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To: Members of the Executive Board

From: The Secretary

Subject: **Assessing Underlying Vulnerabilities and Crisis Risks in Emerging Market Countries—A New Approach**

The attached paper on assessing underlying vulnerabilities and crisis risks in emerging market countries—a new approach will be discussed in an informal Board seminar on **Wednesday, October 3, 2007**.

It is not intended that this paper will be published on the Fund's external website.

Questions may be referred to Ms. Schulze-Ghattas, PDR (ext. 37618) and Mr. Prati, RES (ext. 36275).

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**Assessing Underlying Vulnerabilities and Crisis Risks in Emerging Market Countries—
A New Approach**

Prepared by the Policy Development and Review and Research Departments

(In consultation with the Monetary and Capital Markets Department and other departments)

Approved by Mark Allen and Simon Johnson

September 17, 2007

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EXECUTIVE SUMMARY

The vulnerability exercise (VE), which was established in 2001 to enhance surveillance and crisis prevention in emerging market countries (EMCs), has been redesigned to strengthen its analytic power and limit resource costs.

The new approach distinguishes conceptually between underlying vulnerability and crisis risk. Underlying vulnerability—weak economic and financial fundamentals—is a necessary, though not a sufficient, condition for a crisis. Crises are typically triggered by economic, financial, or political shocks, and significant crisis risks reflect a combination of sizable underlying vulnerability and a high likelihood of such shocks.

Mirroring this conceptual distinction, the VE's operational framework differentiates between assessments of underlying vulnerabilities and crisis risks in EMCs. This differentiation ensures that underlying vulnerabilities are not neglected when the global environment is benign, crisis risks are low, and corrective policies can be more effectively adopted. It has also facilitated the move to a lower frequency of assessments of underlying vulnerabilities, with the option of more frequent assessments of crisis risks; this has helped reduce resource costs.

Assessments of underlying vulnerabilities now combine country-specific judgment with cross-country analysis of vulnerability indicators based on a new database available to all Fund staff. A vulnerability index summarizing information from 20 external, public, financial, and corporate sector indicators has been developed to provide a metric for cross-country comparisons and for analyses of trends in EMCs' underlying vulnerabilities. The output from this work supports vulnerability analyses in bilateral and multilateral surveillance.

Crisis risk assessments benefit from richer information on potential crisis triggers, building on the analysis in the WEO and the GFSR, and including quantified risk assessments for key indicators of the global environment, such as growth, oil prices, and interest rates. An enlarged set of financial market indicators helps gauge markets' views on EMCs' prospects. Expanded scenario analyses examine the potential impact of tail risks in the global outlook on individual countries.

However, the VE methodology needs to evolve further to keep pace with the changes in the global economy and financial markets that are shaping vulnerabilities and crisis risks in EMCs. Strengthening the analysis of private sector vulnerabilities, and of financial transmission channels, remains a key challenge. Finally, with growing private capital inflows to low-income countries, the country coverage of the VE needs to be kept under review.

I. INTRODUCTION

1. **The vulnerability exercise (VE) was established in 2001 as part of a broader initiative to strengthen surveillance and crisis prevention following the capital account crises of the late 1990s.**² The objective was to buttress the staff's capacity to assess vulnerabilities and crisis risks in emerging market countries (EMCs) with access to international capital markets. A framework combining expertise from area and functional departments was set up to identify countries with high risks and a need for closer monitoring. This cross-country exercise was intended to complement, and feed into, the Fund's bilateral and multilateral surveillance. The Board discussed the framework in October 2001.³

2. **In spring 2005, staff undertook a comprehensive review of the VE aimed at improving the analysis and reducing resource costs.** The ensuing changes in the methodology and the operational framework of the VE are described in this paper. The new approach features a clearer distinction between underlying vulnerabilities and crisis risks (chapter II); and a systematic analysis of economic and financial vulnerability indicators, which complements judgment-based assessments of underlying vulnerabilities (chapter III). Crisis risk assessments benefit from an enhanced information set covering the global environment, market views and indicators, and scenarios examining the potential impact of tail events (chapter IV). Chapter V describes the VE's output, which now includes cross-country analyses of trends in key vulnerability indicators that feed into bilateral and multilateral surveillance. Chapter VI discusses the benefits and costs of the new approach, and highlights priorities for further enhancements to the VE methodology.

II. CONCEPTUAL AND OPERATIONAL FRAMEWORK

3. **The VE's conceptual framework draws a clear distinction between underlying vulnerabilities and crisis risks.**⁴ This distinction is supported by stylized facts, as well as analytical and empirical models, of capital account crises in EMCs, which remain the focus of the VE (Box 1).

² The key elements of this initiative—steps to improve data provision, exchange rate analysis, standards and codes, the balance sheet approach, transparency, and surveillance of financial sectors and international capital markets—have been described in several papers (see *Enhancing the Effectiveness of Surveillance—Operational Responses, the Agenda Ahead, and Next Steps*, (SM/03/96, 3/14/2003) for references).

³ See *Approaches to Vulnerability Assessment for Emerging Market Economies*, (SM/01/301, 10/3/2001).

⁴ The importance of this distinction is also acknowledged in the *Report of the Task Force on the Integration of Finance and Financial Sector Analysis into Article IV Surveillance* (SM/07/57, 2/9/2007), which recommends that this distinction should underpin bilateral surveillance more generally.

Box 1. Focus and Country Coverage of the VE

Focus and country coverage of the VE continue to be defined by the special features of capital account crises and EMCs' exposure to these crises.¹

Capital account crises have been marked by large swings in cross-border capital flows, which put strong pressures on reserves and/or exchange rates. These pressures prompted currency crises that were frequently combined with sovereign debt crises, financial and corporate sector crises, or both. Capital account have tended to erupt fairly quickly and were generally associated with large output losses. Management of these crises has proved especially challenging.²

Although currency crises have hit industrial, emerging market, and low-income countries alike, *capital account crises* with their widespread economic and financial dislocations and large output losses have been concentrated in EMCs.³ Two features of EMCs may account for this. First, EMCs have been a major destination of *private* capital flows,⁴ whereas low-income countries have tended to rely primarily on official external financing, although this appears to be changing with the growing interest of private investors in low-income countries' local markets. Second, EMCs typically lack the full range of financial instruments that allows private and public sector agents in advanced economies to hedge against movements in exchange rates and other asset prices. As a result, balance sheet vulnerabilities—the hallmark of past capital account crises—have tended to be more prevalent in EMCs.⁵

¹ The criteria that were used to identify the country universe of the VE are summarized in Annex I.

² See Ghosh et. al., *IMF Supported Programs in Capital Account Crises*, IMF Occasional Paper 210 (2002) for a discussion of the dynamics of macroeconomic adjustment in selected capital account crises.

³ Becker et al. (2007) conclude that currency crises in EMCs have been both more frequent and associated with larger output costs than currency crises in advanced or developing economies. Gupta, Mishra, and Sahay (2003) conclude that output losses following currency crises have tended to be more severe in EMCs with large private capital inflows than in low income countries or in industrial countries. Berg, Ostry, and Zettelmeyer (2007) use duration analysis to predict stops to growth, which are often associated with capital account crises.

⁴ The factors driving capital inflows to EMCs—relatively high marginal products of capital and high real interest rates—as well as the resulting policy dilemmas and vulnerabilities to sudden reversals are discussed in Lipschitz, Lane, and Mourmouras (2002).

⁵ These balance sheet vulnerabilities prompted work on the balance sheet approach; see Allen et al. (2002), and Rosenberg et al. (2005).

4. **Stylized facts of EMC crises suggest that underlying vulnerabilities are a necessary, but not a sufficient, condition for a crisis.** The presence of such vulnerabilities in countries that experienced capital account crises is well documented (Table 1, top panel).⁵ They include macroeconomic *flow imbalances*, which exposed these countries to shifts in external financing flows; and *stock imbalances* (maturity, currency, and interest rate mismatches, as well as high leverage and inadequate levels of liquid assets), which exposed public and private sector balance sheets to sharp declines in asset prices and liquidity risk. In many cases, exchange rate pegs added to these vulnerabilities; nonetheless, capital account crises have not been limited to EMCs with currency pegs.⁶

5. **The proximate triggers of capital account crises were typically external shocks and/or domestic political events** (Table 1, bottom panel). External shocks, such as declines in terms of trade, sudden interest rate increases, or rising risk aversion in global financial markets, triggered declines in exchange rates and other asset prices that weakened balance sheets. Domestic political shocks increased uncertainty about policy directions. The repercussions of these shocks prompted a vicious cycle of capital outflows, declining asset prices, and weakening balance sheets. Contagion through financial and/or economic links helped propagate the shocks across countries.

6. **The interactions between underlying vulnerabilities and shocks are captured in analytical models of EMC crises that allow for multiple equilibria.** These models suggest that in countries with high underlying vulnerabilities—in particular countries with pervasive balance sheet weaknesses—even moderate shocks can prompt a self-fulfilling crisis, that is, an abrupt shift from a good to a bad equilibrium.⁷

⁵ See Roubini and Setser (2004) for a detailed analysis of 14 capital account crises; and Ghosh et al. (2002) for a review of 8 crises.

⁶ In addition to facilitating one-way bets, exchange rate pegs contributed to balance sheet vulnerabilities by encouraging residents to assume currency risk.

⁷ Mechanisms that can generate multiple equilibria include investor expectations that are influenced by the behavior of other investors, and adverse feedback loops between asset price movements and economic fundamentals, such as balance sheet exposures that worsen debt dynamics when exchange rates and interest rates come under pressure, thus validating deteriorating investor confidence. See Masson (1999) for a non-technical discussion of crisis models with multiple equilibria. Jeanne (1997) shows that in models with multiple equilibria, jumps from a good to a bad equilibrium are typically only possible for a certain range of values for the relevant economic fundamentals.

Table 1. Underlying Vulnerabilities and Exogenous Shocks in Selected Capital Account Crises

	Mexico 1994	Thailand 1997	Indonesia 1997	Korea 1997	Russia 1998	Brazil 1999	Ecuador 1999	Turkey 2000	Argentina 2001	Uruguay 2002	Brazil 2002
Underlying vulnerabilities											
Macroeconomic flow imbalances											
External	X			X		X	X		X	X	X
Fiscal	X	X			X	X	X		X	X	X
Stock imbalances											
Low reserves (liquidity risk)	X	X	X	X	X	X	X	X	X	X	X
Public sector	X				X	X	X	X	X	X	X
Financial sector	X	X	X	X	X	X	X	X	X	X	X
Corporate sector	X	X	X	X	X	X	X	X	X	X	X
Exchange rate regime	Soft peg	Soft peg	Soft peg	Soft peg	Peg	Peg	Managed float	Quasi currency board	Currency board	Peg	Managed float
Exogenous shocks											
Global environment	Rise in US interest rates	Terms of trade shocks	Contagion	Terms of trade shock; contagion	Drop in oil prices	Contagion	Contagion, El Niño effect, and a drop in oil prices	Sharp rise in oil prices, and tightening global liquidity	Brazilian devaluation; global liquidity tightening; worsening term of trade	Spillover from Argentina	Global rise in risk aversion
Domestic shocks	Chiapas revolt, two political assassinations	Finance minister resigned	Poor health of President Suharto; uneven early policy response to currency attack	Finance minister resigned	President dismissed prime minister; replacement confirmation held up	Fiscal deficit reduction voted down in December 1998; suspension of state debt payments to the national government in January 1999		Public disagreement between president and prime minister on strategies to deal with the financial sector	Political crisis prior to default and devaluation (resignation of three presidents, social unrest)		Presidential elections

Source: Roubini and Setser (2004), and IMF country data.

7. **However, the discontinuities inherent in these interactions are difficult to model empirically.** Not surprisingly, empirical early warning system (EWS) models have had mixed success trying to predict EMC crises.⁸ Nonetheless, these models do confirm the importance of underlying vulnerabilities in these crises. This suggests that although EWS models are generally not very reliable in predicting crises, they can help identify countries that are crisis-prone, that is, likely to experience a crisis if and when hit by shocks (Box 2).

8. **The new operational framework of the VE mirrors the conceptual distinction between underlying vulnerabilities and crisis risks.** Vulnerabilities and crisis risks, that is, the probability of a crisis over a defined time horizon, are assessed separately, although the former is a key input to the latter.

9. **The operational separation of vulnerability and crisis risk assessments has four advantages.**

- First, it promotes clarity about what is being assessed: countries with severe vulnerabilities may face low crisis risks in favorable global environment; countries with low vulnerabilities will likely face low crisis risks, even in an adverse environment.
- Second, it helps focus attention on underlying vulnerabilities in a benign environment when adverse shocks are rare, crisis risks low, and policies to reduce vulnerabilities are easier to implement than during bad times.
- Third, it allows a more efficient use of resources: underlying vulnerabilities, which tend to evolve fairly gradually, are now examined semi-annually before the IMF's Spring and Annual meetings, while crisis risks can be assessed more frequently as warranted by changes in the global economic and financial market environment.⁹
- Fourth, it permits the use of different methods for vulnerability and crisis risk assessment. While quantitative methods can be used effectively in vulnerability assessments, crisis risk assessments ultimately need to rely on judgment.

⁸ Some statistical methods, such as binary classification trees, allow for discontinuities and non-linear interactions between the factors affecting crisis probabilities but, like traditional logit or probit EWS models, they typically fail to capture the variety of shocks that can trigger a crisis. See Ghosh and Ghosh (2002), Manasse and Roubini (2005), and Chamon, Manasse, and Prati (2007).

⁹ The original framework of the VE envisaged comprehensive quarterly assessments and short monthly updates. The number of interim updates was subsequently reduced from eight to four, but the quarterly frequency of the more comprehensive exercises was maintained until 2005.

Box 2. Early Warning System Models

The objective of Early Warning System (EWS) models is to predict crises. Most models focus on currency crises, some on banking crises, and a few on sovereign debt crises, or on capital account crises, which typically involve a combination of the former.¹ EWS models differ in terms of the definition of crisis episodes and the types of countries covered; the variables used to predict crises and data frequency; and the methodology.

Definition of crisis episodes and country coverage: Crisis definitions depend on the focus of the study and typically rely on one or several indicators to identify crises, including indicators of exchange market pressure, which combine information on changes in the exchange rate, reserves, and interest rates; sovereign debt ratings; and sudden shifts in private capital flows. Some models of currency and banking crises cover industrial and emerging market countries, but most EWS models focus on emerging markets.

Variables and data frequency: Quantitative indicators of economic activity (such as GDP growth), external vulnerability (notably reserve ratios, the current account balance, exchange rate overvaluation), public sector vulnerability (fiscal balance, public debt), and financial sector vulnerability (such as credit growth) generally dominate. Qualitative indicators of institutional and structural weakness; indicators of the external environment (foreign interest rates or growth, dummies for contagion) or indicators of domestic political conditions are included in some studies, but are quite rare.² Monthly or quarterly data frequency is fairly common and motivated by the objective to predict the timing of crises; models with richer variable sets typically use annual data.

Methodology: Logit/probit models and nonparametric indicator-based signaling approaches dominate in the academic literature and investment bank models. Other methods, such as discriminant analysis, binary classification trees, and Markov switching, have been used but are less common.³

The predictive power of EWS models has been extensively tested.⁴ These tests suggest two key conclusions. Out-of-sample, the record of these models in predicting the *timing* of crises is mixed. However, EWS models do succeed in identifying key economic indicators that are linked to crises. While these linkages are not sufficiently precise to anticipate the timing of crises, they provide a systematic analysis of data on indicators that help identify vulnerability, and as such complement judgment-based approaches.

¹ Kaminsky, Lizondo, and Reinhart (1998), Berg et al. (1999), Hawkins and Klau (2000), and Abiad (2003) provide extensive surveys of EWS models of currency crises; Demirguc-Kunt and Detragiache (1998) develop an EWS model of banking crises (1998); Manasse, Roubini, and Schimmelpfennig (2003) examine sovereign debt crises; and Chamon, Manasse, and Prati (2007) analyze capital account crises. Annex II reviews selected EWS models maintained by investment banks.

² Ghosh and Ghosh (2002) include indicators of corporate governance; Bussiere and Mulder (1999) cover measures of political instability; Kamin, Schindler, and Samuel (2001) include indicators of external shocks.

³ See Kaminsky, Lizondo, and Reinhart (1998) for a brief discussion of the main approaches, and Abiad (2003) for a comprehensive survey.

⁴ See, for instance, Berg and Patillo (1999); and Berg, Borensztein, and Patillo (2005).

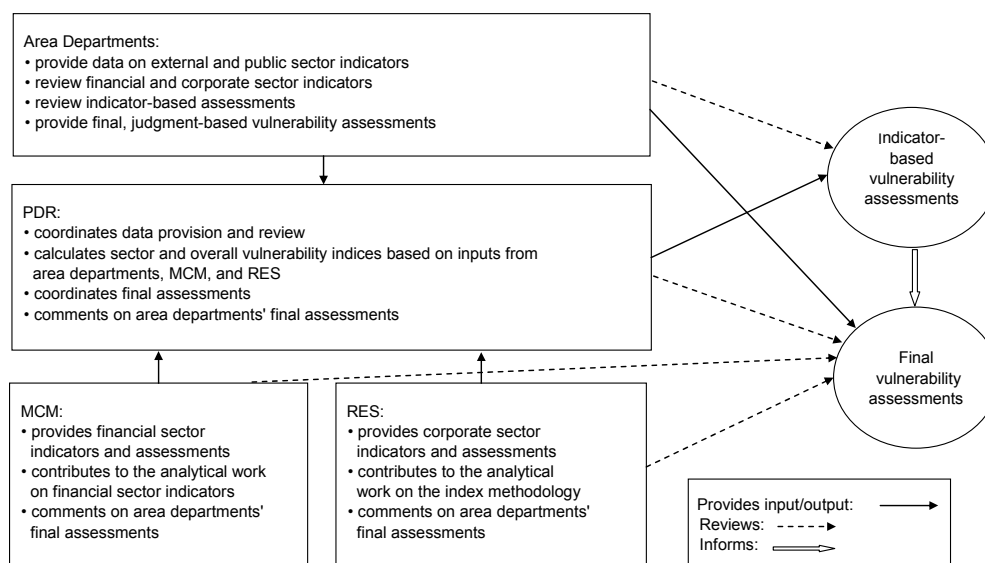
III. ASSESSING UNDERLYING VULNERABILITIES

Indicators and judgment

10. **The assessment of underlying vulnerabilities in the new VE framework combines indicator analysis and judgment.** Analysis of a standard set of quantitative vulnerability indicators provides an objective starting point for the assessment and facilitates cross-country comparisons. Judgment adds the richness of country-specific expertise. The two pillars complement each other. Indicator analysis without judgment risks ignoring important country-specific factors that cannot be captured by a standard set of indicators. Judgment without the cross-checks provided by an objective metric that can be compared across countries may become biased.¹⁰

11. **The operational framework of vulnerability assessments involves two steps** (Figure 1). In the first step, economic and financial indicators for each of the 48 countries covered by the VE are analyzed and combined in a vulnerability index based on a uniform methodology. In the second step, the results from this analysis are vetted by area departments and discussed in an interdepartmental meeting. This scrutiny of the indicator-based results provides an opportunity to bring to bear factors that may be relevant to the assessment of a country's vulnerability but are not captured by the vulnerability index. The examination may conclude that the index over- or understates vulnerabilities and suggest changes to the assessment.

