CHAPTER IV

EARLY WARNING SYSTEM MODELS: THE NEXT STEPS FORWARD

The Mexican (1994–95) and Asian (1997–98) crises stimulated a variety of empirical studies designed to identify both the causes of these crises and the determinants of the associated spillover effects (Kaminsky and Reinhart, 2000). To the extent that past crises can yield useful lessons about factors that contribute to a country's vulnerability to future crises, scholars and policymakers quickly realized that these empirical studies could be one element in a forward-looking early warning system (EWS). As a result, a growing number of international financial institutions (IFIs) and central banks are using EWS models in their surveillance activities. Similarly, several investment banks have developed in-house EWS models aimed at providing foreign exchange trading advice to their clients and complementing their economic analysis of emerging markets.

These models typically have an empirical structure that attempts to forecast the likelihood of a certain type of "crisis" using factors such as country fundamentals, developments in the global economy and/or global financial markets, and, in some cases, political risks. A number of considerations have influenced the development of existing EWS models. First, despite a common origin in the academic models of the mid-1990s, existing EWS models differ sharply among themselves in terms of their definition of a "crisis" and in terms of the time horizon over which they attempt to forecast a crisis. Not surprisingly, these differences reflect the different interests of the various end users. For example, investment bank models define a crisis primarily in terms of variables such as changes in exchange rates and interest rates that are likely to affect the profitability of foreign exchange trading or investment positions. Moreover, investment bank models typically focus on one- to three-month forecast horizons that are regarded as most relevant for foreign exchange trading and investment positions. In contrast, EWS models used by IFIs and central banks in surveillance exercises tend to focus on variables associated with major balance of payments crises, namely large changes in exchange rates and/or central bank foreign exchange reserves. In addition, surveillance-linked EWS models typically attempt to forecast a country's vulnerability to crisis over a much longer time horizon than investment bank models. These models can have a forecast horizon of up to 24 months, reflecting in part the desire to have enough time to formulate corrective policy adjustments.

A second consideration that has affected the specification of the models and the interpretation of their forecasts has been the need to confront the trade-off between so-called type I and type II errors associated with the estimation of the statistical models. Type II errors (the acceptance of a false hypothesis of no crisis) can be minimized if EWS models are designed so that they have a low probability of missing a crisis. Unfortunately, adopting estimation procedures that minimize type II errors typically result in larger type I errors (the rejection of a true hypothesis of no crisis). In other words, the models can be calibrated to catch most crises, but only at the cost of many false claims.

A third consideration has been the availability and timeliness of data. For example, the absence of adequate historical time series on market interest rates and other financial variables has led to the exclusion of such variables in some EWS models. Moreover, variables available only with long reporting lags complicate the updating of forecasts and again discourage the use of what would otherwise be important explanatory variables.

The current EWS models have a mixed record in terms of forecasting accuracy, but they offer a systematic, objective and consistent

method to predict crisis that avoids analysts' biases. Nonetheless, these models are just one of the many inputs into the IMF's surveillance process, which encompasses a comprehensive and intensive policy dialogue. As is the case with risk management models, they are not a substitute for sound and balanced judgments on financial weaknesses. This chapter briefly reviews the nature of the core EWS models used by the IMF in surveillance exercises, examines the performance of these models in terms of the accuracy of both in-sample and out-of sample forecasts, and considers various avenues for improving the usefulness of these models as surveillance tools. In particular, the use of alternative "building blocks" for predicting foreign exchange, debt, and banking crises, as well as the more efficient use of the information embedded in forward-looking asset prices, is discussed.

Current EWS Models at the IMF

As part of the IMF's surveillance activities, the IMF maintains two core EWS models: the Developing Countries Studies Division (DCSD) model and the Kaminsky, Lizondo, and Reinhart (KLR) Crisis Signals model (see Berg and others, 1999).[1] In addition, the results of a number of external EWS models are monitored on an ongoing basis.

The core models attempt to forecast a country's vulnerability to a foreign exchange crisis defined as a large depreciation of the exchange rate and/or extensive losses of foreign exchange reserves over a 24-month forecast horizon. In this context, a crisis is said to have occurred when the "exchange market pressure" index—a weighted average of one-month changes in the exchange rate and foreign exchange reserves—is more than three (country-specific) standard deviations above the country average value.

The core models have parsimonious structures. For example, the DCSD model includes only five explanatory variables (real exchange rate overvaluation, current account, foreign exchange reserve losses, export growth, and the ratio of short-term debt to foreign exchange reserves).[2] In contrast, the KLR Crisis Signals model uses twice as many variables (the first four variables used in the DCSD model as well as the ratio of foreign exchange reserves to M2, the growth of the ratio of reserves to M2, domestic credit growth, change in the money multiplier, real interest rate, and "excess" M1 balances—defined as actual M1 less an estimated demand for money). Box 4.1 describes some of the statistical properties of the two core models.

The output of the core models is complemented by monitoring the results from three investment bank models: Credit Suisse First Boston Emerging Markets Risk Indicator (CSFB-EMRI), Deutsche Bank Alarm Clock (DBAC), and Goldman Sachs GS-Watch.[3] The forecasting horizon is one month for CSFB-EMRI and DBAC, and three months for GS-Watch. The choice of explanatory macroeconomic and financial variables is similar to those in the core IMF models. Among the three, there are some differences in the estimation methodology, but the major difference is in how each model defines crisis events. CSFB-EMRI defines a crisis as an exchange rate depreciation that exceeds 5 percent and is at least double the preceding month's depreciation. In contrast, DBAC defines exchange rate and interest rate events as currency devaluations and interest rate increases exceeding exogenous thresholds (typically a depreciation of more than 10 percent and an interest rate in-

[1]These EWS models are just one of the many inputs into the IMF's surveillance process, which encompasses a comprehensive and intensive policy dialogue.

[2]Efforts to incorporate fiscal sector variables are discussed in Kell and Schimmelpfennig (2002); corporate sector variables are covered by Mulder, Perrelli, and Rocha (forthcoming).

[3]Roy (2001); Garber, Lumsdaine, and Longato (2001); and Ades, Masih, and Tenengauzer (1998). In the future, the IMF may add other models to the list.

Box 4.1. The IMF's Core Early Warning System Models—A Primer

The core Early Warning System (EWS) models used in the IMF are the Developing Country Studies Division (DCSD) and the "modified" Kaminsky, Lizondo, and Reinhart (KLR) models.[1] Both models define a crisis as an event during which an "exchange market pressure" index (EMPI)—a weighted average of monthly percentage depreciations in the nominal exchange rate and monthly percentage declines in foreign exchange reserves—exceeds its mean by more than three standard deviations.[2] The EMPI is used to create the dependent binary variable, a crisis indicator, that is equal to one if a crisis occurs in the subsequent 24 months, and equal to zero otherwise.

The DCSD model uses a multivariate panel probit regression technique to estimate the monthly probability that a country would suffer a crisis in the following 24 months. Explanatory variables include real exchange rate overvaluation, current account balance, foreign exchange reserve losses, export growth, and the ratio of short-term debt to foreign exchange reserves, measured in percentile terms. The model coefficients corresponding to the most recent estimation for the period December 1985 to July 1997 are shown in the table below.

DCSD Model Specification

Variable	Coefficient*
Constant	–3.250
Overvaluation	0.013
Current account	0.007
Foreign exchange reserves	0.007
Export growth	0.002
Short-term debt to reserves	0.002

*Coefficients significant at least at the 10 percent level.

The probabilities obtained from the model are converted into a binary indicator, an early warning indicator that signals a crisis and also allows for the statistical evaluation of different models. The indicator is equal to one (and is said to "call" a crisis) if the probability exceeds a cutoff threshold probability, and equal to zero otherwise. When the indicator is equal to one, the model correctly calls or signals a crisis if one ensues within 24 months, and gives a false alarm otherwise. When the indicator is zero, the model correctly calls a tranquil period if no crisis ensues within 24 months, and misses a crisis otherwise.

A statistical evaluation of the different models' accuracy relies heavily on the choice of the cutoff threshold probability. Clearly, the choice of a low threshold would lead to many false alarms but few missed crises.[3] Alternatively, the choice of a large probability threshold would lead to few false alarms but many missed crises. In DCSD, the optimal selection of the threshold is obtained by minimizing an equally weighted sum of false alarms and missed crisis.

The econometric methodology of the KLR signals model is somewhat different from that of the DCSD model, except for the final stage that determines the threshold probability for an aggregate crisis index and a crisis is called. The KLR model assumes that each individual explanatory variable signals a crisis if its mean exceeds a variable-specific optimal threshold and a crisis occurs in the next 24 months. This threshold, which is expressed in percentile terms and is assumed equal across countries, is determined by minimizing the noise-to-signal ratio: the number of months during which the variable signaled a crisis incorrectly (false alarm or noise) divided by the number of months during which the variable signaled a crisis correctly.

KLR constructs a single composite crisis indicator equal to the weighted-sum of the explanatory variables, with the weights being equal to the inverse of each indicators' noise-to-signal ratio. The probability of crisis for each value of the aggregate index is then obtained by observing how often, within the sample, a given value of the aggregate index is followed by a crisis within 24 months, and the optimal probability threshold for the KLR model is determined in a similar way as for the DCSD model.

[1]The current versions of the models were developed in the IMF Research Department and are currently maintained by the International Capital Markets Department.

[2]Means, standard deviations, and weights are country-specific. Weights are calculated so that the variance of the two components of the index are equal.

[3]From a statistical point of view, the former might be thought of as type I errors and the latter as type II errors, under the null hypothesis of no crisis.

crease of more than 25 percent) and estimates the probability of both events simultaneously using a two-equation framework. Finally, GS-Watch defines a crisis event as one in which a financial price index (FPI) crosses an endogenous threshold, the latter being determined as a function of lagged values of the FPI.[4]

Model Performance

How well have the EWS models performed, especially in periods outside the original sample period used for estimation of the relevant parameters, in terms of both the appropriate forecast of an actual crisis and the avoidance of false signals (either missing an actual crisis or falsely forecasting a crisis that did not occur)?

