INTERNATIONAL MONETARY FUND

Managing Volatility: A Vulnerability Exercise for Low-Income Countries

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EXECUTIVE SUMMARY

The pernicious effects of macroeconomic volatility in low-income countries (LICs) are an important impediment to sustained growth and development. Compared to other countries, LICs are particularly vulnerable to sharp swings in commodity prices, natural disasters, and variable external financing flows—as the ensuing high output, price, and fiscal volatility imposes large growth and welfare costs. LICs' growing trade and financial linkages with the rest of the world can confer important benefits through growth and investment, but also increase their exposure to costly spillovers from abroad. At the same time, countries' underlying vulnerabilities can amplify the impact of external shocks, and limit their capacity to absorb and mitigate their impact.

This paper, part of a broader program of work aimed at helping LICs manage volatility and mitigate external shocks, introduces the analytical framework for a Vulnerability Exercise for Low-Income Countries (VE-LIC). The envisaged exercise will strive to identify vulnerabilities and emerging risks that arise from changes in the external environment in a consistent manner across countries and across time. The objective is to strengthen the staff's capacity to spot vulnerabilities and flag potential pressure points in LICs arising from external triggers before they materialize.

The analytical toolkit for the exercise draws on a range of complementary quantitative tools and country-specific expertise. The VE-LIC will systematically monitor vulnerability indicators that gauge individual country risks to sharp growth declines arising from external shocks, and to banking system stress. At the same time, scenario analysis will examine the potential impact of specific plausible global shocks for LICs, quantify the spillover effects, and assess the scope to withstand the resulting pressures. Formal quantitative tools will provide discipline and inform the use of judgment borne out of country-specific experience, while this judgment, in turn, will impart a useful cross-check and bring relevant information to bear on vulnerability assessments.

The output from this exercise, which would be conducted on an annual basis, will strengthen individual country risk assessments, and provide a metric for cross-country comparisons and analyses across country groups and regions, thereby bolstering Fund surveillance of LICs. Assessments of emerging external risks relative to existing policy buffers will help identify areas where buffers would need to be strengthened, and highlight the scope for pre-emptive policy action, thus enhancing the Fund's advice to its low-income country members. The information generated from this exercise will also provide members with early warning of pertinent global tail risks and allow policymakers to design contingency plans.

Glossary

CPIA   Country Policy and Institutional Assessment

DSF   Debt Sustainability Framework

EWE   Early Warning Exercise

FSI   Financial Soundness Indicators

GFSR   Global Finacial Stability Report

LIC   Low-Income Countries

PRGT   Poverty Reduction and Growth Trust

REOs   Regional Economic Outlook

VEA   Vulnerability Exercises for Advanced Countries

VEE   Vulnerability Exercises for Emerging Markets

VE-LIC   Vulnerability Exercise for Low-income countries

WEO   World Economic Outlook

I. Overview[1]

1.   **This paper introduces a framework for assessing vulnerabilities and emerging risks in low-income countries (LICs) that arise from changes in the external environment**. The proposed Vulnerability Exercise for Low-Income Countries (VE-LIC) will provide a systematic framework to "connect the dots" between vulnerabilities, potential tail risks in the global outlook, and their repercussions for countries and regions. The objective is to flag and assess resilience to emerging risks—and their mapping with underlying structural and policy vulnerabilities that make a country more prone to economic distress in the event of an external shock—before they materialize. The exercise is part of a broader program of work aimed at helping LICs manage volatility and mitigate external shocks.[2]

2.   **The unique features of LICs suggest a different approach to vulnerability analysis than that used for more advanced economies.** The vulnerability exercises for emerging markets (VEE) and advanced countries (VEA), focus on capital account (VEE) or systemic financial sector crises and growth recessions (VEA) that have the potential to trigger significant contagion and dislocation on a regional or global scale. For LICs, by contrast, the focus is primarily defined by their vulnerability to sharp growth declines arising from external shocks, which can generate substantial welfare losses and social dislocation. The framework seeks to assess these risks and vulnerabilities in a systematic way across countries. While domestically-generated shocks also have the potential to disrupt growth, analysis of these is less amenable to standardized cross-country tools. To the extent that such home-grown risks are considered to be significant in specific country cases, they are evaluated by area department teams and reflected in countries' vulnerability assessments.

3.   **This paper sets out a multi-dimensional approach to capture LIC-specific risks and vulnerabilities to external shocks.** LICs are prone to marked fiscal and external instability, debt distress, banking system stress, and steep output drops triggered by sharp swings in the terms of trade and volatile external financing flows.[3] The attendant welfare impacts are particularly pronounced relative to other countries because of their poverty and limited ability to smooth consumption. The envisaged exercise will analyze vulnerabilities through two complementary quantitative approaches. First, it will monitor *vulnerability*

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[2] A forthcoming companion paper will discuss the role of contingent instruments for managing volatility in LICs. A separate paper will review the macroeconomic and policy challenges of LICs facing fragilities, including those arising from fragile political environments and weak institutional capacity.

[3] Capital account crises are rare, as compared to emerging markets, although this could change with their growing global integration.

indicators that assess individual country risks to sharp growth declines arising from external shocks, and to banking system stress. Second, it will conduct *scenario analysis* to quantify LICs' exposure to specific plausible risks, estimating fiscal and external financing gaps, the risk of excessive adjustment, and the growth impact, in the event of specific adverse global scenarios. Vulnerability assessments for individual countries will combine these formal methods with judgment borne out of country-specific expertise.

4. **The exercise does not aim to predict the timing of crises or acute economic distress.** Past attempts at crisis prediction have a mixed record at best. The exercise instead strives to flag the underlying vulnerabilities that predispose countries to economic disruption in the event of external shocks, and examine the interaction of vulnerabilities with emerging external risks, thereby providing a first indication of a possible problem and signaling the potential for pre-emptive policy action to reduce vulnerabilities. Data gaps and limitations, and the diverse nature of risks facing LICs, including those that arise from idiosyncratic factors, inherently limits the ability of cross-country quantitative analysis to identify all pertinent risks or to take full account of country-specific factors. But it can usefully point to potential vulnerabilities that lead to further analysis.

5. **Refining and developing additional quantitative tools to assess risks and vulnerabilities in LICs, remains key.** The methodological framework set out in this paper represents work in progress and will continue to evolve. Further work will be needed to improve the quantitative tools in order to enhance the identification of risks and strengthen the analysis of inward spillovers.

6. **The proposed exercise will bolster the existing surveillance toolkit for LICs.** By applying a consistent, rigorous quantitative approach, the exercise can provide an early indication of vulnerabilities and key risks across countries and country groups, and inform policy advice, both for purposes of prevention and contingency planning. In particular, it can:

- *Strengthen country risk assessments:* The exercise could help area departments strengthen the discussion of external risks, inward spillovers, and linkages in bilateral and regional surveillance. Quantitative tools and data produced by the exercise could additionally be utilized to inform and complement country-specific vulnerability assessments and enhance the policy dialogue with authorities.

- *Generate actionable information***:** An assessment of emerging risks relative to existing buffers could inform the availability of policy space to withstand potential future shocks, identify areas where policy buffers would need to be strengthened, and indicate the need for additional concessional financing or adjustment.

- *Facilitate cross-country assessments and analysis:* The exercise would generate comparative information on LICs' vulnerabilities, providing a metric for cross-country comparisons and for analyses of trends in LICs' underlying vulnerabilities. It would also

provide an efficient vehicle for undertaking periodic cross-country studies on the impact of global developments in LICs and associated policy challenges.[4]

7.   **The paper is structured as follows.** Section II makes the case for the exercise. Section III sets out the conceptual considerations underpinning the analytical framework. Section IV describes the analytical components for the envisaged exercise. The costs and proposed operational modalities of the exercise are described in Section V.

II.   WHY A VE-LIC IS NEEDED

8.   **Compared to other countries, LICs are more susceptible to exogenous shocks.** The frequency, incidence, and economic consequences of external shocks affecting LICs—sharp swings in commodity prices or export volumes, volatile external financing flows, and natural disasters—tend to be higher than in advanced and emerging market countries (Annex 1). Undiversified economic structures and weaker policy and institutional buffers play a key role in propagating shocks through the wider economy. While there is mixed evidence on the relative importance of external versus idiosyncratic shocks—those resulting from policy choices, political turmoil, and luck (e.g. the weather)—in explaining output volatility in LICs, research suggests that external shocks contribute to large output losses and protracted growth slowdowns in LICs.

9.   **The resulting macroeconomic volatility imposes large welfare costs.** The ensuing swings in output, prices, or government finances generate disproportionate consumption volatility for LICs (Figure 1) because of under-developed social safety nets, liquidity constraints, limited risk diversification opportunities on account of shallow financial markets, and other structural impediments. With so many people already near subsistence in these economies, consumption declines can be disastrous. In cases where thin domestic financial markets and weak buffers leave little room for maneuver, fiscal policy itself can amplify the impact of shocks. Stop-and-go public investment and uncertain provision of basic public serves (especially health and education) impose large immediate and long-term costs (World Bank, 2006; Baldacci et al., 2008).

10.   **External risks in LICs have intensified on account of growing trade and financial linkages with the rest of the world (Figure 2).** Increased global integration has been shown to confer significant benefits in terms of economic growth, risk sharing and economic efficiency, but can increase exposure to spillovers from abroad.[5] As LICs continue

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[4] While the Fund has stepped up its efforts to produce such analyses in recent years, such as those undertaken for the food and fuel and the global financial crises, they have not been produced on a regular basis and incorporated into a systemic framework.

