form of international economic cooperation has to be judged by the ability of such efforts to influence the behaviour of - countries.

The process of selection of indicators

Any multilateral surveillance process has to make use of a variety of indicators. It is important not only to define the purposes for which the indicators are to be used but also the analytical framework within which they are to be interpreted. International cooperation thus has two levels: the technical level, at which the primary concern is the selection of indicators, and the interpretation level, at which judgements of whether a country is headed towards economic turmoil are made based on the movements or performance of the indicators. The selection of appropriate indicators is thus an important element in the process of international coordination/cooperation because they provide focus for the discussion of policy options. In the G-7 framework, for instance, these should be broad enough to identify the underlying causes of imbalances, not just the imbalances themselves. In national surveillance, the use of leading indicators is more focused on assessing the prospects of recession or an inflationary surge. In essence, indicators should be useful in judging economic trends in a systematic way.

While a set of basic macroeconomic indicators is used in most countries on an ongoing basis for monitoring domestic developments,⁸ there are a number of other important elements that determine the selection at the international level. First, as the use of indicators at this level is geared primarily to analysing the international interactions of economic policies and performance, trends in domestic policy and performance variables need to be viewed in terms of their implications for international variables such as exchange rates and payment patterns. This, in turn, requires an analytical framework for relating trends in domestic variables to external objectives. Second, emphasis should be on the medium term, and short-term developments should be assessed in the light of their medium-term - implications. Third, the actual developments in particular indicators need to be measured against standards or criteria that would establish a regionally or internationally accepted desirable pattern.

EARLY WARNING SYSTEMS

The provision of an early warning of a crisis is really the product of monitoring. One can make two conclusions after monitoring: either everything is on track or some things are going wrong. Once significant deviations from the desirable trend of a set of indicators are identified policy makers are

alerted to the possibility of crisis. Early warning systems are models that attempt to predict systematically which countries are more likely to suffer from crises. Among these, models designed to predict currency crises are common (see box IV.1 for typologies of crises). The advent of the Asian crisis has stimulated work in this field further. The post-Asian crisis research can be mapped into the following two areas: the development of leading indicators or early warning systems to predict the onset of a crisis; and policy measures that can be taken to avoid similar problems in the future.

Here the concern is primarily with the first, including reviewing the various early warning systems that have been proposed. The second is of interest insofar as it can guide the construction of leading indicators. However, it should be noted that having an early warning system would be of great advantage if it were complemented by a reaction kit of policy response options whenever bad signals were flashing. If the authorities are required, on the basis of warning signals, to consider actions based on a set of policy options (similar to the prompt corrective action rules developed in the United States), then a speculative attack may be averted. It should be recalled that speculative attacks on a currency are significantly affected by uncertainty over the timing and quality of policy responses to disturbances. A reaction kit of policy options may well serve as a clearly articulated contingency plan for governments that could improve the confidence of market participants.

A fundamental issue confronting research in this area is whether crises are, by nature, predictable. If a crisis implies a correction of an unsustainable economic trend, presumably generated by an inconsistent set of policies, then crises should be predictable. This corresponds to the first case in the Radelet-Sachs classification (see box IV.1). To the extent that the monitoring or regulation of banks can spot problematic practices, moral hazard-based crises can also be predicted. It is also contended that some crises may be inherently unpredictable. This would be so in the case of contagion; Radelet and Sachs argue that the Asian crisis belongs more to this category. In their view, the macroeconomic fundamentals of most if not all of the affected countries did not justify the severity of the crisis.

Apart from such theoretical considerations, there are other issues that impinge on the practical side of predicting currency or other types of crises. First, there are doubts that crises are sufficiently similar across countries and over time to allow generalizations from past experience. There is also the question of whether adequate data on the signals of crisis are available, on time, with adequate accuracy and in a way that is interpretable by policy makers. There are difficult measurement problems for some vital indicators. For instance, much of the literature on the Asian crisis has identified underdeveloped banking supervision as a major factor in increasing the vulnerability of the banking system to a crisis. This variable, however, is difficult to quantify, and qualitative assessments may vary significantly. Lastly, even if data were available, the presence of "noise" may not guarantee that a correct interpretation is possible.

A second related issue is the difficulty of constructing an early warning system based on historical data to warn of a crisis that has origins in something new, that is, not covered by previous theories of crises. The world of finance is known for its rapid innovation and increasing complexity of instruments and so this situation is likely to arise. It is also true that policy makers, civil servants and technocrats tend to lag in their understanding of the innovations and their impact on policy.

Still another issue is how an early warning system could cope with a major structural change. For instance, currency crises erupt when an exchange rate peg is deemed unsustainable. In an era of freely floating exchange rates, would there be currency crises? If so, what is the transmission mechanism? Early warning systems constructed using data from a time when fixed exchange rates prevailed may not be useful or meaningful in predicting a crisis under a floating exchange rate regime.

