Assessing Country Risk: Selected Approaches[1]

G. Other Risks

I. Scenario Analysis for Low-income Countries (LICs)

The tool described here is part of a broader assessment framework for LICs. This includes the growth decline vulnerability index, scenario analysis, the food decline vulnerability index, and an assessment of financial vulnerabilities for frontier markets, each described in its own appendix [hyperlinks]. This methodology is documented in an IMF Board paper (IMF 2011a) and Working Paper (Dabla Norris and Bal Gunduz, 2012).

Scenario Analysis

Motivation

Scenario analysis is a tool for evaluating the macroeconomic impact of global shocks on LICs. This, in turn allows for an assessment of the adequacy of external and fiscal buffers across countries.

Methodology

The scenario analysis consists of three main modules that assess the impact of a dynamic, multi-year risk scenario on LICs' economic growth, external balances, and fiscal balances. Regardless of the nature of the shock (whether temporary or protracted), this framework assesses the first round impact of risk scenarios on LICs' economic growth, external balances, and fiscal balances as follows:

Growth Module[2]

The impact of a specific shock scenario on economic growth is assessed using a model that regresses real GDP growth against trading partners' growth, terms of trade, investment, and government consumption.[3] In the regression analysis, partners' growth was interacted with the

[1] This document provides technical background and extended descriptions of the cross-country risk assessment tools discussed in the IMF reference note "Assessing Country Risk: Selected Approaches." It should not be reported as representing the views of the IMF. The views expressed are those of the authors and do not necessarily represent those of the IMF or IMF policy. The document describes research in progress as of June 2017, and is intended to elicit comments and to further debate.

[2] Contributing Author: Atticus Weller.

[3] The residuals from investment and government consumption equations, estimated by regressing these variables on trading partners' growth and terms of trade, are used in the estimation of the growth equation, instead

(continued)

degree of trade openness (expressed as the ratio of exports and imports to GDP) to control for its impact on the size and magnitude of spillovers effects across LICs. A dummy for commodity-exporters is also interacted to test for different elasticities for commodity versus non-commodity exporters.

The only two transmission channels considered when calculating the impact of a shock on individual countries' economic growth are: (i) external demand (partner countries' growth); and (ii) terms of trade (TOT).

Data sources

WEO, DOTS, and IMF staff estimates.

External sector module[4]

The methodology includes estimating export and import equations using a panel error correction model.[5] To assess the impact on external balances, four channels are considered: exports, imports, remittances, and FDI.

- Export volume equations are estimated for each of the food, fuel, and other export commodity groups, and elasticities derived to estimate the sensitivity of export volumes with respect to changes in external demand and relative prices.

- Import volume equations are also estimated for each of food, fuel, and other import commodity groups, and elasticities derived to estimate the sensitivity of import volumes with respect to changes in domestic demand and relative prices. Import volume equations are also estimated for each of food, fuel, and other import commodity groups, and elasticities derived to estimate the sensitivity of import volumes with respect to changes in domestic demand and relative prices.

- Similar dynamic effects are analyzed to assess the impact on remittances and FDI. [6] Both are assumed to depend on changes in growth in source countries.

Shocks that affect (domestic and foreign) growth or global commodity prices are then transmitted to the external accounts through their impacts on exports, imports, FDI and remittances.

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introducing government consumption and investment as variables. This is done in order to avoid multicollinearity problems.

[4] Contributing Author: Pranav Gupta.

[5] Based on the pooled-mean group estimator, see Muscatelli et al. (1992) and Pesaran et al. (1999).

[6] Based on Lueth and Ruiz-Arranz (2008).

Changes in the current account are assumed to be financed out of gross foreign reserves, resulting in determination of external financing needs. If a country's post-shock reserve coverage ratio falls below the minimum adequate level of three months of prospective imports, the country is assessed to have an additional external financing need. More precisely, if pre-shock reserve is above three months of imports and the shock leads to reserves falling below this threshold, the external financing need is equivalent to the amount of financing required to bring the reserves back to three months of imports; whereas if the pre-shock reserve coverage is below three months of imports, the external financing need is the amount of financing required to restore the stock of reserves to its pre-shock level.

Data sources

WEO, IFS, BACI, DOTS, World Bank, OECD and IMF staff estimates.