[5] Global integration can reduce or help mitigate some risks. For example, access to capital markets may allow countries to smooth some types of shocks, such as to the weather. And the integration itself--through greater trade linkages--can support improved institutions, and thus lessen domestically-driven risk (Johnson et al., 2007).

to integrate into the global economy they will become increasingly exposed to global volatility, as put into sharp focus by the 2007-08 food and fuel price shocks and the global crisis. The growing importance of dynamic emerging markets (such as the BRICs) as destinations for LIC exports and sources of financial flows has increased their diversification but also creates new potential spillover risks (IMF, 2011). In addition, financial sectors of many LICs have also become increasingly linked to regional or global cross-border flows. Consequently, LICs face heightened risks from both common shocks and the spillovers effects of downturns in specific countries and regions through various transmission channels.[6]
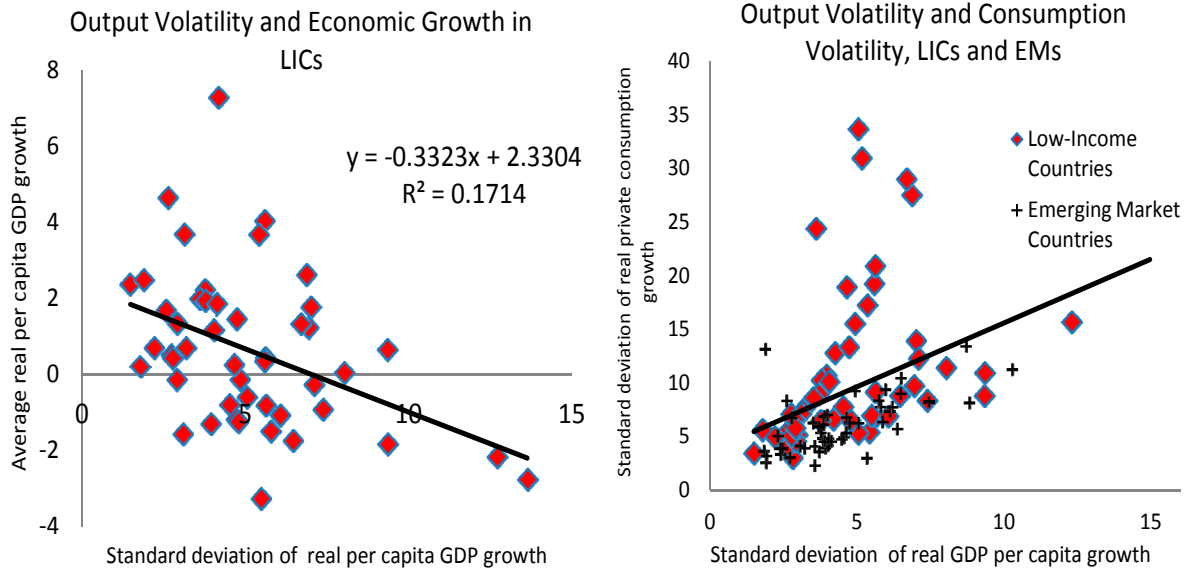
11. **Underlying vulnerabilities in LICs can amplify the impact of future external shocks.** Notwithstanding marked improvements in macroeconomic positions over the past decade, vulnerabilities remain in many LICs. A number of LICs face fragilities defined by their weak institutions, ongoing or recent conflict, and high poverty levels, which put them in a weak position to cope with the effects of shocks and to mediate their social impact. Moreover, progress in strengthening resilience has been uneven across LICs. In some countries, macroeconomic positions have weakened in the wake of the global financial crisis, as policy buffers were expended, and about 40 percent of countries continue to face a high risk of debt distress or to be in debt distress. Such underlying structural and policy vulnerabilities could limit their capacity to absorb future external shocks, including through countervailing policy measures.[7] This also accords with the assessment of the LIC experience in the global crisis: countries that entered the crisis with stronger policy fundamentals weathered it relatively well, with greater scope than in the past to mount a countercyclical fiscal response (IMF, 2010).

12. **These factors taken together argue for a systematic, forward-looking approach that identifies vulnerabilities and emerging risks in LICs, and highlights the scope for pre-emptive policy action.** While concerns about the systemic nature of risks or potential for outward contagion are less pertinent than in mature and emerging economies, the economic and poverty repercussions of the materialization of risks from the external environment can be substantial. Identifying trends that leave countries vulnerable to such events is thus an essential component of a strategy for managing macroeconomic volatility in LICs and increasing resilience to shocks from abroad.

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[6] The increasingly prominent role of the external environment in determining LIC growth prospects is discussed in Dabla-Norris et al., 2010a,b; and Drummond and Ramirez, 2009.

[7] The importance of underlying structural and policy vulnerabilities in reducing resilience to shocks is well established in the empirical literature (see Collier et al., 2006; Acemoglu et al., 2003; and Rodrik, 1999).

Figure 1. Macroeconomic Volatility in LICs, 1980-2009

Output Volatility and Economic Growth in LICs

$$y = -0.3323x + 2.3304$$
$$R^2 = 0.1714$$

Average real per capita GDP growth

Standard deviation of real per capita GDP growth

Output Volatility and Consumption Volatility, LICs and EMs

Standard deviation of real private consumption growth

Standard deviation of real GDP per capita growth

♦ Low-Income Countries

+ Emerging Market Countries

Source: WEO; Fund staff calculations.

Note: Emerging market countries include countries covered in the VEE.

Figure 2. Growing Integration between LICs and the Global Economy

Ratio of FDI, Remittances and Exports to GDP Low-income countries, 1980-2008 (median)

Percent of GDP

1980-1994
1995-2004
2005-2008

FDI/GDP   Remittance/GDP   Export/GDP

Source: WEO; Fund staff

Contributions to Variations in Growth in LIC Regions 1992 -2008

GDP growth in AMs and EMs
Commodity prices
Country and idiosyncratic

Asia   CIS   LAC   SSA
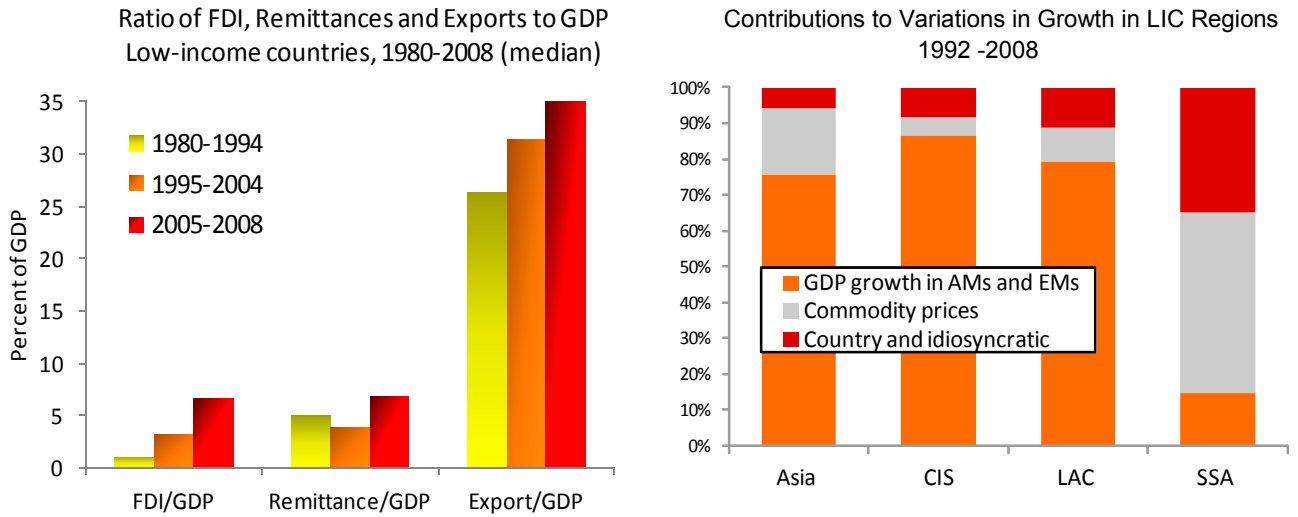
Source: Dabla-Norris et al. (2011)
Note: Generated from variance decomposition of VAR regression

III. CONCEPTS AND SCOPE

13. **The conceptual framework distinguishes between external risks and underlying vulnerabilities.** This distinction is supported by the LIC experience in the global crisis as well as empirical models of the economic impact of external shocks in LICs. Underlying vulnerabilities can arise from weak economic fundamentals, such as macroeconomic imbalances or poor public financial management, or from structural factors, such as narrow revenue bases and current expenditure rigidities. They may persist for long periods without necessarily leading to an immediate economic disruption, but they expose an economy to risks by amplifying the impact of external shocks (Figure 3). The risk of being adversely affected by exogenous shocks thus reflects the confluence of a high likelihood of such shocks together with a sizable underlying structural and/or policy vulnerability.

Figure 3. Risk Associated with being Adversely Affected by External Shocks

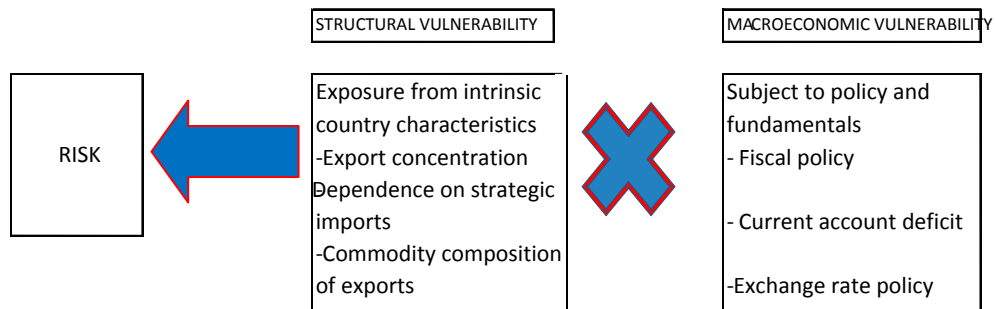|	STRUCTURAL VULNERABILITY		MACROECONOMIC VULNERABILITY
RISK	Exposure from intrinsic country characteristics -Export concentration Dependence on strategic imports -Commodity composition of exports		Subject to policy and fundamentals - Fiscal policy - Current account deficit -Exchange rate policy

14. **This distinction between risks and underlying vulnerabilities allows for greater clarity in assessing the scope to withstand and manage shocks**. Countries with severe vulnerabilities may face low risks of economic disruption in a favorable global environment, while countries with low vulnerabilities will likely face low risks, even in an adverse environment. This conceptual distinction can contribute to providing a measure of the available policy space, as well as signal the kinds of policy challenges LICs will face under less benign global conditions.

15. **The variety of external shocks and of propagation mechanisms argues for the use of a multi-pronged approach.**

- The focus of the exercise is primarily defined by LICs' exposure to sharp declines in growth in the event of external shocks (Annex 1). There are numerous types of shocks facing LICs, and these can manifest themselves in different sorts of severe economic distress (such as declines in consumption or balance of payments crises). An overarching focus on growth, coupled with supporting analysis of pressure points in the external and fiscal accoutns, is an efficient way to capture most of these manifestations. It also focuses

directly on a variable of concern to policymakers—real output growth. In addition, as highlighted by the recent global crisis, while the direct financial sector impact of shocks can be muted in LICs, reflecting their still limited financial integration, these economies can face significant risks of an adverse feedback loop between the real economy and the financial system.