Figure 1. Assessing Underlying Vulnerabilities: Operational Framework



¹⁰ Goldstein, Kaminsky, and Reinhart (2000), Hawkins and Klau (2000), and Berg, Borensztein, and Pattillo (2005) draw similar conclusions. The merits of bringing to bear different types of expertise in the analysis of vulnerabilities are discussed in *Approaches to Vulnerability Assessment for Emerging Market Economies*, (SM/01/301,10/3/2001).

Methodology of the vulnerability index

12. **The VE's vulnerability index is a summary measure of underlying vulnerability that combines information from a range of economic and financial indicators.** The index is derived from twenty indicators—a fairly large set compared to traditional EWS models. The set includes external sector indicators, which appear to have played a role in all countries that experienced capital account crises. It also includes indicators for the public, financial, and corporate sectors, which contributed in varying degrees to the vulnerabilities in these countries. This relatively broad portfolio of indicators has three advantages: it provides an umbrella for monitoring a range of indicators that contain useful information individually; it limits the impact of potential measurement errors in individual indicators on the overall index;¹¹ and it limits the potential for large jumps in the index value inherent in the index methodology, which maps indicator values into zero-one scores (see below).

13. **Construction of the vulnerability index is based on statistical analysis.** Indicators were initially culled from a large set of variables used in empirical EWS models and Fund surveillance.¹² For each of these indicators, the power to discriminate between crisis and non-crisis cases in a panel data set was examined by searching for a split in the dataset that minimizes the combined percentages of missed crises and false alarms (Box 3). Although this simple univariate method ignores interactions among indicators, it utilizes the full set of observations for each indicator, which varies considerably across indicators. Multivariate methods would have implied working with a significantly smaller dataset.¹³

14. **The statistical analysis generated indicator thresholds and weights—the building blocks of the index.** Thresholds that yielded the best split between crisis and non-crisis observations were used to map indicator values into zero-one scores. Differences in discriminatory power (minimum sums of errors) provided guidance on weights, which were used to aggregate indicator scores into sector vulnerability indices. Sector indices were then

¹¹ Such measurement errors can occur when the data underlying the indicator are not derived from a fully representative sample (as, for instance, in the corporate sector), or when there is no universally accepted method for constructing an indicator (as in the case of the indicator of exchange rate misalignment).

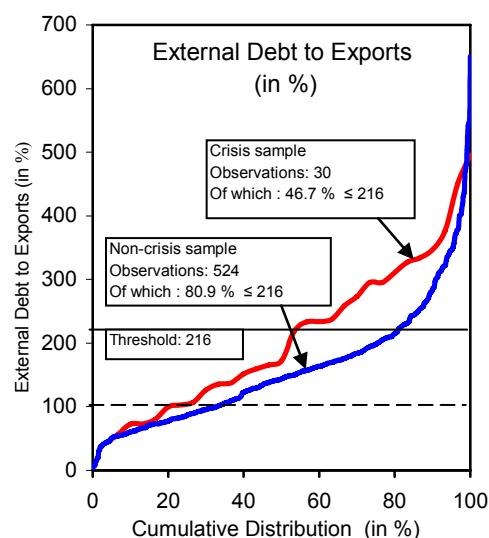
¹² Kaminsky, Lizondo, and Reinhart (1998); Hawkins and Klau (2000); and Abiad (2003) provide comprehensive surveys of the variables used in EWS models. After the Asian crisis, several studies examined the importance of corporate sector and structural variables for crisis prediction (see Mulder, Perrelli, and Rocha (2001), and Ghosh and Ghosh (2002)). Annex II discusses the variables included in selected private sector models.

¹³ Availability of historical data is a particular problem in the financial sector. After the Asian crisis, the IMF made considerable efforts to promote the compilation and use of financial soundness indicators (FSIs). These efforts improved data availability; however, for many countries, FSIs are not available prior to 2000. See *Financial Soundness Indicators* (SM/03/175, 5/14/2003).

Box 3. Statistical Underpinnings of the Vulnerability Index Methodology

The vulnerability index methodology exploits observed differences between the values of economic and financial indicators in years preceding a capital account crisis and the values in years preceding non-crisis periods. The cumulative frequency distributions of these crisis and non-crisis subsamples—which show the percentage of observations in the subsample that are less than, or equal to, a given indicator value—are a convenient way of summarizing the information content of an indicator. The greater the distance between the distributions, the easier it is to pick a threshold that helps discriminate between country conditions that led to a crisis and those that did not.

Example: Economic priors suggest that countries with high ratios of external debt-to-exports are more vulnerable to crises than countries with low ratios. The cumulative distributions of the crisis and non-crisis samples for this indicator confirm this. They show that the ratio of external debt-to-exports exceeds 216 percent—the threshold at which the two distributions are furthest apart—in only 19.1 percent of the non-crisis cases, but in more than half of the crisis cases. This threshold thus discriminates better than others between crisis and non-crisis cases. The discrimination is not perfect: 19 percent of the non-crisis cases and 47 percent of the crisis cases—in total 66 percent—are misclassified. Nevertheless, this threshold discriminates better than any other indicator value: using a threshold of 100 percent would give false alarms in more than 60 percent of the non-crisis cases and miss nearly 25 percent of the crisis cases—a significantly larger sum of errors.



combined into an index of overall vulnerability, using judgment-based sector weights.¹⁴ Table 2 lists the indicators used in the computation of the vulnerability index, the indicator weights in each sector, and the sector weights. Annex III describes the index methodology in greater detail, including the criteria that were used to identify crisis cases, indicator definitions, and the results from the statistical analysis.

¹⁴ Hawkins and Klau (2000) and several of the private sector models surveyed in Annex II follow a similar approach but they use judgment to derive (multiple) indicator thresholds and weights.

Table 2. Vulnerability Indicators and Weights by Sector 1/

Indicator	Weight
External Sector	0.45
Reserves in % of ST debt at remaining maturity plus CA deficit	0.24
Current account (% of GDP)	0.25
External debt (% of GDP)	0.05
External debt (% of exports)	0.26
REER misalignment (% deviation from equilibrium REER) 2/	0.20
Public Sector	0.25
Fiscal balance (% of GDP)	0.20
Primary gap (actual minus debt-stabilizing primary balance, in % of GDP) 3/	0.25
Public debt (% of GDP) 3/	0.15
Public debt exposed to FX risk (% of GDP)	0.20
Public debt exposed to rollover risk (% of GDP)	0.20
Financial Sector	0.15 (0.3) 4/
Capital adequacy ratio (%)	0.22
Return on assets (%)	0.21
Non-performing loans (% of total loans)	0.20
Annual change in credit-to-GDP ratio	0.12
Dummy for institutional/structural weaknesses 5/	0.25
Corporate Sector	0.15
Black-Scholes-Merton probability of default (%)	0.15
Interest coverage ratio	0.32
Real return on assets (%)	0.16
Valuation (earnings-to-price ratio, adj. for CPI inflation, %)	0.27
Leverage (debt in % of assets)	0.10

1/ See Annex III, Table 2 for detailed variable definitions and Annex III, Table 4 for indicator thresholds.

Weights are calculated as 100 - sum of misclassification errors (in %), normalized to sum to 1 in each sector, except for the indicators highlighted in footnotes 2/ and 4/.

2/ Estimates based on CGER ERER approach, where available; based on historical average otherwise.

3/ The weight of the public debt-to-GDP ratio was increased from 0.06 to 0.15, and the weight of the primary gap was reduced by a corresponding amount.

4/ Figure in parentheses indicates financial sector weight when corporate sector data are not available.

5/ MCM's assessment of institutional and structural weaknesses, including weaknesses in the regulatory system, extensive dollarization, and exposure to high government debt. This indicator was not included in the statistical analysis; the weight is based on judgment.

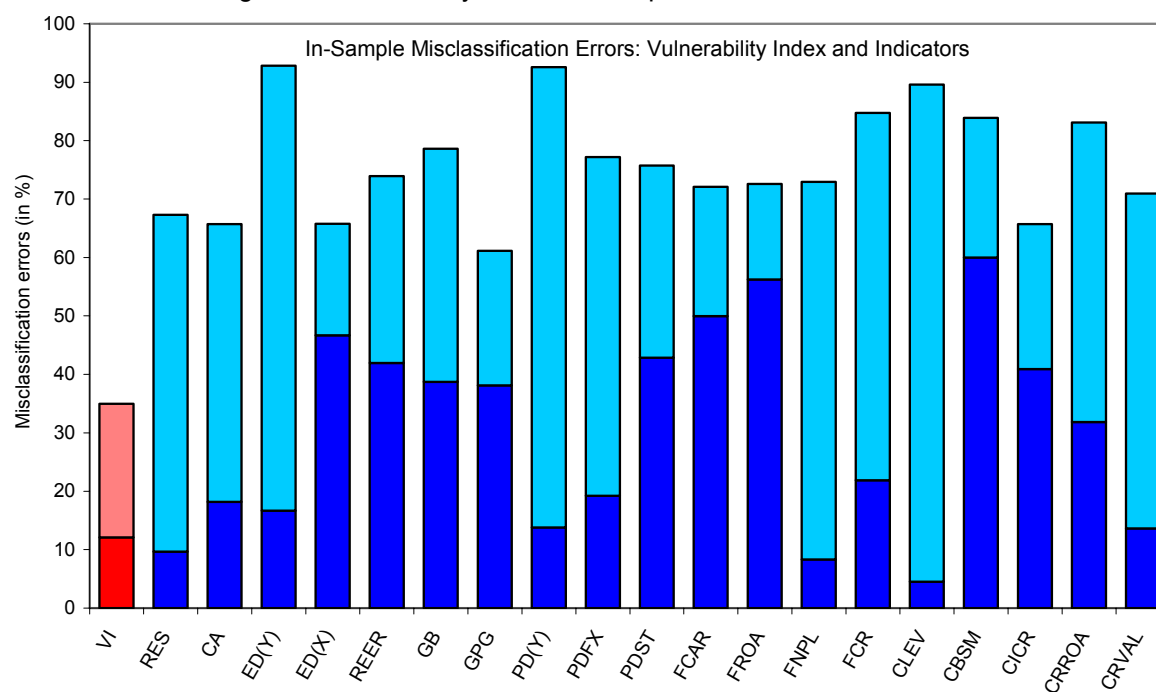
15. **The summary vulnerability index does fairly well in identifying crisis-prone countries in the data sample.** Minimizing the sum of misclassification errors for the index yields a threshold of 0.54, with 88 percent of the crisis cases and 77 percent of the non-crisis cases correctly classified.¹⁵ If false alarms in the two years preceding a crisis are excluded to account for the persistence of underlying vulnerabilities in countries that eventually get into crisis, the number of false alarms declines by one fifth. The summary vulnerability index thus fares much better than any of the individual indicators that feed into the index (Figure 2, top panel). It also compares favorably with the in-sample prediction errors of several other models (Figure 2, bottom panel). However, this comparison needs to be interpreted with caution because these models differ from the analysis underlying the VE's vulnerability index in terms of crisis definition, indicators, country coverage, time period, and even data frequency. Also, given the absence of EMC crises in the past three years, out-of-sample prediction, which is typically weaker than in-sample performance, remains to be tested.

16. **The index could be further strengthened.** In particular, data availability continues to constrain the coverage of financial and corporate sector vulnerabilities (see below).¹⁶ Data limitations also impede the analysis of household balance sheet vulnerabilities, and of balance sheet linkages across sectors, while increasing capital inflows into local EMC debt markets limit the information content of traditional measures of external debt, which typically do not include domestically issued securities purchased by non-residents. These areas, together with further improvements in the measurement of exchange rate misalignment—a key indicator of external vulnerability—are priorities for further development.

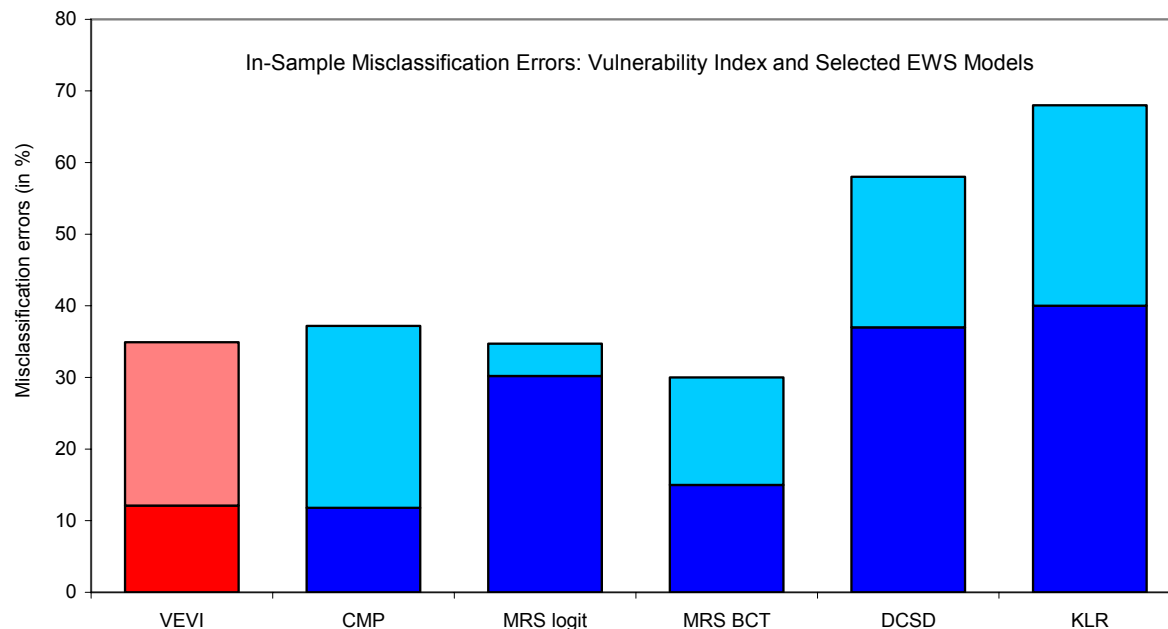
¹⁵ Only lagged indicator values were used for the in-sample testing of the vulnerability index. To overcome the constraints imposed by missing variable observations for earlier years, aggregate indices were calculated from the available indicators for each country and year, with weights rebased to add to 100 for the available indicators. Thus, while the aggregate indices typically cover 19 indicators for recent years (MCM's indicator of financial sector institutional strength is only available for 2006 and 2007), they are based on a smaller number of indicators for the 1990s.

¹⁶ Work on the compilation of financial soundness indicators (FSIs), which includes selected indicators for the corporate and household sector, is proceeding and promises significant improvements in data availability, although lack of historical time series will likely continue to constrain statistical analyses. The group of countries participating in the Coordinated Compilation Exercise (CCE) for FSIs includes more than half of the VE countries. The outcome of the CCE and proposals for future Fund work in this area are expected to be discussed by the Board in November.

Figure 2. Vulnerability Index: In-Sample Misclassification Errors



VI: aggregate vulnerability index; RES: reserve cover; CA: current account balance in % of GDP; ED(Y): gross external debt in % of GDP; ED(X): gross external debt in % of exports; REER: overvaluation of real effective exchange rate; GB: overall fiscal balance in % of GDP; GPG: primary gap in % of GDP; PD(Y): public debt in % of GDP; PDFX: public debt exposed to fx risk in % of GDP; PDST: public debt exposed to rollover risk in % of GDP; FCAR: financial sector (FS) capital adequacy ratio (%); FROA: FS return on assets (%); FNPL: FS NPLs (% of total loans); FCR: FS credit growth; CLEV: corporate sector (CS) leverage; CBSM: CS BSM default probability; CICR: CS interest coverage ratio; CRROA: CS real return on assets; CRVAL: CS valuation. See Annex III. Table 2 for detailed variable definitions.



VEVI: VE vulnerability index; CMP: Chamon, Manasse, and Prati (2007), Binary Classification Tree (BCT), capital account crises, panel data (1994-2005); MRS logit: Manasse, Roubini, and Schimmelpfennig (2003), logit model, sovereign debt crises, panel data 1990-2001; MRS BCT: Manasse, Roubini and Schimmelpfennig (2003), BCT, sovereign debt crises, panel data (1990-2001); DCSD: Developing Countries Studies Division of the IMF, Berg, Borensztein, Miles-Ferretti, and Pattillo (2000), probit model, currency crises, panel data 12/1985 to 5/1997; KLR: Kaminsky, Lizondo, and Reinhart (1998), signaling approach, currency crises, panel data 12/1985 to 5/1997; results for DCSD and KLR are based on Berg, Borensztein, and Pattillo (2005).

Note: The comparison in the lower panel needs to be interpreted with caution as the studies differ in terms of crisis definition, country coverage, indicators, methodology, time period, and data frequency.

■ False alarms (in % of total non-crisis observations)
■ Missed crises (in % of total crisis observations)

Judgment-based vulnerability assessments

17. **The indicator-based analysis captures much, but not all, of the information that is relevant to the assessment of EMCs' underlying vulnerabilities.** Sector and overall vulnerability indices are, therefore, carefully scrutinized by area and functional departments to ensure that adjustments for shortcomings in the data and relevant country-specific information not reflected in the indices are incorporated in the final assessment.