Fiscal Sector Module[7]

The analysis of the impact of a shock scenario takes into account the important role of fiscal revenue from commodity production. Fiscal revenue is estimated as a country-specific weighted average of revenue from general economic activity, assumed to be driven by GDP growth, and of revenue from the production and export of non-renewable natural resources. The elasticity of commodity-related fiscal revenue to global commodity prices is set in line with country-specific historical observations.

In a "passive fiscal policy approach," primary spending is assumed to remain unchanged in nominal terms. As a result, spending as a share of GDP changes only to the extent that nominal GDP growth changes under the scenario.

Data sources

WEO, World Bank and IMF staff estimates.

References

Dabla-Norris, E. and Y. Bal Gündüz, 2012, Exogenous Shocks and Growth Crises in Low- Income Countries: A Vulnerability Index, IMF Working Paper 12/264.

International Monetary Fund, 2007, "Assessing Underlying Vulnerabilities and Crisis Risks in Emerging Market Countries—A New Approach," (SM/07/328).

International Monetary Fund, 2011a, "Managing Volatility: A Vulnerability Exercise for Low-Income Countries" (Washington).

[7] Contributing authors: Andrew Hodge and Jiangyan Yu.

Lueth, Erik, and Marta Ruiz-Arranz, 2008, "Determinants of Bilateral Remittance Flows," *The B.E. Journal of Macroeconomics,* Vol. 8 (1), p. 26.

Muscatelli, Vito Antonio, T.G. Srinivasan, and David Vines, 1992, Demand and Supply Factors in the Determination of NIE Exports: A simultaneous Error-Correction Model for Hong-Kong, *The Economic Journal*, Vol. 102 (415), pp. 1467–1477.

Pesaran, M. Hashem, Yongcheol Shin, and Ron P. Smith, 1999, Pooled Mean Group Estimation of Dynamic Heterogeneous Panels, *Journal of the American Statistical Association*, Vol. 94 (446), pp. 621–634.

II. Food Decline Risk in Low-income Countries (LICs)

The tool described here is part of a broader assessment framework for LICs. This includes the growth decline vulnerability index, scenario analysis, the food decline vulnerability index, and an assessment of financial vulnerabilities for frontier markets, each described in its own appendix [hyperlinks]. This methodology is documented in an IMF Board paper (IMF 2011a) and Working Paper (Dabla Norris and Bal Gunduz, 2012).

Food Decline Vulnerability Index and Natural Disasters[8,9]

Motivation

Understanding the impact of natural disasters on access to food supply and the available coping mechanisms is important. This is critical to putting in place emergency financing mechanisms and other appropriate policy measures. The Food Decline Vulnerability Index (FDVI) aims to assess countries' vulnerability to a sharp drop in food supply following natural disasters.

The analysis requires operational definitions of food supply and food supply decline episodes. Based on the database of the Food and Agriculture Organization (FAO) of the United Nations, food supply measures the "total quantity of foodstuffs produced in a country added to the total quantity imported and adjusted for any change in stocks that may have occurred since the beginning of the reference period." Food supply decline episodes are defined as a large drop in daily food supply measured in kilocalories per capita. More precisely, a "food crisis" occurs when two conditions hold: (i) the two-year average level of daily food supply per capita falls below the pre-shock three-year average; and (ii) year-on-year growth of food supply per capita is negative. These episodes are matched with natural disaster episodes, which are identified as those natural disasters where the

[8] The approach draws on the signal extraction methodology described in Box 2 of the main text.

[9] Contributing authors: Olumuyiwa Samson Adedeji and Jana Gieck Bricco.

number of people affected or the damage caused exceeds the 50th percentile of the country-specific distribution.

A general-to-specific approach was used to identify the leading indicators of food supply episodes. The analysis uses 12 variables, based on results from probit regressions and a number of variables considered in the literature[10] as main determinants of a food supply decline: food supply growth (measured in kilograms per capita for the period 1990–2009);[11] the World Bank's CPIA index; Gini coefficient; life expectancy; share of agriculture in total GDP; fiscal indicators (government balance in percent of GDP and tax revenues in percent of GDP), and external indicators (reserves in months of imports and growth in trading partners). The estimation of thresholds and weights for each indicator is based signal-to-noise ratios as described in Box 1 of the reference note.

Data sources

FAO; World Bank; EM-DAT; and IMF, WEO and staff estimates

References

Burg, J., 2008, "Measuring Populations' Vulnerabilities for Famine and Food Security Interventions: The Case of Ethiopia's Chronic Vulnerability Index," Disasters, 32 (4), pp. 609-630.