- Quantifying the impact of plausible near-term systemic external risks through scenario analysis can provide important complementary information by articulating the specific pressure points. Past experience shows that adverse shocks translate in LICs into sharp declines in fiscal revenue—reflecting narrow and volatile tax bases (Gupta et. al., 2005)—and increased borrowing requirements, balance of payments pressures, heightened debt risks, and the likelihood of painful adjustment (IMF, 2003; IMF, 2009).

16. **The nature of the risks, cross-country heterogeneity, and data limitations shape the scope and methodology of the exercise**.

- **Capturing relevant transmission channels.** In contrast to advanced and emerging market countries, the dominant transmission channels of inward spillovers in LICs largely reflect real-side linkages: trade flows, FDI, remittances, terms of trade, aid, and, to a lesser extent, financial sector flows.[8] The impact of common shocks—such as global recessions, falling commodity prices, or rising global interest rates—could vary significantly across countries, depending on the degree of dependence on specific export markets, reliance on specific products and services (e.g., commodities and tourism), or financing (e.g., remittances versus aid).

- **Accounting for cross-country heterogeneity.** LICs are more heterogeneous as a group than the countries covered in the VEE and the VEA. While some countries have gained market access and are increasingly exposed to volatility of private capital inflows, others remain in fragile situations; commodity exporters also face inherently different challenges than importers. Accordingly, the exercise would need to account for a wide range of country circumstances, while avoiding undue fragmentation in the analytical framework. Possible country groupings could include commodity exporters/importers, fragile states, small islands, and more/less financially integrated countries, in addition to geographic regions.

- **Balancing coverage and depth.** Given data limitations in LICs, the exercise needs to craft a balance between maximizing the breadth of country-coverage and depth of the analysis (see Annex II for country coverage). The timeliness, frequency, and availability of relevant macroeconomic and financial sector data vary significantly across LICs. For some countries, a detailed breakdown of the components in the fiscal and external accounts or on domestic debt markets is simply not available. These data gaps and

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[8] This is in contrast to advanced and emerging market countries, where risks of common distress across financial institutions, sovereigns, or asset markets feature more prominently in the vulnerability assessments.

weaknesses are a key constraint on the coverage of potential indicators and analytical tools that could be utilized across a wide spectrum of LICs.

IV. ANALYTICAL COMPONENTS

17. **The VE-LIC's quantitative analysis rests on two complementary approaches**: (i) model-based analyses to identify *underlying vulnerabilities* to sharp growth declines in the event of large external shocks, and to banking system crises, and (ii) spillover and scenario analysis to quantify the impact of *specified global tail-risks* (low-probability, high-impact events) on LICs' growth prospects, and on their fiscal and external accounts. An illustration of the structure of the exercise is provided in Figure 4. This section provides a description of the methodology underlying each of these two approaches, describes the operational framework for vulnerability assessments, and outlines priority areas for further development of the analytical framework.

Figure 4. Analytical Components of the VE-LIC
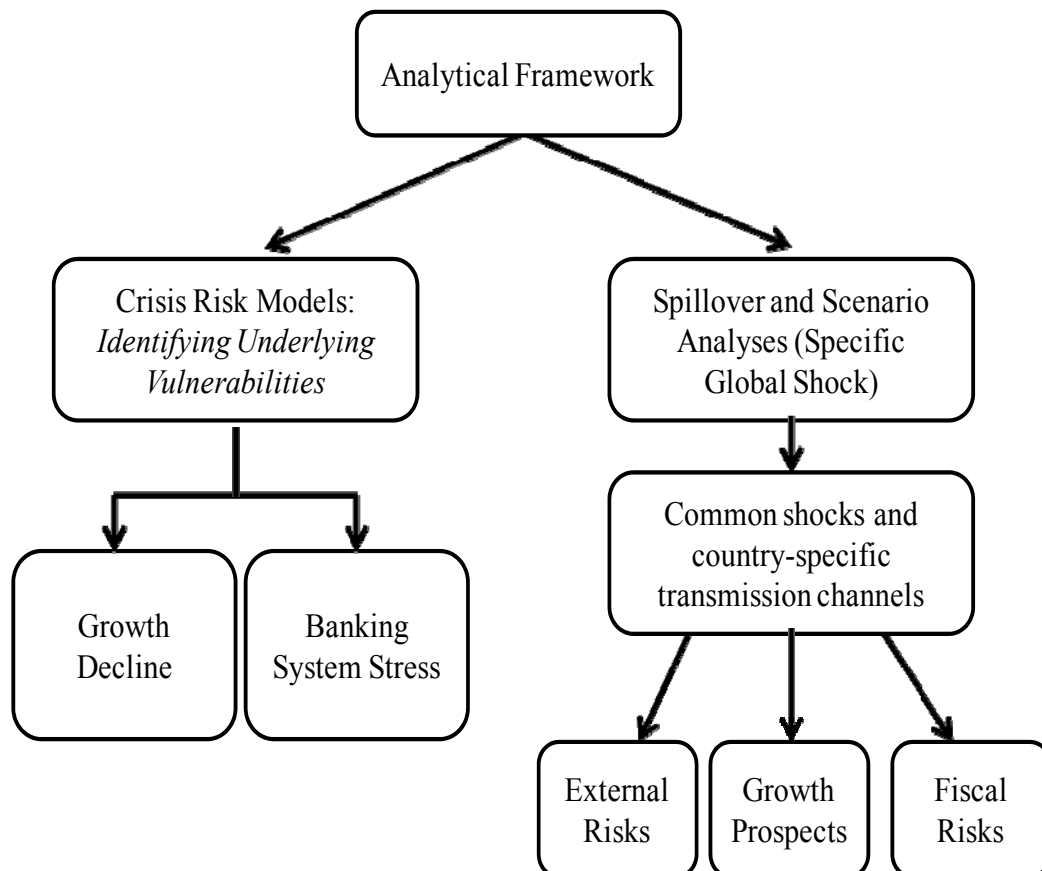
A. Assessing Underlying Vulnerabilities

18.   **Crisis-risk models are used to quantify countries' overall vulnerability to growth declines in the event of external shocks, and to banking system crises**. Such models typically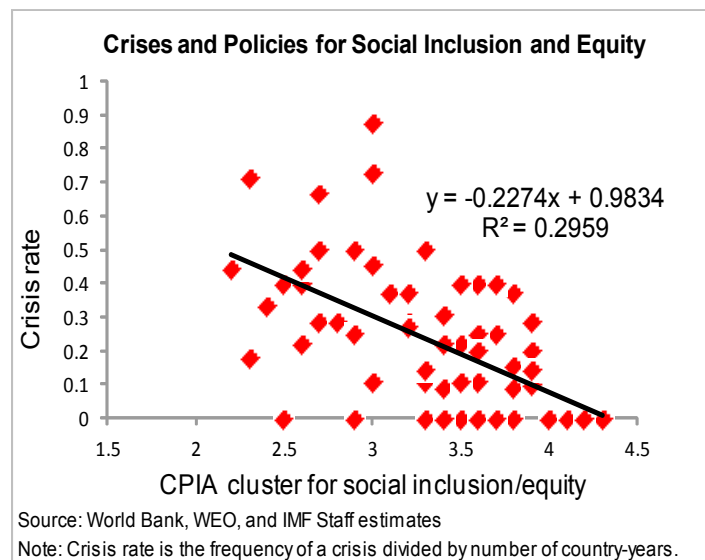 extract information from the correlation of various economic and financial fundamentals with past crisis events. An empirical methodology similar to the VEE and the VEA will establish a range of economic vulnerability indicators for individual countries.

Methodology of the vulnerability index for growth crises

19.   **The VE-LIC's growth decline vulnerability index provides a summary measure of underlying vulnerabilities in the event of large external shocks**. The approach taken here is to identify observations (country-years) in which a country is hit by a severe external shock (external demand, terms of trade, FDI, aid, remittances, or a natural disaster). A "severe" shock is deemed to have occurred if the annual percentage change in one or more of the relevant shock variables falls in the bottom 10 percent of the country-specific frequency distribution for the variable(s) concerned.[9] Within this sample of shock events, we identify *growth crises*, defined as episodes in which the country experiences negative per capita real GDP growth in the year of the shock, as well as below-trend output per capita level in the two post-shock years (Annex II has further details). Lagged values of various economic and structural "vulnerability indicators" (see below) are then used to predict whether a country hit by a shock also experiences a growth crisis.

20.   **The vulnerability indicators are selected based on the experience in previous crisis episodes.** A large number of indicators were considered based on empirical studies of growth declines and protracted growth slowdowns in LICs in the event of exogenous shocks. These include indicators of overall economic health (past real GDP growth and inflation), external indicators (export growth reserves, current account balances, external debt) and public sector indicators (government spending, the fiscal balance, revenue growth, and public debt).[10] Given the key role played

Crises and Policies for Social Inclusion and Equity

$y = -0.2274x + 0.9834$
$R^2 = 0.2959$

Crisis rate (y-axis)
CPIA cluster for social inclusion/equity (x-axis)

Source: World Bank, WEO, and IMF Staff estimates
Note: Crisis rate is the frequency of a crisis divided by number of country-years.

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[9] For analytical purposes, a distinction can be made between the frequency and strength of shocks affecting a country, and the effect that a shock of a given size and frequency can have on a country's output. In this analysis, we focus on the second type of vulnerability by standardizing the frequency of shocks to isolate the impact on growth of country fundamentals and characteristics.