A thorough evaluation of the IMF's EWS models recently concluded that the core models' forecasts are significant predictors of actual crises but that they still generate a substantial number of false alarms and missed crises (see Berg, Borensztein, and Pattillo, 2001). The study stresses the importance of out-of-sample prediction for an EWS model to be a useful surveillance tool, as well as the trade-off between missing crises and generating false alarms. The relatively long 24-month prediction horizon led the authors to evaluate the models according to the forecasts issued in July 1999. Overall, the authors concluded that the DCSD model performed reasonably well, as countries with a predicted probability of crisis above 50 percent subsequently had crises, and no crisis country had a probability of crisis below 26 percent. Furthermore, the DCSD model called 59 percent of the crises correctly but issued a large number of false alarms, 78 percent.[5]

In contrast, investment bank models do not perform as well as the core models when predicting exchange rate crises out-of-sample, but they appear to have satisfied their commercial objectives. Both the GS-Watch and CSFB models have an adequate in-sample performance (the percent of crises correctly called is 66 percent and 61 percent, respectively), but their out-of-sample predictions are much weaker (the percent of crises correctly called falls to 54 percent and 27 percent, respectively).[6] However, investment bank models are regarded by the investment banks as performing reasonably well when evaluated solely on the merits of their short-term trading and/or investment recommendations. For example, the expected return of currency portfolios based on GS-Watch have consistently outperformed market neutral portfolios of emerging markets currencies (see Ades, Masih, and Tenengauzer, 1998).

The more recent performance of EWS models can be examined in terms of their forecasts in the periods surrounding two episodes that took place in 2001 and satisfy the EWS models definition of a crisis: namely, the devaluation of the Turkish lira in February 2001 and the devaluation of the Argentine peso in early January 2002.

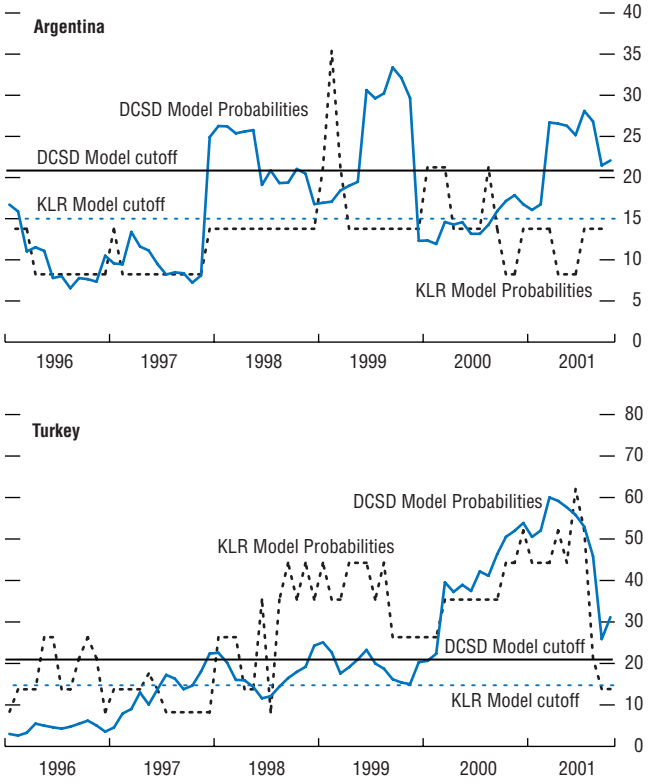
The predicted probabilities of crisis and cutoff probabilities for the IMF's DCSD and KLR models before these episodes are shown in Figure 4.1. Both the DCSD and KLR Crisis Signals models correctly called for a crisis during the entire year preceding the Turkey crisis of February 2001. More precisely, both models correctly called the Turkey crisis in respectively 19 and 14 of the 24 months preceding the crisis. For the January 2002 crisis in Argentina, the DCSD model only started to signal problems in March 2001, when the run on the banks and foreign exchange reserves began. By October 2001, the DCSD model still called the crisis but only marginally and after a counterfactual decline in the probability of a foreign exchange crisis. The

[4]The FPI, a weighted average of three-month exchange rate and reserve changes, is similar to the "exchange market pressure index" used in DCSD.

[5]A false alarm may not necessarily be bad if it signals real risks are eliminated through, for example, policy adjustments.

[6]The corresponding number of false alarms as percent of total alarms are 74 percent and 94 percent (in-sample) and 87 percent and 96 percent (out-of-sample).

Figure 4.1. The IMF Early Warning System Models: Developing Country Studies Division (DCSD) and Kaminsky, Lizondo, and Reinhart (KLR) Probabilities of Crisis



Source: IMF staff calculations.

KLR model has not called a crisis in Argentina since August 2000.[7]

The performance of investment bank models during these two crises was also mixed. CSFB-EMRI missed the Turkish episode, since it was predicting a decline in risk one month ahead of the crisis. In Argentina, the model indicated a significant increase in the country's risk score. In October 2001, DBAC called the Argentine episode correctly and predicted a possible devaluation as large as 20 percent, in part owing to the inclusion of interest rates as part of the definition of crisis. However, DBAC also missed the devaluation of the Turkish lira. Finally, GS-Watch correctly signaled events in Turkey three months ahead. For Argentina, GS-Watch did call a crisis from September 2001 to early December 2001. However, as in the case of the DCSD model, the GS-Watch model indicated that the crisis probability in Argentina declined in November and early December 2001. Also, as in the DBAC model, the GS-Watch model has issued a significant number of false alarms in the last quarter of 2001, as it called crisis in the next three months in almost every emerging market analyzed with the exception of Bulgaria, China, Chile, and Peru.

In sum, the current EWS models show mixed results in terms of forecasting accuracy, but they offer a systematic, objective, and consistent method to predict currency crisis, that helps avoid analysts' biases. Moreover, such models offer a single measure of risk in a statistically optimal way, that can be easier to interpret than, for instance, a large number of indicators giving different signals. Some analysts, noting the diverse group of countries singled out as most (and least) vulnerable by the different models, have suggested averaging the models' predictions. However, recent experience does not suggest that averaging leads to significant

[7]One of the reasons for the models' contrasting performance in the Argentina and Turkey crises is explored in the discussion on debt crises in the next section.

improvements.[8] As a result, the next section discusses other avenues of improvement of EWS models.

EWS: A Way Forward

The recent evaluations of the performance of EWS models, as well as the experience with emerging markets crises around the turn of the century, suggest two potential avenues for increasing the usefulness of these models as surveillance tools. First, the different nature of recent financial crises suggests the desirability of developing a set of "building blocks" that would help forecast not only foreign exchange but also debt and banking crises, and identify the linkages between them. Second, EWS models could be improved or augmented by a more efficient use of the information embedded in forward-looking asset prices to anticipate financial market pressures. Although several crises took market participants by surprise, the increasing number of financial instruments available in emerging markets, combined with new techniques for extracting information from the prices of such instruments, suggest that this could be a fruitful avenue to pursue.[9]

Foreign Exchange Crises

Most of the existing EWS models omit the use of short-term interest rates as either a component of the definition of a foreign exchange crisis or as a determinant of the crisis. Domestic interest rates could be included as an independent event/equation along the lines of the DBAC model, or they could be combined with exchange rates in a more complete measure of "financial market pressures." Similarly, excessive money or domestic credit creation is a key determinant of "first generation" foreign exchange crises, but the lags in the availability of monetary aggregates make them a less useful predictor of such crises; interest rates could reflect money market pressures in a more timely fashion.[10]

Stock market prices have some degree of predictive power in all market models, as well as in KLR,[11] and sectoral stock prices show promising results that are worth pursuing further. In particular, Becker, Gelos, and Richards (2000) argued that sectoral differences in stock market performance may constitute valuable leading indicators of currency crises in emerging markets. Using company level data, the study indicates that around a year before the 1994–95 Mexican currency crisis net importers and financial companies began to continuously underperform the market, while net exporters showed continuously high abnormal stock returns.

New methods to extract information about market expectations from derivative prices could also be used as part of an EWS. Traditionally, forward exchange rates have been used in the mature markets to extract information about ex-

[8]See Forbes (2001). For example, the three most vulnerable countries in October 2001 were Malaysia, Israel, and Mexico for CSFB-EMRI; Turkey, South Africa, and the Czech Republic for DBAC; and Poland, India, and Argentina for GS-Watch. Furthermore, on many occasions the models' predictions of changes in the average vulnerability of emerging markets move in different directions. From February 2001 to August 2001, average vulnerability according to CSFB-EMRI increased by 26 percent. In the same period, average vulnerability according to GS-Watch declined by 16 percent.

[9]The use of financial market data suggests that the definition of a crisis and the prediction horizon may have to be adjusted to the shorter history and higher frequency of the data. Ideally, from the policymaker's point of view, it would be optimal to have indicators that signal a crisis several months or even years in advance. However, in the KLR model, all the indicators send their first crisis signal between a year and a year-and-a-half before the crisis erupts, and most of them give persistent signals that grow in intensity as one approaches the crisis. It seems that not much would be lost by moving to a 12-month horizon.

[10]First generation models of crises are driven by excessive domestic credit creation needed to finance budget deficits, while second generation models explain crises as the result of shifts in investors' expectations whenever there is a conflict between a fixed exchange rate and other government objectives. Third generation models of crises emphasize financial frictions (Krugman, 1999).

[11]Berg and Pattillo (1999) find that a rerun of the KLR model yields a noise-to-signal ratio greater than one for stock prices; this is in part due to a change in sample that removes some European countries and adds other emerging markets.

pected future spot rates.[12] The proliferation of offshore nondeliverable forward markets for emerging market currencies, together with the deepening of onshore markets in some countries, increases the feasibility of applying these methods to emerging markets. For instance, a substantial increase in the probability of devaluation of the Argentine peso was priced in the 12-month nondeliverable forward rates by late July–early August 2001 (see Figure 4.2). Also, the experience with the Korean *won* shows that once restrictions are removed and the market deepens, the offshore nondeliverable forward market leads the domestic spot market—suggesting that price discovery happens primarily offshore and that information from offshore markets could be used to predict onshore financial pressures (Park, 2001).

More recently, new techniques based on foreign exchange option prices provide market expectations on the whole risk-neutral probability distribution of future exchange rates (see Soderlind and Svensson, 1997; and Annex II of IMF, 1997). Unlike traditional exchange rate forecasts that provide only a point estimate of the mean of future exchange rates, option prices allow for the derivation of the probabilities associated with different ranges for the value of the underlying exchange rate. An example of the potential usefulness of these techniques is provided in Figure 4.3, which plots the probability density functions for the Brazilian *real* at different dates in July, October, and December of 2001.[13]

Figure 4.2. Forward Exchange Rates for Argentine Peso
(Twelve-month Argentine peso per U.S. dollar nondeliverable forward exchange rate)

Source: IMF staff calculations based on data from Bloomberg L.P.

[12]Although forward rates are generally biased predictors of future spot rates, they could be used together with survey expectations of exchange rates and other factors that explain systematic forecast errors in foreign exchange markets (Lewis, 1995).