If an early warning system was accurate and therefore credible, and authorities always acted on the basis of the warning, then policy action might avert a crisis. This is the intended effect. However, because of the action, technically the warning raised earlier becomes a false alarm as no crisis materializes – and the system may be seen as perverse. Thus an automatic reaction function of policy to crisis signals may ironically limit the predictability of crises.⁹

If the markets deem the early warning system to be credible, then a signal of an impending crisis may in fact also precipitate or trigger a crisis. This possibility, which works through the formation of expectations of the market players, creates a dilemma, and not just a conceptual problem, as market expectations have a tendency to overshoot and so may influence the economic situation of countries unnecessarily. Therefore, does having more information and warnings create crises, or lessen their severity? Does hiding information from the market avert crises or only postpone the day of reckoning and deepen the result?

In any case, if indeed leading indicators can be found, or early warning systems constructed, efforts in this direction are worthwhile in view of the large costs of a crisis. However, to anticipate a crisis, access to timely and accurate information and data is critical. Policy makers need to know the status of and changes in key economic variables. Surveillance, and the monitoring of key economic variables, are thus an important function of policy-making. Moreover, in a more open global economy,

with greater economic links between countries via trade, finance and investment, this function needs to be fulfilled on the international level and not just nationally.

Identification of leading indicators

As the term implies, an early warning system consists of economic indicators that signal in advance the onset of a crisis. This idea, however, is not without its difficulties. The development of leading indicators presumes that an economy exhibits consistent and regular patterns of behaviour prior to a crisis. It assumes that the same economic variables will get out of line ahead of an impending crisis, crisis after crisis. However, not all crises are alike, and consequently one would not expect that the same indicator would be a good signal for each type of crisis. Ideally, one would like to have several observations for the same type of crisis and test which indicators would signal each of them. This ideal has to be tempered, however, by empirical considerations. It is highly unlikely that enough observations can be gathered on crises of a similar origin or nature¹⁰ in recent times to make statistical analysis feasible. If they could, it would certainly reflect badly on the ability of policy makers to learn from mistakes.

Most of the research studies on early warning systems analyse data on crises for a cross-section of countries to identify the indicators that have historically foreshadowed crises. One could argue, though, that each country (or economy) is unique and indicators that work for some countries might not work for others. For example, in developed countries a significant proportion of the population invests in stock markets, making stock market indexes an important indicator. On the other hand, in many developing countries the stock market may be too thin and insignificant to have major implications for the economy. Again, this issue reflects an empirical constraint that instances of crises for a single country may not afford enough observations for statistical testing.

The models used for predicting crises can be classified into three types:

- A signals approach – a set of economic indicators exceeding a certain threshold constitutes a signal of an approaching crisis. Policy makers can keep track of a single indicator deemed representative of the sector being monitored (an example is the New Zealand Reserve Bank focus on the inflation rate). Instead of relying on a single catch-all indicator, a group of indicators considered reflective of various aspects of the economy may be chosen. This form is more common as the use of a number of indicators is less likely to be thrown off by “noise” than that of a single indicator. In both cases, often one cannot predict the exact timing of a crisis but can indicate stress or vulnerabilities in the system
- Probit or logit models that compute the probability of a crisis occurring based on indicators
- A regression model approach

The first two approaches have also found application in the economic literature for forecasting business cycle turning points. Conceptually, the only difference in the currency crisis literature is that the approaches are used to signal or estimate the probability of a currency crisis rather than a turning point in the business cycle.

Whichever approach is adopted, the leading indicators should ideally possess certain properties:

- Timeliness – a signal of an impending crisis, even if correct, is of limited use if it arrives after the onset of the crisis or with insufficient time left to avert it
- Low noise – the number of false signals is minimized, and a leading indicator should not fail to signal a crisis that does occur

Recent research

A brief survey of the theoretical literature on early warning systems may be found in the annex to this chapter. Three of the recent and more comprehensive empirical studies are summarized below; other recent empirical studies are listed and described briefly in the annex.

In a recent example of the use of multiple indicators, eight indicators of a financial crisis were proposed.¹¹ It is argued that these would have signalled the Asian crisis. These eight indicators, their critical regions (as determined by the author’s rules of thumb), and their values in 1996 for the five

Asian countries most affected by the crisis are presented in table IV.1. (Unfortunately, the author does not explain the basis for his rules of thumb for the critical range of values.)

It is clear from the table that not all of the countries were experiencing values for the variables that were critical in 1996, except for foreign debt as a percentage of GDP. However, each country - (except Malaysia) had at least two variables in the critical range. Such an approach has the advantage of being fairly simple to understand. Nevertheless, the data requirements in terms of timeliness and accuracy are not easy to meet.

In another paper,¹² 28 selected empirical studies on leading indicators for currency crises by various authors were surveyed covering a number of countries, both industrial and developing, and spanning the period from the 1950s to the 1990s. The approach involves monitoring the evolution of several indicators that tend to exhibit unusual behaviour in the period preceding a crisis. When an indicator exceeds or goes below a certain threshold value, this is interpreted as a warning signal that a currency crisis may take place within the following 24 months. The variables (either levels or growth rates) reported as having the best track record within this approach include exports, deviations of the real exchange rate from the trend, the ratio of broad money to gross international reserves, output and equity prices.