Capaldo J., P. ., Karfakis, M. Knowles, and M. Smulders, 2010, "A Model of Vulnerability to Food Insecurity," Food and Agriculture Organization, ESA Working Paper 10-03.

Dabla-Norris, E. and Y. Bal Gündüz, 2012, Exogenous Shocks and Growth Crises in Low- Income Countries: A Vulnerability Index, IMF Working Paper 12/264.

Economist Intelligence Unit, 2013, "Global Food Security Index: An Annual Measure of the State of Global Food Security.

International Monetary Fund, 2007, "Assessing Underlying Vulnerabilities and Crisis Risks in Emerging Market Countries—A New Approach," (SM/07/328).

International Monetary Fund, 2011a, "Managing Volatility: A Vulnerability Exercise for Low-Income Countries" (Washington).

Lucas, P. L. and H. Hilderink, 2004, "The Vulnerability Concept and Its Application to Food Security," National Institute for Public Health and the Environment (RIVM Report 550015004).

[10] See Burg (2008); Lucas and Hilderink (2004); Capaldo et al., (2010); and Economist Intelligence Unit (2013).

[11] To take into account food supply growth beyond 2009 in the FDVI indicator, a simple regression is used based on lagged food supply growth, lagged natural disaster shocks and a constant to forecast food supply growth in subsequent years.

Economist Intelligence Unit, 2013, "Global Food Security Index: An Annual Measure of the State of Global Food Security.

III. Supplementary Crisis Models for Emerging Markets [12]

Growth, fiscal and financial crises are defined as follows:

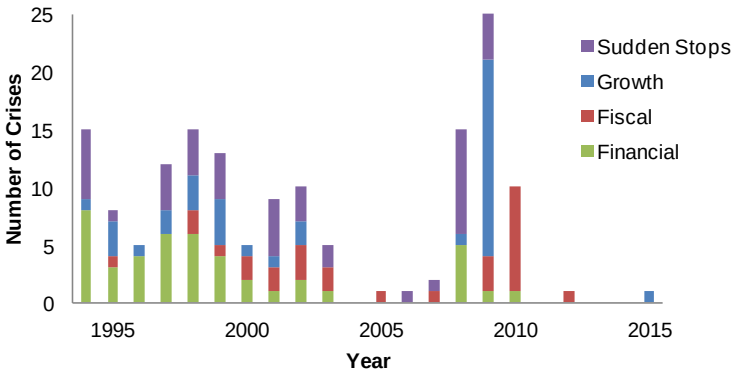
- Growth crises are defined as years when the decline in growth relative to the previous five-year average growth rate has been in the 5th percentile tail.

- Fiscal crises are defined as year-on-year increases in the fiscal balance of 2.5 percent of GDP, from a balance of -2.5 percent of GDP or lower. This definition captures abrupt adjustments but does not take into account the reason for the adjustment.

- Financial crises are defined as banking and currency crises, from the dataset of Laeven and Valencia (2012)[13].

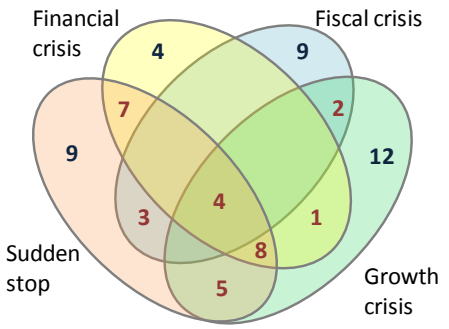
These crises have occurred both separately and alongside each other, and they have different macroeconomic properties. The incidence of these crises, and their overlap with each other and with sudden stops, is illustrated in Figures 1 and 2. Sudden stops are often associated with other types of crises, but all types of crises do occur alone. As Figure 3 indicates, each type of crisis is

Figure 1. Crisis Incidence in EMs, 1994-2015 1/



1/ Data on financial crisis incidence is available up to 2010. Sudden stops are defined in the webpage on the sudden stop model. Data on sudden stop incidence is available up to 2009.