[10] A number of financial sector variables were also considered, but their explanatory power was found to be weak, in part, reflecting the stronger feedback loop in LICs from the real economy to financial systems.

by weak institutional capacity in amplifying the impact of shocks in LICs (see chart), the World Bank's Country Policy and Institutional Assessment (CPIA) index is also included as a proxy for institutional quality.[11]

21.   **Statistical analysis is used to derive an overall vulnerability index from the historical relationships between growth declines and the various indicators.** For each potential indicator, the power to discriminate between crisis and non-crisis cases in the paneldata set of shock events is examined using a univariate approach. This approach involves searching for a threshold value that minimizes a weighted sum of the fraction of crises missed ("missed crises") and the fraction of non-crises called as crises ("false alarms"). Given that crises are costly, the approach penalizes missing crises more heavily than calling false alarms. If an indicator crosses the relevant threshold ("raises a flag"), it is interpreted as signaling an appreciably higher probability of crisis.[12]

22.   **The individual indicators are then aggregated into sector indices, and the sector indices into an overall vulnerability index.** The aggregation uses weights given by the relative explanatory power (goodness-of-fit) of the individual indicators or sectors. The overall vulnerability index is thus the weighted average of the "flags raised". Finally, this overall index is mapped into vulnerability ratings (high, medium, or low) by imposing cut-off values.[13] Figure 5 shows the indicators used in the computation of the index, as well as the indicator and sector weights.[14]

23.   **The robustness of the univariate approach is tested by using alternative multivariate models.** The univariate approach was chosen on the basis of consistency, given its use in the VEE and VEA, and its ability to include a potentially larger number of variables. Multivariate estimation provides a useful robustness test, however, given its ability to allow for interaction among indicators. The estimated thresholds from multivariate methods were found to be broadly similar to those estimated one at a time, providing some comfort in the robustness of the chosen thresholds. Annex III describes the index

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[11] The CPIA is a broad indicator of the quality of a country's present policy and institutional framework. It is based on 16 criteria which are grouped into four clusters: economic management, structural policies (related to trade, financial depth and labor and firm flexibility), policies for social inclusion and equity, and public sector management and institutions.

[12] These thresholds may be different from those derived for other crisis events, such as the thresholds for external debt derived in the debt sustainability framework, which correspond to the probability of experiencing external debt distress. Moreover, the thresholds in this model identify growth crisis events conditional on external shocks, which could differ from unconditional thresholds derived from all growth crisis events.

[13] The cut-off value for a high rating is estimated by minimizing the combined percentages of missed crises and false alarms for the overall index. The discrimination between medium and low rating was based on a threshold which corresponds to a probability of crisis of one third if the overall index is above the chosen threshold.

[14] The indicators included in the construction of the index were culled from a larger set (see Annex III). Considerations used to exclude indicators included weak model performance.

methodology in greater detail, including the definition of the crisis event, indicators, and the results from alternative approaches.

24.   **The vulnerability index performs fairly well in identifying crisis-prone** countries **both in and outside the data sample.** Over the 1990-2008 period, the index correctly calls 80 percent of the crisis cases, while 71 percent of the non-crisis cases are correctly classified.[15] The overall vulnerability index far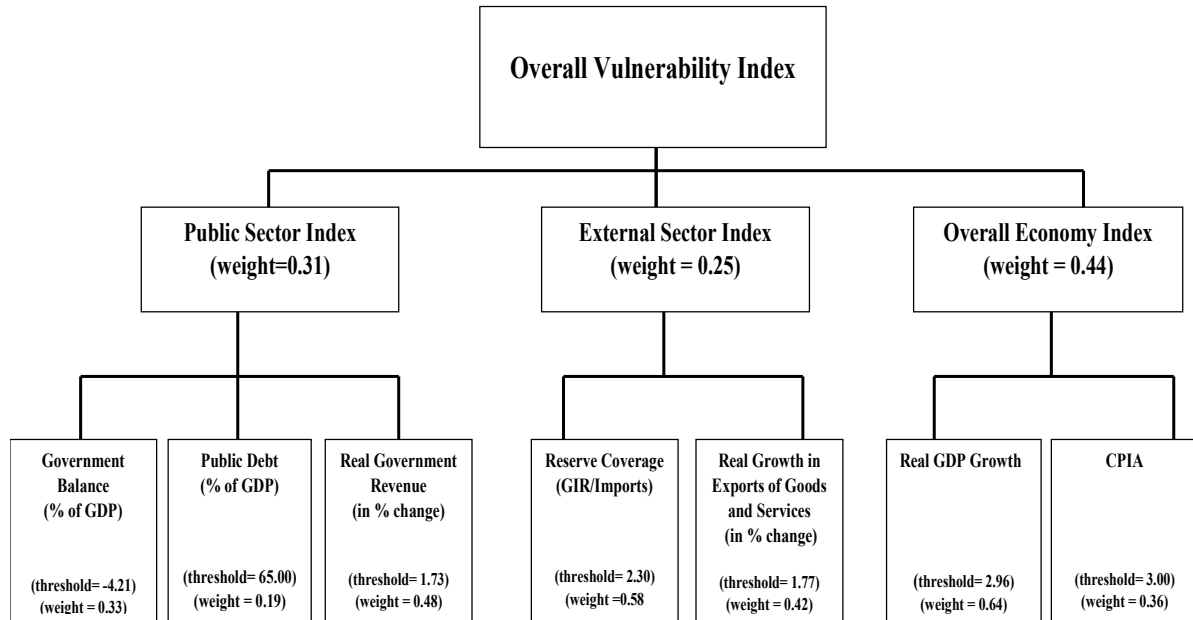es much better than any of the individual indicators that feed into the index (see chart). The overall index also performs well in explaining growth crises in LICs during the recent global recession. The model's out-of-sample predictions for 2009 correctly flagged 9 out of the 13 countries (70 percent) that experienced a "growth crisis," while false alarms occurred in only 15 percent of the non-crisis cases. Moreover, two out of the four crisis cases missed would have been flagged as

being moderately vulnerable by the index. While out-of-sample predictions tend to be weaker than in-sample performance, these results provide additional evidence of the model's goodness-of-fit.

Growth Vulnerability Index: In-Sample Misclassification Errors

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

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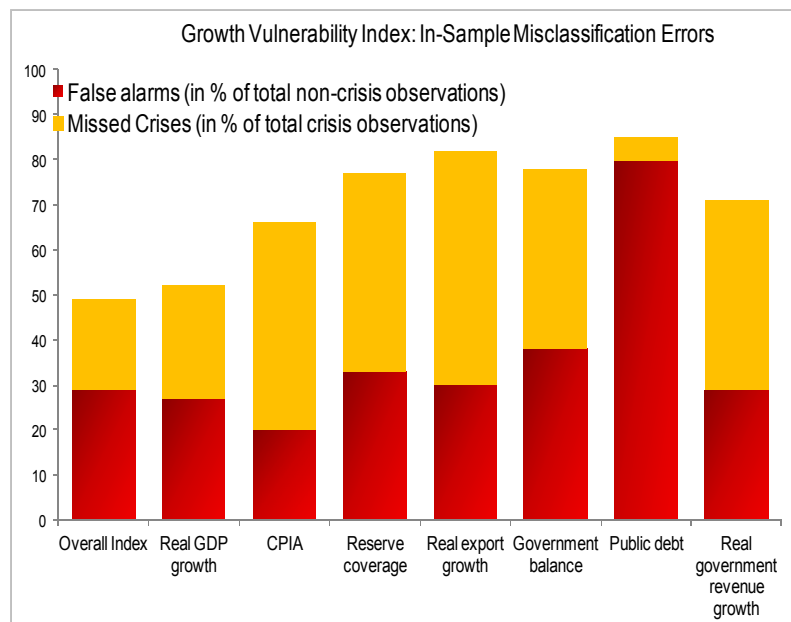
[15] The model also compares well with the in-sample prediction errors of the model included in the VEE and other early warning models developed in the Fund. The sudden-stop model developed for the VEE correctly called 60 percent of crisis cases, while 75 percent of the non-crisis cases were correctly specified (see SM/07/328). However, this comparison should be interpreted with caution because these models differ from the analysis underlying the VE-LIC's vulnerability index in terms of crisis definition, indicators, and country coverage.

Figure 5. Growth Decline Model: Vulnerability Indicators and Weights by Sector

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                        ┌─────────────────────────────┐
                        │  Overall Vulnerability Index │
                        └─────────────────────────────┘
              ┌──────────────────┼──────────────────┐
    ┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
    │ Public Sector    │  │ External Sector  │  │ Overall Economy  │
    │ Index            │  │ Index            │  │ Index            │
    │ (weight=0.31)    │  │ (weight = 0.25)  │  │ (weight = 0.44)  │
    └──────────────────┘  └──────────────────┘  └──────────────────┘
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Government Balance (% of GDP)	Public Debt (% of GDP)	Real Government Revenue (in % change)	Reserve Coverage (GIR/Imports)	Real Growth in Exports of Goods and Services (in % change)	Real GDP Growth	CPIA
(threshold= -4.21) (weight = 0.33)	(threshold= 65.00) (weight = 0.19)	(threshold= 1.73) (weight = 0.48)	(threshold= 2.30) (weight =0.58)	(threshold= 1.77) (weight = 0.42)	(threshold= 2.96) (weight = 0.64)	(threshold= 3.00) (weight = 0.36)

Assessing vulnerabilities to banking crises

25.   **The VE-LIC's banking crisis vulnerability index will estimate the likelihood of a country undergoing severe banking system stress.** Banking crises typically impose large fiscal and output costs, and contribute to raising poverty levels in developing countries (Caprio and Klingebiel, 2003). Experience suggests that external shocks can have adverse feedback loops to LIC financial systems. Strains in the banking sector—banks dominate the financial systems in LICs—can materialize as negative shocks trigger a deterioration in loan portfolios, increase credit risk, and reduce liquidity buffers to deal with liquidity shocks.[16] These effects are amplified if domestic policies are lax, financial systems are shallow, and if there are existing banking sector vulnerabilities (such as high shares of nonperforming loans (NPLs) and low capital adequacy ratios). At the same time, positive real and/or financial shocks can fuel lending cycles and mask banking sector soundness.

26.   **The methodology for identifying vulnerabilities to banking system stress is based on a similar approach to that used for "growth crises."[17]** A banking crisis in LICs is identified when a country's banking system experiences a large number of defaults, a sharp

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[16] The potential deterioration in asset quality is magnified by substantial risk concentration that prevails in a number of LICs.

[17] Unlike the growth crisis index, however, the banking crisis index estimation procedure is not restricted to observations in which a country has been hit by a negative external shock. Thus, factors that contribute to stand-alone banking crises are also analyzed. In part, this reflects the fact that banking crises are relatively rare events compared to growth crises as we define them, so that restricting to a shocks-only sample would not provide adequate data.

increase in non-performing loans, bank runs, or a marked increase in interest rates. Macroeconomic and banking system indicators (such as NPLs, capital adequacy ratios, and rapid credit growth) that foreshadowed past crises are drawn from the empirical literature on banking crises in developing countries. As with the growth vulnerability index, the approach consists of examining a range of indicators one-by-one to identify thresholds that best separate crisis and non-crisis cases in the dataset. The overall banking crisis vulnerability index is a weighted average of the flags raised in three sectors: overall economy and public sector, the external sector, and the banking sector. Annex IV describes the index methodology, including the definition of the crisis event and indicators.