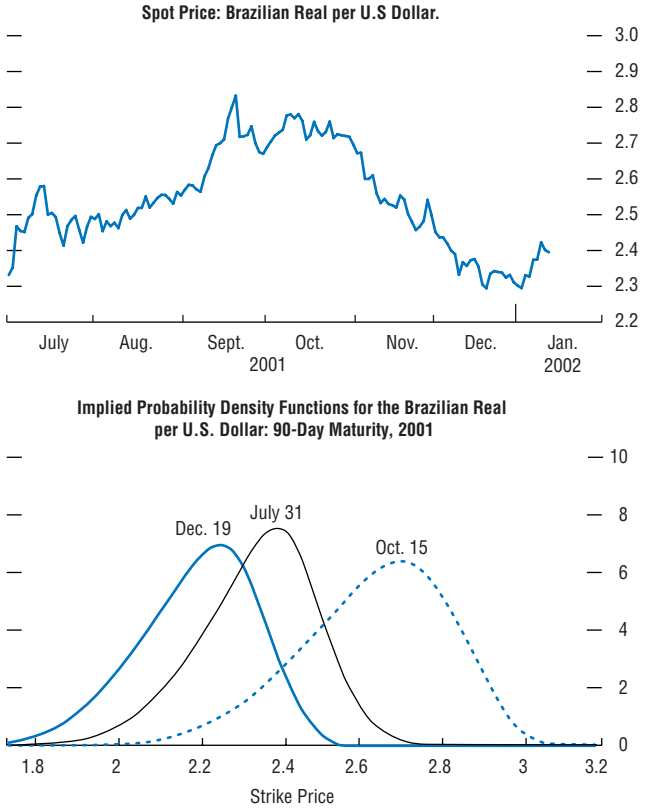
[13]While these methods have been applied mostly to mature market currencies, Campa, Chang, and Refalo (1999) used them to study the credibility of the Brazilian Real Plan of 1994–97. The method used to derive the probability density functions in Figure 4.3 differs from the ones used in that paper and follows that suggested in Malz (1996). In both cases, these are risk-neutral probability density functions, and there may be a bias derived from the need to compensate risk averse investors (Breuer, 2002).

By the end of July, forward rates on the Argentine peso had increased sharply. The implied probability density function for the *real* on July 31, 2001, shows that markets underestimated somewhat the contagion effects from Argentina. The Brazilian *real* exchange rate hit 2.60 on September 10, 2001, a level that at the end of July was considered by market participants to be likely with only a 2 percent probability. However, by mid-October, the implied probability density function displayed negative skewness, indicating the market was pricing currency options as if it expected a reversal of the depreciation of the *real* that had taken place between the end of July and mid-October. Since the Argentine peso continued to trade in the forward market at a substantial discount from spot, this suggests that market expected the *real* to decouple from the peso. The *real* did appreciate between mid-October and mid-December, and the December probability function shifted to the left and its dispersion decreased.

Debt Crises

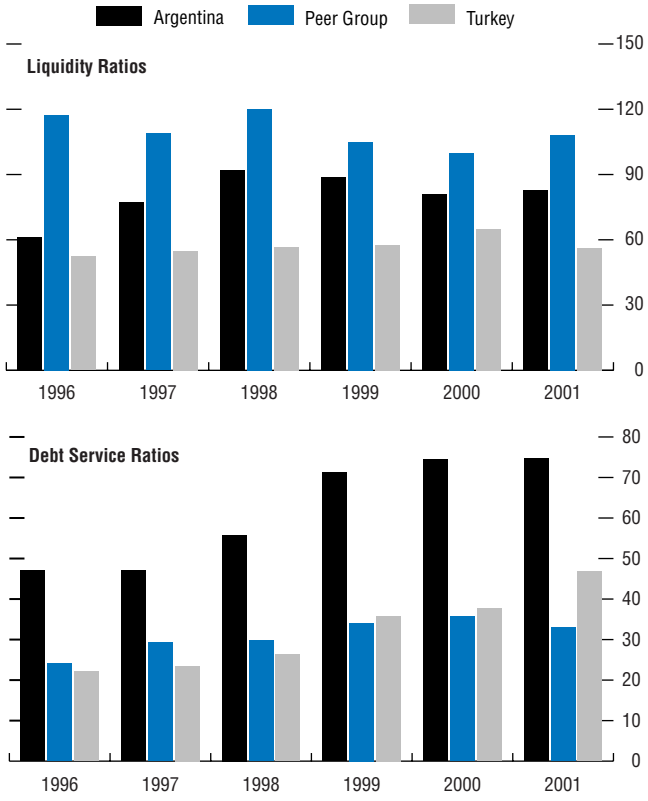
There have been important recent crises (such as in Pakistan and Argentina) in which debt crises occurred either without or well before foreign exchange crises, and it may be that predicting debt crises is a worthwhile goal in and of itself. Recent research has highlighted the role of short-term external debt and rollover difficulties during such crises (Detragiache and Spilimbergo, 2001). However, while the inclusion of short-term debt in an early warning system has improved the performance of the DCSD model relative to others, the changing nature of crises suggests that it may be too restrictive to focus just on foreign exchange crises models. In particular, the short-term debt/reserves variable is a good indicator of liquidity problems, but it is not necessarily a good predictor of external solvency crises. This point is illustrated in Figure 4.4, which shows liquidity ratios, as well as debt service ratios (a traditional determinant of country risk) for Argentina, Turkey, and their peer group. While Argentina had a good external

Figure 4.3. Spot Price and Implied Probability Density Function for the Brazilian Real



Source: IMF staff estimates based on JP Morgan data and Bloomberg.

Figure 4.4. Argentina and Turkey: External Liquidity and Debt Service Ratios[1]



Sources: FitchResearch; and IMF staff estimates based on FitchResearch

[1]The figures for 2001 are FitchResearch estimates. Liquidity ratio is defined as official reserves incl. gold plus banks' foreign assets/debt service plus liquid external liabilities; debt service ratio is defined as debt service/current receipts; Argentina's peer group by December 2000 included: Brazil, Colombia, Costa Rica, El Salvador, India, Kazakhstan, Lebanon, Panama, Peru, Philippines, Slovakia, Turkey, Venezuela.

liquidity position relative to Turkey, the country's debt-service indicator was more than twice that of its peer group in 1999–2000. This reflected, and anticipated, the sovereign's solvency problems that would become more evident in 2001.

Traditional models of country (credit) risk and external solvency indices could be used as part of an EWS for emerging market crises.[14] An example of a country risk model is provided by Eichengreen and Mody (2000), who developed an econometric model of the determinants of emerging market debt spreads. The model was estimated for the years 1991–95 and produced satisfactory out-of-sample forecasts for 1996.[15] The debt service to exports ratio is statistically significant in the regression,[16] and has a sample average of 0.20; Argentina's figure for 1999–2000 is more than three times that average. An example of a model using external solvency indices is provided by Cohen (1991), who develops a simple solvency index that allows him to empirically assess whether or not indebted nations may have passed the point where they would default on their debt-service obligations.

The above models could be complemented with information on the term structure of emerging market bond spreads as well as on credit default swaps. The term structure of sovereign yield spreads could reflect expectations about the probable *timing* of any default, and the path of resolution and recovery of market access. In a recent study, Cunningham, Dixon, and Hayes (2001) show that Argentina's zero-coupon spread curve was sharply inverted by the end of July 2001 while the Brazilian curve was upward

[14]Just as in the case of a balance of payments crisis, one would need an operational definition of what constitutes a "debt" or "sustainability" crisis.

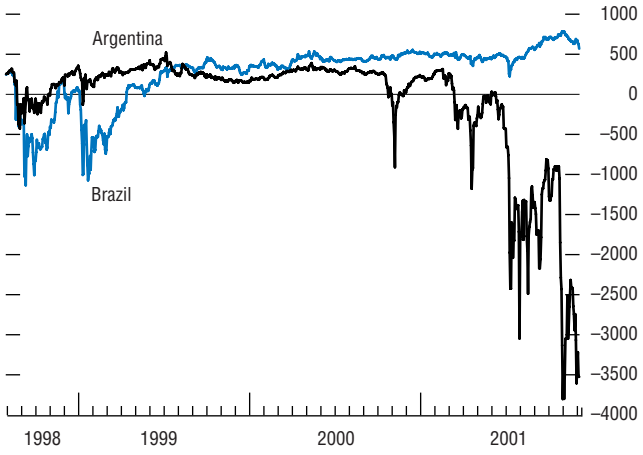
[15]Deviations of spreads from the levels predicted by credit ratings could also signal the need for further scrutiny of a country's fundamentals and market technicals, warning about potential reassessments of a country's creditworthiness (Sy, 2001).

[16]Other significant determinants of spreads included factors such as the ratio of external debt to GDP, debt reschedulings, maturity of the instruments, and the existence of a private placement.

sloping, suggesting a heightened short-term credit risk in Argentina that was somewhat—but not totally—reduced after the June 2001 debt swap. The same pattern of curve inversion is indicated by default swap spreads: the differential between 10-year and one-year Argentina default swap spreads became strongly negative in the second half of last year (Figure 4.5), implying a higher short-term probability of default. Moreover, the differential is several times larger than the similar negative differentials observed during the Brazilian crises of 1998–99.

Recent experience has shown that temporary market closures (also referred to as "sudden stops" in capital inflows) have become a feature of international capital markets, and that this could increase the vulnerability of countries with relatively large external financing needs. Market closures are systemic rather than country-specific events that can be defined as the weeks when aggregate gross flows to all emerging markets are below 20 percent of average issuance levels (see IMF, 2001b). While in some cases market closures start with difficulties in a particular emerging market, in others they are the result of conditions in mature markets that constrain the supply of funds to the emerging market asset class as a whole. Preliminary studies have shown that mature market factors—such as the closure in the U.S. high-yield bond market and global equity market volatility—increase the probability of closure for emerging market issuers. More generally, studies show that factors like high U.S. interest rates and high-yield corporate bond spreads are associated with less issuance of emerging market debt. At the same time, domestic emerging market factors, such as high local market returns and high debt amortizations, are associated with higher issuance levels and lower probabilities of bond market closures (see Annex III of IMF, 2001a).