This research suggests that: (a) an effective warning system should consider a broad variety of indicators – a currency crisis usually seems to be preceded by economic and sometimes political - problems; (b) those variables that receive ample support as useful indicators of currency crises include international reserves, the real exchange rate, credit growth, money supply as a ratio of international reserves, real GDP growth and the fiscal deficit; (c) several foreign, political, institutional and financial variables also have some predictive power in anticipating a currency crisis – banking-sector problems stand out in this regard; and (d) (surprisingly) variables associated with the external debt profile did not fare well. Also contrary to expectations, the current account balance did not receive much support as a useful indicator of crisis. This may be because information provided by the behaviour of the current account balance may already have been reflected to some extent in the evolution of the real exchange rate.

There are limits to the usefulness of this approach for a particular country precisely because the set of indicators proposed are those that perform well in warning of crises over a large sample of countries. If each country is peculiar to itself, as this research suggests, then the best set of leading indicators for a particular country is unique and not necessarily the same as the general set. Nevertheless, the proposed set could be useful as a starting point for those countries or economies that have not yet found a set of leading indicators.

However, if it is accepted that the more important ability of an indicator is to predict a crisis when one in fact does occur later¹³ (in other words, not miss a true crisis), then the results are not very promising. The literature would refer to this as avoiding a type I error that is, failing to signal a crisis that in fact occurs; a type II error corresponds to a false alarm that is, signalling a crisis when none in fact follows. The following simplified version of the table reported in the *IMF Staff Papers* highlights this aspect of the results. On the average, the indicators signalled a crisis correctly only 68 per cent of the time; that is to say, they missed 32 per cent of the crises.

Berg and Patillo¹⁴ undertook a comparison and evaluation of three early warning models of currency crisis. The models they picked represented the three classes of early warning models enumerated earlier. Specifically, they evaluated the Kaminsky-Lizondo-Reinhart model discussed earlier as a representative of the signals approach, the Frankel and Rose probit model¹⁵ as a representative of the probit/logit approach, and the Sachs, Tornell and Velasco model¹⁶ for the cross-country regression approach. They attempted to replicate the results of these three models, introducing and experimenting with slightly different specifications along the way. Unfortunately, their conclusion is not very promising from the perspective of those who hope for a viable early warning system. While they find that the models are better than naive guesswork, they would not have predicted the 1997 crisis very well.

All the models surveyed tried to come up with leading indicators that performed well over a cross section of countries and crises. As pointed out earlier, precisely because crises and economies can vary in nature, "one size may not fit all" when it comes to leading indicators. In most developed economies, work has been done to identify leading indicators of business cycles (see box IV.2 for a discussion of those used in the United States). In terms of the elements of the composite indexes of leading indicators of business cycles as compared with those for currency crises, it is noticeable that the former tend to be more micro in nature. The only variable common to both is stock prices; other variables which measure similar economic phenomena are the monetary aggregates (M1 and M2), interest rates and GDP. This finding is consistent with the work of Estrella and Mishkin,¹⁷ who found that financial variables (specifically stock prices) are useful for forecasting recessions in the United States economy.

In general, all the models attempting to produce early warning systems or leading indicators of currency crises focused only on macro variables. Some even avoided using micro variables (specifically banking industry variables) in favour of macro variables whose forecasts are more readily available.¹⁸ It is therefore not surprising that there is very little overlap in the composition of both types of indicators. However, even if these types of leading indicators were effective as early warnings of - currency crises, their usefulness outside of OECD countries may be limited, as not many other countries collect data on similar leading indicators.

THE WAY FORWARD

Does the fact that the prediction of a crisis appears difficult render early warning systems, - surveillance and monitoring mechanisms futile? Not exactly, but it may mean a change in the orientation of such mechanisms. Rather than concentrate efforts on avoiding crisis or identifying oncoming shocks to the system, it may be more realistic to engage in activities that monitor how robust or vulnerable a country/financial system is to any internal and external disturbance. This can be carried out by engaging in monitoring the conditions of countries related to economic, financial and institutional stress. Thus, even though accurately forecasting the timing of crisis is likely to remain an elusive goal for academics and policy makers alike, there is clearly a need to develop a warning system that helps monitor whether a country may be slipping towards a potential crisis.

There appear to be at least two strategies in which countries, regional or multilateral institutions can engage in order to avoid or contain the effects of crisis. The first is to engage in surveillance and early warning systems that can detect the possibility of oncoming shocks, as discussed earlier. The second is to concentrate efforts in making the real and financial economy more robust and less vulnerable to shocks. Closely allied to this are measures to strengthen financial systems and improve risk management. Of course, these two strategies are not mutually exclusive, but the choice of priority will have implications for where efforts and budgets are directed.

In the light of the inherent limitations of surveillance and early warning systems, the second strategy of strengthening the financial system and making the economy more robust against stress requires to be pursued simultaneously. There are two channels through which a crisis can occur:

- Pursuit of policies that leave economies dangerously exposed to the loss of investor confidence; in this sense, crises are internally generated
- Crises occur because of systemic risks, of which contagion is a familiar manifestation. However, the degree of damage to countries hit by contagion varies according to the extent of weakness of the fundamentals of those countries. The implication is, again, that good fundamentals made possible by sound policies still matter

While the role of international cooperation in surveillance and monitoring was underscored in the wake of the recent Asian crisis, an appropriate crisis-prevention strategy also involves improving policy-making at the national level. There is thus great scope for enhanced international cooperation to assist countries in this area.