B. Spillovers and Scenario Analysis

27.   **In addition to the vulnerability indices, the exercise will use complementary spillover models and scenario analysis to assess a country's vulnerabilities to specific global shock scenarios**. The nature of the scenarios to be analyzed would vary across rounds of the exercise, depending on global conditions and perceived risks at the time. In general, however, the analysis of downside risks contained in the WEO and GFSR, and the identification of global tail-risks from the IMF's Early Warning Exercise (EWE), would be expected to feed into the VE-LIC. The topic would change for each round, and would be determined in consultation with departments as part of the work program.

28.   **Having identified the potential global shocks, the next step is to assess the impact on LICs.** This analysis draws on in-depth, systematic analyses of the relevant transmission channels to capture susceptibility to different types of shocks. The topical analysis could include, for instance, a discussion of the implications of a sharp increase in food and fuel prices for LICs, the knock-on effects on LICs of higher world interest rates, or a sudden change in the aid and trade policy environment. The main transmission channels considered are trade linkages, foreign direct investment, aid, and remittances.

29.   **A number of empirical tools and model simulations have been developed to quantify the spillover effects.** To capture exposures to different advanced and emerging market countries, the analysis relies on bilateral data on trade, aid, FDI, and remittance flows to LICs (Figure 6). It draws upon recent studies that employ panel regression models to quantify the impact of changes in advanced and emerging market economy growth and financial market conditions on trade and specific financing outflows to LICs. Data on exports, FDI, remittances, and aid shares are combined with the estimated elasticities from the regression analysis to compute the potential spillover effects on trade and financing flows for individual countries. Country-specific trading patterns are used to translate global commodity price changes into country-specific terms of trade effects.

Figure 6. Spillover Channels to LICs from Advanced and Emerging Market Countries
(In percent of total inflows)
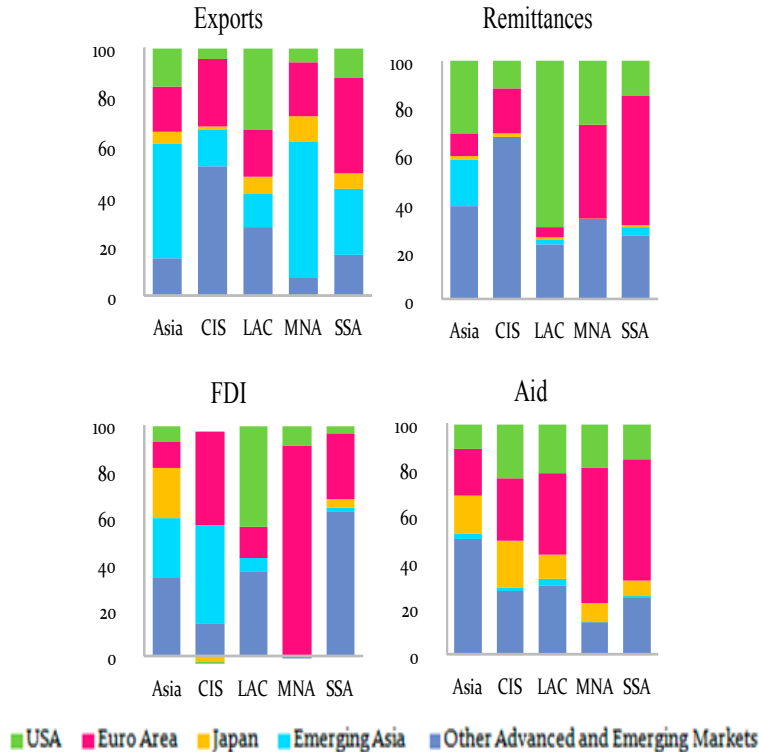
Source: COMTRADE database, World Bank, OECD, and IMF staff estimates.
Note: MCA: Middle East & North Africa; LAC: Latin America & Caribbean; SSA: Sub-Saharan Africa; CIS: Commonwealth of
Independent States.

30. **Scenario analyses will involve examining a range of indicators in different sector "modules".** Scenario analyses undertaken for the VE-LIC will be anchored on baseline country-specific projections reported in the WEO, and the key scenario parameters based on the analytical tools described above. The simulations will generate estimates of financing shortfalls in the fiscal and external accounts resulting from adverse external shocks, while the sectoral indicators will highlight the scope to withstand the resulting pressures, thus capturing risks along multiple dimensions. Examples of the potential coverage of indicators in these modules, which could vary depending on the shock scenario for the specific round of the exercise, includes:

- **Growth prospects**. This module assesses the implications for LICs' growth of downside/tail-risks risks to global growth and associated changes in commodity prices.[18] The potential downside effects on growth are calculated using information on country-specific terms of trade changes, partner country trade weights, and drawing on recent empirical models that estimate LICs' growth elasticities to trading partner growth.

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[18] The analysis would make use of RES's Global Projections Model (GPM), which quantifies risk to global growth at the regional level for major advanced and emerging market countries.

- **External sector.** The external module derives estimates of gross financing gaps for individual countries that could arise on account of the adverse scenario. Large gross financing gaps would then indicate vulnerability to short-term financing pressures. The effects of possible policy responses to emerging financing shortfalls are also analyzed. Specifically, indicators examine how a draw-down of reserves to cover the financing shortfalls affect reserve cover, and the potential for import compression in the absence of adequate reserve buffers.

- **Fiscal sector.** The fiscal module assesses the additional budget financing needs arising from the adverse scenario. This analysis captures country-specific conditions, including the size of revenue and spending elasticities to key macroeconomic parameters (e.g., economic growth), government revenue and expenditure composition, and the level of public expenditures. This is complemented by additional indicators to assess budget rigidities and revenue exposure to changes in the macroeconomic variables under the adverse scenario. An indicator of fiscal space measures the extent to which countries have room to respond to the shock without curtailing priority expenditures, taking into account pre-shock debt levels and fiscal deficits.[19]

C. Summary Country-Specific Assessments

31.   **The number of flags raised by the different components conveys a measure of each country's vulnerabilities.** For the crisis-risk models, the model outcomes are aggregated first by sector, and then across sectors to arrive at overall country ratings for the risk of a growth decline and banking system stress. Each module for the scenario analysis provides a rating (or quartile position) to quantify the extent of relative vulnerability for the various indicators (for e.g., size of financing gaps in response to shocks). The identified vulnerabilities for the indicators in the scenario analysis are aggregated by sector (external, fiscal, and growth) using equal weights to derive sectoral vulnerability ratings. Reflecting the wide variety of risks faced by LICs and their relative heterogeneity, there would be no attempt to create a summary vulnerability rating that aggregates across all the models and sectoral indicators for each country. Instead the flags raised by the different analytical components would be collated for each VE-LIC round and presented in a regular structure.

32.   **The quantitative analysis could, however, fail to capture country-specific information that is relevant to the assessment of vulnerabilities.** For instance, political instability and other home-grown shocks, are not only a source of macroeconomic instability in their own right, but can also affect a country's ability to respond to external shocks. A standardized cross-country quantitative approach will not adequately reflect such individual country circumstances. Similarly, data gaps and shortcomings, which are particularly acute in LICs, could weaken the conclusions stemming from the analytical tools. Judgment borne out

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[19] The analysis of fiscal space is also informed by country risk ratings on external debt as identified by the Debt Sustainability Framework (DSF).

of country-specific expertise can play an important role both to inform and assess results from quantitative tools, including the appropriateness of estimated elasticities and variables included in the vulnerability indices.[20]

33.   **Consequently, the vulnerability assessments will involve a two-stage process, combining quantitative analysis with judgment.** First, a uniform methodology would be applied to derive numerical ratings as described above. These would provide an objective starting point for the assessment and facilitate cross-country comparisons. Second, the quantitative assessments would be vetted by area departments. By scrutinizing the results derived from the quantitative analysis, they would bring to bear factors that may be relevant to the assessment of a country's vulnerability, but are not adequately captured by the quantitative tools. The examination may bring to light suggested areas for changes to the assessment. These judgment-based adjustments would then be incorporated in the final country assessments.

34.   **An illustration of the exercise based on an interdepartmental dry-run conducted earlier this year is presented in Annex V.** The findings of the analytical tools developed to date, including the growth decline and banking system stress models are presented. The simulation for the scenario analysis assesses the implications for LICs of a double-dip recession in the global economy in 2011-2012 (a downside scenario from the October 2010 WEO) and the associated effect on global commodity prices, tracing the impact on LICs' growth prospects, fiscal and external vulnerabilities. The simulation also illustrates how vulnerabilities across countries and regions could potentially be flagged by collating outputs from the various modules for different regions and country groups.[21]

D.   Priorities for Further Development of the Framework

35.   **The VE-LIC methodology is work in progress, and will continue to evolve.** The analytical tools and indicators described above have been developed in a collaborative process involving area and functional departments. Work is ongoing to further refine the quantitative tools and indicators to assess underlying vulnerabilities, strengthen the analysis of relevant transmission channels and spillovers, and improve data quality and coverage.

36.   **A number of priority areas for further development have already been identified.** These include expanding the coverage of indicators in the crisis risk models, in order to limit the impact of potential measurement errors in individual indicators on the

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[20] Judgment-based assessments also play a crucial role in the VEE in determining the final ratings derived from the empirical models and in assigning crisis risk ratings to countries.

[21] The typology of country groups used for the illustration is based on the classification of exporter type used in the WEO's analytical groups (commodity vs. non-commodity exporters) and the unique features of small island economies, including the structure of production and reliance on tourism for generating output and employment, which increases their exposure to external shocks. The categorization of fragile states will take into account the definition of "fragility" adopted by the World Bank.

overall indices[22], further refinements to the empirical tools, and the addition of new modules in the spillovers and scenario analysis:

- Further analysis could suggest testing for the inclusion of additional indicators, such as the ratio of short-term debt to reserves, real exchange rates, liquidity indicators, and exchange rate regimes, to improve the predictive power of the growth crisis model.

- While data gaps in the financial sector are particularly acute for LICs, the index for banking system stress would be further improved by expanding the coverage of bank crisis episodes in LICs and incorporating additional indicators of banking system soundness, such as return on assets, liquidity ratios, credit-to-GDP gap measures, banking assets to GDP ratios, and possibly qualitative indicators that capture institutional and structural weaknesses.[23] The inclusion of these indicators could also be informed by testing the out-of-sample predictive power of the model in capturing banking system crises in LICs.