Figure 4.5. Slope of Default Swap Curve
(Ten-year spread minus one-year spread, basis points)

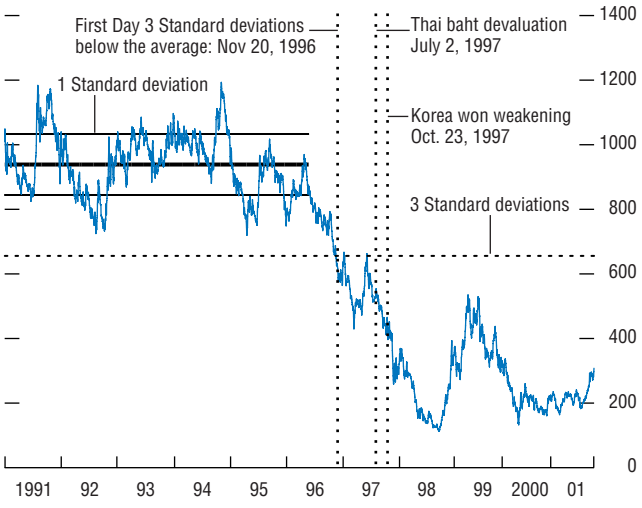


Sources: IMF staff estimates based on JP Morgan data.

Banking Crises

Banking crises share several common determinants with foreign exchange crises, and are sometimes a main cause of an exchange crisis,

Figure 4.6. Korea: Financial Institutions Index (1991–2001)[1]



Source: Korea Stock Exchange.

[1]Sectoral index based on the set of financial companies in KOSPI of the Korea Stock Exchange. The thick solid line represents the average of the index through 05/30/96; the thin lines represent the corresponding standard deviation bands.

but recent efforts to predict banking crises have met with limited success. Kaminsky and Reinhart (1999) and Kaminsky (1998) find that excessive credit growth, recessions, and the burst of asset price bubbles tend to precede banking crises. However, with the exception of stock market prices, these variables (in particular, monetary and credit aggregates) are available with relatively long lags in emerging markets. More important, models that appropriately assign a higher weight to type II errors for banking crises, had low predictive power relative to the Asian banking crises.[17] Also, studies that look at individual bank balance sheet indicators (see Gonzalez-Hermosillo, 1999), which could potentially identify problems in systemically important banks, find that loan quality and equity deteriorate rapidly before a bank fails. However, the lack of consistent cross-country results and the scarcity and lack of timeliness of data on these variables in emerging markets make individual bank failure quite difficult to predict.[18]

Bank stock prices may provide useful predictive information, and while only some emerging markets banks are publicly traded, these are in general the ones that would eventually cause systemic banking problems. Studies for the United States, for instance, show that stock prices help predict the financial condition of individual banks, even after taking into account past rating and financial statement information (see Berger, Davies, and Flannery, 2000; and Gunther, Levonian, and Moore, 2001). There is no systematic evidence for emerging markets, but Figure 4.6 demonstrates the potential usefulness of forward-looking bank stock prices to predict banking crises: the financial sector subcomponent of

[17]Demirguc-Kunt and Detragiache (1999) stress that, the higher the cost of missing a crisis relative to the cost of taking preventive action, the more concerned the policymaker will be about type II errors relative to type I errors.

[18]The Financial Soundness Indicators (FSI) database, currently under construction in the IMF's Monetary and Exchange Affairs Department, could provide a useful input for a banking crises building block of an enhanced EWS.

Korea's stock market index fell by more than three standard deviations almost a year before the onset of the foreign exchange crisis in Korea, a forewarning of potentially serious problems in the banking system.

Banking crises are intimately linked to corporate financial stress, and new tools developed to estimate forward-looking measures of credit risk of both banks and corporates could be used as part of an EWS. These methods combine structural models of default with standard portfolio theory to assess the probability of extreme portfolio losses related to emerging market credit events. Structural models of default rest on the premise that a firm defaults on its debt when the market value of assets falls below the book value of its liabilities; viewing equity claims as a call option on the underlying asset value allows for the use of stock market prices to estimate market-based default probabilities.[19] A preliminary application of these methods to selected emerging markets, using KMV LLC proprietary software and techniques (see Bohn and Chai, 2001), suggest that they are not only usable in emerging markets but also that they lead to results that the authors regard as superior to those of econometrically-fitted models given the problems with the availability and quality of the data.

Financial Market Linkages

The development of separate "building blocks" for predicting foreign exchange, debt, and banking crises should take into account the close links between financial markets, and that one should be able to capture spillovers across bond, equity, and loan markets. Some of these linkages are already incorporated into each building block, but others are more subtle and may require a second stage of (joint) estimation and/or the use of scenario analyses. For example, Flood and Marion (2001) argue that studying currency and banking crises either in isolation or in perfect correlation with each other is inappropriate, producing biased estimates of the likelihood of crises. A key linkage between the two crises derives from the fact that government guarantees to depositors weaken the government's ability to fulfill other guarantees, such as that of maintaining a fixed exchange rate. Chang and Velasco (2000) relate bank and debt crises by jointly modeling the behavior of domestic bank depositors and foreign debt creditors. Finally, Christiano, Gust, and Roldos (forthcoming) show how a foreign exchange crisis could exacerbate the effects of a "sudden stop" in capital inflows (i.e., a debt crisis), by reducing the value of domestic assets that could be used as collateral in international credit markets. Although incorporating these linkages into a general EWS may be challenging, the insights could be taken into account in scenario analyses.

Contagion and Cross-Country Linkages

Contagion measures are included in some of the investment bank EWS models, but the ad-hoc treatment in these models contrasts sharply with the research on the issue. Traditional measures of contagion compare sample correlations among asset returns of different countries during tranquil and crises periods (see, for example, IMF, 2001b). However, unconditional correlations ignore the existence of interdependencies, both through international trade and financial linkages across countries.[20] There are two ways to overcome these limitations.

One approach is to assume that standard interdependencies are associated with small shocks to fundamentals whereas large crises and sporadic shocks may generate panics and herding behavior unrelated to fundamentals. This approach assumes that linkages across asset mar-

[19]These models are based on the work of Black and Scholes (1973) and Merton (1973).

[20]Forbes and Rigobon (2001), and Corsetti, Pericoli, and Sbracia (2001) review the main issues in the measurement of contagion.

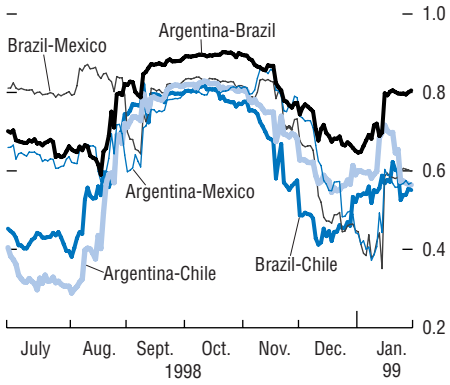
Box 4.2. Alternative Measures of Contagion

The major emerging market crises of the 1990s were often associated with extensive spillover effects (contagion) across countries and markets. Such contagion has been viewed as arising from trade linkages, financial linkages (such as a common lender), a "wake-up" call that leads investors to reevaluate their view on countries that are "similar" to the crisis countries, and herding behavior.

The extent and pattern of contagion during a crisis has often been measured by examining changes in the level of correlation between financial variables in different markets and countries such as bond spreads and equity returns. For example, in the aftermath of the Long-Term Capital Management (LTCM) debacle and Russian default in the fourth quarter of 1998, the correlations between equity markets jumped upwards for all equity markets (see the first Figure). In contrast, the continuing problems faced by Argentina during the last quarter of 2001 did not affect stock markets in the region substantially as witnessed by the decline in correlations (see Chapter II).

Although the changing pattern of correlations provides one indicator of contagion, these correlations do not directly measure the behavior that is more relevant during crisis periods, namely the degree to which large negative returns in one country or market are associated with large negative returns in another country or market.[1] Understanding how large shocks are transmitted across markets, and characterizing this transmission mechanism quantitatively is important if the effects of small financial shocks in one country propagate to another country in a different manner than large shocks. Indeed, large negative returns might have a higher level of correlation across countries if their occurrence leads investors to reevaluate the risks associated with investing in certain groups of countries or classes of assets.

Correlation of Daily Equity Returns During Russian Crisis and Long-Term Capital Management Failure[1]



Recent developments in extreme value theory (EVT) have allowed for a more precise measure of what can be called "extreme correlation"—the likelihood that a large negative financial return in one country is accompanied by a large negative return in another country. To derive this extreme correlation, one needs first to specify what constitutes a "large" or extreme negative return. In many studies, the criteria has been to focus on the bottom 5 percent of the negative returns over a specified sample period.[2] Given this criteria, one can show that the univariate distribution of extreme returns is well captured by the class of generalized Pareto distributions, and that the degree of extreme correlation between two series of

[1] Indeed, simple Pearson correlations can be deceptive when studying the comovements between large negative returns in two markets. For example, for a data sample obtained from a bivariate normal distribution with constant correlation coefficient, the correlation of the subsample including large returns is higher than the correlation of the subsample including small returns (Boyer, Gibson, and Loretan, 1997, and Embrechts, McNeil, and Straumann, 1999). Therefore, an increase in correlation does not necessarily identify a contagion episode.

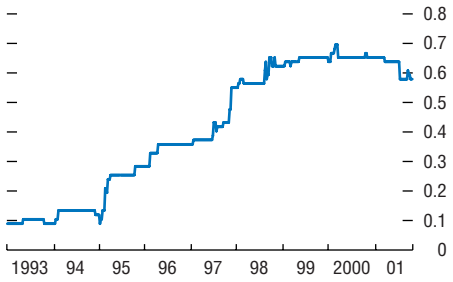
[2] More sophisticated methods can be used to determine the threshold value that determines whether returns are extreme or not. See Longin and Solnik (2001); and Poon, Rokinger, and Tawn (2001).

returns is given by the so-called Chi dependence measure, χ.[3]

The dependence measure χ can be roughly regarded as the conditional probability that, when a return in one market is the lower say 5 percent of all its outcomes, the other return will also be in the lower 5 percent of its outcomes. A higher value of χ implies an increasing likelihood that large negative returns in one market will be associated with large negative returns in the other.