Figure 2. Overlap of EM Crises 1/



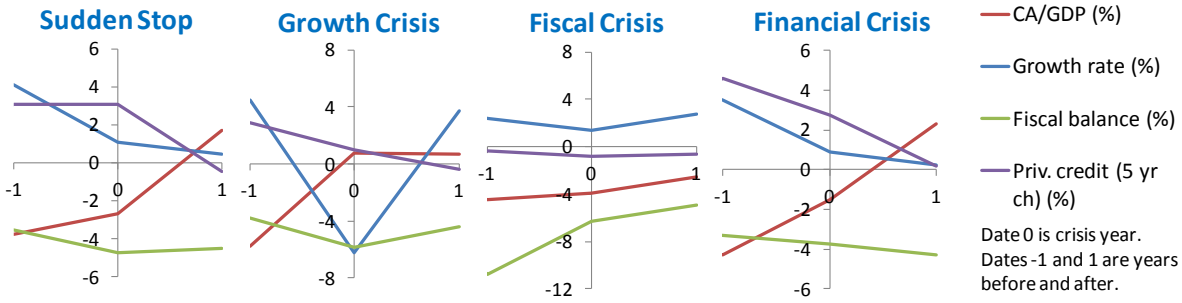
1/ Crises in the same or adjacent years are regarded as coincident.

[12] Contributing author: Suman Basu.

[13] Laeven and Valencia (2009, 2012) define a systemic banking crisis as an episode when a country's corporate and financial sectors experience a large number of defaults, and financial institutions and corporations face difficulties repaying contracts on time, with the result that NPLs rise sharply. They define a currency crisis as an episode of nominal depreciation of the currency of at least 30 percent that is also at least a 10 percent increase in the rate of depreciation compared to the year before.

associated with different macroeconomic dynamics. For these reasons, it is appropriate to assess the risk of each type of crisis separately.

Figure 3. Macroeconomic Dynamics Around EM Crises, 1994-2009



For each type of crisis, a separate crisis probability model is estimated using a signal

Table 1. Data used in the VEE crisis probability models 1/

Variable	Source	Variable	Source
Crisis calculations		**Public sector**	
Real GDP	WEO	General government balance/GDP	WEO, CSD
Cyclically-adjusted primary deficit/GDP	CSD	Primary gap/GDP 3/	WEO, CSD
		Public debt/GDP 3/	WEO, CSD
Financial crisis dummy	LV	EMBI sovereign spread	Bloomberg
		Financial sector	
Medium-term		Capital adequacy ratio	CSD
Private sector credit growth (5-yr)	WB WDI	Return on bank assets	CSD
Housing price growth (5-yr) 2/	OECD HPD, GPG	Non-performing loans	CSD
Stock price growth (5-yr) 2/	Bloomberg	**Household balance sheets**	
REER growth (5-yr)	INS	Housing price acceleration 2/	OECD HPD, GPG
		Stock price acceleration 2/	Bloomberg
Near-term		**External Sector**	
Real sector		Current account/GDP	WEO
Black-Scholes-Merton default prob.	CVU, CSD	External debt/GDP	WEO, CSD
Return on corporate assets	CVU, CSD	External debt/exports	WEO, CSD
Price to earnings ratio	CVU, CSD	Deviation from EBA norm	EBA
Interest coverage ratio	CVU, CSD	REER acceleration	INS
Inflation	WEO	Absolute oil balance/GDP	WEO

1/ WEO = IMF World Economic Outlook, CSD = IMF Common Surveillance Database, CVU = IMF Corporate Vulnerability Utility, EBA = IMF External Balance Assessment, INS = IMF Information Notice System, WB WDI = World Bank World Development Indicators, OECD HPD = OECD Housing Prices Database, GPG = Global Property Guide, LV = Laeven and Valencia (2012).

2/ Real housing and stock prices are used in the VEE because nominal data suffer from structural breaks in inflation.
3/ Primary gap/GDP and public debt/GDP variables are used only for the fiscal crisis modules of the VEE.

extraction approach (Box 1 of the reference note). The models are estimated on data from the period 1994-2010: since crises in EMs have occurred regularly over many decades, including the global financial crisis period generates little risk of over-fitting.

The models use two distinct types of variables to forecast crisis risks (Table 1). *Medium-term variables* are designed to capture the build-up of imbalances over time. Housing, stock prices, and the real effective exchange rate are used because sustained growth in these variables is likely to be associated with the emergence of asset price bubbles—which are liable to reverse. *Near-term variables* are designed to capture the resilience of the economy to shocks *e.g.*, capital assets ratio, EMBI sovereign bond spread, absolute oil balance) and indicators that asset price bubbles have already begun deflating (*e.g.*, housing and stock price accelerations, which measure the change in housing and stock price growth rates in percentage points relative to the previous year).