- The estimation of elasticities in the spillovers and scenario analysis will need to be further calibrated to capture heterogeneity among LICs and their susceptibility to both common and country-specific shocks.

- Increasing financial sector linkages and risks of sharp reversals in capital flows to the more globally-integrated LICs call attention to the need for monitoring these developments. Given their small market size, the volatility of such flows could have a significant macroeconomic impact, making these LICs vulnerable to the type of sudden stops experienced by emerging market countries. An assessment of financial sector linkages and spillovers, including through the use of market-based indicators, would thus be increasingly pertinent for the more integrated LICs.

- Shocks in LICs frequently tend to have large distributional impacts, adversely affecting poverty dynamics. Analysis of the poverty and distributional impacts of external shocks would need to be incorporated in the exercise in a separate module, drawing on World Bank input.

V. OPERATIONAL MODALITIES

37.   **The envisaged exercise would be conducted on an annual basis, with the first full run launched ahead of the 2011 Annual Meetings.** In the past, relatively limited financial and trade integration and deep-seated structural impediments have meant that crises impacted

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[22] Such measurement errors are more likely in the case of the banking stress index as definitions of key indicators, such as NPLs, can vary considerably across countries.

[23] Work on the compilation of financial soundness indicators (FSIs) in recent years has improved data availability for a large number of LICs, although lack of historical time series will likely continue to constrain statistical analyses (FSIs are not available prior to 2000 for a majority of LICs).

LICs less quickly than emerging markets.[24] Moreover, long data lags and other associated data constraints could be a key impediment to more frequent assessments. Growing integration and accelerating structural change in many LICs have led to shocks being transmitted more rapidly, and the annual frequency of the proposed exercise would not preclude undertaking ad hoc assessments if warranted by sudden adverse changes in the global environment and other potential risk factors.

Organization

38.   **Implementing the VE-LIC would require close collaboration and consultation with departments.** The exercise would draw primarily on resources from FAD, MCM, RES, and SPR (coordinator), with the assistance of area departments. Area departments would be involved in all stages of the exercise, from initial consultations through the finalization of the vulnerability assessments. They would provide critical data inputs for the exercise, bring country-specific expertise to bear on the assessments, and play a role in communicating the results of the exercise back to member countries through Article IV consultations and REOs. The selection of the spillover and scenario analysis as well as any special topics to be covered in each round of the exercise would also be determined in an interdepartmental meeting at the outset of each round. In addition, country teams would be provided with a flexible and user-friendly template to conduct their own scenario and vulnerability assessments, separately from the full-fledged exercise.

Linkages with other established vehicles of Fund surveillance

39.   **The VE-LIC's output would feed into bilateral and regional surveillance.** The vulnerability indicators and indices, analyses of global trends and their impact in the spillover and scenario analysis, a comprehensive cross-country database, and quantitative templates for conducting country-specific vulnerability assessments would be available to area and functional department staff. These would support and complement vulnerability assessments in bilateral and regional surveillance. The exercise would also generate comparative information on vulnerabilities that could be used to illustrate how countries compare with their peers, and facilitate cross-country analytical studies. The quantitative spillover tools could help strengthen the discussion with country authorities of external risks, spillovers, and linkages.

40.   **The quantitative tools developed for the exercise could also feed into the EWE.** Synergies between the proposed exercise and the EWE could be explored by making an explicit link between identified global tail-risks and their impact on LICs, where relevant.

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[24] By contrast, capital account crises in emerging markets, and, as witnessed by the current global crisis, financial crises in advanced countries tend to erupt fairly quickly. The associated crisis risks thus warrant more frequent monitoring. To this end, the VEA and VEE are conducted on a bi-annual basis.

While LICs are unlikely to generate significant outward spillovers, the EWE could assess inward spillover and contagion risks to LICs under certain adverse global shock scenarios.

Communication

41.   **Management and senior staff would be apprised of the key findings of the exercise.** The results of the country-specific assessments combined with a topical analysis of global developments that affect vulnerabilities in LICs would be discussed at an interdepartmental meeting and summarized in a short note to management.

42.   **The broad findings from the exercise could be used to inform and alert other stakeholders about emerging risks as needed.** A routine reporting of the VE-LIC results on a standalone basis to the Board and other stakeholders is not envisaged at this stage. Rather, the findings could be used as input to staff papers on topical cross-country issues (of the kind that were written during the food and fuel price crisis and the global recession), and to support broad policy prescriptions by the Fund on how to contain risks and increase resilience. While information on individual country vulnerabilities in LICs is relatively less market sensitive than for advanced and emerging market countries, there could be risks to private capital flows (such as FDI or portfolio flows), donor assistance, and domestic debt markets. Consequently, as in the VEE and the VEA, country-specific information would not be provided either to the Board or to the general public.

Costs of the Proposed Exercise

43.   **The exercise will require additional staff resources, some of which could be offset by savings elsewhere.** The VE-LIC is envisaged to engage about 6-7 staff who would spend some 3 months a year preparing the exercise, and additional Fund-wide resources would be required in setting up and running the exercise, and preparing the database. Preliminary estimates suggest that these activities would require a total of 3.25-4 staff-years per year on a permanent basis Fund-wide.[25] This would include 2 staff-years for area departments and around 1.5 for functional departments. Savings achieved from streamlining analytical studies on the impact of global developments on LICs, and reducing ad hoc data demands on country teams by broadly standardizing requests, could offset some of the additional resource costs.[26]

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[25] This estimate does not include the resource cost of additional methodological work (estimated at around 0.5 - 1 staff-years) that would be needed.

[26] Over time, these requests are envisaged to be integrated in other Fund-wide data management systems.

ANNEX I. MACROECONOMIC VOLATILITY IN LICs AND ITS IMPACT

44.   This annex provides details on the nature of macroeconomic volatility faced by LICs and its negative impact on output and welfare, drawing on the extensive literature on the subject. It begins with a discussion on the frequency and incidence of volatility in LICs, before turning to its implications for growth and poverty.

Macroeconomic volatility in LICs

45.   Macroeconomic volatility in LICs reflects a high frequency of exogenous shocks. Real external shocks and natural disasters are more frequent in LICs as compared to advanced and emerging market countries. An analysis of different shocks shows that the frequency of shocks varies considerably across country subgroups. Drawing upon the taxonomy in Becker et al. (2007), the shocks analyzed here include the following events for the period 1970-2007:

- *financial and macroeconomic*—currency crisis, banking crises, debt crises, and reversal in financial flows;

- *country-specific external*—terms of trade shocks and natural disasters;

- *socio-political*—wars and political turbulence.

46.   As seen in the table below, the shock frequency increases sharply and monotonically as the income level of the country group falls. In particular, large terms of trade shocks occur almost 6 times as often in LICs as compared to advanced countries. Similarly, large natural disasters and political shocks are also unequally distributed, occurring more often in LICs as compared to other countries.

47.   The high frequency of external shocks in LICs' is partly related to their greater exposure to such shocks. Macroeconomic volatility is generated by the intrinsic instability of the development process, including the structure of production and the nature of specialization in LICs (Koren and Tenreyro, 2007). This reflects their dependence on primary commodities, whose prices experience substantial short-term variability relative to the price of other tradable and industrial goods, less-diversified exports, their reliance on climate-dependent sectors such as agriculture and tourism for generating output and employment, and concentration of external financing flows, such as aid, tourism receipts, and remittances, from specific advanced and emerging market countries.[27] LICs as a group suffer much higher terms-of-trade volatility than other countries, with median volatility that is nearly twice as high as in the rest of the world (Figure 1, panel D). Moreover, as evidenced by the current

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[27] For instance, Alturki et al. (2009) find that Russia influences growth in LICs in Central Asia and the Caucasus largely through the remittance channel and, to a limited extent, the financial channel. Sun and Samuel (2009) document the importance of the U.S. for tourism receipts, FDI, and remittances in the Caribbean LICs.

crisis, they are also increasingly exposed to volatility and shocks originating in the output volatility of trade partners.[28]

Table 1. Frequency of Shocks Across Country Groups
(1970-2007)

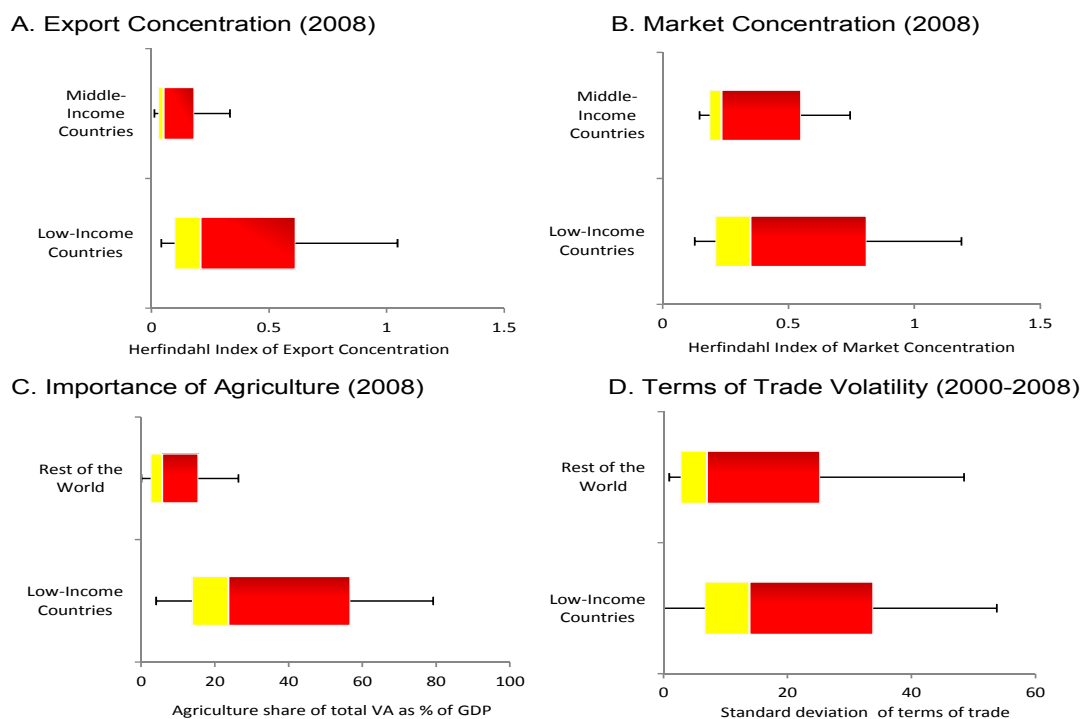|	Frequency of Shocks					
	Advanced Economies		Emerging Markets		Low-Income Countries	
	Total Number	Probability (In percent of country years)	Total Number	Probability (In percent of country years)	Total Number	Probability (In percent of country years)
Financial and Macroeconomic Shocks						
Banking Crisis	13	1.1	53	3.2	51	1.9
Currency Crisis	13	1.1	69	4.1	99	3.8
Debt Crisis	0	0.0	28	1.7	28	1.1
Reversal of Capital Flows	46	3.9	141	8.5	405	15.4
Country Specific External Shocks						
Terms of Trade Shock	45	3.8	160	9.6	453	17.2
Disaster	17	1.4	35	2.1	72	2.8
Socio-Political						
War	20	1.7	51	3.1	77	2.9
Political Shock	5	0.4	32	1.9	84	3.2