18. **Judgmental adjustments to the indicator-based assessments are frequently prompted by weaknesses in the data underlying these assessments.** Data weaknesses are a particular problem in the financial sector, where coverage and definitions of key indicators, such as non-performing loans, varies considerably across countries;¹⁷ and in the corporate sector, where the available aggregate data cover varying, and in some cases relatively small, samples of companies.¹⁸ Gaps in the data on private sector assets and liabilities constrain definitions of debt- and reserve-related indicators, which, as a result, may not adequately reflect countries' vulnerabilities in these areas. In a few instances, judgmental adjustments have been required because a clustering of indicator values just above or below the thresholds produced index scores that exaggerate or understate vulnerabilities.

19. **Equally important are adjustments capturing vulnerabilities not represented by any of the indicators.** These include economic vulnerabilities, such as those arising from extensive dollarization, capital inflows into domestic markets, and balance sheet vulnerabilities in the household sector; as well as political vulnerabilities, such as weaknesses in a country's institutional and policy framework that affect its ability to respond to shocks.

20. **While judgment is a critical element of the VE's approach, the correspondence between indicator- and final (judgment-based) vulnerability assessments has been fairly high.** On average, the two assessments agree for two thirds to three quarters of the VE countries. The correspondence is typically higher for the assessments of overall vulnerability than for the sectors, and there is no clear evidence of bias, with positive and negative deviations between indicator-based and final vulnerability assessments broadly balanced.

IV. ASSESSING CRISIS RISKS

21. **Predicting capital account crises is more difficult than identifying vulnerabilities that make countries crisis-prone.** As discussed in chapter II, the interactions between shocks and underlying vulnerabilities that catalyze foreign and domestic investor sentiment and prompt large shifts in capital flows are hard to capture in formal models. Both the

¹⁷ MCM therefore reviews and adjusts, if necessary, the financial sector vulnerability indices derived from the "raw" indicators to correct for weaknesses in the quality of financial sector data.

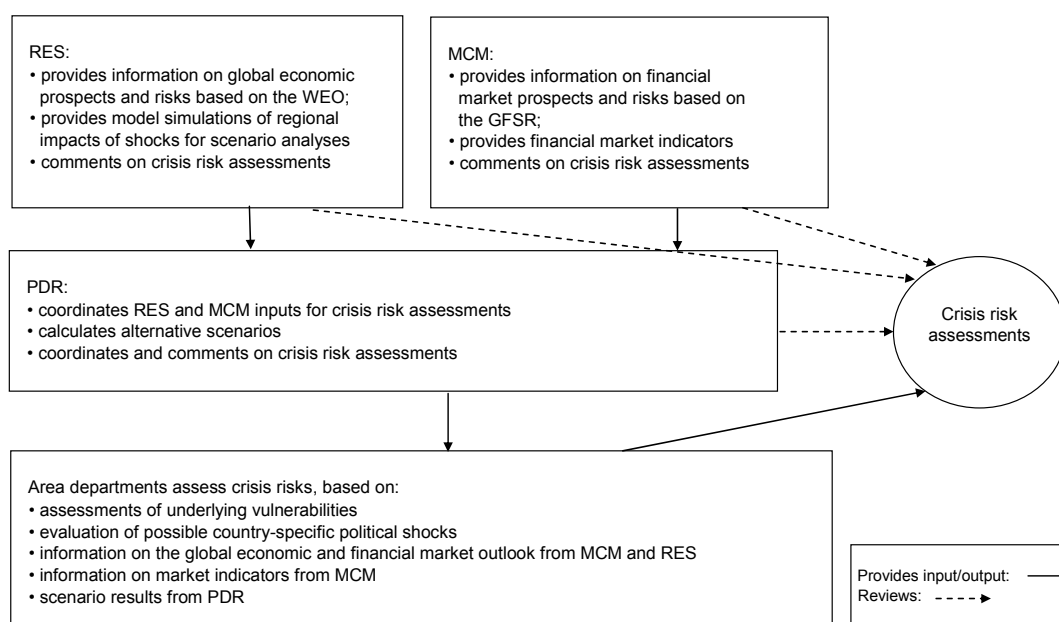
¹⁸ Corporate sector indices are produced by RES using its corporate vulnerability utility.

discontinuities that characterize these interactions and the variety of shocks that can act as crisis triggers are difficult to model. While many EWS models incorporate variables on the global economic and financial market environment, and even indicators of political risk, these variables typically cover only a small subset of potential crisis triggers.¹⁹

22. **In light of these difficulties, crisis risk assessments in the new VE framework continue to rely on informed judgment.** To ensure that risk assessments are comparable across countries, the concept of crisis risk has been clarified. Crisis risk assessments focus on the probability of a capital account crisis occurring at any time within a 12-month window. Three risk categories are distinguished: low, medium and high. However, it is understood that crisis risk assessments can only identify broad ranges of crisis probabilities and no attempt is made to produce precise numerical estimates.

23. **Crisis risk assessments combine information on countries' underlying vulnerabilities with an analysis of potential shocks that could trigger a crisis.** This analysis incorporates information from the WEO and the GFSR on the outlook for the global economic and financial market environment, market intelligence, as well as analyses of country-specific political risks. Figure 3 shows the operational and governance structure of the assessment process.

Figure 3. Assessing Crisis Risks: Operational Framework



¹⁹ Hawkins and Klau (2000) review indicators of the external environment in EWS models.

24. **The analysis of potential crisis triggers has been strengthened.** Coverage of financial market intelligence has been expanded, contagion and spillover channels are examined more systematically, risks to the global outlook are being quantified, and scenario analyses are used more systematically to stress-test key vulnerability indicators. The objective is to ensure that a common view on possible global or regional shocks and their likelihood underpins judgments about crisis risks in individual countries, thus limiting potential inconsistencies across countries. Analyses of country-specific political risks remain the domain of area departments.

Financial market conditions

25. **Information on financial market conditions is key to assessing crisis risks.**²⁰ Given the catalytic role of investor sentiment in capital account crises, indications of concurrent or possible future changes in sentiment—whether broad-based or vis-à-vis individual countries—need to be examined. This analysis builds on the general assessment of financial market conditions and risks in the GFSR, and on various financial market indicators provided by MCM (Box 4).

26. **Information on general market conditions helps gauge possible shifts in sentiment vis-à-vis EMCs as an asset class.** Data on financing flows to EMCs provide a useful starting point but need to be complemented by forward-looking indicators. These include indicators of interest rate expectations in mature markets derived from prices of options and futures, and measures of market risk appetite produced by investment banks, which are typically based on volatility indicators and credit spreads. Interpreting these measures of risk appetite is not straightforward, because it is difficult to distinguish changes in markets' assessment of risk from changes in risk appetite.²¹ Nevertheless, whether driven by a reassessment of risks or changing risk appetite, changes in these indicators provide useful information on general market sentiment and a metric for interpreting country-specific indicators.

27. **Country-specific market intelligence reveals investors' risk assessments for individual countries.** Sovereign bond and CDS spreads, for instance, indicate market perceptions of sovereign default risk. Credit ratings are another useful, though often lagging, indicator of sovereign risk. In countries with open capital accounts, interest differentials can signal pressure in the currency markets, while implied yields derived from offshore forward and spot exchange rates provide important signals in countries with capital controls. Unfortunately, availability of these market indicators varies considerably across countries.

²⁰ The *Report of the Task Force on the Integration of Finance and Financial Sector Analysis into Article IV Surveillance* (SM/07/57, 02/09/2007) recommends greater use of market indicators in bilateral surveillance.

²¹ See Kumar and Persaud (2002).

Box 4. Financial Market Indicators Monitored in the VE

General market indicators

Mature market interest rates, such as the Federal Funds rate and Treasury yields, provide benchmarks for EMC bonds and loans, and influence EMC bond spreads.¹

Measures of volatility, such as the Chicago Board Options Exchange Volatility Index (VIX), which measures implied volatility based on S&P 500 options prices, provide information on key determinants of investor risk appetite.²

Data on financing flows to EMCs, such as gross and net issuance of EMC bonds, loans, and equity in international markets; flows into EMC bond and equity funds; and changes in BIS-reporting banks' exposure to EMCs are a good starting point for assessing EMCs' financing conditions, even though they are backward-looking.

Country-specific indicators

Sovereign bond spreads and **credit default swap (CDS) spreads** convey broadly similar, but not identical, signals about sovereign default risk. While CDS spreads tend to lead bond spreads in econometric tests,³ and provide a purer measure of risk since no riskless benchmark is required, data on spreads are available for a larger set of EMCs (74 percent of the VE universe) than CDS spreads (57 percent). Moreover, market liquidity, which provides an indication of the reliability of the risk measure, is recorded for bond markets but not for CDS markets. Both indicators are monitored in the VE, together with **credit ratings**.

The **differential between domestic and global interest rates** has become a useful indicator of exchange rate pressure in a growing number of EMCs as capital account openness and investor appetite for local currency sovereign instruments has increased. This indicator exploits the "forward premium puzzle," that is, the empirical regularity that high interest rate currencies (currencies at a forward discount) tend to appreciate relative to low interest rate currencies.⁴

Implied yields calculated from differentials between offshore forward and spot exchange rates using covered interest parity provide information on interest rate pressures in markets where capital controls cloud the signal from domestic interest rates.

Option prices provide measures of uncertainty and the balance of risks about a range of financial asset prices including interest rates and the exchange rate. However, coverage is limited to a few large EMCs.

¹ Kashiwase and Kodres (2005) analyze the impact of the three-month Federal Funds futures rate, and of volatility in that rate, on EMC bond spreads.

² See Illing and Aaron (2005) for a survey of risk appetite indices produced by investment banks, the Bank of England, and the BIS.

³ Chan-Lau and Kim (2004). ⁴ See Burnside, Eichenbaum, and Rebelo (2007).

Contagion

28. **Channels of contagion and spillovers, which propagate shocks across countries, are also analyzed.** Direct spillovers through trade channels are increasingly being examined in the context of scenario analyses (see below). Cross-country asset price correlations and information about countries' exposure to different types of capital flows, common lenders and/or leveraged flows help assess risks of financial contagion (Box 5).

Global economic prospects and risks

29. **The WEO provides assessments of the outlook for the global economic environment.** The central forecast of the WEO and the distribution of risks associated with this forecast define the baseline outlook. In the past, the risks in the baseline were generally described in qualitative terms, leaving considerable room for interpretation as to their magnitude. In order to reduce this ambiguity, fan charts are now used to quantify the distribution of possible outcomes for key variables: oil prices, interest rates, and global growth.²²

Scenario analyses

30. **Adverse scenarios provide a framework for stress-testing key vulnerability indicators to identify potential pressure points.** These scenarios focus on tail risks such as adverse shocks to global growth, oil and non-oil commodity prices, mature market interest rates, and investor risk appetite. They have been part of the VE from the start and have focused on the financing shortfalls in the balance of payments resulting from these shocks.

31. **The analytical framework for these scenarios has been strengthened.** Key scenario parameters are quantified at the regional level based on model simulations conducted by RES. The framework for assessing the impact of the shocks has been expanded to examine the effects of possible responses to the emerging financing shortfalls. Specifically, the scenarios examine how a draw-down of reserves to cover the financing shortfalls would affect reserve covers; how exchange rate depreciation would affect private sector balance sheets and public debt exposed to currency risk; and how a rise in domestic interest rates would affect the fiscal balance and public debt. These stress tests indicate whether a country has scope to respond to adverse shocks without setting off a vicious cycle of deteriorating vulnerability indicators, weakening investor sentiment, and capital outflows. Possible avenues for further refinement of such stress tests include the Contingent Claims Approach (CCA), which uses market price data to derive and stress-test key risk indicators.²³

²² RES produces fan charts on the balance of risks to the global growth outlook, and on the outlook for oil prices for each VE round. Fan charts for oil prices are derived from option prices.

²³ Building on Merton's key insight in option pricing theory that *liabilities are contingent claims on total assets*, the CCA derives an estimate of the value of total assets from the liabilities side of a balance sheet. The distribution of implied asset values can then be used to develop a range of risk indicators, such as: distance to distress, probability of default, credit spreads, and the market value of foreign currency denominated debt.

However, CCA analyses are resource-intensive and constrained by limited data availability; relatively few have been done so far for EMCs.

Box 5. Contagion

Contagion—the transmission of a crisis from one country to others—has been an important crisis trigger in past capital account crisis episodes. The literature distinguishes between two types of contagions: fundamentals-based contagion,¹ and pure contagion.

Fundamentals-based contagion works through economic spillovers. The main transmission channels are trade linkages, foreign direct investment, and exchange rate devaluations, as well as common external shocks, such as falling commodity prices and rising global interest rates. Fundamentals-based contagion thus affects countries that have either close economic ties or similar features that expose them to the same types of shocks.

Pure contagion spreads through financial markets channels and can affect countries that have neither close economic links nor similar features. Since investors' country investment decisions are tied together by considerations of managing overall risk and returns in a portfolio, an event affecting investment in one country may have repercussions on investment decisions in other countries, particularly if costly information prevents perfect discrimination among countries. Portfolio management techniques may directly link investment decisions for different countries, and low liquidity may necessitate sales of the most liquid assets, including emerging market assets.²

Efforts to identify *pure contagion* in empirical studies have met with mixed success. However, this may reflect the relatively narrow focus on co-movements in asset prices that are (i) clearly different in crisis and tranquil periods, and (ii) entirely unrelated to economic fundamentals.³ From a practical perspective, the abundant evidence—both circumstantial and statistical—on co-movements of asset prices in currency, equity, and bond markets matters more because it highlights important financial linkages among EMCs, and between EMCs and mature markets. Direct linkages through bank flows are another important transmission channel for financial shocks.

¹ See Dornbusch, Park, and Claessens (2000), and Claessens and Forbes (2004).

² Calvo and Mendoza (2000) highlight the role of costly information in financial market contagion; Chakravorti and Lall (2004) focus on portfolio management techniques.

³ See Forbes and Rigobon (2002).

Associated with these risk indicators are *sensitivity measures* that report how responsive the credit risk indicators are to changes in value and volatility of assets. See Gray, Merton, and Bodie (2006) for a detailed exposition of the CCA.

V. THE VE AS A TOOL OF FUND SURVEILLANCE

32. **The VE feeds into Fund surveillance through two channels.** The VE's principal output—a semi-annual report—provides information on EMCs' underlying vulnerabilities and near-term crisis risks to management and senior staff. The VE's assessment process provides a forum for a regular interdepartmental dialogue on these issues.

33. **The new framework has expanded the VE's output, strengthening its role as a tool of Fund surveillance.** Greater reliance on quantitative vulnerability indicators has produced a wealth of cross-country information and has facilitated systematic cross-country analyses of these indicators. While the VE's semi-annual report on underlying vulnerabilities and crisis risks is subject to restricted circulation as it discusses risk assessments for individual countries, most of the VE's quantitative output covers either cross-country averages or information based on published data, which can be circulated more widely.²⁴

34. **Some of the VE's new output could be made available to the Board.** Analyses of global and regional trends in vulnerability indicators and indices, cross-country comparisons of vulnerability indicators, and a databank covering annual observations from 1993 to 2006 for some 40 variables and 48 emerging market countries²⁵ are now available to area and functional department staff. This information supports vulnerability assessments in bilateral surveillance, and feeds into the Economic Counselor's WEMD presentations. Annex IV contains a sample of VE outputs that could be circulated to the Board.

VI. BENEFITS, COSTS, AND PRIORITIES FOR FURTHER IMPROVEMENTS

Benefits of the new framework

35. **The conceptual distinction between underlying vulnerabilities and crisis risks has strengthened the analysis.** It has promoted greater clarity about what is being assessed, and paved the way for the operational separation of vulnerability and crisis risk assessments with different assessment methodologies tailored to each task.

36. **Combining indicator analysis and judgment has made the assessment of underlying vulnerabilities more structured and transparent, while making full use of country-specific expertise.** Analysis of vulnerability indicators and indices has helped focus the inter-departmental discussion, has facilitated systematic cross-country comparisons of trends in underlying vulnerabilities, and has produced a comprehensive database on indicators of underlying vulnerabilities. Nonetheless, even though indicator- and judgment-based assessments often coincide, judgment remains an important corrective when indicators do not tell the full story.

²⁴ The bulk of the data used to construct the vulnerability indices is published in other Fund documents such as Article IV staff reports, the WEO, GFSR, and IFS.

²⁵ Data availability varies, however, considerably across variables and countries.

37. **Crisis risk assessments benefit from the improved analysis of underlying vulnerabilities, and from a more systematic analysis of potential crisis triggers.** Better calibration of the risks to the global economic and financial market outlook, expanded coverage of financial market intelligence, and scenario-based stress tests have facilitated this analysis and have improved cross-country comparability of crisis risk assessments.

38. **Greater use of quantitative vulnerability indicators has expanded the VE's output, and its input to Fund surveillance.** Results and data from the analysis of vulnerability indicators are disseminated more widely to support vulnerability assessments in bilateral and multilateral surveillance. A summary of these results and data—illustrated in Annex IV—could be shared with the Board.

Costs

39. **While the increased data intensity has added to resource costs, this has been more than offset by savings elsewhere.** Significant savings have been achieved by lowering the standard frequency of vulnerability assessments from quarterly to semi-annual, and by moving from frequent routine updates of crisis risks to a flexible schedule driven by market conditions and other potential risk factors. In addition, data submission procedures have been rationalized, and written input requirements have been cut substantially. On balance, these changes are estimated to have reduced the resource costs of the VE by close to 20 percent—nearly one staff year.²⁶ In addition, the database established for the VE will lower data gathering costs in bilateral and multilateral surveillance.

Priorities for further improvements

40. **With changes in the global economy and financial markets reshaping EMCs' vulnerabilities and the features of possible future crises, the VE needs to adapt continuously to provide value to Fund surveillance.**

- Assessments of vulnerabilities in the financial, corporate, and household sectors need to be developed further to capture potential exposures to shocks. Vulnerabilities associated with extensive dollarization, inter-sector financial linkages, and asset price booms remain to be adequately covered.
- Assessments of exchange rate misalignment, a key leading indicator in past currency crises, need to be placed on a stronger analytical footing for countries without CGER assessments.²⁷

²⁶ This estimate does not include the resource cost of the methodological work and of the transition to the new framework.