While the value of χ can be examined during any given period to measure the degree of contagion as represented by the extreme correlation of asset returns, one can also consider how the value of χ has evolved over time to see if the degree of contagion has been rising or falling. As an example, the second figure portrays the evolution of the average χ values for a number of Latin American countries during the 1990s. Using weekly returns on stock indices over a 15-year period between December 31, 1987 and October 25, 2001, the extreme correlation measure is estimated for the bottom 5 percent of the negative returns using five-year rolling windows.[4] A number of results stand out. First, there has been a secular increase in the values of the χ throughout the 1990s. Second, the values of χ become statistically different from zero (at the 5 percent level of confidence) only in the period since the Russian crisis of late 1998 (see Chan-Lau, Mathieson, and Yao, 2002). These results suggest that, for at least the Latin American economies included in the sample, a large negative return in the equity market in one country has become increasingly likely to be associated with large negative outcomes in the other markets. The reasons for this secular increase in the extreme correlation between the Latin American markets are as yet not fully understood. One possibility is that the nature of the investor base for Latin American equities has changed over the course of the 1990s, with so-called "crossover" investors playing an increasingly important role.[5] Such investors will place a relatively small fraction of large portfolios in emerging market investments if they expect them to offer an attractive return. However, since the benchmarks used to evaluate the performance of portfolio managers of crossover investors typically do not encompass emerging market assets, they can abruptly reduce or eliminate their holdings of emerging market assets if the outlook for emerging markets deteriorates or if managers become more risk adverse and seek lower overall volatility of their holdings.

Average Extreme Correlations (χ) of Weekly Equity Returns for Selected Latin American Countries[1]



Source: IMF staff calculations based on data from Primark Datastream LLC.

[1]Average of five-year rolling windows for estimates of χ for the following country pairs: Argentina-Brazil, Argentina-Chile, Argentina-Mexico, Brazil-Chile, and Brazil-Mexico.

[3]See Coles, Heffernan, and Tawn (1999). If x and y are two series of returns on equities, the

$$\chi = \lim_{u \to 1} 2 - \frac{\log \Pr[F_x(-x) > u, F_y(-y) > u]}{\log u}$$

where u is the threshold value whose exceedance defines large returns, i.e. $u = 1 - 0.05 = 0.95$ for the bottom 5 percent negative returns, $\Pr(i, j)$ is the joint probability of i and j occurring, and F_x, F_y are the cumulative marginal density functions of x and y.

[4]The temporal behavior of χ is virtually the same if one starts with an initial five-year window and incrementally adds weekly observations until the full sample is utilized. These results and calculation of extreme correlations for emerging markets and for mature markets are discussed in Chan-Lau, Mathieson, and Yao (2002).

[5]Such investors would include large mature markets institutional investors such as pension funds and insurance companies.

kets in periods of stress can be characterized by means of a measure derived from extreme value theory, one that captures the dependence or correlation between the extreme values of returns (or the tails of the distribution of returns). The approach allows for the derivation of the probability that a crisis occurs in one country, conditional on a crisis happening in another one. Estimates for the G-5 countries suggest that simultaneous crashes in stock markets are about two times more likely than in bond markets (Hartmann, Straetmans, and de Vries, 2001). A recent application of these techniques to emerging markets (Box 4.2) suggests that the intensity of stock market linkages during crises periods in Latin America has increased in recent years, a phenomenon that could be explained by shifts in the investors base holding emerging market assets.

Another approach estimates the empirical relevance of the different channels of transmission of shocks across countries and argues that only the unexplained residual correlation across returns should be regarded as contagion. For example, Kaminsky and Reinhart (2000) examine the role of international bank lending, the potential for cross-market hedging, and international trade in the transmission of crises across countries. The authors conclude that contagion is more regional than global, and that, although it is sometimes difficult to distinguish between channels, financial sector linkages appear to improve forecasting performance relatively more than trade linkages. Also, they claim that even though these estimates reflect past contagion, to the extent that current cross-hedging strategies use historical correlations, they could be a good forecast of future contagion. The incorporation of these linkages to an EWS should take into account the evolving nature of the investor base for emerging market instruments in order to assess potential changes in the relative importance of different channels. For instance, the change in investor behavior toward sectoral (rather than country) allocations is likely to have changed the nature of cross-country equity market correlations.

Conclusion

Going forward, EWS models will continue to be one element in the IMF's multilateral surveillance activities. To enhance the usefulness of these models, the IMF staff will focus on incorporating more information from forward-looking asset prices as well as developing "building blocks" for the prediction of foreign exchange, debt, and banking crises. In addition, there will be further analyses of the determinants of the extent and scope of contagion during crises. The IMF staff will report periodically on the progress made in developing these additional tools of analysis.

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CHAPTER V

ALTERNATIVE FINANCIAL INSTRUMENTS AND ACCESS TO CAPITAL MARKETS

Over the past several years, emerging market borrowers have used a number of debt instruments, many of which embody innovative features, to maintain access to global capital markets and better manage their debt through risk diversification. While emerging market borrowers are quite likely to make use of alternative debt instruments[1] at times of relative tranquility, the need for their use may increase at times of market turbulence or financial stress, when investor appetite for emerging market debt diminishes and costs of borrowing rise. In these circumstances, emerging market countries must maintain sound economic policies, both to signal their commitment to economic reform and adjustment and/or to differentiate themselves from the countries in crisis and limit the potential damage from contagion. Notwithstanding the adoption of those policies, to meet their financing needs and maintain access to capital markets, sovereigns could face the daunting task of issuing debt that on the one hand appeals to investors, but that on the other avoids locking themselves into high debt-service costs for prolonged periods of time and creating inflexible debt structures that could exacerbate future crises and have implications for financial stability, more generally.

It is evident from Table 5.1 that over the past several years, in addition to reopening and augmenting existing debt issues, emerging market sovereigns sought to reduce borrowing costs and extend the maturity of debt instruments through the use of collateral, warrants, and a greater reliance on derivatives—all common features in mature financial markets, but less common in the sovereign emerging market debt context.[2] More recently, some of these instruments have been used less frequently, while others remain in common use.

While the role of alternative debt instruments in international finance and their implications for the new financial architecture have been discussed in earlier IMF studies, not much attention has been paid to comparing the relative merits of these instruments in enabling emerging market sovereigns to access capital markets or diversify risk on a sustained basis and the concerns they may raise for the management of sovereign debt, crisis resolution, and the functioning of emerging markets.[3,4]

This chapter focuses on the alternative debt instruments used by emerging market sovereigns to access capital markets from 1997 through 2001, a period marked by a number of financial crises. It examines the potential for conflict between a sovereign's desire to maintain access to capital markets and the principles of sound debt management practices recognized and endorsed by the international community. In particular, the analysis addresses the following questions:

[1]The term alternative financial instruments is broadly defined to capture various debt instruments (bonds and loans) other than new "plain vanilla" bonds and regular (unenhanced) loan issues used by emerging market sovereigns.

[2]The analysis focuses on sovereign borrowing (including the public sector) since the discussion of the role of innovations is intertwined with issues relating to sovereign debt management strategy and private sector involvement in the resolution of crises.

[3]See the IMF's "Involving the Private Sector in Forestalling and Resolving Financial Crises—Background Paper," available at http://www.imf.org/external/pubs/ft/series/01/index.htm

[4]A key conclusion that has emerged from earlier discussions of the role of alternative debt instruments is that there is a potential for greater risk shifting, but at the same time, a concern that such instruments could burden emerging market sovereigns with an excessively rigid debt structure—an issue that comes back to haunt when the sovereign faces a financial crisis.

Table 5.1. Emerging Market Sovereign Bond and Loan Issues by Type

(In millions of U.S. dollars, unless otherwise specified)

	1997		1998		1999		2000		2001	
	Jan–June	July–Dec	Jan–June	July–Dec	Jan–June	July–Dec	Jan–June	July–Dec	Jan–June	July–Dec
Regular	34,839	28,818	41,659	15,404	21,995	14,773	29,247	14,588	21,211	12,953
of which loans	9,646	7,200	20,739	7,805	7,809	2,233	4,325	2,333	2,453	3,654
number of transactions[1]	158	119	132	58	64	58	80	45	51	44
Augmentations	9,139	5,093	8,338	2,830	10,908	6,126	6,777	5,584	8,891	7,178
number of transactions	9	8	17	15	26	24	14	14	19	19
Step-down	. . .	1,672	3,286	416	938	. . .	. . .	. . .	. . .	. . .
number of transactions	. . .	5	8	2	3	. . .	. . .	. . .	. . .	. . .
Step-up	300	405	564	. . .	162	. . .	. . .	. . .	. . .	. . .
number of transactions	1	1	1	. . .	1	. . .	. . .	. . .	. . .	. . .
Calls	2,547	1,044	150	1,550	33	100	1,120	310	300	. . .
of which loans	. . .	110	. . .	50	. . .	. . .	. . .	185	. . .	. . .
number of transactions[1]	10	8	1	3	1	2	4	7	1	. . .
Puts	2,742	310	2,695	1,369	1,233	1,310	80	1,215	. . .	2,062
of which loans	445	110	195	163	. . .	94	80	185	. . .	. . .
number of transactions[1]	17	5	4	8	4	8	1	6	. . .	3
Warrants	. . .	. . .	. . .	1,000	2,500	. . .	. . .	. . .	. . .	**[2]
number of transactions	. . .	. . .	. . .	1	3	. . .	. . .	. . .	. . .	1
Structured notes[3]	. . .	1,000	1,750	905	. . .	. . .	. . .	. . .	. . .	. . .
number of transactions	. . .	2	2	3	. . .	. . .	. . .	. . .	. . .	. . .
Collateralized	7,059	5,433	3,042	5,610	1,016	1,939	3,247	860	970	530
of which loans	6,700	5,233	2,942	3,110	93	1,261	3,247	860	970	530
number of transactions[1]	26	31	22	11	6	9	11	6	6	3
Total	56,626	43,775	61,484	29,083	38,785	24,247	40,471	22,557	31,372	24,041
of which loans	16,792	12,653	23,876	11,128	7,902	3,589	7,652	3,562	3,423	4,184

Sources: Bondware and Loanware.
Note: Includes all countries covered by the EMBI Global Index and covers issuance by all forms of government and the public sector.
[1]Includes bonds and loans.
[2]Panama issued warrants in the context of retiring/swapping some debt maturing in 2002.
[3]Owing to the non-transparency associated with structured notes, coverage may be incomplete.

- What kinds of alternative instruments have been introduced, and what impact do they have on sovereign borrowing costs and on enabling access to capital markets on terms consistent with medium-term viability?
- Is the use of various alternative debt instruments consistent with sound debt management practices or does it merely push risks and problems to the future?
- Are these techniques consistent with efforts of the international community to involve the private sector in crisis resolution, both in terms of the private sector maintaining exposure to a country at times of crises and in terms of creating flexible debt structures?

Alternative Financial Instruments: What Are They and How Do They Work?