The models allow for inter-sectoral spillovers. Each type of crisis is analyzed in a model featuring variables from all sectors of the economy. Therefore, inter-sectoral spillovers are allowed in reduced-form, *e.g.*, financial sector variables may be estimated to increase fiscal crisis risks if in the historical sample, financial sector distress has caused the realization of public sector contingent liabilities.

Crisis probability estimates are derived using a non-parametric approach. Each model aggregates the threshold breaches of individual variables into an overall composite value using weights determined by the signal-to-noise ratio. Then, as shown in Figure 4, a non-parametric approach is used to estimate the historical crisis frequency observed at different levels of the composite value. A separate estimation is conducted for each type of crisis. Finally, the estimated mappings are used to convert each country's composite values in the current year into crisis probabilities.

Figure 4. Crisis Probability Mapping for EMs

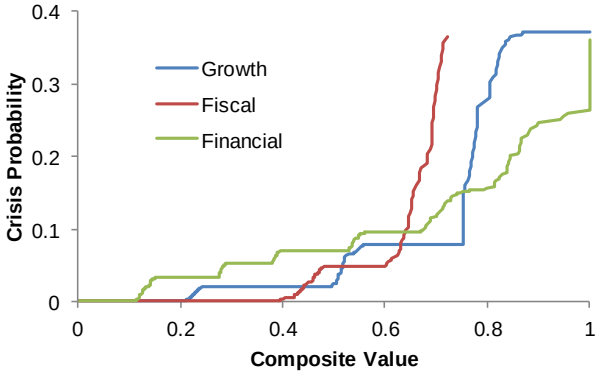


Table 2. VEA sum of errors

	Estimation sample 1985-2007 1/
Growth crisis	0.39
Fiscal crisis	0.20
Financial crisis	0.19

1/ Errors calculated over non-missing crisis observations

References

Berg, Andrew, and Catherine Pattillo, 1999. "Are Currency Crises Predictable? A Test," IMF Staff Papers, vol 46(2), pp. 107-38.

Chamon, Marcos, and Christopher Crowe, 2013. "Chapter 34 - Predictive Indicators of Financial Crises," in *The Evidence and Impact of Financial Globalization*, edited by Gerard Caprio, Thorsten Beck, Stijn Claessens and Sergio L. Schmukler. Academic Press, San Diego, 2013.

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Laeven, Luc, and Fabián Valencia, 2008, "Systemic Banking Crises: A New Database," IMF Working Paper 08/224.

Laeven, Luc, and Fabián Valencia, 2012, "Systemic Banking Crises Database: An Update," IMF Working Paper 12/163.

IV. Supplementary Crisis Models for Advanced Economies [14]

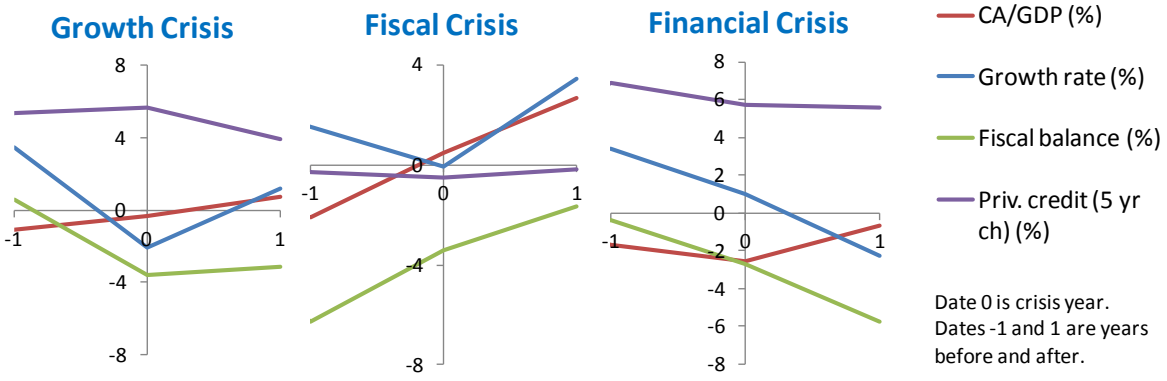
Growth, fiscal and financial crises are defined as follows:

- Growth crises are defined as years when the decline in growth relative to the previous five-year average growth rate has been in the 5th percentile tail.