²⁷ While an extension of the CGER methodology would improve methodologically on the simple past average currently used for these countries, the performance of the vulnerability index may improve only marginally

- The analysis of financial market indicators and the identification of spillover channels from mature to emerging financial markets will need to keep pace with rapidly changing market structures.
- Further analytical work to assess the impact of global economic and financial conditions on key vulnerability indicators would strengthen vulnerability assessments, improve scenario analyses, and help identify the policy challenges posed by a less benign global environment.

41. **Finally, the country coverage of the VE will need to be kept under review.** With increasing private capital flows to low income countries, some of these countries may become exposed to similar risks as emerging market countries.

because CGER misalignments capture the exchange rate adjustment needed to restore equilibrium *over the medium term* and may thus have little predictive power *in the short term*.

ANNEX I. COUNTRY UNIVERSE OF THE VE

42. The VE covers EMCs with significant links to international financial markets.²⁸ The following inclusion and exclusion criteria were used to delineate this country universe:

43. Inclusion criteria:

- inclusion in the EMBI global bond index, dollar or Euro;²⁹ *or* inclusion in the MSCI emerging market equity index; *or* a recent international bond issues; *or*
- a significant degree of domestic financial sector development *and* significant links between domestic banks and international banks, as indicated by a ratio of broad money to GDP exceeding 40 percent *and* BIS reporting banks' exposure to the country exceeding 10 percent of the country's GDP (excluding offshore financial centers).

44. Exclusion criteria:

- classification as industrial country in IFS; *or*
- GDP of less than SDR 5 billion in 2004;³⁰ *or*
- large positive net international investment position.³¹

45. Table 3 lists the countries included in the VE country universe and indicates the criteria for international capital market access met by each country.

²⁸ See *Approaches to Vulnerability Assessments for Emerging Market Economies*, (SM/01/301, 10/3/2001) for a discussion of the coverage of the vulnerability exercise.

²⁹ Except countries with only Brady bonds outstanding.

³⁰ This exclusion criterion is motivated by the need to limit the resource costs of the VE. The following countries were excluded on account of this criterion: Belize, Cape Verde, Djibouti, Fiji, The Gambia, Grenada, Guyana, Honduras, Maldives, Malta, Sao Tome, St. Lucia, St. Vincent and the Grenadines, Vanuatu, Zimbabwe.

³¹ The following countries were excluded on account of this criterion: Hong Kong, Iran, Kuwait, Qatar, Saudi Arabia, Singapore, United Arab Emirates.

Table 3. Country Coverage of the Vulnerability Exercise

Country	International capital market access 1/				Significant financial links between international and domestic banks 2/
	EMBIG \$	EMBIG €	MSCI	International bond issue	
Algeria	x				
Argentina	x	x	x		
Bosnia & Herzegovina					x
Brazil	x	x	x		
Bulgaria	x	x			x
Chile	x		x		x
China,P.R.: Mainland	x	x	x		
Colombia	x	x	x		
Costa Rica				2005	x
Croatia	x	x			x
Czech Republic		x	x		x
Dominican Republic	x				
Ecuador	x				
Egypt	x		x		x
El Salvador	x				x
Estonia				2007	x
Guatemala				2004	
Hungary	x	x	x		x
India			x		x
Indonesia	x		x		x
Israel			x		x
Jamaica				2007	
Jordan			x		x
Kazakhstan				2007	
Korea		x	x		x
Latvia				2007	x
Lebanon	x				x
Lithuania		x			x
Malaysia	x	x	x		x
Mexico	x	x	x		x
Morocco	x		x		x
Pakistan	x		x		
Panama	x				
Peru	x	x	x		
Philippines	x	x	x		
Poland	x	x	x		x
Romania		x			
Russia	x	x	x		
Serbia	x				x
Slovak Republic		x			x
South Africa	x	x	x		x
Sri Lanka			x		x
Thailand	x		x		x
Tunisia	x				
Turkey	x	x	x		x
Ukraine	x	x			x
Uruguay	x				x
Venezuela, Rep. Bol.	x	x	x		

1/ Inclusion in at least one of the three indices (unless only Brady bonds are outstanding), or recent international bond issue by sovereign or private entity.

2/ BIS reporting banks' exposure to the country exceeding 10 percent of GDP and broad money exceeding 40 percent of GDP in 2006; excluding offshore centers.

ANNEX II. EWS MODELS MAINTAINED BY INVESTMENT BANKS

46. Many investment banks continue to maintain EWS models although they appear to be placing less emphasis on these models than in the past.³² Strategists attribute this trend to (i) the limited number of emerging market countries that maintain fixed exchange rates without strong reserves; (ii) the relative economic stability of emerging market countries over the last several years, which has reduced clients' interest in strategies to take advantage of a potential reversal; (iii) relative poor performance of these models in predicting developments in emerging markets currencies.

47. Surveys of EWS models maintained by investment banks are not as readily available as surveys of relevant academic studies.³³ This annex summarizes the key feature of five bank models: Bank of America's Currency Crisis Indicator (BOA-CCI),³⁴ UBS's Financial Vulnerability Indicator (UBS FVI),³⁵ Lehman Brothers' Damocles,³⁶ Deutsche Bank's Alarm Clock (DB-AC),³⁷ and Citibank's Currency Crisis Index for Risk Management (CCI).³⁸ While these models differ in focus, country coverage, and methodology, like the approach of the VE, they rely on a great deal of judgment in the analysis of the relevant indicators, and place a premium on transparency and a clear "bottom line" of the assessments. Table 4 summarizes the objectives and methods of these five models.

³² Goldman Sachs no longer maintains the GS-Watch Framework for Predicting Financial Crisis in Emerging Markets, which was developed in 1998. Credit Suisse has replaced its Currency Risk in Emerging Markets Model with a "fair-value" model designed to indicate both overvaluation and undervaluation of exchange rates.

³³ Kaminsky, Lizondo, and Reinhart (1998), Hawkins and Klau (2002), and Abiad (2003), provide comprehensive surveys of various types of EWS models but these surveys cover relatively few private sector models. The paper on *Early Warning Systems in Fund Work* (SM/01/301, 10/4/2001) also reviews a few private sector models.

³⁴ Bank of America, *The Currency Crisis Indicator*, Monograph 182, Volume 30, November 2002.

³⁵ UBS, *Emerging Markets: Financial Vulnerability, Liquidity, and Spreads*, UBS Investment Research, 6/2006.

³⁶ Lehman Brothers, *Damocles: A Wider Spread*, Global Economics, 24 May 2006.

³⁷ Deutsche Bank, *Alarm Clock – Descriptive Manual Version 4*, October 2002.

³⁸ Citibank, *Currency Crisis Index for Risk Management*, Working Paper, July 2004.

Table 4. Summary of Selected EWS Models Maintained by Investment Banks

Output and coverage	Input	Methodology	Comment
Bank of America: Currency Crisis Indicator (CCI) 1/ Indicator of risk of currency depreciation; risk categories: low, medium, high, very high; magnitudes of depreciation: 5, 10, or 20 percent, 3 months ahead. Coverage: 18 emerging market economies.	3 variables reflecting global market conditions; 8 indicators of country economic and financial strength, vulnerability to external financial shocks, and international competitiveness.	Variable observations mapped into five-tier scoring system, with scores linked to percentile buckets from panel dataset. Aggregation of scores based on weights reflecting each variable's significance in a regression on 3-month spot rate moves. Weights are scaled to define an index range from 5 to 25.	For index ranges signaling "high risk," the risk of depreciation predicted by the index has historically exceeded currency movements priced into the NDF market.
UBS: Financial Vulnerability Indicator (FVI) 2/ Indicator of sovereign default risk used to benchmark emerging market bond spreads and to identify cheap/rich valuations. Coverage: 16 emerging market	Variables determining a country's external financing needs (debt service, imports) and sources (reserves net of Fund credit, exports, net transfers).	Calculation of single indicator: proportion of new financing (PNF) = financing needs/financing sources.	UBS notes that discrepancies between bond spreads and the indicator are often explained by political risk.
Lehman Brothers: Damocles 3/ Prediction of external crisis over a one year horizon; crisis is defined as a month-on-month exchange rate movement against the US dollar of more than 3 standard deviations from sample mean. Coverage: 17 emerging market economies.	10 macroeconomic and financial variables updated monthly: current account, external debt to GDP, short-term external debt to exports, reserves to imports, reserves to short-term external debt, broad money to reserves, domestic private credit to GDP, real short-term interest rates, real exchange rate, stock market index.	Mapping of variable observations into 0/1 scores, with thresholds reflecting analysts' experience and judgment. Variable scores are aggregated into a composite index, with weights reflecting each variable's performance in predicting a crisis in the sample period (1996 to present). An aggregate index score of 75 suggests a 1-in-3 chance of a crisis, and a score of 100 a 1-in-2 chance.	Lehman notes that the model does not take into account indicators of banking sector soundness and political stability, and external conditions, which may exacerbate or alleviate a country's vulnerability.
Deutsche Bank: Alarm Clock 4/ Estimated probability of exchange rate or local interest rate event. Exchange rate events: 5, 10, 15, 20, or 25 percent depreciation in the next 30 days. Coverage: 22 emerging market economies.	For the exchange rate regressions: monthly observations on stock market indices, domestic credit growth, industrial production, the real exchange rate, and indicators of devaluation and market pressure contagion. For the interest rate regressions: domestic credit growth, M2 to reserves, claims on the private sector to GDP, reserves to imports, the real exchange rate, lagged currency crisis and interest rate crisis dummies, and regional dummies.	Simultaneous logit regressions to account for interdependence between exchange rate and interest rate events.	"Action triggers" prompt recommendations for investors to switch from long to short emerging market currency positions. Selection of action triggers (probability thresholds) is based on profit and loss analysis of investment strategies using different trigger thresholds. Lack of uniformity of emerging market interest rate products makes predictions of interest rate events less useful for portfolio strategies.
Citibank: Currency Crisis Index for Risk Management 5/ Composite index of underlying vulnerabilities in emerging markets. Coverage: n.a.	Real effective exchange rate, short-term capital inflows to GDP, current account balance in percent of GDP, short-term debt to reserves, equity indices (MSCI subcomponent annual returns), industrial production, export growth, growth of M2 to reserves.	Mapping of variable observations into 0,1,2 scores, based on 2 thresholds. Noise-to-signal ratios (share of misclassified non-crises to share of correctly classified crises) calculated from a sample of past crisis and non-crisis cases are used to select thresholds and weights the aggregation the scores. Values of the composite index within a certain range define a "vulnerability zone."	Index is used for Citibank's own risk management, not to assist with trading strategies.

1/ Bank of America (2002); 2/ USB (2006); 3/ Lehman Brothers (2006); 4/ Deutsche Bank (2002); 5/ Citibank (2004).

ANNEX III. THE VULNERABILITY INDEX METHODOLOGY

48. This annex provides details on the methodology used to construct the VE's vulnerability index. It begins with the identification of the crisis episodes in the dataset, followed by an overview of the indicator selection process, a discussion of the statistical method used to select indicator thresholds and weights, and a summary of the results of the analysis.

Identification of crisis episodes

49. The dataset underlying the statistical analysis covers 48 emerging market countries and 14 years (1993-2006). It includes 33 crisis episodes.³⁹ These episodes refer to capital account crises, that is, crises marked by sudden stops in capital flows and typically associated with currency, sovereign, banking, or corporate crises.

50. The 33 crisis episodes in the sample were identified in a two-stage process. At the first stage, several crisis indicators were used to select a set of possible crisis episodes: two measures of sudden stop in net private capital flows;⁴⁰ measures of exchange market pressures used in EWS models of currency crises; sovereign defaults; Fund programs (only years with positive net disbursements); and banking and corporate crises identified in other studies.⁴¹ At the second stage, IMF desk economists reviewed the crisis events defined by these criteria to identify a final set. This review helped resolve ambiguities about dating the inception of a crisis, discard episodes that were identified by some crisis indicators but should not be considered a capital account crisis (for instance, a spurious capital flow reversal due to the end of a privatization program), and add episodes that no crisis indicator had picked up.⁴² Table 5 summarizes the episodes identified by the different criteria, definitions and sources of the criteria used, and the final set of crisis episodes. Only the first year of the crisis (crisis *inception*) is considered in the final set.

³⁹ Data availability varies, however, across indicators. For some indicators, especially in the financial sector, data are available in a consistent format only from 2000 onward.

⁴⁰ There is no standard definition of sudden stop. In some cases, a sharp and sudden reversal in capital flows is easy to classify as a sudden stop (for example, Thailand 1997). In other instances, a steady decline takes place over a prolonged period of time resulting in a crisis (for example, Venezuela from 1998 to 2000). Footnotes 3 and 4 in Table 1 describe the numerical rules used to address this issue. Catão (2006) uses similar rules.

⁴¹ Sudden stop indicators were the main criteria used in this initial selection of potential capital account crisis years. The other indicators were used to confirm the existence of a crisis, to select potential crisis episodes that did not translate into a substantial deterioration in net private capital flows, or to fine-tune the year of inception of the crisis.

⁴² Appendix II in Chamon, Manasse, and Prati (2007) provides country-by-country details on the selected crises.

Table 5. Capital Account Crisis Episodes

Country	Capital account crises 1/2/	Sudden stop I 1/3/	Sudden stop II 1/4/	EWS 1/5/	Sovereign default 1/6/	IMF program 1/7/	Banking crisis 1/8/	Corporate crisis 1/9/
Algeria	1994	1995, 2004	1995	1993-94	1995-96	1994-97		...
Argentina	1995, 2001	2001	2001	1995, 2001	2001-04	1992-96, 2000-01	1995, 2001-02	2002
Bosnia&Herz.		...	...		...	1995, 1998-2002		...
Brazil	1998, 2002	2002	2002	1998, 2000	1983-94	1998-99, 2001-03	1994-99	2001-02
Bulgaria	1994	1996	1996	1994	1994	1991-94, 1997-00 2003		...
Chile		1998, 1999	1998, 1999	99				
China		1998	1998					
Colombia	1999, 2002	1998, 1999	1998, 1999	1993, 1995			1999-2000	2000
Costa Rica							1994-97	...
Croatia				1999		1994-95, 1997		...
Czech Rep.	1997	1997	1997	1993				...
Dominican Rep.	2003	1999, 2003	1999, 2003	1994, 1998-2000	1981-02	1998, 2003-05		...
Ecuador	1999	2000, 2004	2000, 2004	1998-2000	1982-95, 1999-00	1994, 2000-03	1995-2002	...
Egypt		1999	1999	1993				...
El Salvador		2001	2001	1995, 2002	1981-96			...
Estonia						1995		...
Guatemala		2002	2002	1995				...
Hungary	1994	1996	1996	2003				1995
India				1996-97			1991-94	1993
Indonesia	1997	1998, 1999	1998, 1999	1997-98	1998-2000, 2002	1997-00, 2003	1992-95, 1997-02	1997-98, 2000
Israel	1997, 2002	2002	2002	1993, 1998				...
Jamaica	2003	2002	2002	1994, 2003			1996-00	...
Jordan		2002	2002	1993, 1995		1994-99, 2002		...
Kazakhstan				1994		1993-96, 1998		...
Korea	1997	1997	1997	1995-97		1997-98	1997-02	1996-98
Latvia				1994-95, 2003-04		1992-94		...
Lebanon	2001	2000	2000					...
Lithuania	1999	2000	2000			1992-97		...
Malaysia	1997	1998	1998	1994, 1997-98			1997-01	1998
Mexico	1994	1995	1995	1994		1995	1994-97	1998
Morocco								...
Pakistan	1998			1993, 1995-96, 1999-2000	1998-99	1994, 1999, 2001-02		...
Panama		2000	2000		1983-96	1994, 1996, 1998		...
Peru		1997	1997	1998	1983-97	1997		...
Philippines	1997	1998	1998	1993, 1997		1997-00		1997, 2001
Poland				1993-94, 2001		1994		2001
Romania	1999	1999	1999	1999		1994, 1997, 2003		...
Russia	1998	1999, 2000	1999, 2000	1997-98	1995-00	1994-98		1998
Serbia		...	...	...	...	2000-03, 2005		...
Slovak Rep.						1993-94		...
South Africa	2001	2000	2000	1996, 1998				...
Sri Lanka		1995, 2003	1995	1993, 1995, 1997-98		1992-94, 2001- 03, 2005		...
Thailand	1997	1997	1997	1995, 1997		1997-99	1997-02	1996-97
Tunisia		1995, 2000	1995, 2000	2000			1991-95	...
Turkey	1994, 2001	2001	2001	1993-94, 2000-01		1994-95, 1999-02	1994, 2000-02	1994, 1998, 2000-02
Ukraine	1998	1995	1995	1994	1998-00	1994-98		...
Uruguay	2002	2002	2002	2002	2002	1998, 2002-04	2002	...
Venezuela	1994, 2001	1999, 2000	1999, 2000	1994, 2002	1995-97		1993-97	1994-95, 1998, 2002

1/ Years in the table indicate the periods in which a given crisis criterion was met; blank cells indicate that the criterion was not met in any year of the 1993-2005 window; "..." indicates that the relevant information was not available.

2/ The year indicates the inception of the crisis. The primary criterion for identifying crises is a sudden stop; other criteria were taken into account; the final identification reflects country desks' comments.

3/ Sudden stop I: a year in which one of the following holds (where means and standard deviations are computed based on the 1993-2004 values deflated by the U.S. CPI):

- net private capital flows are at least 1.5 standard deviations below their mean and have declined by at least 0.75 standard deviation from the previous year; or
- net private capital flows have declined by at least 1.5 standard deviations from the previous year and at least 0.75 standard deviation from two years before; or
- net private capital flows have declined by at least 0.75 standard deviation from the previous year and at least 1.5 standard deviations from two years before.

The source of net private capital flows data is the World Economic Outlook database.

4/ Sudden stop II: a sudden stop I in which also net private capital flows/GDP have declined by at least 3 percent from the previous year and 2 percent from two years before.