Footnotes

¹ In the past 20 years, more than 125 countries have experienced at least one serious banking crisis. In some cases, the extent of the crisis was so deep that the cost of resolution would exceed 10 per cent of total GDP. See Morris Goldstein, *The Future International Financial Architecture*, report of the Independent Task Force on - Safeguarding Prosperity in a Global Financial System, chaired by Carla Hills and Peter Peterson, Council on Foreign Relations, 1999, available at <<http://www.foreignrelations.org/public/IFATaskForce.html>> (18 January 2000).

² Communiqué of the agreed summary of discussions of "A new framework for enhanced Asian regional cooperation to promote financial stability", Meeting of Asian Finance and Central Bank Deputies, Manila, 18-19 November 1997.

³ Joint Ministerial Statement, Special ASEAN Finance Ministers Meeting, Kuala Lumpur, 1 December 1997, - available at <www.aseansec.org/economic/prfin97.htm> (18 January 2000).

⁴ While there exist multilateral institutions such as IMF tasked with the oversight of elements of the international financial system, the role of IMF at the international level is not analogous to that of a central bank at the domestic level.

⁵ A. Crockett, "Strengthening international economic cooperation: the role of indicators in multilateral surveillance", *IMF Working Paper*, No. 76 (Washington DC, 1987).

⁶ The seven countries are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

⁷ The G-7 consultation process began as the Group of Five process in 1985, in which the economic leaders of the five major industrialized countries met and discussed policy coordination matters in an informal setting.

⁸ This set includes GDP growth rates, interest rates, fiscal deficit as a percentage of GDP, monetary growth rates, exchange rates, inflation rates, unemployment rates, current account and trade balance, foreign-currency reserves, budget performance, monetary conditions, domestic demand growth, fiscal balance and composite indicators. For a discussion of these indicators, see Wendy Dobson, "Economic policy coordination: requiem or prologue?", in *Policy Analyses in International Economics* (Washington DC, Institute for International Economics, 1991), pp. 283-297.

⁹ Andrew J. Filardo, "How reliable are recession prediction models?", *Federal Reserve Bank of Kansas City Economic Review*, vol. 84, No. 2 (Second Quarter 1999), pp. 35-56, available at <<http://www.kc.frb.org/publicat/econrev/ermain.htm>> (19 January 2000).

¹⁰ In practice, not all crises may be put neatly into boxes that is, the delineation between one type of crisis and another may not be black and white.

¹¹ Dominick Salvatore, "Could the financial crisis in East Asia have been predicted?", *Journal of Policy Modeling*, vol. 21, No. 3 (May 1999), pp. 341-347.

¹² Graciela Kaminsky, Saul Lizondo and Carmen Reinhart, "Leading indicators of currency crises", *IMF Staff Papers*, vol. 45, No. 1 (March 1998), pp. 1-48.

¹³ This might be the case if, whatever early warning system is used, it is not disseminated to the public. From a policy maker's perspective, it might be more tolerant of a system issuing false alarms rather than one which fails to signal a crisis that in fact occurs later.

¹⁴ Andrew Berg and Catherine Pattillo, "Are currency crises predictable? A test", *IMF Staff Papers*, vol. 46, No. 2 (June 1999), pp. 107-138.

¹⁵ Jeffrey Frankel and Andrew Rose, "Currency crashes in emerging markets: an empirical treatment", *Journal of International Economics*, vol. 41, Nos. 3/4 (November 1996), pp. 351-366.

¹⁶ Jeffrey Sachs, Aaron Tornell and Andres Velasco, "Financial crises in emerging markets: the lessons from 1995", *Brookings Papers on Economic Activity*, vol. 1 (Washington DC, Brookings Institution, 1996), pp. 147-215 with summary of the article available at <http://www.brook.edu/press/bpea/bpea1_96.htm> (25 January 2000).

¹⁷ Arturo Estrella and Frederic S. Mishkin, "Predicting U.S. recessions: financial variables as leading indicators", *Review of Economics and Statistics*, vol. 80, No. 1 (February 1998), pp. 45-61, available at <<http://mitpress.mit.edu/journal-abstracts.tcl?issn=00346535&volume=80&issue1>> (25 January 2000).

¹⁸ See, for example, Asli Demirguc-Kunt and Enrica Detragiache, "Monitoring banking sector fragility: a multivariate logit approach with an application to the 1996-97 banking crises", *Policy Research Working Paper*, No. WPS 2085 (Washington DC, World Bank, 1999).

Table IV.1. Leading indicators of financial crises, 1996

	Indonesia	Malaysia	Philippines	Republic of Korea	Thailand	Critical region
1. Savings rate (% of GDP)	29	37	20	33	33	< 24
2. Budget deficit (surplus) (% of GDP)	(1.2)	(0.9)	0	0.1	(3)	> 3
3. Current account deficit (% of GDP)	3.3	4.9	4.7	4.8	7.9	> 5
4. Foreign debt (% of GDP)	59.7	42.1	47.3	32.1	50.3	> 30
5. Short-term debt (% of GDP)	14.9	..	9.1	10.3	20.8	> 10
6. Current account deficit less foreign direct investments (% of GDP)	1.4	4	0.6	5.2	6.8	> 3
7. Debt service (% of exports)	36.8	8.2	13.7	7	11.5	a
8. Months of import cover	5.5	3.3	2.3	1.1	5.1	a

Source: Dominick Salvatore, "Could the financial crisis in East Asia have been predicted?", *Journal of Policy Modeling*, vol. 21, No. 3 (May 1999), pp. 341-347.