- Fiscal crises are defined as year-on-year increases in the fiscal balance of 2.5 percent of GDP, from a balance of -2.5 percent of GDP or lower. This definition captures abrupt adjustments but does not take into account the reason for the adjustment.

- Financial crises are defined as banking and currency crises, from the dataset of Laeven and Valencia (2012)[15].

Figure 3. Macroeconomic Dynamics Around AE Crises, 1985-2010



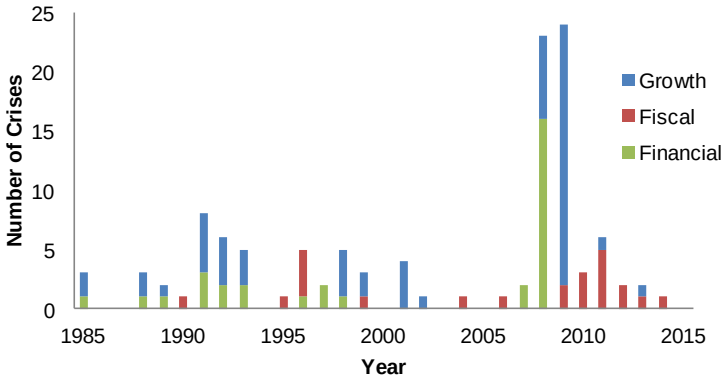
[14] Contributing author: Suman Basu (Research Department, IMF).

[15] Laeven and Valencia (2009, 2012) define a systemic banking crisis as an episode when a country's corporate and financial sectors experience a large number of defaults, and financial institutions and corporations face difficulties repaying contracts on time, with the result that NPLs rise sharply. They define a currency crisis as an episode of nominal depreciation of the currency of at least 30 percent that is also at least a 10 percent increase in the rate of depreciation compared to the year before.

These crises have occurred both separately and alongside each other, and they have different macroeconomic properties. The incidence of these crises, and their overlap, is illustrated in Figures 1 and 2. Growth and financial crises are especially related, but all types of crises do occur alone. As Figure 3 indicates, each type of crisis is associated with different macroeconomic dynamics. For these reasons, it is appropriate to assess the risk of each type of crisis separately.

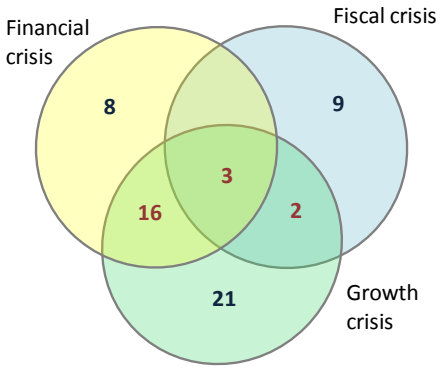
For each type of crisis, a separate crisis probability model is estimated using a signal

Figure 1. Crisis Incidence in AEs, 1985-2015 [1/]



[1/] Data on financial crisis incidence is available up to 2010.

Figure 2. Overlap of AE Crises [1/]



[1/] Crises in the same or adjacent years are regarded as coincident.

extraction approach (Box 1 in reference note). The models are estimated on data from the period 1985-2007: since crises in AEs are relatively rare, including the global financial crisis period would generate an over-fitting problem.

The models use two distinct types of variables to forecast crisis risks (Table 1). *Medium-term variables* are designed to capture the build-up of imbalances over time. Housing and stock prices are used because sustained growth in these variables is likely to be associated with the emergence of asset price bubbles—which are liable to reverse. *Near-term variables* are designed to capture the resilience of the economy to shocks (*e.g.*, price to earnings ratio, capital assets ratio, external debt/GDP) and indicators that asset price bubbles have already begun deflating (*e.g.*, housing and stock price accelerations, which measure the change in housing and stock price growth rates in percentage points relative to the previous year). Household balance sheet vulnerabilities are captured both directly (*e.g.*, household liabilities to GDP ratio) and also through interaction with asset prices (*e.g.*, household liabilities to GDP ratio interacted with housing price acceleration).