5/ Indicator of exchange rate pressure used in EWS models exceeds 2-standard-deviation threshold. Source: IMF Monetary and Capital Markets Department (MCM).

6/ Source: Manasse and Roubini (2005), updated with sovereign debt default indicator from Celasun, Debrun, and Ostry (2006).

7/ Only years in which total disbursements exceed total repayments (principal, charges, and interest).

8/ Source: Demirguc-Kunt and Detragiache (IMF Staff papers, 1998), updated by IMF, MCM.

9/ Source: IMF Research Department (based on Corporate Vulnerability Utility).

Selection of vulnerability indicators

51. Table 6 lists the operational definitions of the 24 indicators included in the statistical analysis. These indicators were selected from a larger set of variables used in empirical EWS models and Fund surveillance.⁴³ This set was narrowed down to include only indicators that could be constructed for all countries in the VE universe and capture the flow and stock vulnerabilities in the external, public, financial, and corporate sectors identified in studies of past capital account crises.

Selection of the statistical method

52. The statistical analysis uses information from past capital account crises to identify a framework for mapping information from individual vulnerability indicators into a summary measure of vulnerability. Several statistical methods were considered:

- *Multivariate logit or probit regressions.* These regressions allow for interactions among indicators and produce estimates of crisis probabilities that can be interpreted as vulnerability indices. However, they do not provide clear thresholds that distinguish between high and low vulnerability cases, and, most importantly, they significantly constrain the usable dataset when data availability varies considerably across variables. Moreover, as with all regression methods, the number of variables that can be meaningfully considered simultaneously in multivariate logit or probit regressions is limited.
- *The binary classification tree (BCT) methodology.* This non-parametric approach to analyzing large datasets identifies variables and associated thresholds that discriminate well between crisis and non-crisis cases. It has been applied in several studies of EMC crises.⁴⁴ However, while the BCT method is well suited for identifying complex interactions between different indicators, the results are difficult to map into an aggregate vulnerability index.⁴⁵

⁴³ Kaminsky, Lizondo, and Reinhart (1998); Berg, Borensztein, Milesi-Ferretti, and Pattillo (1999); Hawkins and Klau (2000); and Abiad (2003) provide comprehensive surveys of the variables used in EWS models. After the Asian crisis, several studies examined the importance of corporate sector and structural variables for crisis prediction (see Mulder, Perrelli, and Rocha (2001), and Ghosh and Ghosh (2002)). Annex II discusses the variables included in private sector models.

⁴⁴ See Ghosh and Ghosh (2002), Manasse and Roubini (2004), and Chamon, Manasse, and Prati (2007).

⁴⁵ The methodology minimizes a cost function that focuses on misclassifications of crisis and non-crisis cases to identify variables and thresholds that split up the full sample into “purer” crisis and non-crisis sub-samples (nodes). Each of these nodes is characterized by a set of conditions—indicators falling below (or above) the identified thresholds. See Chamon, Manasse, and Prati (2007) for a detailed discussion of the methodology.

Table 6. Indicator Definitions

Variable	Variable Definition	Source
External Sector:		
Reserve cover I	Gross international reserves (eop) in percent of short-term (ST) external debt at remaining maturity (ST debt plus maturing medium- and long-term (MLT) debt, eop).	Desk data
Reserve cover II	Gross international reserves (eop) in percent of ST external debt at remaining maturity (eop) plus current account (CA) deficit projected for the next year (if >0).	Desk data
Reserve cover III	Gross international reserves (eop) in percent of ST external debt at remaining maturity (eop) plus projected CA deficit (if >0) adjusted for net FDI inflows.	Desk data
Reserve cover IV	Gross international reserves (eop) in percent of ST external debt at remaining maturity (eop) plus projected CA deficit (if >0) adjusted for net FDI inflows, plus FX deposits (eop).	Desk data
Current account	Current account balance in percent of GDP.	Desk data
External debt to GDP	Gross external debt (end of period) in percent of GDP.	Desk data
External debt to exports	Gross external debt (end of period) in percent of exports of goods and non-factor services.	Desk data
Exchange rate overvaluation I	Percent of difference between real effective exchange rate (REER) and the historic average of the REER, based on all observations to t-1.	RES
Exchange rate overvaluation II	Percent difference between REER and CGER estimate of equilibrium REER; or historical average, where CGER estimate is not available.	RES
Public Sector:		
Fiscal balance	Overall fiscal balance in percent of GDP, covering general government (30 countries); central government (10 countries); consolidated public sector (7 countries); central government and public enterprises (1 country).	Desk data
Primary gap	Primary balance in percent of GDP minus debt-stabilizing primary balance; same coverage as fiscal balance.	Desk data
Public debt ratio	Gross public debt in percent of GDP; same coverage as fiscal balance.	Desk data
Public debt exposed to exchange rate (FX) risk	Gross public debt denominated in foreign currency or linked to the exchange rate, in percent of GDP; same coverage as fiscal balance.	Desk data
Public debt exposed to rollover risk	ST public debt at remaining maturity in percent of GDP; same coverage as fiscal balance.	
Financial Sector:		
Capital adequacy	Regulatory capital in percent of risk-weighted assets.	MCM
Return on assets	Earnings before extra-ordinary items and taxes (EBET) in percent of total assets.	MCM
Non-performaing loans	Non-performing loans (NPLs) in percent of total loans.	MCM
Credit growth	Change in private sector credit-to-GDP ratio	MCM
Foreign currency loans	Loans denominated in foreign currency in percent of total loans.	MCM
Corporate Sector:		
BSM default probability	Black-Scholes-Merton measure of default probability.	RES
Interest coverage ratio	Earnings before interest and taxes (EBIT) to interest payments due.	RES
Leverage	Debt in percent of assets.	RES
Real return on assets	EBIT in percent of assets, adjusted for CPI inflation.	RES
Valuation	Inverse of price-to-earnings ratio, adjusted for CPI inflation.	RES

- *Univariate methods.* These methods examine a range of indicators one-by-one to identify variables and thresholds that separate crisis and non-crisis cases in a given dataset.⁴⁶ While univariate methods ignore interactions among variables, they permit a transparent mapping from indicators to aggregate indices, and can easily accommodate differences in data availability across variables.

53. With data availability varying significantly across indicators, a simple, univariate statistical method was chosen to construct the vulnerability index. The method employs a decision rule to split the data samples for each indicator into crisis and non-crisis sub-samples. The rule minimizes the sum of missed crises (in percent of all crisis observations) and false alarms (in percent of all non-crisis observations), thereby attaching significantly higher costs to missed crises than to false alarms.⁴⁷

54. In addition to this “minimum sum of errors” rule, three alternative decision rules were considered to examine the sensitivity of the statistical results to variations in the rule.

- A univariate application of the binary classification tree (BCT) methodology, which is based on a similar, albeit more complicated, cost function that accommodates variable weights for missed crises and misclassified non-crises.
- Maximization of the signal-to-noise ratio, that is, the ratio of the percentage of correctly classified crises (signal) to the percentage of misclassified non-crises (noise).
- Targeting a uniform 33 percent share of missed crises for all variables.

Results from the statistical analysis and index construction

55. Table 7 summarizes the results from the statistical analysis. The preferred decision rule produces reasonable thresholds for all but one indicator: foreign currency loans for which the split is counter-intuitive (a higher share of foreign currency loans in total loans implies lower vulnerability). The BCT methodology identifies similar (in some cases identical) thresholds to the preferred rule if the cost of missing a crisis is set at 7-8 times that of misclassifying a non-crisis.⁴⁸

⁴⁶ The signal extraction approach proposed by Kaminsky, Lizondo, and Reinhart (1998); Hawkins and Klau (2000); and most of the investment bank models reviewed in Annex II fall in this category.

⁴⁷ Since the datasets for the individual indicators contain on average about 14 non-crisis observations for each crisis observation, missing a crisis is much more costly than calling a false alarm.

⁴⁸ See Chamon, Manasse, and Prati (2007) for a detailed discussion of the BCT methodology.

Table 7. Indicator Thresholds for Alternative Decision Rules 1/

Variable	Crisis observations	Non-crisis observations	Direction to be safe	Preferred Rule: Minimizing Sum of Misclassification Errors			Alternative 1: Univariate BCTs 2/			Alternative 2: Maximizing Signal-to-Noise Ratio 3/			Alternative 3: Targeting 33 Percent Missed Crises		
				Threshold	Mis-classified crises (%)	Mis-classified non-crises (%)	Threshold	Mis-classified crises (%)	Mis-classified non-crises (%)	Threshold	Mis-classified crises (%)	Mis-classified non-crises (%)	Threshold	Mis-classified crises (%)	Mis-classified non-crises (%)
External sector indicators															
Gross international reserves (%)															
Reserve cover I	30	482	>	156.9	3.3	66.2	157.4	3.3	66.2	20.0	96.7	1.2	97.0	33.3	43.6
Reserve cover II	30	482	>	88.7	13.3	49.8	88.7	13.3	49.8	20.0	93.3	1.7	65.6	33.3	36.3
Reserve cover III	30	481	>	90.9	20.0	43.7	120.7	6.7	58.6	20.8	93.3	1.7	78.3	33.3	38.3
Reserve cover IV	25	419	>	62.1	24.0	43.4	77.5	12.0	56.6	9.5	96.0	1.0	56.3	32.0	39.9
Current account (% of GDP)	33	547	>	-2.7	18.2	47.5	-2.7	18.2	47.5	-24.7	97.0	0.4	-3.3	33.3	42.6
Gross External Debt															
% of GDP 4/	30	524	<	21.5	0.0	92.7	59.9	90.0	26.7	140.8	96.7	1.1	37.6	33.3	67.7
% of exports	30	524	<	216.0	46.7	19.1	215.7	46.7	19.1	451.4	93.3	1.5	151.8	33.3	45.4
REER overvaluation	31	528	<	6.4	41.9	32.0	7.5	45.2	28.8	50.6	96.8	0.4	-0.5	32.3	47.9
Public sector indicators (% of GDP)															
Overall fiscal balance															
Primary gap	31	501	>	-3.6	38.7	39.9	-5.4	58.1	21.6	-24.2	96.8	0.2	-2.9	32.3	49.9
Public debt	21	382	>	-1.8	38.1	23.0	-1.8	38.1	23.0	-25.0	90.5	0.3	-0.2	33.3	35.9
Public debt exposed to rollover risk	29	485	<	22.0	10.3	81.9	145.5	93.1	1.2	146.3	93.1	1.2	34.8	34.5	67.6
Public debt exposed to fx risk	14	368	<	10.5	42.9	32.9	2.7	0.0	76.1	37.9	92.9	1.6	5.6	35.7	54.3
	26	433	<	20.4	19.2	58.0	20.4	19.2	58.0	108.4	96.2	0.9	22.6	34.6	55.2
Financial sector indicators															
Capital adequacy ratio (%)															
Return on assets (%)	12	276	>	12.0	50.0	21.7	11.3	58.3	14.5	11.3	58.3	13.4	14.8	33.3	56.5
NPLs (% of total loans)	32	545	>	0.2	56.3	16.1	0.2	56.3	16.3	-15.2	96.9	0.2	1.7	34.4	72.8
Change in the credit-to-GDP ratio	12	277	<	4.9	8.3	64.6	3.2	0.0	74.4	4.9	8.3	64.6	7.6	33.3	53.8
Fx loans (% of total loans) 4/	32	525	<	0.3	21.9	62.9	8.0	84.4	5.9	11.3	90.6	2.3	0.6	34.4	59.0
	19	362	<	0.5	0.0	99.2	37.9	78.9	40.1	1.5	5.3	93.6	13.0	31.6	70.7
Corporate sector indicators															
BSM default probability (%)															
Leverage (%) 4/	20	247	<	2.7	60.0	23.9	2.7	60.0	23.9	21.1	95.0	2.8	0.4	35.0	56.3
Interest coverage ratio	22	267	>	12.9	4.5	85.0	21.5	63.6	58.8	44.9	90.9	0.7	17.6	31.8	68.2
Real return on assets (%)	22	266	>	6.5	40.9	24.8	6.5	40.9	24.8	-0.1	95.5	0.4	10.0	31.8	39.8
Valuation (earnings to price ratio)	22	267	>	2.6	31.8	51.3	2.7	31.8	51.3	-28.7	86.4	6.4	2.6	31.8	51.3
	22	267	>	1.4	13.6	57.3	1.4	13.6	57.3	-27.0	86.4	7.1	0.5	31.8	52.1

1/ See Table 2 for variable definitions.

2/ The Binary Classification Tree (BCT) methodology seeks a threshold that splits the sample into the "purest" possible crisis and non-crisis sub-samples.

3/ The signal-to-noise ratio is defined as the percentage of correctly classified crisis observations (signal) to the percentage of incorrectly classified non-crisis observations (noise).

4/ The BCT splits for these variables occur at a tail of the distribution. In that vicinity, the expected direction to be safe is contradicted.

56. The signal-to-noise ratio produces thresholds characterized by very high percentages of missed crises and very low noise (false alarms). Targeting a constant rate of missed crises across all indicators identifies less extreme thresholds than the signal-to-noise ratio, but these thresholds typically involve larger sums of misclassification errors than the preferred rule.

57. Table 8 shows the selected indicators and thresholds, as well as indicator weights. Selection of these indicators is based on the preferred, “minimum sum of errors” decision rule.⁴⁹ In general, thresholds with the lowest sum of misclassification errors were selected. However, in a few cases where the computations produced widely different thresholds with only marginal differences in error sums, thresholds with the lowest share of missed crises were chosen.⁵⁰ “Raw” indicator weights were defined as 100 minus the indicator’s error sum, so that the weight of an indicator rises with its power to discriminate between crisis and non-crisis cases. These “raw” weights were used to select among competing indicator definitions, and to guide the selection of the weight of each indicator in its sector, though judgmental adjustments were made in some cases.⁵¹ Sector weights were set so as to reflect the relative importance of different indicators in a multivariate setting. This suggested a relatively large weight for the external sector.

58. To examine which indicators have close substitutes and are, therefore, potentially redundant, pair wise correlations—both unadjusted and adjusted for country-specific differences in the means—were calculated for all selected indicators (Table 9). For most indicators, the correlation coefficients are relatively low. Only the current account and the exchange rate misalignment indicator, and some of the external and public sector debt indicators are fairly strongly correlated, but not to a degree that would render some of them entirely redundant.

⁴⁹ One of the twenty indicators—the dummy for institutional and structural weaknesses in the financial sector—was not included in the statistical analysis. This dummy reflects MCM’s assessment and can take on only three values: 0, 0.5, and 1.

⁵⁰ See Table 4.

⁵¹ These adjustments are highlighted in Table 4.

Table 8. Indicator Thresholds and Weights 1/

Variable	Threshold	Direction to be safe	Weight
External Sector			0.45
Reserves in % of ST debt at remaining maturity plus CA deficit 2/	101.0	>	0.24
Current account (% of GDP)	-2.7	>	0.25
External debt (% of GDP) 2/	32.8	<	0.05
External debt (% of exports)	216.0	<	0.26
REER misalignment (% deviation from equilibrium REER) 3/	6.4	<	0.20
Public Sector			0.25
Fiscal balance (% of GDP)	-3.6	>	0.20
Primary gap (actual minus debt-stabilizing primary balance, in % of GDP) 4	-1.8	>	0.25
Public debt (% of GDP) 2/ 4/	25.6	<	0.15
Public debt exposed to FX risk (% of GDP)	20.4	<	0.20
Public debt exposed to rollover risk (% of GDP)	10.5	<	0.20
Financial Sector			0.15 (0.3) 5/
Capital adequacy ratio (%)	12.0	>	0.22
Return on assets (%)	0.2	>	0.21
Non-performing loans (% of total loans)	4.9	<	0.20
Annual change in credit-to-GDP ratio	0.3	<	0.12
Dummy for institutional/structural weaknesses 6/	...	...	0.25
Corporate Sector			0.15
Black-Scholes-Merton probability of default (%)	2.7	<	0.15
Interest coverage ratio	6.5	>	0.32
Real return on assets (%)	2.6	>	0.16
Valuation (earnings-to-price ratio, adj. for CPI inflation, %)	1.4	>	0.27
Leverage (debt in % of assets)	12.9	<	0.10

1/ The thresholds are those reported in Table 3 (preferred rule), except for those highlighted in footnote 2/. Weights are calculated as 100 - sum of misclassification errors in Table 3, normalized to sum to 1 in each sector, except for those highlighted in footnote 4/. See Table 2 for detailed indicator definitions.

2/ These thresholds differ from those in Table 3. They were chosen because they involve a lower share of missed crises with only marginally larger sums of errors.

3/ Estimates based on CGER ERER approach, where available; based on historical average otherwise.

4/ The weight of the public debt-to-GDP ratio was increased from 0.06 to 0.15, and the weight of the primary gap was reduced by a corresponding amount.

5/ Figure in parentheses indicates financial sector weight when corporate sector data are not available.

6/ MCM's assessment of institutional and structural weaknesses, including weaknesses in the regulatory system, extensive dollarization, and exposure to high government debt. This variable was not included in the statistical analysis; the weight is based on judgment.