^a The author does not mention a specific critical value.

Table IV.2. Performance of early warning indicators

<i>Indicator</i>	<i>Number of crises with available data</i>	<i>Percentage of crises called</i>
Real exchange rate	72	57
Banking crises	26	37
Exports	72	85
Stock prices	53	64
M2/international reserves	70	80
Output	57	77
"Excess" M1 balances	66	61
International reserves	72	75
M2 multiplier	70	73
Domestic credit/GDP	62	56
Real interest rate	44	89
Terms of trade	58	79
Real interest differential	42	86
Imports	71	54
Bank deposits	69	49
Lending rate/deposit rate	33	67

Average = 68.1

Source: Graciela Kaminsky, Saul Lizondo and Carmen Reinhart, "Leading indicators of currency crises", *IMF Staff Papers*, vol. 45, No. 1 (March 1998), table 1, p. 20.

Box IV.1. Identifying crises

The important issue that arises when considering an early warning system is what exactly constitutes a crisis.^a A useful starting point is the IMF taxonomy in *World Economic Outlook*,^b which classifies crises into the following types:

- Currency crisis – when there is a significant devaluation of a currency with loss of reserves and/or a significant rise in interest rates in an attempt to defend the currency, caused by a speculative attack on the currency or a sudden unexpected event
- Banking crisis – when potential or actual bank failure or bank run causes banks to suspend internal servicing of their liabilities or leads to large-scale government intervention
- Foreign debt crisis – when a country cannot service its foreign debt, whether public or private

All of these are crises not only in the sector of origin but for the economy as a whole, as they cause drastic falls in output and employment. While international early warning systems are primarily concerned with currency crises, the three types of crisis are closely interrelated, particularly for countries with open capital accounts.

An alternative classification of crises has been provided by Radelet and Sachs.^c While the IMF classification focuses on the manifestations of crises, the Radelet-Sachs classification focuses on the possible causes:

- Macroeconomic policy-induced crisis – this basically follows from Krugman's analysis^d of excessive domestic credit expansion being inconsistent with the pegged level of the exchange rate
- Financial panic – a situation of multiple equilibria where adverse equilibria occur. Each creditor rationally withdraws from a solvent borrower if other creditors also withdraw, often preceded by a circumstance in which each creditor extends further loans (and is willing to do so) if the other creditors do likewise
- Bubble collapse – investors purchase financial assets above their fundamental value in the expectation of future gain; the bubble eventually bursts and a crisis occurs
- Moral hazard crisis – banks overlend and, in the process, lend to risky ventures
- Disorderly workout – a grab race by creditors for an illiquid or currently insolvent borrower's assets, even though the borrower would be worth more as an ongoing enterprise. The problem here is essentially a lack of coordination among creditors

^a There are also political crises, for example, the Aquino assassination in the Philippines, current political turmoil in Indonesia etc., which have important impacts through economic channels, such as capital flight and reduced investment flows, but which are not included here.

^b IMF, *World Economic Outlook* (Washington DC, May 1999), p. 74, available at <<http://www.imf.org/external/pubs/ft/weo/1999/02/index.htm>> (24 January 2000).

^c Steven Radelet and Jeffrey Sachs, "The onset of the East Asian financial crisis", *HIID Working Paper* (Massachusetts, Harvard Institute for International Development, March 1998), available at <<http://www.hiid.harvard.edu/pub/other/eaonset2.pdf>> (25 January 2000).

^d Paul Krugman, "A model of balance-of-payments crisis", *Journal of Money, Credit, and Banking*, vol. 11, No. 3 (August 1979), pp. 311-325.

Box IV.2. Conference Board leading indicators of economic activity

[At first blush, this strand of the literature does not seem directly of interest to the question of financial or currency crises. However, some papers^a suggest an important link, that banking and balance-of-payments crises are normally preceded by or contemporaneous with either recessions or below-normal economic growth. If this is the case, then these Conference Board-type leading indicators could function as early warning systems, or at least complement them. An interesting question also arises concerning the composition of the many early warning systems for financial crises as compared with leading indicators of an economy, say, the Conference Board Indexes of Leading Indicators. If in fact they are similar, then this again suggests their possible use as an early warning mechanism.

The Conference Board has a set of leading indicators, as well as sets of coincident and lagging indicators. These indicators, which were first constructed by the National Bureau of Economic Research, have been used in the United States since 1961. The U.S. Bureau of Census continued this work after the National Bureau turned over responsibility for maintaining the indexes to it in that year. The indexes were presented in its monthly government economic report, *Business Cycle Developments*. Recently, the responsibility for maintaining these indexes was transferred to the Conference Board. The latest composition of these indices is presented below. While they have not been 100 per cent accurate, they have arguably been of great help to policy makers, and the latest updates are awaited with anticipation by market watchers.

Since the pioneering efforts of the National Bureau of Economic Research, other organizations have come up with their own leading indicators. For example, the American Institute for Economic Research regularly features its own primary leading, roughly coincident, and lagging indicators in its research papers.^c

The table below shows the components of the Institute's indicators for comparison with the Conference Board's counterparts shown above.