Table 1. Data used in the VEA crisis probability models 1/

Variable	Source	Variable	Source
Crisis calculations		**Public sector**	
Real GDP	WEO	General government balance/GDP	WEO
Cyclically-adjusted primary deficit/GDP	OECD EO	Primary gap/GDP 3/	WEO
		Public debt/GDP 3/	WEO
Financial crisis dummy	LV	**Financial sector**	
		Capital adequacy ratio	Bankscope
Medium-term		Return on bank assets	Bankscope
Private sector credit growth (5-yr)	WB WDI	Non-performing loans	Bankscope
Housing price growth (5-yr) 2/	OECD HPD, GPG	**Household balance sheets**	
Stock price growth (5-yr) 2/	Bloomberg	Housing price acceleration 2/	OECD HPD, GPG
Construction sector contribution to GDP growth (5-yr)	OECD	Stock price acceleration 2/	Bloomberg
		Household liabilities/GDP	OECD EO
Financial sector contribution to GDP growth (5-yr)	OECD	Interaction: Household liab./GDP *Housing price growth (5-yr)	OECD EO, OECD HPD
		Interaction: Household liab./GDP *Housing price acceleration	OECD EO, OECD HPD
Near-term		**External Sector**	
Real sector		Current account/GDP	WEO
Black-Scholes-Merton default prob.	CVU	External debt/GDP	EWN, WEO
Return on corporate assets	CVU	External debt/exports	EWN, WEO
Price to earnings ratio	CVU	Deviation from EBA norm	EBA
Interest coverage ratio	CVU		
Inflation	WEO		

1/ WEO = IMF World Economic Outlook, CVU = IMF Corporate Vulnerability Utility, EBA = IMF External Balance Assessment, WB WDI = World Bank World Development Indicators, OECD = OECD Website, OECD EO = OECD Economic Outlook, OECD HPD = OECD Housing Prices Database, GPG = Global Property Guide, LV = Laeven and Valencia (2012), EWN = External Wealth of Nations dataset, updated version of Lane and Milesi-Ferretti (2007).

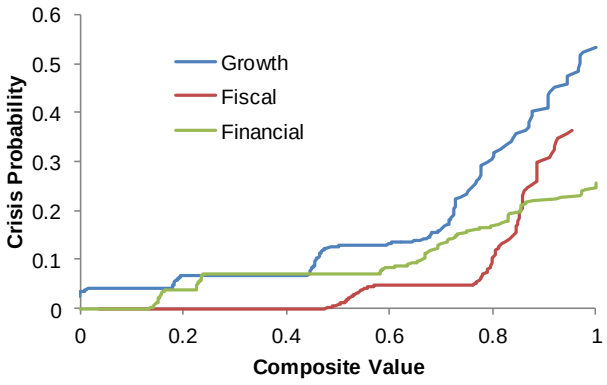
2/ Nominal housing and stock prices are used in the VEA because they interact with nominal contracts held on financial sector and household balance sheets.

3/ Primary gap/GDP and public debt/GDP variables are used only for the fiscal crisis modules of the VEA.

The models allow for inter-sectoral spillovers. Each type of crisis is analyzed in a model featuring variables from all sectors of the economy. Therefore, inter-sectoral spillovers are allowed in reduced-form, *e.g.*, financial sector variables may be estimated to increase fiscal crisis risks if in the historical sample, financial sector distress has caused the realization of public sector contingent liabilities.

Crisis probability estimates are derived using a non-parametric approach. Each model aggregates the threshold breaches of individual variables into an overall composite value using weights determined by the signal-to-noise ratio of each variable . Then, as shown in Figure 4, a non-parametric approach is used to estimate the historical crisis frequency observed at different levels of the composite value. A separate estimation is

Figure 4. Crisis Probability Mapping for AEs



conducted for each type of crisis. Finally, the estimated mappings are used to convert each country's composite values in the current year into crisis probabilities.

References

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Chamon, Marcos, and Christopher Crowe, 2013. "Chapter 34 - Predictive Indicators of Financial Crises," in *The Evidence and Impact of Financial Globalization*, edited by Gerard Caprio, Thorsten

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Laeven, Luc, and Fabián Valencia, 2008, "Systemic Banking Crises: A New Database," IMF Working Paper 08/224.

Laeven, Luc, and Fabián Valencia, 2012, "Systemic Banking Crises Database: An Update," IMF Working Paper 12/163.

Lane, Philip R., and Gian Maria Milesi-Ferretti, 2007, "The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004," *Journal of International Economics*, Vol. 73, pp. 223-250.