Financial market turbulence or financial stress is typically characterized by a loss of investor appetite for emerging market debt and higher borrowing costs for some or all of the following reasons: (1) reduced liquidity in secondary markets for emerging market debt; (2) higher risk premiums that (temporarily) push up borrowing costs; (3) a rise in the perceived risk of default by sovereign borrowers; (4) increase in market uncertainty, including from risks of contagion; (5) increased risk aversion among investors; and (6) increased uncertainty about future prospects of the sovereign borrower.

Table 5.2. Market Conditions and Alternative Financial Instruments

Financial Market Conditions	Alternative Financial Instruments	Advantages	Disadvantages
Diminished or uncertain secondary market liquidity. Reduced demand for new issuance.	**Augmentation:** use of techniques for reopening of existing issues.	Builds large fungible issues that promote secondary market liquidity. Allows sovereign to issue in smaller increments and to do so more seamlessly.	Bond covenants need to accommodate reopenings. If too large, may impact overall yield curve and spread of all outstanding issues.
Higher risk premiums that (temporarily) push up interest rate costs for the borrower.	**Time varying instruments:** *Step-up and step-downs:* allow the sovereign to shape present and future cash flows differently.	Sovereign can issue instruments with longer maturity without locking in high short-term rates.	Provides investors with an upside potential reflected in higher average coupon rates.
Markets have different expectations (too pessimistic) compared to fundamental outlook of the authorities.	**State contingent instruments:** Includes options and warrants.	Sovereign can reduce borrowing costs by providing insurance to investors against adverse outcomes.	Difficulty in pricing. Relatively high market premium. Puts—the exercise by investors may compound the difficulties of debt managers in adverse outcomes.
Market spreads may be volatile or out of line with medium run trends.	**Structured notes:** includes fixed income instruments linked to derivatives, such as swaps, caps, floors, and futures.	Allow the sovereign to hedge market outcome risk or to provide a payoff to investors based on future economic conditions.	Tend to be complex and may be difficult to price efficiently. Nontransparent. Need to be set into a sophisticated risk management strategy to avoid debt management risks.
Rise in the perceived risk of default by sovereign borrowers.	**Collateralized instruments:** including instruments that borrow against future flows.	Reduce spreads and improve rating of instrument. Could potentially provide significant market access when uncertainty is overwhelming and restricts other forms of market access.	May result in rise in spreads of uncollateralized instruments by subordinating existing instruments. Inflexibility could complicate debt management. Could run counter to efforts to secure private sector involvement in crisis resolution.

In such circumstances, emerging market borrowers often have adjusted their debt management strategies, and have made use of debt instruments, embodying innovative features, to maintain access to capital markets and diversify risks (Table 5.2).[5] The alternative debt instruments—which include debt augmentation, time varying and state contingent instruments, structured notes, and collateralized borrowing—seek to mitigate one or more of the above concerns by changing the nature of the debt instrument, its payoff, as well the commitment of the sovereign borrower to meet its debt obligations. The use of such instruments could, however, also be undertaken at times of relative tranquility provided they are consistent with the overarching and constant goals of improving fundamentals and sound debt management and build credibility with markets.

Augmentations

Sovereign borrowers have become increasingly aware of the importance of well function-

[5]Risk diversification refers to linking debt-service costs to the underlying ability to pay.

ing secondary markets for their debt instruments. Liquidity of these markets can be improved through a practice of building large fungible issues along the yield curve by reopening and expanding existing debt, often termed "augmentation." Reopening and expanding an existing issue with which investors are already familiar makes the existing stock of bonds more liquid—by widening the number of investors in a single issue, opportunities for secondary market transactions increase. It also makes it more likely that the larger bond stock will be included as a benchmark in several emerging market indices, thereby increasing the potential universe of portfolio investors. Liquid secondary markets, in turn, provide issuers with a benchmark for pricing new issues.

Augmentation offers advantages that are particularly useful in times of financial market turbulence. With reduced demand for new instruments in such circumstances, augmentation allows the sovereign to access capital markets in smaller amounts and across a series of bonds (as compared to a single large-size issue), helping the issuance to be more easily absorbed into the market and with minimum disruption (existing issues are already aligned with market conditions).[6] Furthermore, augmentations can also be used to maintain liquid markets when shortages of a particular bond series arise owing to a technical market squeeze by short sellers.[7] Reflecting these advantages, data presented in Table 5.1 show increasing use of augmentation, rising up from a share of only one-fifth in 1997, to more than one-third of all bond issuance in 1999 and 2001, suggesting that augmentation has been usefully deployed to maintain market access during difficult periods.[8,9]

Augmentations are not, however, without limitations. In particular, augmentations, like all bond issuance, dilute the claims of previous holders of the bond, and may put pressure on secondary market bond prices, increasing the spreads and cost of issuance and potentially disrupting secondary markets. Investors sometimes demand explicit protection against such risks, including by embedding rules in bond contracts to protect primary market buyers of bonded debt—such as by ensuring that augmentations take place when prices are close to par. In other cases, investors might require an additional premium *ex ante* to allow for future augmentation, which in turn could bear upon sovereign debt management strategy.[10]

Time-Varying Instruments

These include instruments in which coupon payments change over time.

Step-ups and Step-downs

In the period from 1997 through 1999, several key emerging market sovereigns issued bonds that included a step-down or step-up feature, where coupon payments are higher (lower) for a short initial time period, but then decrease (increase) over the medium to long term.[11] Table 5.1 shows that the issuance of step-downs increased during the Asian crisis and peaked during the first half of 1998—owing in large part to the issuance prior to the creation of the Euro by Argentina, and to a lesser extent,

[6]Recently, South Africa augmented by $250 million one of its global bonds—in the wake of pressures on the Rand, one could interpret this as a "testing of the waters" for market access.

[7]Augmentations of this sort, which Argentina and others have used, are called "reverse inquiries."

[8]EMBI spreads increased sharply in 1999 to average 1,032 basis points, while in 2001, spreads averaged 890 basis points.

[9]Reflecting some of the benefits accruing from a well-developed yield curve, there has been a proliferation of augmentations of debt denominated in U.S. dollars relative to debt denominated in other currencies.

[10]For augmentations to be viable, some minimum number of bonds of an appropriate maturity need to be outstanding, while the bond documentation needs to incorporate a tap feature that allows the size of the issue to be increased at the discretion of the debtor.

[11]A bond can have several steps (e.g., some older Brady bonds had numerous steps). However, the recent sovereign emerging market bonds generally have only one step.

Brazil, Venezuela, and Turkey, of bonds in various Euro-11 currencies and at coupons that had step-down features that would merge into one highly liquid euro-denominated benchmark—before declining following the onset of the Russia crisis.

The motivation for step-downs is that it allows debt instruments with initially high coupons, reflecting existing market conditions, to converge to the yields being paid on already existing sovereign debt. By doing so, the instrument usually becomes fungible with another bond issue and the two are traded as one. Thus, the issue achieves the benefits of longer-term borrowing and enhanced liquidity, while avoiding locking the borrower into continuous high debt-service costs after the market has returned to more normal conditions. Despite the potential benefits, a limitation of the step-down feature is that it is considerably less flexible than a bond with an embedded call option (discussed below), because if the coupon rate that it steps down to is higher than the prevailing market rate at that future point in time, the issuer might find the initial choice less than optimal.

In contrast to step-downs, an embedded step-up feature in a bond reflects the willingness of the market to accept the sovereign's belief that economic prospects will improve over time, thereby improving the ability of the sovereign to service its debt. The cash-flow relief initially could help the borrower to put its house in order to ensure economic stability and growth. In this way, a step-up bond has positive risk diversification features. Step-up bonds are, in general, instruments with a long duration, and may appeal more to certain classes of investors who have a longer investment horizon. That said, the step-up feature in bond contracts have remained rare in recent *new issuance*, although Argentina used this feature in the context of a voluntary debt swap in June 2001.

State-Contingent Instruments

These include instruments in which the payments depend upon future economic and/or market conditions.

Options

A call option would normally be reflected as a covenant in the bond or loan contract, stating that on a certain date (or dates) prior to the maturity date of the instrument, at the discretion of the issuer, the debt can be redeemed at par. The call option provides an important advantage to the issuer by allowing the possibility to refinance at a substantially lower rate, if market conditions improve. Consequently, it is able to capture the benefits of improved economic conditions without taking on additional funding risks (as would be the case for put options exercisable at the discretion of the creditor). In return, however, the holder (the seller of the call option) will demand a higher yield, both because he is exposed to reinvestment risk pertaining to the principal and because the price appreciation potential for a callable bond is restricted. Furthermore, in certain cases, the call option, by making the instrument more complex or less easily tradable, will require an additional premium on liquidity grounds. Call options are particularly attractive when there exists asymmetric risk preference and information, because of which the market and the issuer disagree about the likely future path of the sovereign's borrowing cost.

Notwithstanding the apparent advantages of the instrument, they have not proved popular in the pure sovereign context since the onset of the Asian crisis and the last use of the instrument was in the second half of 1998.[12] Arguably, difficulties in pricing the options efficiently to reflect their true value have deterred sovereigns from adopting this technique to access capital markets. It is also quite likely that market perception of a significant likelihood of a call option embedded in a new instrument issued at times of

[12]Refers to borrowing solely by the central government. They continue to be used, however, by quasi-sovereign borrowers.

stress being exercised would lead investors to seek a large upfront premium that borrowers are unwilling to pay, thereby leading to a decline in their overall use.

In contrast to a call option, a put option in a bond or loan contract would provide the creditor with the right, but not the obligation, to redeem the debt instrument before the maturity date. Borrowers write put options as a means to achieve lower spread in the belief that over time spreads will decline, or at least remain stable, in which case the put would not be in the money, and would not be exercised.[13] By issuing debt with an embedded put feature, however, the issuer risks being subject to a rapid increase in refinancing needs at times of emerging pressures, which could make a difficult situation worse. In the context of the Asian crisis, a number of emerging market borrowers, in the face of a total loss of access to international capital markets, faced significant pressures in their external accounts following creditors' decision to exercise put options. In the context of improvements in sovereign debt management strategy, put options have been relatively rare in their use in the pure sovereign context in recent times, although a number of public sector entities continue to use them.

Warrants

An innovative feature, which has occasionally been used by emerging market sovereign borrowers, is the use of warrants embedded in new bond issues. Embedded warrants in nonsovereign bonds are fairly common and have usually been of the equity warrant type (i.e., they have included a call option that gives the bondholder the right, but not the obligation, to buy a certain amount of shares at a specified price). Bond warrants, in contrast, give the holder of the warrant the right, but not the obligation, to buy another sovereign bond (usually long term), at a predetermined price at some future date. Hence, warrants can be seen as sold call options by the sovereign issued out of the money (i.e., they become in the money if spreads come down faster than contracted before the exercise date) that are embedded in an otherwise plain vanilla bond. Argentina revived the use of bond warrants in November 1998 by embedding a warrant in a $1 billion bond issue. This structure, which previously had not been used in a sovereign context since the early eighties, was well-received and subsequently copied by other issuers, with some alterations (Box 5.1).