Table 9. Pair Wise Correlations of Vulnerability Indicators

	Reserve cover (reserve cover I)	External debt in % of GDP	Exchange rate misalignment	External debt in % of GDP	Fiscal balance % of GDP	Primary gap % of GDP	Public debt % of GDP	PD exposed to FX risk % of GDP	PD exposed to rollover risk % of GDP	FS CAR return on assets %	FS change in credit to GDP ratio	CS BSM prob. of default	CS interest cover ratio %	CS real return on assets %	CS real valuation leverage %
Unadjusted 1/															
Reserve cover (reserve cover II)	1.00														
CA % of GDP	0.27	1.00													
External debt in % of exports	-0.25	-0.04	1.00												
Exchange rate misalignment	-0.21	-0.50	-0.16	1.00											
External debt in % of GDP	-0.43	0.03	0.61	-0.04	1.00										
Fiscal balance % of GDP	-0.21	0.41	-0.03	-0.23	-0.06	1.00									
Primary gap % of GDP	-0.03	0.04	-0.22	0.04	-0.29	0.19	1.00								
Public debt (PD) % of GDP	0.08	0.04	0.54	-0.17	0.54	-0.46	-0.24	1.00							
PD exposed to FX risk % of GDP	-0.25	0.17	0.77	-0.17	0.79	-0.07	-0.25	0.74	1.00						
PD exposed to rollover risk % of GDP	-0.14	-0.27	0.20	0.23	0.23	-0.55	0.02	0.52	0.37	1.00					
FS capital adequacy ratio %	-0.27	0.05	0.11	0.24	0.23	0.06	0.10	0.14	0.13	0.03	1.00				
FS return on assets %	-0.06	0.08	-0.31	0.22	-0.37	0.14	0.53	-0.40	0.34	0.31	1.00				
FS NPLs %	0.25	0.20	0.20	-0.31	0.32	-0.39	-0.15	0.54	0.46	-0.24	-0.29	1.00			
FS change in credit to GDP ratio	0.11	-0.06	-0.15	0.14	-0.26	0.11	0.10	-0.16	-0.26	-0.11	-0.12	0.13	-0.28	1.00	
CS BSM probability of default	-0.11	-0.05	0.22	-0.01	0.06	-0.02	-0.01	-0.05	0.07	-0.09	0.04	-0.15	0.12	-0.07	1.00
CS interest coverage ratio %	0.50	-0.02	-0.16	0.05	-0.16	-0.11	-0.01	0.02	-0.17	0.00	-0.06	-0.06	0.02	0.11	-0.13
CS real return on assets	0.33	-0.14	-0.27	-0.24	-0.25	-0.05	0.03	0.03	-0.33	-0.07	-0.31	0.07	0.11	-0.13	0.27
CS real valuation %	0.03	-0.08	0.11	-0.12	0.04	0.02	-0.15	-0.02	-0.02	-0.09	-0.15	-0.32	0.03	-0.03	0.66
CS leverage %	-0.16	0.03	0.16	-0.39	0.23	0.04	-0.16	0.18	0.22	0.06	-0.14	-0.38	0.28	-0.22	0.29
Adjusted 2/															
Reserve cover (reserve cover II)	1.00														
CA % of GDP	0.12	1.00													
External debt in % of exports	-0.36	-0.18	1.00												
Exchange rate misalignment	0.13	-0.55	0.13	1.00											
External debt in % of GDP	-0.30	0.21	0.58	-0.36	1.00										
Fiscal balance % of GDP	0.09	0.25	-0.31	-0.15	-0.17	1.00									
Primary gap % of GDP	0.05	-0.05	-0.30	0.05	-0.37	0.24	1.00								
Public debt (PD) % of GDP	-0.12	0.21	0.21	-0.47	0.74	-0.14	-0.30	1.00							
PD exposed to FX risk % of GDP	-0.22	0.17	0.44	-0.41	0.84	-0.19	-0.37	0.88	1.00						
PD exposed to rollover risk % of GDP	-0.05	0.04	-0.09	0.06	0.05	-0.17	0.07	0.14	0.08	1.00					
FS capital adequacy ratio %	0.09	0.18	-0.12	-0.12	0.03	-0.04	-0.02	0.15	0.08	0.11	1.00				
FS return on assets %	0.06	-0.21	-0.34	0.22	-0.56	0.00	0.47	-0.42	-0.54	0.04	0.08	1.00			
FS NPLs %	-0.18	0.09	0.33	-0.11	0.31	-0.31	-0.20	0.22	0.28	0.11	-0.25	-0.42	1.00		
FS change in credit to GDP ratio	0.11	-0.21	-0.17	0.20	-0.26	0.22	0.09	-0.19	-0.25	-0.10	-0.14	0.20	-0.29	1.00	
CS BSM probability of default	-0.08	0.00	0.11	-0.02	0.07	-0.15	-0.06	-0.05	0.04	-0.27	-0.16	-0.23	0.30	-0.10	1.00
CS interest coverage ratio %	0.39	-0.02	-0.18	0.00	-0.09	0.06	0.05	-0.03	-0.10	-0.12	-0.08	0.01	-0.16	0.10	-0.09
CS real return on assets	-0.05	-0.03	-0.18	-0.14	0.01	0.06	0.09	0.23	0.08	-0.02	0.01	0.04	0.00	0.16	-0.03
CS real valuation %	-0.06	0.00	-0.16	-0.15	0.05	0.04	0.04	0.25	0.12	-0.05	0.00	-0.02	0.05	0.13	0.18
CS leverage %	-0.25	0.07	0.25	-0.12	0.24	-0.10	-0.21	0.13	0.24	0.09	0.00	-0.25	0.31	-0.13	0.24

1/ Based on "raw" panel data for each indicator. See Table 2 for indicator definitions. FS: financial sector; CS: corporate sector.

2/ Data were adjusted for differences in country means. See Table 2 for indicator definitions. FS: financial sector; CS: corporate sector.

59. The indicator thresholds need to be interpreted carefully. For some forty percent of the indicators (reserve cover, the current account balance, the public debt ratio, non-performing loans in the financial sector, credit growth, corporate interest coverage ratios, and valuation in the corporate sector) the thresholds miss relatively few crises (a quarter at most) but are typically associated with relatively large percentages of false alarms. The thresholds for most other indicators miss more crises but they misclassify fewer non-crisis observations. These differences in the “strictness” of the selected indicator thresholds ultimately reflect the features of the underlying distributions of the indicator values in the crisis and non-crisis samples. As indicated in Table 7, making all thresholds equally strict by limiting the share of missed crises to 33 percent would produce larger overall misclassification errors. Moreover, differences in strictness help create complementarities among the vulnerability indicators and improve their combined performance: strict thresholds help limit the number of missed crises; less strict thresholds help limit the number of false alarms.

60. Based on the selected indicators, thresholds, and weights, sector and overall vulnerability indices were calculated for all countries. Each indicator observation was assigned a zero or a one value, depending on whether the observation was below or above the identified threshold. These indicator scores were aggregated into sector indices, and the sector indices were combined into an overall vulnerability index, with index values ranging from zero (lowest possible vulnerability score) to one (highest possible score).

ANNEX IV. MONITORING UNDERLYING VULNERABILITIES

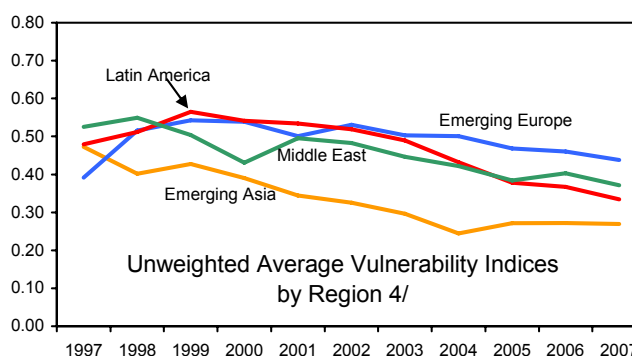
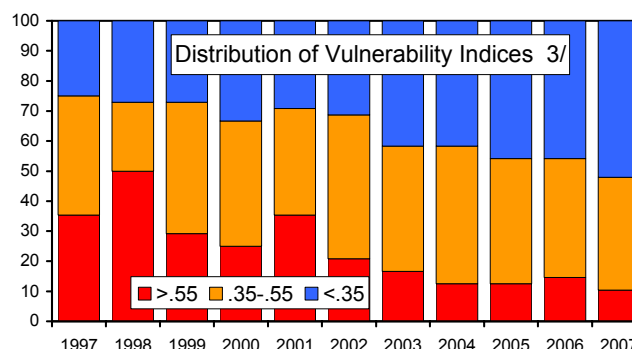
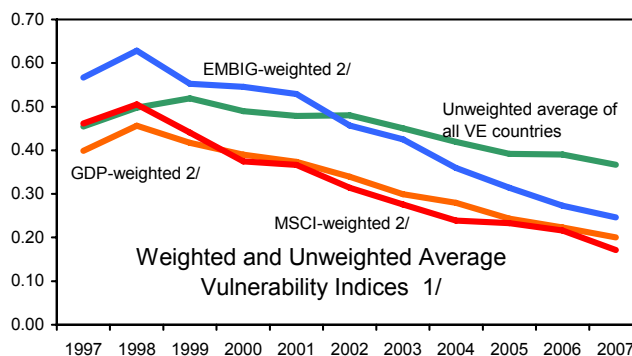
61. This annex provides a sample of the VE output that could be circulated to the Board. The description of aggregate trends in EMC vulnerabilities by sector and region is based on the analysis of the September 2007 vulnerability exercise. Tables 10 and 11 are samples of cross-country tables on key vulnerability indicators that are available for some 20 indicators.

In most EMCs, underlying vulnerabilities are now at the lowest level in a decade.

62. Four years of strong growth, buoyant commodity prices, and—until recently—mostly favorable financial market conditions have supported policy improvements and helped reduce underlying vulnerabilities in many countries. The aggregate index of EMCs' underlying vulnerabilities is now at the lowest level since 1997, with country indices signaling low vulnerability in half of the VE countries.

However, trends in underlying vulnerabilities vary considerably across regions.

63. While underlying vulnerabilities in Asia, the Middle East, and, in particular, Latin America have declined significantly, little progress has been made in emerging Europe. Indeed, the decline in the average vulnerability index for the region reflects for the most part improvements in Russia and the Ukraine; underlying vulnerabilities in most other countries in the region are either unchanged or have increased.



1/ Left scale refers to index values, which range from 0 to 1. 2/ GDP weights are based on 2006 WEO data; EMBIG weights refer to 9/4/07; and MSCI weights refer to 8/2005. 3/ Bars indicate percentages of countries with index values >0.55, 0.35 - 0.55, and < 0.35. 4/ Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa.

The regional bifurcation of underlying vulnerabilities reflects diverging trends in the external sector.

64. In marked contrast to other regions, external vulnerabilities in emerging Europe have trended up in recent years and are now higher than any time in the past decade (Figure 4). These diverging trends reflect in large part developments in current account positions, which have been in surplus in recent years across Asia (except in Sri Lanka), many countries in the Middle East (except Lebanon, Jordan, Pakistan, and Kazakhstan), and most of Latin America (except Central America). This contrasts with large deficits in emerging Europe (except Russia), which are projected to reach or exceed 5 percent of GDP this year in all but three countries (Czech Republic, Poland, and Ukraine), with deficits in the Baltics and Southeastern Europe well into the double digits, and up from the projections in the Spring WEO.

65. Relatively low reserve covers⁵² and rising external debt-to-GDP ratios in emerging Europe reinforce these vulnerabilities, while reserve positions in Asia and most of the Middle East have strengthened significantly. In Latin America, reserve covers have increased less, but external debt ratios have come down sharply as capital inflows to local markets (which are typically not counted as external debt) have enabled countries to retire externally issued debt. However, while this switch has reduced balance sheet exposure to currency risk, it has increased the risk of sudden outflows from local markets, as witnessed in the recent market turmoil.

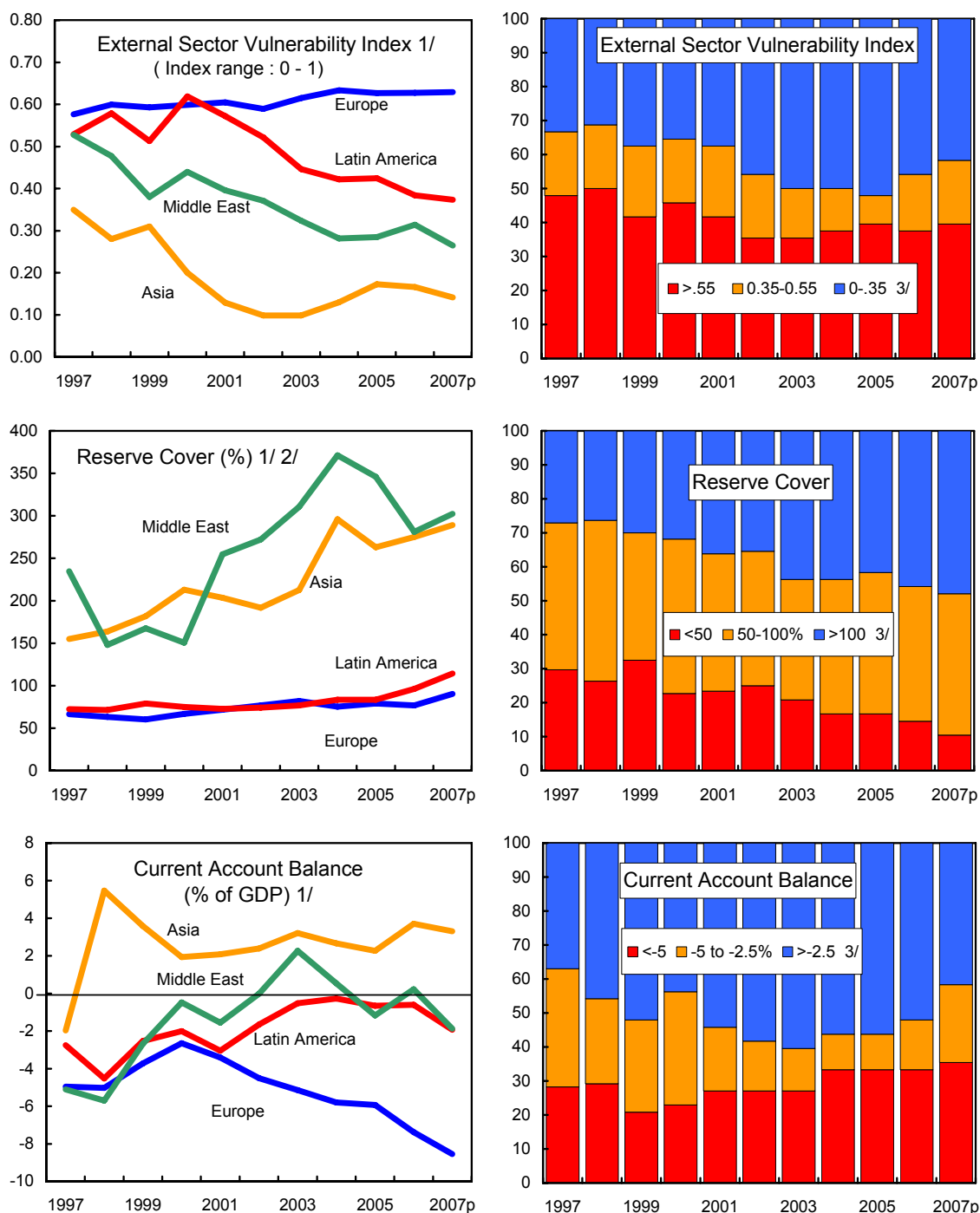
Public sector vulnerabilities have trended down across all regions, but public debt remains relatively high in many EMCs.

66. Unlike vulnerabilities in the external sector, public sector vulnerabilities have declined across all regions (Figure 5). Boosted by strong growth and, in many EMCs, improved policy frameworks, primary and overall fiscal balances have strengthened significantly in the past four years. While fiscal positions are projected to weaken this year in over half of the VE countries, large declines are mainly concentrated in oil and metals producers, many of which (except Venezuela) have been running surpluses in recent years. Although substantial declines are also projected for many other EMCs, primary balances would remain strong enough to stabilize the public-debt-to GDP ratio, except in Lebanon and the Czech Republic.

67. Despite recent declines, public debt-to-GDP ratios remain higher than a decade ago in many EMCs, particularly in Latin America. Still, government exposure to currency risk has declined significantly, although large improvements as in Brazil are the exception. Much less progress has been made in lengthening maturities, and many EMC sovereigns remain significantly exposed to rollover risk.

⁵² Reserves in percent of short-term external debt at remaining maturity and current account deficit.

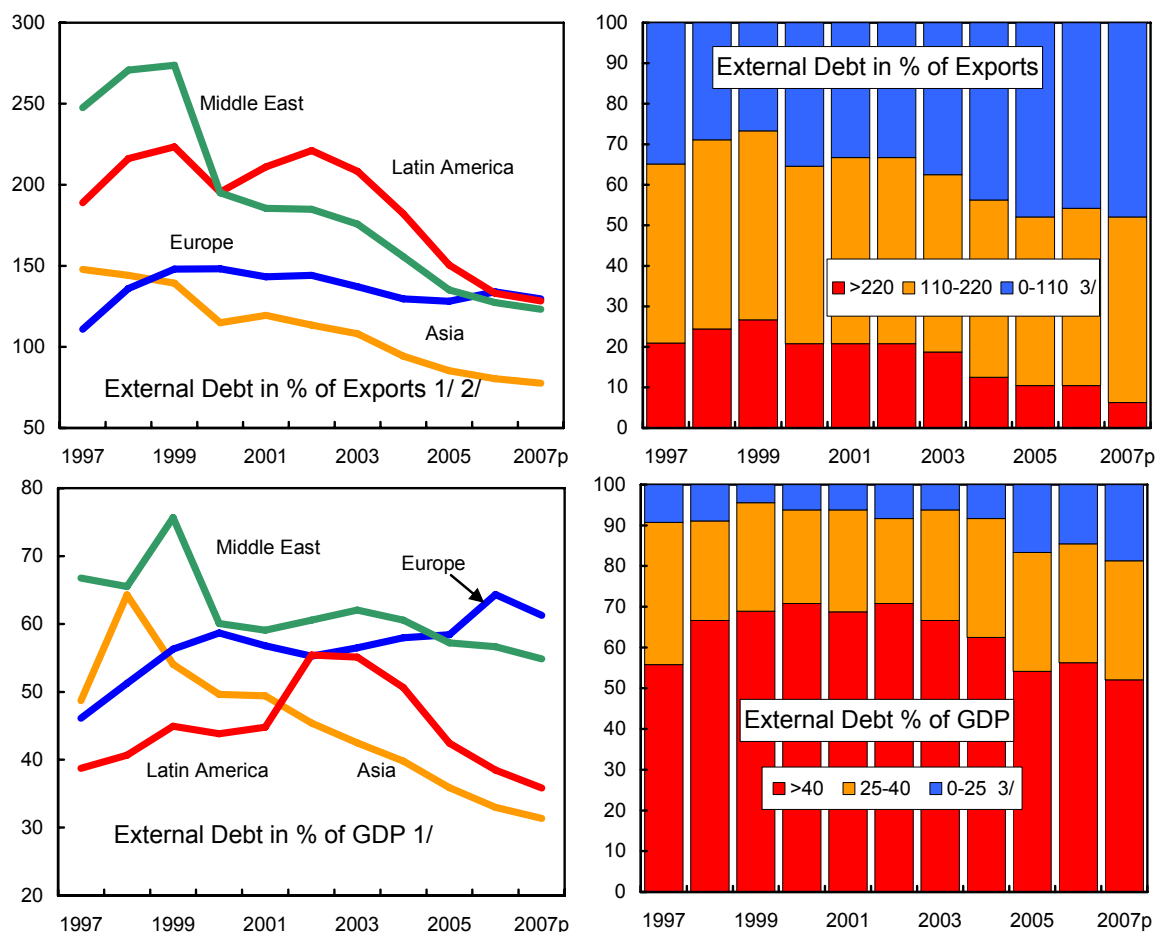
Figure 4. External Sector Vulnerability Indices and Indicators



Source: PDR calculations based on area department data.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 2/ Gross international reserves to short-term external debt at remaining maturity and current account deficit. 3/ Bars show percentage of countries in each group; left scale indicates percent.