Sources and definitions: Staff calculations based on GDP data from WEO, IMF. The dates for currency, banking, and debt crises, are based on Laeven-Valencia Database (2008). Reversals in financial flows are defined as a 5 percentage point of GDP decline in financial account, drawn from the IMF's WEO. Terms-of-trade shocks are defined as a 10 percent worsening in the terms of trade of goods, drawn from the WEO data bank.
The dates of disasters, and wars, are from CRED (www.em-dat.net), and Correlates of War (www.correlatesofwar.com) respectively. Natural disasters refer to large disasters (if the number of injured times 0.3 plus the number of killed is greater than 0.01 percent of the coutnry's total population).
For political shocks, we refer to the measure developed by the Polity IV Project (Marshall and Jaggers, 2002). Shocks to the political system are defined as a deterioration by 3 points or more in the Polity index.

[28] The importance of external demand as a key transmission channel during the current financial crisis is highlighted in IMF (2010).

Figure 1. Distribution of Country Characteristics among LICs and the Rest of the World

A. Export Concentration (2008)

B. Market Concentration (2008)

C. Importance of Agriculture (2008)

D. Terms of Trade Volatility (2000-2008)

Source: WEO; UN Comtrade; IMF Direction of Trade Statistics; WDI; and Fund staff calculations.
Note: For each country group, the figure plots the minimum, maximum, and median of the relevant variable. The shaded boxes show the inter-quartile range.

48.   Home-grown vulnerabilities, both idiosyncratic and policy-induced, have historically been an important source of macroeconomic volatility in LICs. Research suggests that idiosyncratic shocks in LICs—related to social conflict, economic mismanagement, and political instability—have historically accounted for the bulk of overall macroeconomic volatility (Raddatz, 2007). LICs as a group are characterized by greater fiscal volatility than other countries, owing to more narrow and concentrated tax bases, and pressures for increasing government expenditures during positive shocks that often result in difficult adjustments in the longer-term. Moreover, macroeconomic vulnerabilities—such as large fiscal and external balances, high and variable inflation, and unsustainable debt ratios—serve to amplify the impact of exogenous shocks (Collier et al., 2006).

49.   The importance of external shocks as a source of macroeconomic volatility in LICs has increased over the past decade.[29] There has been a marked shift in the sources of instability as macroeconomic policies have improved across a range of LICs, and as policymakers have upgraded institutions. This, in conjunction with their growing integration

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[29] The IMF paper on "Fund Assistance for Countries Facing Exogenous Shocks" contains a detailed discussion of the incidence and economic and poverty impact of exogenous shocks in LICs.

to the global economy, has resulted in external shocks becoming an increasingly important source of macroeconomic volatility in LICs. For instance, Raddatz (2008) finds that the relative importance of external shocks as sources of output instability in LICs, including in Sub Saharan Africa, has increased 2.5 times in the last 15 years than in the previous 15 year period.

Consequences for growth and welfare

50.   Macroeconomic volatility induced by external shocks imposes large welfare costs through its negative impact on output growth. A large body of evidence finds that adverse external shocks have a significant impact on growth.[30] In particular, research suggests that that the negative impact of external shocks on growth is especially pronounced in LICs relative to other countries (Berg et al., 2011; Collier et al., 2010; Collier and Goderis, 2009; Burnside and Tabova, 2009).[31] In the short-run, growth is reduced through the effect on aggregate demand, external balances, and the government's fiscal position. Moreover, these effects are asymmetric: while negative shocks impede growth, positive shocks do not necessarily contribute to growth (Collier and Goderis, 2007).

51.   In the medium-run, shock-induced macroeconomic volatility is associated with severe output losses. While the persistence of the shock's impact depends on the nature of the shock, the transmission mechanism, country-specific characteristics, and policy responses, research suggests that large external shocks in LICs on average translate into substantial output losses over the medium-term (Berg et. al, 2010). Using an event study approach, staff analysis finds that large external demand shocks result in a cumulative loss of over 6 percentage points of growth over a 5 year period (Figure 2, left panel). In addition, growth down-breaks, broadly defined as extended periods of markedly slow growth, are associated with external shocks and macroeconomic volatility in LICs (Hausmann et al., 2006; Berg et al., 2008).

52.   The magnitude of output loss also depends on the type of shock. Becker et al. (2007) assess the economic impact of different types of shocks for the 1970-2001 period, showing that the expected cost, as measured by the expected annual loss of output associated with each type of shock, can be substantial for several types of shocks.[32] In particular, terms of trade shocks were found to be the most costly in LICs, followed by debt crises, and global

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[30] The results depend on the methodology employed for the analysis, with larger impacts being demonstrated by studies that use cross-country, time-series and general equilibrium models than those using panel vector autoregression methods.

[31] Hnatkovska and Loayza (2005) find that the growth impact of volatility reflects the harmful effect of sharp negative fluctuations ("crisis" volatility) rather than the impact of repeated but small cyclical movements ("normal" volatility).

[32] Yearly output losses are defined as drops in per capita GDP relative to pre-event GDP and are cumulated over the duration of the event (See Becker et al., 2007, for details).

interest rate hikes. By contrast, sudden stops in capital flows were found to be most costly for emerging markets.

Figure 2.GDP Growth Loss and External Shocks in LICs, 1980–2007

GDP Growth Losses under External Demand Shock

GDP Growth Losses under Terms of Trade Shock
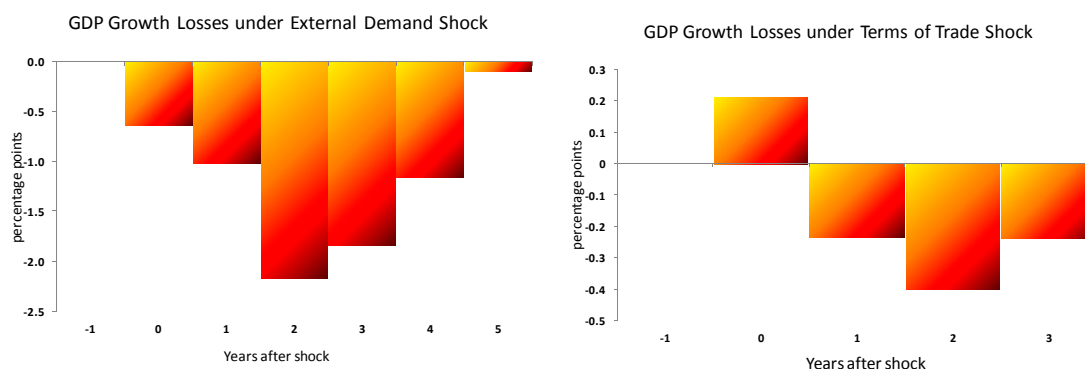
Source: Crispolti and Tsibouris (2011)
Note: The figures represent foregone GDP growth, measured as the percentage change from a linear growth trend, from large external demand and terms of trade shocks (falling below the 10th percentile of the country-specific distribution).

53.   Volatility impacts long-run growth through reductions in investment, worsening of economic policy and, in extreme cases, by increasing the risk of conflict. In particular, economic, political, and policy-related uncertainty associated with higher volatility tends to depress investment in both physical and human capital, particularly in countries that are credit constrained.[33] There is also evidence pointing to a higher risk of civil war and internal conflict and protracted growth downturns due to greater economic volatility, which is exacerbated by the structure of income in LICs.[34]

54.   The impact of shocks on macroeconomic volatility is amplified by weaker policy and institutional buffers relative to other countries. In many LICs, notwithstanding the counter-cyclical response during the global crisis, stabilization policies to counter shocks are more deficient, social safety nets are under-developed and automatic stabilizers weaker than in other countries. A combination of shallow financial markets and weak links to global capital markets makes it difficult for countries to diversify risk and access financial resources in times of distress. Despite the potential of aid to cushion against shocks, aid volatility itself is

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[33] Aghion et al. (2005) examine the effect of credit constraints on the cyclical behavior of productivity-enhancing physical investment, volatility and growth; Krueger and Lindah (2001) analyze the effects of exogenous shocks on investment in education and health. Using firm-level data, Chong and Gradstein (2009) find that policy volatility has an adverse effect on firms' entry into productive industries, thereby affecting economic growth.

[34] Brückner and Ciccone (2010) find that downturns in international commodity prices made the onset of civil war more likely in Sub-Saharan African countries. See also Blattman and Miguel (2010) for a review of literature on the linkages between conflict, external shocks, and low growth.

a source of instability in LICs.[35] Consumption smoothing is also difficult due to inadequate reserve buffers to protect against import compression. In addition, limited exchange market flexibility in many LICs hampers adjustment by restricting the economy's ability to reallocate resources in response to shocks (Broda, 2004). The impact of structural impediments—related to trade, financial depth, and labor and firm flexibility—in reducing resilience to shocks is also well documented in the empirical literature (Collier and Goderis, 2009; Loayza and Raddatz, 2007).[36]

55.   These factors translate into large welfare losses, with attendant implications for poverty. It is well documented that macroeconomic volatility, as proxied by output, price, or fiscal volatility, is reflected disproportionately in consumption volatility for LICs (Perry, 2009). Declines in consumption are more precipitous in LICs than in other countries because of low savings, liquidity constraints, limited risk diversification opportunities, and the greater dependence of the poor on public services, which exposes them to fiscal cuts in real terms, including through inflation. Research also suggests that poverty levels sharply during deep downturns induced by external shocks, which do not recover to previous levels as output recovers (Agenor, 2002). Shocks have long-term effects on poverty, in part, due to the inefficient coping strategies poor households embrace in the absence of alternatives. Strategies such as self-protection and reliance on informal networks usually provide inadequate protection, and frequently lead to adjustments with detrimental long-term negative effects on their productivity and ability to climb out of poverty (Carter and Barrett, 2005; Clarke and Dercon, 2009).