A comparison of the sets of leading indicators reveals that, while they are not exactly the same (the American Institute's leading indicator has 12 components to the Conference Board's 10 components), there is a remarkable commonality in the nature of the economic variables included, for example money supply, stock prices, housing etc. A similar finding holds for the coincident and lagging indicators of both institutions. This suggests validity in the type of variables included as components in the indicators and lends credence to the idea that there is an early warning system for the business cycle.

The Conference Board Composite Indexes of Indicators^b

Leading Index

- 1 Average weekly hours, manufacturing
- 2 Average weekly initial claims for unemployment insurance
- 3 Manufacturers' new orders, consumer goods and materials
- 4 Vendor performance, slower deliveries diffusion index
- 5 Manufacturers' new orders, non-defense capital goods
- 6 Building permits, new private housing units
- 7 Stock prices, 500 common stocks

Coincident Index

- 1 Employees on non-agricultural payrolls
- 2 Personal income less transfer payments
- 3 Industrial production
- 4 Manufacturing and trade sales

Lagging Index

- 1 Average duration of unemployment
- 2 Inventories to sales ratio, manufacturing and trade in 1992 dollars
- 3 Labour cost per unit of output, manufacturing

8	Money supply, M2	4	Average prime rate
9	Interest rate spread, 10-year Treasury bonds less federal funds	5	Commercial and industrial loans
	income ratio	6	Consumer instalment credit to personal
10	Index of consumer expectations	7	Consumer price index for services

Components of American Institute for Economic Research indicators^d

Primary Leading Indicators

- 1 M1 money supply
- 2 M2 money supply
- 3 Month percentage change in sensitive materials prices
- 4 New orders for consumer goods
- 5 Contracts and orders for plant and equipment
- 6 New housing permits
- 7 Ratio of manufacturing and trade sales to inventories
- 8 Vendor performance, slower deliveries diffusion index
- 9 Index of common stock prices
- 10 Average work week in manufacturing
- 11 Initial claims for state unemployment insurance
- 12 Three-month percentage change in consumer debt

Primary Roughly Coincident Indicators

- 1 Non-agricultural employment
- 2 Index of industrial production
- 3 Personal income in manufacturing
- 4 Manufacturing and trade sales
- 5 Civilian employment as a percentage of the working-age population
- 6 Gross domestic product

Primary Lagging Indicators

- 1 Average duration of unemployment
- 2 Manufacturing and trade inventories
- 3 Commercial and industrial loans
- 4 Ratio of debt to income
- 5 Percentage change from a year earlier in manufacturing labour cost per unit of output
- 6 Composite of short-term rates

^a See in particular Daniel C. Hardy and Ceyla Pazarbasioglu, "Leading indicators of banking crises: was Asia different?", in *IMF Working Paper*, No. 91 (Washington DC, June 1998) and Graciela L. Kaminsky and Carmen M. Reinhart, "The twin crises: the causes of banking and balance-of-payments problems", *The American Economic Review* (June 1999), pp. 473-500.

^b The Conference Board, "Composite indexes of leading, coincident, and lagging indicators: September 1999", *Leading Economic Indicators & Related Composite Indexes*, available at <<http://www.tcb-indicators.org/leiarchive/leisep99.htm>> (20 January 2000).

^c American Institute for Economic Research, "AIER's primary leading, coincident and lagging statistical indicators", *Research Paper* (December 1999), available at <<http://www.aier.org/businesscycles.html>> (20 January 2000).

^d American Institute for Economic Research, "AIER's primary leading, coincident and lagging statistical indicators", *Research Paper* (December 1999), available at <<http://www.aier.org/businesscycles.html>> (20 January 2000), p. 3.

Annex

EARLY WARNING SYSTEMS FOR CURRENCY CRISES: RECENT RESEARCH

Theoretical underpinnings

Most leading indicator models or warning systems employ economic theory to guide them in the selection of the indicators to be included. At this point, the literature is sufficiently rich in theories on the causes of currency crises to separate them into first- and second-generation models.

First-generation models focused on imbalances in macroeconomic fundamentals, often citing the role of excessive public-sector deficits. The seminal paper in the first-generation category is that of Krugman.^a In his model, under a fixed exchange rate regime, domestic credit expansion in excess of money demand growth leads to a gradual but persistent loss of international reserves and ultimately to a speculative attack on the currency. This suggests that expanding money supply to finance fiscal deficits may cause excessive credit growth, which in turn

brings pressure to bear on a currency in a fixed exchange rate regime, and eventually causes its collapse. Variables like the fiscal deficit and the monetary base grow faster and beyond a certain size before a crisis. A number of papers have extended Krugman's basic model to suggest that the evolution of the real exchange rate, the trade or current account balance and domestic interest rates could be used as leading indicators of crises.

While the traditional approach stresses the role played by declining international reserves in triggering the collapse of a fixed exchange rate, some recent models have suggested that the decision to abandon the parity may stem from the authorities' concern about the evolution of other key economic variables. For example, the presence of banking problems reflected in the relative price of bank stocks, the proportion of non-performing loans, central bank credit to banks or a large decline in deposits could also indicate the high likelihood of a crisis. Leading indicators may also include political variables.