In effect, warrants allow the issuer to "buy down" the headline spread today, in return for a commitment to pay more in the future should the outlook for the country improve and spreads fall to the extent that the warrants become in the money. The country will then issue new debt in the improved economic environment at rates above the prevailing market rates. Conversely, in the event that spreads do not fall below the strike price, the warrant will not be exercised and the country will have benefited from lower initial issuing costs.[14] Hence, by making debt-service payments countercyclical, warrants provide risk-shifting benefits, and entail risks only to the extent that effective borrowing costs in the future could increase if economic prospects improve sharply.

Market commentary has highlighted a number of technical benefits from this structure, including an increase in liquidity. Furthermore, warrants, being a type of call option paid for by the buyer, provide the owner of the warrant with a significant amount of extra leverage. They would appeal, in particular, to institutional investors who are forbidden by home market regulations to take regular option positions but are allowed to hold warrants that are attached to a

[13]Such options would be exercised when they are "in the money"—that is, in circumstances in which the secondary market price of the underlying debt instrument (identical in every respect except for the absence of the put option) is below the put price (usually par).

[14]If there is a need to restructure the issued bond before the exercise date, it seems clear that the warrant would be worthless and hence be ignored from the standpoint of pricing the restructured instrument.

Box 5.1. Recent Bond Warrants

Following its introduction in the sovereign context by the Argentine government in November 1998, there have been several instances of sovereigns issuing a bond with an attached warrant.

Argentina I

On November 18, 1998, Argentina launched an unusual seven–year sovereign Eurobond that included a bond warrant. The bond was favorably received, and was increased from an initial $750 million to $1 billion, at a spread of 622 basis points. The Eurobond (the so-called "host bond") included a warrant that gave the holder the right, but not the obligation, to buy the Argentine 2027 bond (the so-called "back bond") at 93.3 percent of par. The value of the warrant was estimated at launch time to be 64 basis points, which was the sweetener provided by the issuer. The warrant, which was subsequently exercised, had a maturity of approximately one year and expired in December 19, 1999.

Mexico

Mexico launched a $1 billion sovereign bond on February 5, 1999, which included a fairly complex warrant structure. The holder of the warrant was given the right, one year after the launch, to exchange some specific Brady bond issues into either: a yet to be issued floating rate note, due 2005, paying LIBOR plus 4.75 percent, or a reopening of the United Mexican States Bond, due 2016 with a 11.375 percent coupon. Exchange ratios, which provided for the exercise price of the warrant, were set at launch. Warrants were detachable at launch and could trade separately. The warrants were subsequently exercised.

Argentina II

Argentina issued its second bond with an embedded warrant attached in February 1999. The major difference between this warrant and the previous Argentine one was that it was issued during considerably improved market conditions and the warrant, allowing another $500 million to be issued, exercised into the host bond (maturing February 2009) instead of a different bond. Market reactions were reportedly positive, yet the size was limited to $1 billion in face of $2 billion worth of demand (allowing certain investors to be targeted). The warrant was valued around 20 to 30 basis points, resulting in a modest yield curve pickup of 20 basis points compared to the outstanding bonds maturing in 2017. The warrants, which were subsequently exercised, were not detachable until one month after launch.

Colombia

The Republic of Colombia launched in March 1999 a $500 million Eurobond with a 10.875 percent semiannual paying coupon maturing in March 2004. The bond issue also included a warrant giving the right to exercise the warrant, one year from the host bond's issue date, into a yet-to-be-issued Republic of Colombia bond, with a maturity of 19 years. The attached warrants are said to have saved 87 basis points of the headline spread of the bond issue. Warrants were subsequently exercised.

Panama

On June 26, 2001, Panama offered to purchase for cash and warrants up to $245 million aggregate principal amount of its 7.875 percent notes due February 13, 2002, in order to minimize the carrying cost of this issue. The offer was to expire on July 10, 2001, or once the $245 million aggregate principal of the 2002 notes was validly tendered, whichever came first. Under the terms of the offer, if Panama would purchase any 2002 notes, the tenderer would receive, for each $1,000 principal amount of 2002 notes purchased, a cash payment of $1,039.375 and two warrants, each of which would entitle the holder, on January 16, 2002, to exercise an option to purchase $1,000 principal amount of Panama's newly issued 9.375 percent Global Bonds due July 23, 2012 (the "2012 Bonds") for cash at an exercise price of $990. If, however, the number of warrants exercised on January 16, 2002, would result in the issuance of less than $100,000,000 aggregate principal amount of 2012 Bonds, Panama would instead issue and deliver, in respect of each warrant exercised, $943.10 principal amount of its outstanding 9.625 percent Global Bonds due February 8, 2011 (the "2011 Bonds"). These 2011 Bonds, if issued would be a further issue of and form a single series with outstanding 2011 Bonds.

Finally, warrants were in the money and $182 million (57 percent of the total) were exercised.

bond. Another factor affecting the use of warrants is the perceived advantage of tailoring the instrument to a particular class of creditor. In the case of the Mexican sovereign bond issued in 1999, the warrant was immediately detachable, which according to market sources led relative value players to buy the bond plus warrant and immediately sell the bond, causing the bond price to drop immediately after syndication broke. In contrast, in the Argentine bond issue of February 1999, the warrant was first separable one month after the issue, and hence specifically targeted longer-term investors. Argentina's success in targeting the desired group of investors was also helped by excess demand for the issue, which allowed the lead managers to discriminate between new money accounts and switching accounts (investors that sell one Argentine bond to buy the one being issued, thereby shifting the yield curve in the process).

Despite their potential benefits, the use of warrants by sovereign issuers has significantly diminished in recent years—although Panama used this feature in 2001 in the context of retiring/swapping some bonds maturing in 2002—in large part because of the difficulty, and potential inefficiency, in the pricing of debt instruments containing warrants.[15] However, because of their risk diversification features (sweetener would only need to be paid in the "good" state of the world), emerging market sovereigns might consider the use of warrants in the future.

Structured Notes

In the aftermath of the Asian crisis, structured notes became a popular means for emerging market borrowers to access international capital markets, although their popularity has waned significantly in recent years. These instruments are powerful tools for intermediating credit and risk, and can be used to achieve virtually any risk/reward profile, but their complexity and nonuniformity pose distinct challenges for emerging market borrowers and lenders.

Structured notes are fixed income securities linked to derivatives. The embedded derivative transactions are most commonly swaps, although options, futures/forwards, credit-linked derivatives, caps, and floors can be used as well. As such, they are often fairly complex transactions with varying contingent payoffs.[16] For emerging markets, structured notes have so far been issued by Argentina, Colombia, the Philippines, and Ukraine. These transactions have in total amounted to about $3.7 billion, with a spike in issuance during the second half of 1998. Since then, however, they have seldom been used.

Structured notes allow for the hedging of almost any risk, and could be designed such that the payoff on the note is linked to the payment capacity of the issuer. Therefore, structured notes are unique in their ability to diversify risks and payments across states. In addition, since structured notes combine traditional debt instruments with derivatives, investors that might otherwise be off limits to derivative markets can obtain indirect access to these markets. The market for this innovative financial instrument, however, is rather nontransparent. More often than not, structured notes are tailor made to suit specific investors and sold in relative obscurity. As a result, general market information relating to issuance of structured notes, the availability of various types, and information on market participants is hard to come by, which in turn renders the pricing of these instruments very difficult. A further limitation arising from

[15]The absence of sufficient liquidity among other things affects adversely the fair pricing of warrants.

[16]Since their inception in 1983, structured notes rapidly increased in volume globally and, including secondary structured notes, amount in notional terms to more than $300 billion. With maturities ranging anywhere from three months to as long as 10 years, structured notes have been mostly denominated in U.S. dollars and issued by corporations, financial institutions, including banks, specialized government agencies, sovereigns, and multilateral institutions, such as the World Bank. U.S. government agencies are among the largest issuers of structured notes, and the most active of these agencies are the Federal Home Loans Banks (FHLB).

tailor-making these instruments relates to liquidity. Given that they are customized, it is not surprising that structured notes are not very liquid instruments in secondary markets, and this would imply that potential buyers, despite the customization of the instrument, would expect a liquidity discount. From the sovereign's point of view, a structured transaction would only make sense when it has some benchmark bonds that would provide guidance in the pricing process of the structured note.

Collateralization

Under some conditions of market stress, sovereigns could face prohibitive borrowing costs. In such circumstances, some emerging market borrowers have adjusted their debt management strategies to offer collateralized instruments. The use of collateral to back financial instruments is a common feature of private market borrowing, but outside of project financing, it has been less common in the sovereign context. In most cases, collateral has taken the form of current assets, or assets created or acquired using borrowed funds. In addition to traditional forms of collateralized borrowing, more recently, future flows of hard currency receipts have served as collateral for borrowing by a number of public enterprises, and this development could potentially have significant implications for sovereign market borrowers. The remainder of this section focuses on collateralization through the use of future flows, although the discussion of the costs and benefits applies equally to other forms of collateralized borrowing.

Borrowing Against Future Flows

Following the Mexican crisis in late 1994, there was an increase in borrowing against the future flow of hard currency income from the export of goods and services (Box 5.2).[17] A number of these transactions have been backed by exports of goods, typically oil, but including metals, minerals, auto parts, plastics, and liquor. Other forms of collateral have included tourism-generated credit card receivables, workers' remittances, receipts from long-distance telephone calls, and airline ticket receivables from foreign routes.

As a result of the implicit insurance investors derive from the collateral, issues backed by future flows typically are rated above the sovereign foreign-currency rating, and have spreads below the sovereign spread, reflecting the belief of rating agencies and markets that these securities are *de facto* senior to sovereign international bonds. In addition to being securitized, a number of these transactions have been supported by private bond insurance, which among other things enhances the creditworthiness of the instrument. The insurance company's guarantee of repayment raises the insured issue's credit rating to AAA, a practice common for industrial country municipal issues.[18]

A pledge of future flows as collateral can have benefits for both borrowers and lenders, often reflects normal commercial practice, and may foster a more efficient allocation of trade and external financing. Collateral increases the costs of default by increasing recovery ratios should default occur and enhances the willingness to repay, thereby signaling a commitment to policies that allow repayment. The decline in the probability of default lowers spreads and increases the range of creditors able and willing to hold the asset. During a period of financial turmoil, use of collateralization may help encourage new credits by effectively subordinating existing debt and ensuring that new creditors are repaid first. Collateralization, however, brings risks and costs—including the creation of less flexible debt structures, the potential delinking of the pursuit of good policies from market financing,

[17]The technique was first used in an emerging market context by Telmex in 1987 to borrow against its net long-distance receivables from AT&T.