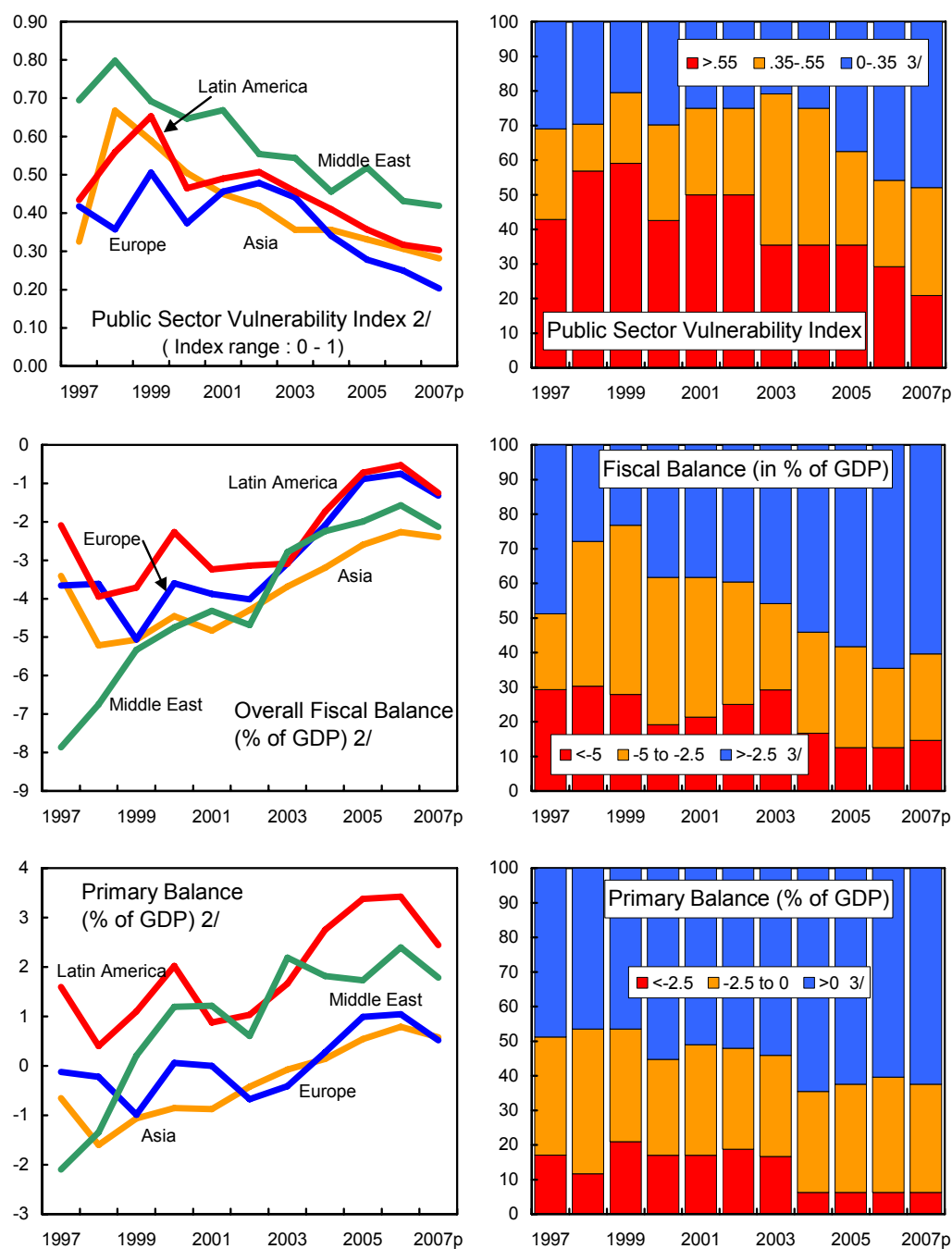
Figure 4. External Sector Vulnerability Indices and Indicators (concl.)



Source: PDR calculations based on area department data.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 2/ Gross external debt to exports of goods and non-factor services. 3/ Bars show percentage of countries in each group; left scale indicates percent.

Figure 5. Public Sector Vulnerability Indices and Indicators

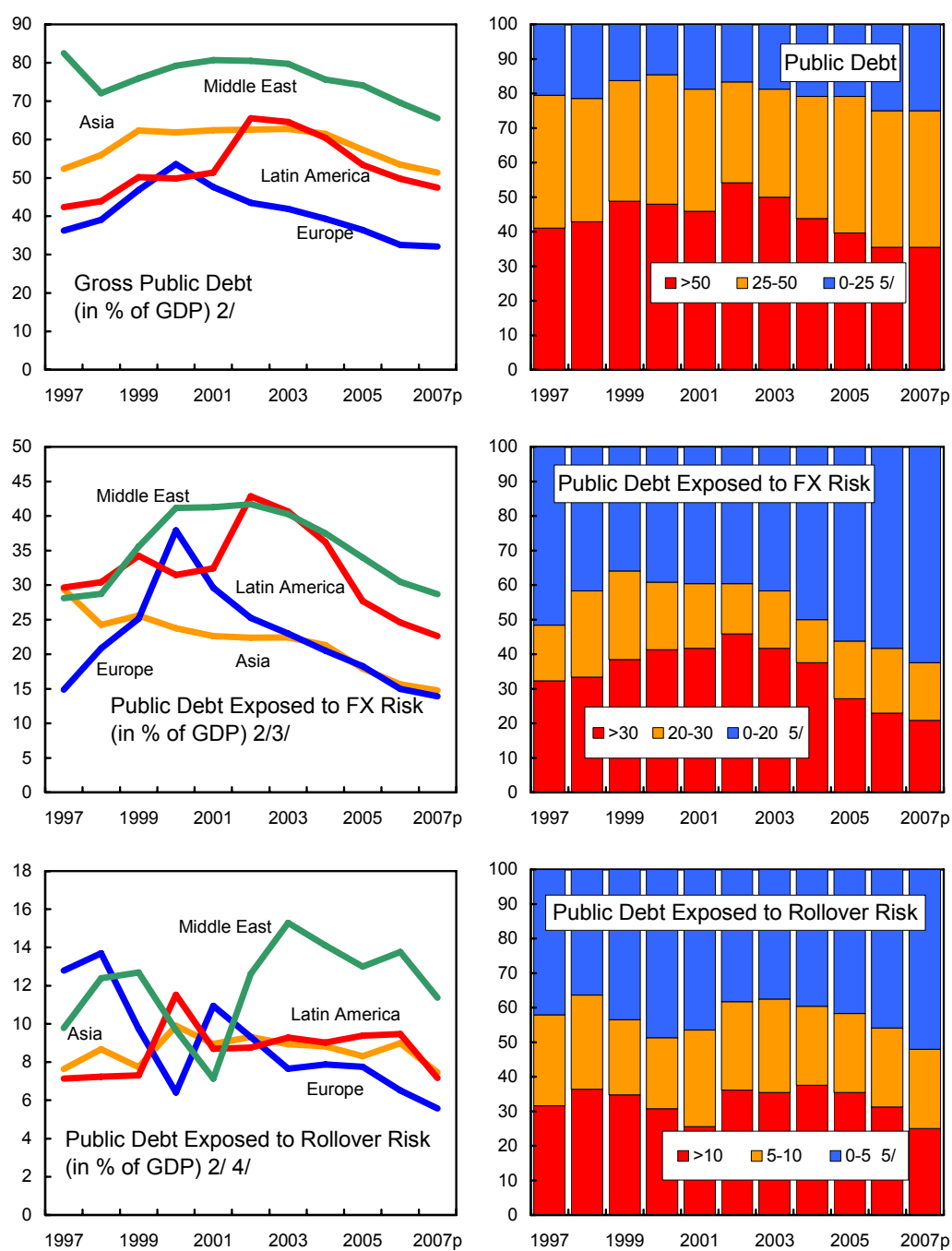


Source: PDR calculations based on area department data.

1/ General Government for the majority of countries covered.

2/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 3/ Bars show percentage of countries in each group; left scale indicates percent.

Figure 5. Public Sector Vulnerability Indices and Indicators (concl.) 1/



Source: PDR calculations based on area department data.

1/ General government for the majority of countries covered. 2/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 3/ Public debt denominated in foreign currency or linked to the exchange rate. 4/ Short-term public debt at remaining maturity. 5/ Bars show percentage of countries in each group.

Trends in financial sector vulnerabilities highlight the close link between external and private sector exposures.

68. While vulnerabilities in the financial sector appear to have declined in recent years in Asia, Latin America, and the Middle East, the vulnerability index for emerging Europe has edged up (Figure 6).

69. Rapid credit growth and extensive foreign currency lending to unhedged borrowers are key sources of financial sector vulnerability in a number of EMCs. In several countries in emerging Europe, credit growth accelerated sharply in the past two years, with cumulative increases in private sector credit-to-GDP ratios in the 18 to 40 percentage points range in the Baltics, Bulgaria, and Ukraine.⁵³ In these countries, as well as in several Latin American countries (Costa Rica, Peru), foreign currency loans account for 40 – 80 percent of lending, and expose banks indirectly to currency risk.⁵⁴

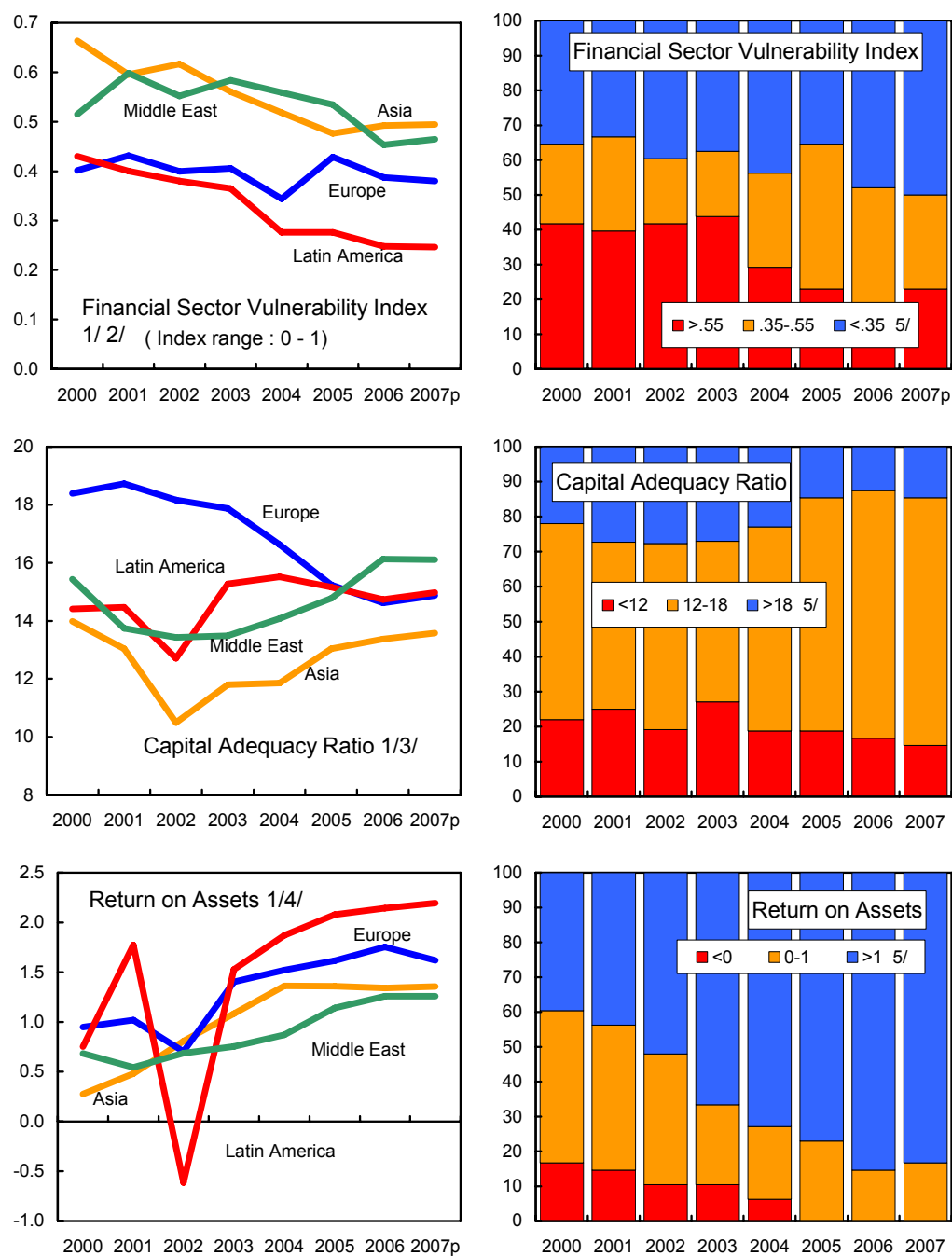
70. So far, these vulnerabilities have not yet affected key financial soundness indicators. With loan portfolios growing rapidly, NPL and capital adequacy ratios have declined in many European EMCs, although the latter declined from high levels and are now in line with those in other EMCs (except in Russia). However, this could change if and when the credit cycle turns.⁵⁵

⁵³ In Bulgaria, credit growth accelerated sharply in 2004-05, but slowed in 2006 after the introduction of restrictions, which prompted a shift to direct foreign borrowing by corporates.

⁵⁴ Due to data constraints, the financial sector vulnerability index does not incorporate an indicator of the degree of dollarization in the financial system. However, a dummy for institutional and structural weaknesses is intended to capture this vulnerability.

⁵⁵ Chapter IV of the April 2004 WEO suggests that 75 percent of credit booms in EMCs were associated with banking crises, and 85 percent with currency crises. Recent developments in EMCs with rapid credit growth, notably the build-up of large current account deficits, fit the stylized facts of past credit booms discussed in this chapter.

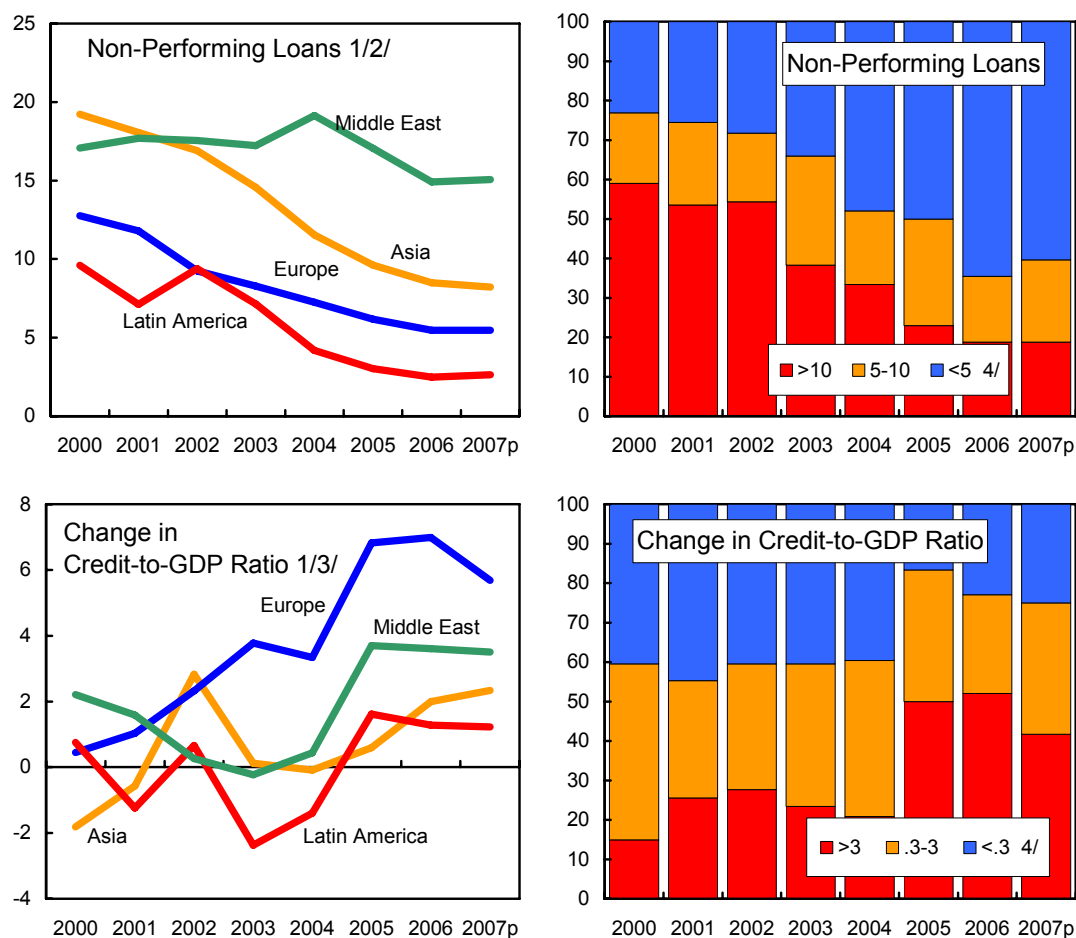
Figure 6. Financial Sector Vulnerability Indices and Indicators



Source: PDR calculations based on MCM and area department data.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 2/ Index for 2007 is based on latest available 2006 data. 3/ Regulatory capital in % of risk-weighted assets. 4/ Earnings before extraordinary items and taxes (EBET) in %. 5/ Bars show percentage of countries in each group; left scale indicates percent.