Second-generation models allow the possibility of crises even though an economy does not suffer continuous deterioration in its economic fundamentals. These models underscore the role of expectations of economic agents in a crisis. Some of these models introduce the concepts of herding behaviour and contagion effects. In herding behaviour, "information costs may lead foreign investors to take decisions based on limited information and therefore to be more sensitive to rumours".^b Further, as financial markets are now much more interrelated than they were a decade ago, individual investors now have many more ways to cover risks, and losses in one market may force liquidations in others. Thus, a loss by investors in country A may cause them to liquidate in country B (or a set of countries B, C etc.), possibly triggering a crisis, if not at least putting some stress on the financial system of country B. These models have the unpleasant implication that crises arising in financial markets are likely to be unpredictable; if a crisis can occur in a country even without poor fundamentals, then it will not be reflected in its usual macroeconomic variables since it is merely guilty by association.

There are three variants of the contagion effects hypothesis.^c The first hypothesizes that trade links may be the channel through which attacks on one currency are transmitted to another. If a country's competitor in exports suffers a devaluation of the currency, then the country itself may also suffer a currency attack owing to the perceived need to maintain export competitiveness with the other country. It has been found that the greater the correlations of export shares, the greater is the tendency of these countries' currencies to depreciate by more or less the same amount.

The second channel of contagion is related to financial market linkages. There is a demonstration effect on the part of borrowers; when domestic borrowers saw what was happening in other Asian countries where the exchange rate peg had given way they tried to cover themselves to avoid the same fate. This only served to increase the downward pressure on their own currencies. Another financial channel saw the crisis spread through the action of international lenders; heavy losses in one market by retail investors forced liquidation in several markets. It is still typical for investors to calculate historical correlations between rates of return on investments in different countries; high correlations would thus lead to immediate selling of all investments should one of them come under pressure.

A third variant relates to a common cause. For instance, policies undertaken by industrial countries may have similar effects on emerging markets. An interest rate increase in the United States may decrease the attractiveness of several other markets at the same time, leading to a sudden and unexpected outflow of short-term capital, which is highly sensitive to interest rate differentials, or a change in tax rates in a developed country may affect the savings behaviour and so the size and composition of international capital flows.

These theories of contagion provide important reasons why the empirical relationship between economic data and the occurrence of crises is likely to be imperfect.

Recent empirical studies

Most recent empirical studies on early warning systems follow one of the three models outlined in this chapter: the signals approach, probit or logit models, and regression models. A few additional studies belonging to each category are described briefly below.

(a) Signals approach

Work by Lawrence Lau and Jung-Soo Park^d (which preceded that of Salvatore) sought to identify signals of fundamental vulnerability in selected Asian countries similar to those which existed in the economy of Mexico prior to the Mexican crisis. This work was initially carried out in September 1995 and is therefore certainly a prescient one. Selected economic indicators for China; Hong Kong, China; Indonesia; Malaysia; Philippines; Republic of Korea; Singapore; Taiwan Province of China; and Thailand were compared with those of Mexico. The paper itself provides sparse details on the authors' criteria for determining whether the indicators are at problematic levels, that is, sufficiently similar to Mexico.

Most of the countries that were later hit by the Asian crisis were found to have several of the following commonalities with Mexico (though not necessarily all at the same time): falling real exchange rates; low or lowered rate of growth of real GDP; high relative rate of inflation; high interest rate differential; rising interest rate differential; high real rate of interest; large negative trade balance; large negative current account balance; and high ratio of foreign portfolio to foreign direct investment.

(b) Probit or logit models

A study by Dongchul Cho and Kiseok Hong^e examined the cause of the Asian crisis empirically. The study first identified the general causes of a currency crisis using a comprehensive data set, and then applied the result to

the Asian case. The study then compared various international linkages of currency crises with each other and determined which one was most relevant.

The study used a probit equation that related crisis episodes to standard macroeconomic fundamentals along with various contagion measures to determine which variables were most significant. The dependant variable for probit estimation was a crisis index, which took the value 1 if a currency crisis occurred and 0 otherwise. A currency crisis was defined as a depreciation of the nominal exchange rate of at least 25 per cent, which was also at least a 10 per cent historical increase in the rate of depreciation for the country. Three sets of variables were used in the model: (i) macroeconomic indicators: GDP growth rate, real domestic credit growth rate, inflation rate, fiscal deficit/GDP ratio; (ii) external variables: current account/GDP ratio, changes in the terms of trade, changes in the real exchange rate, foreign reserves/short-term debt ratio, FDI/GDP ratio, total foreign debt/GDP ratio, short-term debt/total foreign debt ratio; and (iii) foreign conditions: GDP growth rate, interest rate in developed countries, crisis incidents of foreign countries. Data covered 103 developing countries, including the crisis-hit Asian and Latin American countries, for the years 1980 through 1996.

The results of the estimation suggested that in general a country might undergo a currency crisis even when its domestic fundamentals were not particularly weak. The contagion of crises was found to take place most often among countries that were in geographical proximity; economic linkages such as international trade and finance turned out to be insignificant once geographical proximity was taken into account. This pattern of contagion implied that intraregional cooperation was critical in preventing future currency crises.