V. Policy Implementation Risk[16]

Motivation

Policy implementation risk aims to capture the risk that necessary reforms are not implemented and effective policy responses are constrained due to a divided political landscape, capacity constraints, political upheaval, or military conflict in the most extreme cases. The tools described below are in their infancy and currently rely on a variety of external measures from a diverse set of sources, including indicators for government stability and socioeconomic conditions, political unrest and volatility, and governance.

[16] Contributing Authors: Preya Sharma and Kevin Wiseman

A. Advanced Economies

The assessment is informed by the Political Risk Group's International Country Risk Guide (ICRG) indicators for *Government Stability* and *Socio-Economic Conditions*.

B. Low-income Countries

The assessment is informed by the World Bank's *Governance Indicator of Political Stability and Absence of Violence*.

C. Emerging Markets

Identifying episodes of political stress

Political stress episodes are based on the Cross-National Time Series (CNTS) database. The following six variables are chosen to represent political or social unrest. Political stress episodes are defined as times when the total number of events each year is at least one standard deviation above the mean for each country based on historical data:

- *General Strikes*: Any strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority.
- *Government Crises*: Any rapidly developing situation that threatens to bring the downfall of the present regime - excluding situations of revolt aimed at such overthrow.
- *Riots*: Any violent demonstration or clash of more than 100 citizens involving the use of physical force.
- *Anti-Government Demonstrations*: Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature.
- *Number of Major Cabinet Changes*: The number of times in a year that a new premier is named and/or 50% of the cabinet posts is assumed by new ministers.
- *Changes in Effective Executive*: The number of times in a year that effective control of executive power changes hands. Such a change requires that the new executive be independent of his predecessor.

Selecting political and social indicators

The drivers of episodes of stress are multifaceted, qualitative in nature and are often present for sustained periods of time before erupting. To move toward a quantifiable index capable of monitoring these factors on a timely basis, regression analysis is used to assess which indicators are correlated with episodes of unrest. Eleven subcomponents of the ICRG political risk scores[17] and socio-economic indicators including unemployment, poverty, growth, demographics and inequality are tested. The selected indicators used are shown below. They include seven ICRG scores and four socio-economic indicators which were shown to be well correlated with episodes of stress.

The benefit of using ICRG scores is that they use a consistent methodology to combine political, social and economic information with expert judgment from analysts. In addition, the scores are available on monthly basis from 1985 for most emerging markets, providing a historic and timely set of data. Most of the socio-economic data is slower moving but captures structural features of countries which make them more susceptible to political or social unrest. Inequality, youth unemployment and demographic data are from the World Bank's WDI database. GDP per capita growth data is from the WEO.

Thresholds for each indicator are set at a level which minimizes the likelihood of missed stress episodes and false alarms (based on the methodology described in Box 1 of the reference note)**.** A summary measure is developed as a weighted average of zero/one scores if each indicator breaches the threshold. The weights reflect the relative importance of each indicator in the overall index based on how well it captures episodes of political stress. The weights are normalized and sum to 100.

The ICRG scores which were included are described below[18], where higher scores indicate lower risk:

- *Government Stability*: an assessment both of the government's ability to carry out its declared program(s), and its ability to stay in office. Sub-components include government unity, legislative strength, and popular support.

- *Socioeconomic Conditions*: this assesses socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction. It includes unemployment, consumer confidence and poverty.

- *Internal Conflict*: an assessment of political violence in the country and its actual or potential impact on governance. Its subcomponents are risk of civil war/coup threat, terrorism/political violence and civil disorder.

[17] We test 11 out of the 12 subcomponents of the ICRG political risk score. The investment profile score is not tested as this is less relevant for this analysis.

[18] Descriptions are cited from ICRG Methodology: http://www.prsgroup.com/PDFS/icrgmethodology.pdf

- *Military in Politics*: The military is not elected and can become involved in government because of an actual or created internal or external threat. This could imply the distortion of government policy, for example by increasing the defense budget. It also captures the threat of military take-over which can force an elected government to change policy or cause its replacement by another government more amenable to the military's wishes.

- *Law and Order*: The law component is an assessment of the strength and impartiality of the legal system, while the order sub-component is an assessment of popular observance of the law.

- *Ethnic Tensions*: This component is an assessment of the degree of tension within a country attributable to racial, nationality, or language divisions.

- *Democratic Accountability*: This is a measure of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one.