Figure 6. Financial Sector Vulnerability Indices and Indicators (concl.)



Source: PDR calculations based on MCM and area department data.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean; Middle East: Middle East and North Africa. 2/ In % of total loans. 3/ Private sector credit to GDP. 4/ Bars show percentage of countries in each group.

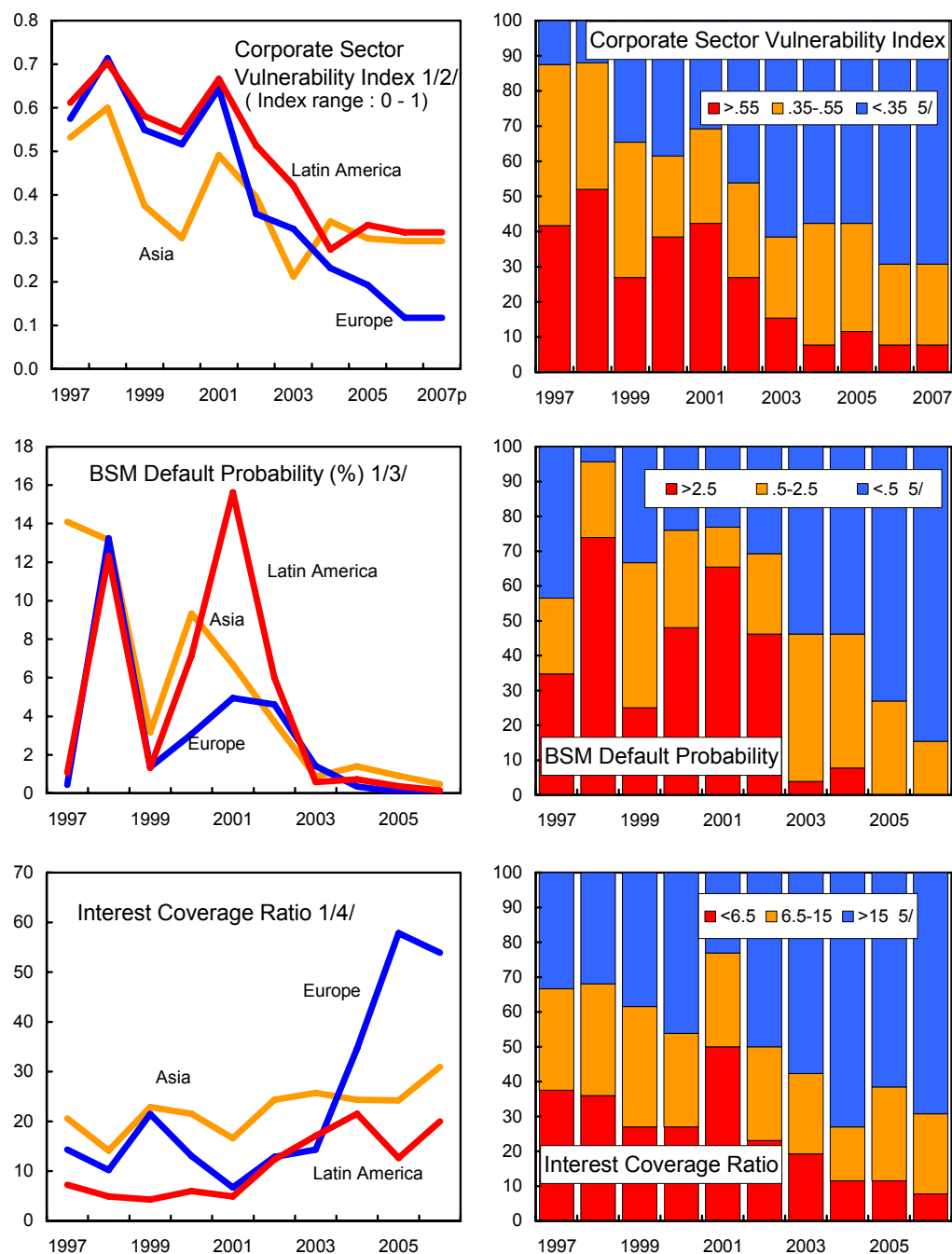
Corporate sector vulnerabilities have declined amid strong growth and benign financing conditions

71. Underpinned by strong growth, benign financing conditions, and structural improvements, corporate vulnerabilities in most EMCs have declined in recent years in all regions, particularly in emerging Europe (Figure 7). Implied default probabilities have dropped sharply, interest cover ratios have risen, and real returns on assets have recovered; Turkey has seen a particularly sharp recovery. Valuations have risen in emerging Europe, but have declined in Asia, and remain relatively low in Latin America.⁵⁶ However, while corporate vulnerability indices have been low for well over half of EMCs since 2003, this conclusion is based on limited coverage and it is not clear whether the available data provide a fully accurate picture, given the lack of transparency in the accounts of corporates in many EMCs.⁵⁷ Moreover, the indices do not capture vulnerabilities associated with increased exchange rate exposure from foreign currency borrowing.

⁵⁶ Defined as the inverse of the price/earnings ratio adjusted for CPI inflation.

⁵⁷ Corporate sector data are available only for half of the countries in the VE. Moreover, the company data underlying the aggregate corporate vulnerability indices are often available only with a lag, limiting the sample of companies for the most recent years. The VE uses current year indicators if they are based on a sample covering at least two thirds of the companies in the full sample used in previous years; in other cases, aggregate indicators for the previous year are used.

Figure 7. Corporate Sector Vulnerability Indices and Indicators

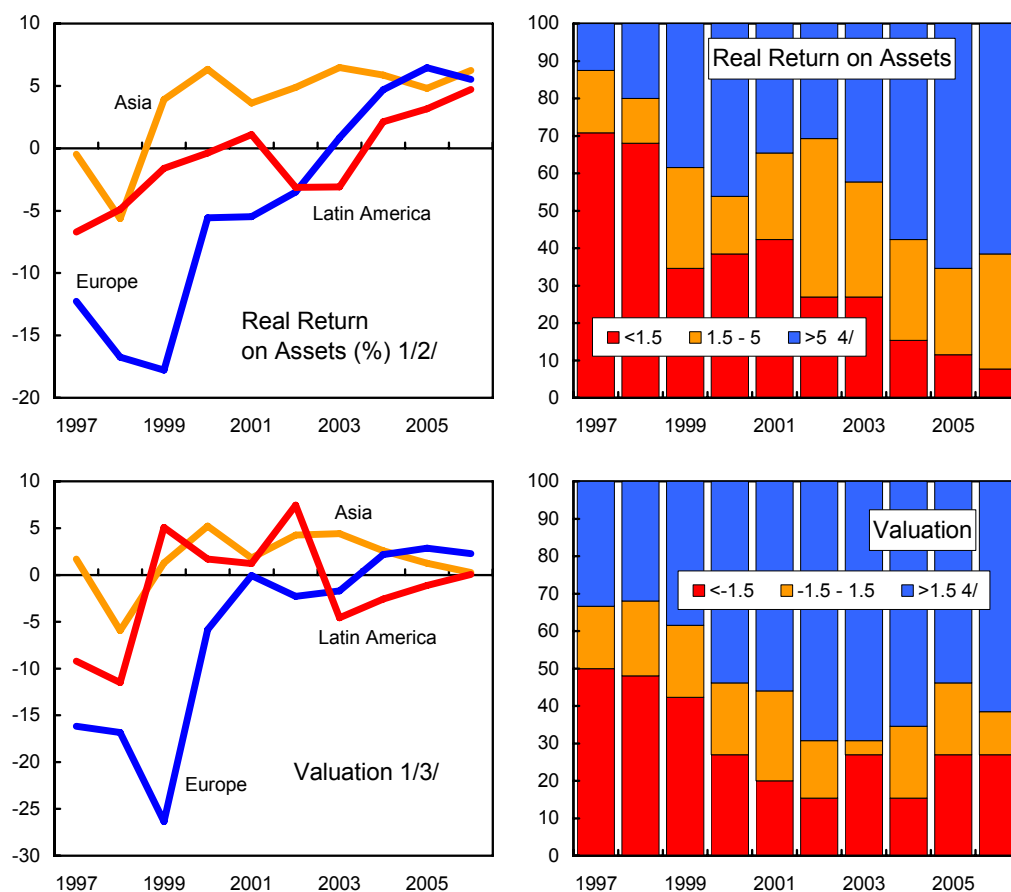


Source: RES corporate vulnerability unit. Data cover only 26 countries.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean. 2/

Indices for 2006 and 2007 are based on latest available data—2005 in some cases. 3/ Black-Scholes-Merton default probability. 4/ Earnings before interest and taxes (EBIT) to interest payments due. 5/ Bars show percentage of countries in each group; left scale indicates percent.

Figure 7. Corporate Sector Vulnerability Indices and Indicators (concl.)



Source: RES corporate vulnerability unit. Data cover only 26 countries.

1/ Unweighted regional averages (excluding South Africa). Regional groups are defined as: Asia: emerging Asia; Europe: Central & Eastern Europe, Turkey, Israel; Latin America: South America, Central America, Caribbean. 2/ EBIT in % of assets, adjusted for CPI inflation. 3/ Inverse of price earnings ratio, adjusted for CPI inflation. 4/ Bars show percentage of countries in each group.

Table 10. Selected Vulnerability Indicators - Current Account Balances 2000-2007
(In percent of GDP)

	2000	2001	2002	2003	2004	2005	2006	2007p
Algeria	16.7	12.8	7.6	13.0	13.1	20.7	25.6	15.4
Argentina	-3.2	-1.4	8.9	6.3	2.1	1.9	2.5	0.0
Bosnia&Herzegovina	-7.5	-13.3	-19.1	-20.9	-19.7	-21.7	-11.5	-13.3
Brazil	-3.8	-4.2	-1.5	0.8	1.8	1.6	1.2	1.0
Bulgaria	-5.6	-5.6	-2.4	-5.5	-6.7	-12.2	-15.8	-17.5
Chile	-1.2	-1.6	-0.9	-1.1	2.2	1.1	3.6	4.0
China	1.7	1.3	2.4	2.8	3.6	7.2	9.4	11.9
Colombia	1.0	-1.3	-1.9	-1.2	-0.9	-1.6	-2.0	-3.9
Costa Rica	-4.3	-4.4	-5.6	-4.8	-4.3	-4.8	-4.9	-4.9
Croatia	-2.6	-3.7	-8.3	-6.1	-5.4	-6.3	-7.8	-8.3
Czech Republic	-4.7	-5.3	-5.7	-6.3	-5.2	-1.6	-3.1	-3.2
Dominican Republic	-5.2	-3.4	-3.7	6.0	6.1	-1.4	-3.2	-3.7
Ecuador	5.3	-3.2	-4.8	-1.4	-1.7	0.7	3.5	0.6
Egypt	-1.2	0.0	0.7	2.4	4.3	3.2	0.8	1.4
El Salvador	-3.3	-1.1	-2.8	-4.7	-4.0	-4.7	-4.8	-4.7
Estonia	-5.4	-5.2	-10.6	-11.6	-12.6	-10.1	-15.7	-17.1
Guatemala	-6.1	-6.7	-5.9	-4.7	-5.1	-5.1	-5.2	-5.0
Hungary	-8.4	-6.0	-7.0	-7.9	-8.4	-6.8	-5.8	-4.9
India	-1.0	0.3	1.4	1.5	0.1	-1.0	-1.1	-1.3
Indonesia	4.8	4.3	4.0	3.5	0.6	0.1	2.7	1.1
Israel	-0.8	-1.1	-0.9	1.2	2.4	3.4	5.7	4.4
Jamaica	-4.9	-10.6	-13.0	-9.4	-5.8	-11.1	-11.1	-10.6
Jordan	0.7	-0.1	5.6	11.6	0.0	-17.8	-13.6	-13.6
Kazakhstan	3.0	-5.4	-4.2	-0.9	0.8	-1.8	-2.2	-2.9
Korea	2.4	1.7	1.0	2.0	4.1	1.9	0.7	0.1
Latvia	-4.8	-7.7	-6.4	-8.2	-12.9	-12.6	-21.1	-25.0
Lebanon	-17.2	-19.3	-14.2	-13.2	-15.5	-13.6	-6.2	-10.6
Lithuania	-5.9	-4.7	-5.2	-6.9	-7.7	-7.1	-10.9	-12.3
Malaysia	9.4	8.3	8.4	12.7	12.6	15.3	16.9	14.7
Mexico	-3.2	-2.8	-2.2	-1.4	-1.0	-0.6	-0.2	-1.2
Morocco	-1.3	4.3	3.6	3.2	1.7	2.4	3.4	1.8
Pakistan	-0.3	0.5	3.9	4.9	1.8	-1.4	-3.9	-4.0
Panama	-5.9	-1.5	-0.8	-4.5	-7.5	-5.0	-3.8	-5.9
Peru	-2.8	-2.1	-1.9	-1.5	0.0	1.3	2.8	1.3
Philippines	-2.9	-2.5	-0.5	0.4	1.9	2.0	4.3	3.3
Poland	-5.8	-2.8	-2.5	-2.1	-4.2	-1.7	-2.3	-2.8
Romania	-3.7	-5.5	-3.3	-5.8	-8.4	-8.7	-10.3	-13.1
Russia	18.0	11.1	8.4	8.2	10.1	11.1	9.7	5.5
Serbia	-1.7	-2.4	-7.9	-7.0	-11.7	-8.5	-11.5	-14.0
Slovak Republic	-3.3	-8.3	-8.0	-6.0	-7.8	-8.6	-8.3	-5.3
South Africa	-0.1	0.3	0.8	-1.1	-3.2	-4.0	-6.5	-6.5
Sri Lanka	-6.5	-1.1	-1.4	-0.4	-3.2	-2.8	-4.9	-5.1
Thailand	7.6	4.4	3.7	3.3	1.7	-4.4	1.6	1.8
Tunisia	-4.3	-5.2	-3.3	-2.7	-1.9	-1.1	-2.2	-2.5
Turkey	-5.0	2.4	-0.8	-3.3	-5.2	-6.2	-7.9	-6.9
Ukraine	4.7	3.7	7.5	5.8	10.6	2.9	-1.5	-3.2
Uruguay	-2.8	-2.9	3.2	-0.5	0.3	0.0	-2.4	-2.8
Venezuela	10.1	1.6	8.2	14.1	13.8	17.8	15.0	6.8
Median	-2.9	-2.3	-1.7	-1.1	-0.9	-1.6	-2.3	-3.2
Average emerging Asia	1.9	2.1	2.4	3.2	2.7	2.3	3.7	3.3
Average emerging Europe	-2.3	-3.2	-4.4	-5.0	-5.6	-5.9	-7.5	-8.8
Average Latin America	-2.0	-3.0	-1.6	-0.5	-0.3	-0.7	-0.6	-1.9
Average Middle East & North Africa	-0.5	-1.6	0.0	2.3	0.5	-1.2	0.2	-1.9
Average all EMCs	-1.3	-2.0	-1.6	-1.0	-1.5	-2.1	-2.1	-3.4

Source: Area department data.

Table 11. Selected Vulnerability Indicators: Current Account Balances Ranked 2007
(In percent of GDP)

	2002		2007	
	Value	Rank	Value	Rank
Latvia	-6.4	(9)	-25.0	(1)
Bulgaria	-2.4	(21)	-17.5	(2)
Estonia	-10.6	(4)	-17.1	(3)
Serbia	-7.9	(7)	-14.0	(4)
Jordan	5.6	(42)	-13.6	(5)
Bosnia&Herzegovina	-19.1	(1)	-13.3	(6)
Romania	-3.3	(17)	-13.1	(7)
Lithuania	-5.2	(13)	-12.3	(8)
Lebanon	-14.2	(2)	-10.6	(9)
Jamaica	-13.0	(3)	-10.6	(10)
Croatia	-8.3	(5)	-8.3	(11)
Turkey	-0.8	(29)	-6.9	(12)
South Africa	0.8	(33)	-6.5	(13)
Panama	-0.8	(30)	-5.9	(14)
Slovak Republic	-8.0	(6)	-5.3	(15)
Sri Lanka	-1.4	(26)	-5.1	(16)
Guatemala	-5.9	(10)	-5.0	(17)
Hungary	-7.0	(8)	-4.9	(18)
Costa Rica	-5.6	(12)	-4.9	(19)
El Salvador	-2.8	(19)	-4.7	(20)
Pakistan	3.9	(40)	-4.0	(21)
Colombia	-1.9	(23)	-3.9	(22)
Dominican Republic	-3.7	(16)	-3.7	(23)
Ukraine	7.5	(43)	-3.2	(24)
Czech Republic	-5.7	(11)	-3.2	(25)
Kazakhstan	-4.2	(15)	-2.9	(26)
Poland	-2.5	(20)	-2.8	(27)
Uruguay	3.2	(37)	-2.8	(28)
Tunisia	-3.3	(18)	-2.5	(29)
India	1.4	(35)	-1.3	(30)
Mexico	-2.2	(22)	-1.2	(31)
Argentina	8.9	(48)	0.0	(32)
Korea	1.0	(34)	0.1	(33)
Ecuador	-4.8	(14)	0.6	(34)
Brazil	-1.5	(25)	1.0	(35)
Indonesia	4.0	(41)	1.1	(36)
Peru	-1.9	(24)	1.3	(37)
Egypt	0.7	(32)	1.4	(38)
Morocco	3.6	(38)	1.8	(39)
Thailand	3.7	(39)	1.8	(40)
Philippines	-0.5	(31)	3.3	(41)
Chile	-0.9	(28)	4.0	(42)
Israel	-0.9	(27)	4.4	(43)
Russia	8.4	(47)	5.5	(44)
Venezuela	8.2	(45)	6.8	(45)
China	2.4	(36)	11.9	(46)
Malaysia	8.4	(46)	14.7	(47)
Algeria	7.6	(44)	15.4	(48)

Source: Area department data.

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