A study by Daniel Hardy and Ceyla Pazarbasioğlu^f used a multinomial logit model to identify the role of the macroeconomic, banking sector and real sector indicators in the emergence of banking system difficulties. The data sample covered 50 countries, 38 of which suffered a total of 43 episodes of banking system crisis and comprised 323 observations for the period 1980-1997. Three groups of explanatory variables were used: real-sector variables (rate of growth, consumption growth, investment growth and capital-output ratio); banking-sector variables (deposit liabilities, credit to private sector, and foreign gross liabilities); and potential shocks (inflation, real interest rate, real exchange rate, real growth in imports and terms of trade).

The empirical findings suggested that banking distress was associated with a fall in real GDP growth, boom-bust cycles in inflation, rapid credit expansion, rapidly increasing capital inflows, rising interest rates, a declining capital/output ratio, and a sharp reduction in real exchange rates with an adverse trade shock. The paper also found that in Asian countries, variables such as credit growth and rising foreign liabilities, which were proxies for vulnerability of the banking and corporate sector, were more important than traditional macroeconomic indicators. This suggests that the construction of early warning systems should not focus solely on macroeconomic indicators. In fact, this seems to have been the story of the Asian crisis: everyone was preoccupied with the "nice" macroeconomic picture but missed seeing the weaknesses at the micro level, for example, banking system flaws.

(c) Regression models

Kaminsky and Schmukler^g conducted a regression analysis to determine the reaction of financial markets to news – either rumours or fundamentals – in crisis episodes. The test was conducted for the Asian crisis for the period beginning in 1997 until the end of 1998. Nine economies were included: Hong Kong, China; Indonesia; Japan; Malaysia; Philippines; Republic of Korea; Singapore; Taiwan Province of China; and Thailand. The analysis concentrated on the 20 largest one-day swings in stock prices.

The results indicated that the source of the largest one-day swings could not be explained by any apparent substantial news – either economic or political – but seemed to be driven by herd instincts of the market itself. The results also indicated that rumours, or concerns unrelated to the actual information, affected foreign markets as strongly as they affected domestic financial markets, suggesting the presence of important contagion effects. There was also some evidence that investors overall reacted instantaneously and more strongly to bad news than to good news.

Dadush, Riordan and Wolfe^h used a regression model to identify the main sources of error in World Bank forecasts completed at the end of 1997. Recognizing that the evolution of a crisis was inherently impossible to anticipate with accuracy, the authors sought to draw some lessons for macroeconomic modelling and prediction which might improve the understanding of the forces at work.

Analysis of forecast errors was carried out for GDP growth, domestic demand, private consumption, total investment, exports, imports and current account balance. The substantial forecast errors for these variables were attributed to four factors: a failure to appreciate fully the interactions of foreign credit with the domestic banking sector and highly indebted domestic firms; underestimation of the extent of spillover effects within the region; inadequate forecast of the decline in regional import volumes and in prices of traded goods induced in part by the downturn in regional activity; and failure to anticipate the depth of the continued recession in Japan.

The study suggested that in the light of the foregoing, the following lessons can be drawn: (i) more careful and frequent monitoring of balance-sheet effects is called for, particularly for the accumulation of short-term foreign currency liabilities in the banking system and changes in corporate leverage; (ii) in determining the severity of a crisis, it is clear that expectations matter; the light of this, investors ought to hedge their exposures; (iii) since the advent of contagion is an important factor, analysis and forecasting of developments should be conducted in a regional or global context; (iv) forecasting models should incorporate interactions between the banking and non-financial corporate sectors; and (v) in the projection of the effects of external shocks, there is a need to account for the special nature of developing countries as marginally creditworthy borrowers.

To conclude, although each of the above models does make some contribution to understanding the causes of crises and contagion, none of them can accurately predict the timing of a crisis. Hence, these models have a useful but limited role in formulating an early warning system.

^a Paul Krugman, "A model of balance-of-payments crises", *Journal of Money, Credit, and Banking*, vol. 11, No. 3 (August 1979), pp. 311-325.

^b Gerardo Esquivel and Felipe Larrain, "Explaining currency crises", *Development Discussion Paper*, No. 666 (Massachusetts, Harvard Institute for International Development, November 1998).

^c There may be several reasons for expecting crises to be contemporaneous in time. See, for example, the discussion in Paul R. Masson, "Contagion: monsoonal effects, spillovers, and jumps between multiple equilibria", *IMF Working Paper*, No. 142 (Washington DC, 1998).

^d Lawrence J. Lau and Jung-Soo Park, "Is there a next Mexico in East Asia?", paper presented at the project LINK World Meeting, Pretoria, South Africa, 25-29 September 1995.

^e Dongchul Cho and Kiseok Hong, "The Asian currency crisis: domestic fundamentals and international linkage", *Working Paper* (Korea Development Institute, August 1999).

^f Daniel C. Hardy and Ceyla Pazarbasioglu, "Leading indicators of banking crises: was Asia different?", *IMF Working Paper*, No. 91 (Washington DC, June 1998).

^g G.L. Kaminsky, and S.L. Schmukler, "What triggers market jitters? A chronicle of the Asian crisis", *World Bank Working Paper* (April 1999).

^h U. Dadush, M. Riordan, and B. Wolfe, "Some lessons from forecasting errors in the recent crisis", Development Prospects Group (World Bank, May 1999).