[18] MBIA–Ambac is nearly the sole supplier of bond insurance for emerging market debt, having guaranteed over $3 billion, including $1.75 billion of PEMEX's' oil-backed issue.

Box 5.2. The Structure of Future-Flow Securitizations—Modalities and the Case of PEMEX

In a typical securitization against future receivables, income is typically assigned to an offshore subsidiary created specifically for this purpose, called a special purpose vehicle, which issues the bond. The borrower provides irrevocable instructions to foreign importers that purchase its exports requiring them to make payments to an account controlled by the transaction's trustee. The trustee first pays debt service to investors and transfers to the special purpose vehicle any excess receipts (the transactions are typically overcollateralized three to four times). These documents can have the force of contracts in foreign jurisdictions, binding companies such as Exxon, Mobil, AT&T, Visa, and MasterCard to make payments into the trustee account. The transaction shifts jurisdiction over hard currency payments to a court system trusted by investors; otherwise, borrowing against future flow of export income parallels industrial country finance institutions' practice of securitizing their loan receivables. The rating of the bond issued by the special purpose vehicle is determined by many factors, including the nature of the receivable, the degree of over-collateralization, redirection of payment risk, the rating of the sovereign, and the rating of the receivable generating process. Ratings of individual tranches can be further enhanced by the use of mono–line insurers and/or subordination.

In one prominent example, PEMEX, the Mexican state-owned oil and gas company, issued $4.1 billion of bonds in December 1998, February 1999 and July 1999 secured by future oil export receivables.[1] These transactions are notable for a number of reasons. First, they accounted for 24 percent of all emerging market issues backed by future flows of income. Second, PEMEX is an important source of tax and nontax revenue for the Mexican government. Finally, a bond insurance company, MBIA–Ambac guaranteed $1.35 billion of the issues, raising the credit rating to AAA rating (S&P), while the nonguaranteed portions received a BBB rating (S&P). The sovereign credit rating for Mexico at that time was (and still is) BB (S&P).

[1]Specifically, PEMEX issued the bonds through a special purpose financing vehicle, PEMEX Finance, incorporated in the Cayman Islands. The issues are secured by PEMEX's account receivables from foreign clients, through a contract (a "receivables purchase agreement") that gives PEMEX Finance the right to purchase, from time to time, accounts receivables that have been generated or will be generated in the future.

and possibly increasing the cost of unsecured borrowing—that require close monitoring (see following section for further detail).

Policy Implications

To maintain sustained access to capital markets on terms consistent with medium-term viability as well as for purposes of risk diversification, emerging market borrowers may wish to make use of alternative debt instruments embodying innovative features. Pressures to do so may increase at times of financial crises, when access to capital markets is significantly reduced. The issuance of such debt, however, must be consistent with sound debt management practices—among other things to ensure that efforts to maintain market access do not come at an excessive cost, either in terms of an inflexible debt structure or in terms of increasing effective borrowing costs. From a policy perspective, use of innovations must also be compatible with efforts of the international community to secure private sector involvement in the resolution of crises and improve the international financial architecture more generally.

Augmentations provide sovereign borrowers a simple means, reflecting sound debt management practice and devoid of significant costs, to maintain (and reaccess) capital markets. Their continued use over the past several years is a clear reflection of this realization. By improving

the liquidity of existing debt instruments, and by catering to the specific needs of investors, augmentations enable sovereigns to maintain access to capital markets in a series of small steps until market sentiment improves. The successful use of augmentations in the context of financial crises will, however, depend among other things on whether the issuing sovereign is the source of a crisis or is a victim of contagion. If the sovereign is the source of a crisis, it is quite likely that markets would dictate the need for other types of enhancements for the sovereign to regain access on favorable terms, while if the sovereign is a victim of contagion, augmentations may be sufficient for the sovereign to maintain access to capital markets.

Time varying and state-contingent financial instruments, including step-downs and embedded call options, can provide market access at headline spreads and allow for a reasonable balance between the provision of enhancements to entice investors and the opportunity for the sovereign debtor to lower debt-servicing costs in the future. Neither technique, however, provides much in the way of risk diversification. In the case of call options, the future interest rate is uncertain, while in the step-down it is contracted ahead of time.[19] The proper timing of a call option is inherently difficult to determine before hand since it depends quite critically on the existence of asymmetric risk preference and information between the sovereign debtor and investors. However, because of the likelihood that the sovereign will have superior information than the market, the market will compensate by demanding a higher price for the option. Therefore, only in a select few circumstances, when the quality of the sovereign's information is better than anticipated (i.e., the information asymmetry is unexpectedly large) or when the risk preferences diverge significantly, will the sovereign find it advantageous to issue a bond with an embedded call option.

The use of put options in debt instruments, while providing emerging market borrowers access to capital markets on favorable terms, could come at a significant cost in terms of increasing the debt-service burden of borrowers at times of financial stress, and could thereby make a difficult situation worse. Therefore, from the sovereign's perspective, put options need to be carefully considered to ensure consistency with sound debt management practices, in particular, the management of debt profiles and risks arising from the possible exercise of the options.

In contrast to step-downs and options, bond warrants provide risk diversification to emerging market sovereigns by offering the opportunity to issue debt that "buys down" headline spreads prevailing at times of crises or contagion in return for an explicit commitment to pay higher spreads—on new bonds—in the future, if economic prospects and market sentiment improve, leading to a decline in market spreads on sovereign bonds. Without creating an inflexible debt instrument, warrants can provide significant risk-shifting benefits and breathing room at times of crises by lowering debt service in the near term, and only expose the sovereign to risk in terms of higher borrowing rates (than market rates) in the future when strong economic adjustment facilitates sharp economic recovery. As a result, from the sovereign borrower's perspective, warrants may be more cost-effective and consistent with sound debt management in the context of countries in crises, rather than for those suffering from contagion, since the upside potential for these countries will probably take time to manifest itself. Warrants are, however, more complex than conventional bonds, underscoring the importance for sovereigns to make thorough assessments of the associated benefits and risks prior to using them. Nonetheless, if properly un-

[19]Between a bond embedded with a step-down feature and a plain vanilla bond, the choice for the sovereign is basically the same, except that with the plain vanilla bond the yield curve can be augmented, while with the step-down the new instrument can simply merge with an existing bond. Hence, the trade-off is between a better-defined yield curve and a more liquid benchmark-like bond (the merger of the new bond and the existing one).

derstood and fairly priced, they can provide an important source of risk insurance for emerging market borrowers.

As with other derivative products, structured notes can be used to either manage existing risk or assume new risk. Among the numerous fixed income securities available in the market, structured notes are special in that they can be customized to satisfy the unique requirement of individual investors, allowing for the possibility of exotic payoffs and higher-than-market yields under certain scenarios, including links to any currency, interest rate, stock index or combination thereof, and exposure to different market sectors within one packaged security. In general, from a market access perspective, structured notes could play a useful role in expanding the interested emerging market investor class, by particularly catering to previously unsatisfied pockets of demand. There are, however, significant risks and impediment to their wider use. Owing to their complexity and nontransparency, structured instruments can be difficult to price, while the underlying structure could be inflexible. Therefore, like warrants, structured instruments, when properly understood, fairly priced, and issued in moderate amounts, can provide an important means for emerging market borrowers to maintain market access to capital markets.

Collateralized borrowing, by subordinating other forms of debt and providing insurance to assure creditors that debts to them will be serviced, could potentially provide the sovereign borrower significant market access, and possibly at terms consistent with medium-term viability, especially at times of financial stress and when overwhelming uncertainty restricts other forms of market access. Care and restraint is, however, required in their use since the costs that such borrowing will impose on the sovereign borrower could be significant.

In an unsecured sovereign bond issue, market access and spreads are determined by the level of confidence that investors have in the country's underlying policies and prospects, thus exerting crucial market discipline.[20] Collateralized borrowing can, however, weaken the link between the availability of finance and the quality of policies, as investors are assured of payment regardless of the policies pursued by the government. This weakens the incentives for sovereigns to adhere to appropriate policies, thereby eroding the quality of unsecured credits. Also, to the extent that such borrowing subordinates other forms of debt, it could increase the costs of unenhanced borrowing. Furthermore, since collateralized debt is effectively unreschedulable, it limits a country's room for maneuver in the event of future payment difficulties. In addition, the successful use of collateralized instruments by one emerging market sovereign to regain market access may lead to a proliferation of their use, including by other emerging market borrowers, as investors seek deals with similar security, thereby widening the scope of a potential financial crisis as debt structures become more inflexible.

Finally, by reducing the net exposure of the private sector to sovereign risk, collateralized borrowing also runs counter to the efforts of the international financial community to involve the private sector in the resolution of crises, while in light of their role in creating less flexible debt structures, they could be inimical to the efforts of the international community in encouraging a wider use of financial instruments that can facilitate a restructuring of sovereign debt in extreme circumstances.

Concluding Remarks

Emerging market sovereigns may face significant risks in relying on debt issuance denomi-

[20]This approach is mirrored in the IMF (and World Bank) policy of not demanding collateral for use of resources, but instead looking to the quality of macroeconomic and structural policies to provide "collateral." Collateralization may also raise a "safeguard" issue for international financial institutions since the earmarking of assets could affect the capacity of a sovereign debtor to service its financial obligations to them.

nated in foreign currency. Therefore, prudent sovereign debt management practices would limit additional risks that arise from borrowing using debt instruments that create, among other things, inflexible debt structures and further shift risks to the sovereign borrower. A number of alternative debt instruments, including augmentations and those embedded with risk diversification features, such as warrants, can potentially provide emerging market borrowers with access to capital markets without posing significant costs and can allow debt-service payments to be countercyclical, thereby contributing to the maintenance of economic and financial stability. Some debt instruments, including bonds with put options and collateralized instruments, however, can pose significant risks (and costs). Hence, emerging market sovereign borrowers need to develop appropriate policies to assess risks associated with borrowing using alternative financial instruments prior to using them to maintain access to capital markets, both during normal market conditions and at times of financial stress.

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