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[35] Arellano et al (2005) suggest that a one-standard-deviation increase in aid volatility is associated with a decrease in manufactured good exports by up to four percentage points; Celasun and Walliser (2005) find that unpredicted aid volatility may bear permanent costs in terms of lost output.

[36] For instance, Collier and Goderis (2009) show that regulations that delay the speed of firm closure significantly and substantially increase the short-term growth loss from adverse price shocks in commodity-exporting countries; in the case of natural disasters, the negative effect on short-term growth is increased by labor market regulations that prevent an efficient re-allocation of workers.

ANNEX II. COUNTRY COVERAGE OF THE VE-LIC

The VE-LIC covers all the PRGT-eligible countries subject to the following exclusion criteria:

Exclusion criteria:

- Significant gaps or weakness in data including the timeliness, frequency, and availability of relevant macroeconomic and financial sector data.

- High degree of financial development making it at par with that of other emerging markets. Vietnam falls under this exclusion criterion.

- High level of income (as measured by the GDP per capita in PPP terms) but does not fall under the small country exception rule. Armenia and Georgia are excluded based on this criterion.

Table 1. Countries included in the VE-LIC Country Universe.

Table 1: Country Coverage of the Vulnerability Exercise	
Afghanistan	Liberia
Bangladesh	Madagascar
Benin	Malawi
Bolivia	Maldives**
Burkina Faso	Mali
Burundi	Mauritania
Cambodia	Moldova
Cameroon	Mongolia
Cape Verde*	Mozambique
Central African Republic	Myanmar
Chad	Nepal
Comoros	Nicaragua
Congo, Democratic Republic of	Niger
Congo, Republic of	Nigeria
Cote d'Ivoire	Papua New Guinea
Djibouti	Rwanda
Dominica**	Sao Tome & Principe
Eritrea	Senegal
Ethiopia	Sierra Leone
Gambia, The	Solomon Islands
Ghana	St. Lucia**
Grenada**	St. Vincent & the Gren.*
Guinea	Sudan
Guinea-Bissau	Tajikistan
Guyana	Tanzania
Haiti	Togo
Honduras	Uganda
Kenya	Uzbekistan
Kyrgyz Republic	Yemen, Republic of
Lao, People's Dem.Rep	Zambia
Lesotho	

* Maintained on the PRGT eligible countries list due to small country exception

** Maintained on the PRGT eligible countries list due to short-term vulnerability

ANNEX III. THE VULNERABILITY INDEX METHODOLOGY FOR GROWTH DECLINES

56.   This annex provides details on the methodology used to construct the underlying vulnerability index for a growth decline in the event of large external shocks. 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

57.   The dataset underlying the statistical analysis covers 59 LICs and 18 years (1990-2008). Large negative *shocks events* in LICs are identified if the annual percentage change of the relevant variable falls below the 10th percentile in the left-tail of the country-specific distribution (Figure 1).[37] In particular, shock episodes include one or more of the following six shocks: (i) external demand; (ii) terms of trade; (iii) FDI; (iv) aid; (v) remittances; (vi) climatic shocks (large natural disasters).[38] Defining large negative shocks over country-specific distributions can better capture cross-country heterogeneity among LICs, particularly with respect to their economic structure and vulnerability to external shocks. It implies that each country experiences the same frequency of shocks, so that the focus is on the reaction to the shock. For each shock, only the first year of the shock event is considered in the final set.

58.   Within the sample of identified shock events, a *crisis* is defined as a large real output drop when the following two conditions hold: (i) the post-shock two-year average (*t* and *t*+1) level of real output per capita falls below the pre-shock three-year trend; and (ii) growth of output per capita is negative at time *t*. Research suggests that adverse output developments in LICs tend to induce breaks in trend growth rather than fluctuations around a trend. The definition of crisis events thus attempts to capture the combined effects of level drops in output per capita and declines in growth. The dataset includes 135 crisis episodes, and the unconditional probability of a crisis is 23 percent. The average growth of output per capita is 2 percent for normal episodes and -2.32 percent for crises episodes.

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[37] The choice of the 10th percentile reflects reasonably severe events, but alternative thresholds such as the 5th percentile were also considered. This resulted in a smaller number of shock observations for the empirical approached, and resulted in less robust results.

[38] FDI, aid, and remittances are measured as ratios to GDP. Large natural disasters are identified if the number of people affected and the economic damage was considered to be among the top 25th percentile of the distribution.

Figure AIII.1 Identification of Exogenous Shock Episodes
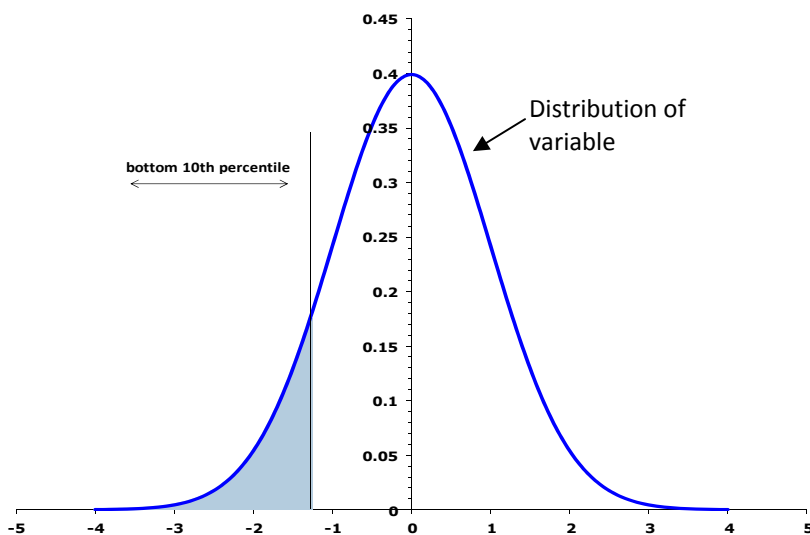
Selection of vulnerability indicators

59.   A large number of indicators were considered based on empirical studies of growth declines and protracted growth slowdowns in the event of exogenous shocks (see Table 1 for a list of indicators considered). The set includes indicators that could be constructed for a majority of LICs and capture the flow and stock vulnerabilities in the external and public sectors as well as institutional weaknesses identified in past studies and Fund surveillance. A number of financial sector variables were also considered, but their explanatory power was found to be weak, in part, reflecting the stronger feedback loop from the real economy to LIC financial systems.

Selection of the statistical method

60.   The objective is to utilize information from past growth declines conditional on large exogenous shock episodes in LICs to provide a framework for mapping information from underlying vulnerability indicators into a summary measure of vulnerability. Specifically, only lagged values of indicators to the crisis event are used. Three approaches were considered:

61.   Multivariate panel logit without thresholds. These panel regressions estimate the likelihood (probability) of an output decline defined as indicated above. The dependent variable is defined as a zero-one binary variable which takes a value of one if a real output drop occurs. The analysis produces an estimate of crisis probability that can be interpreted as a (composite) vulnerability indicator. The threshold for the crisis probability is estimated by minimizing the combined percentages of missed crises (Type I error) and false alarms

(Type II error). Moreover, the marginal contribution of each of the underlying variables to the probability of a crisis can be determined (not reported).[39]

Table AIII. 1 List of Vulnerability Indicators Considered

Variable	Definition
Overall Economy and Institutional Quality:	
Real GDP growth	Real growth of GDP in constant 2005 prices
Institutional quality (CPIA)	Overall country CPIA scores
Inflation	Annual percentage change in the CPI
External Sector:	
Reserve cover I	Gross international reserves in months of imports
Reserve cover II	Gross international reserves as share of M2
Current account	Current account balance in percent of GDP
Current account plus FDI	Current account balance plus FDI in percent of GDP
External debt to GDP	Gross external debt (end of period) in percent of GDP
Exchange rate regime	Dummy for flexible/fixed exchange rate regime
Real export growth	Percentage change of real exports of goods and services
Fiscal Sector:	
Government expenditure	Government expenditure in percent of GDP
Fiscal balance	Fiscal balance in percent of GDP
Revenue growth	Percentage change of real government revenue
Public debt ratio	Gross public debt (end of period) in percent of GDP

> ➢ *Pros:* allows for interactions among indicators to derive a composite probability; provides an easy test for the statistical significance of individual variables; assumes a continuous relationship between explanatory variables and likelihood of crisis.

> ➢ *Cons:* thresholds for individual indicators are not obtained; variables included in the regression analysis can be constrained by data availability; multicollinearity among variables makes it difficult to consider a large number of indicators simultaneously.

- *Multivariate panel logit with thresholds.* This approach, while similar to the one described above, involves simultaneously estimating both the thresholds for each variable as well as the effect of being above (or below) the threshold on the crisis probability. The threshold for the crisis probability is estimated by minimizing the combined percentages of Type I and Type II errors.

> ➢ *Pros:* allows for interactions among indicators; can derive explicit thresholds for indicators.

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[39] Not all variables identified in Table 1 were included in the model based on their significance.

> ➢ *Cons:* variables included in the regression analysis can be constrained by data availability; multicollinearity among variables makes it difficult to consider a large number of indicators simultaneously; imposes thresholds when the underlying data may behave in a linear fashion.

- *Univariate statistical method.* This method, which is used in the VEE and the VEA, examines a range of indicators one-by-one to identify variables and thresholds that separate crisis and non-crisis cases in a given dataset. For each of the individual indicators, the approach involves searching for a split that minimizes the combined percentages of Type I and II errors.[40] Thresholds that yield the best split are used to map indicator values into zero-one scores. These indicators are then aggregated into sectoral indices using weights that depend on the individual indicator's ability to discriminate between crisis and non-crisis cases (minimum sum of errors estimation rule), and subsequently aggregated into an overall vulnerability index.

  > ➢ *Pros:* can accommodate differences in data availability across variables; allows for the inclusion of a potentially larger number of variables.

  > ➢ *Cons:* ignores interactions among variables; difficult to test for statistical significance of individual variables; imposes thresholds when the underlying data may behave in a linear fashion; uncertainty surrounding any point estimate could be substantial, generating significant instability of the estimated thresholds.

Results from the statistical analysis and index construction

62.   Differences in discriminatory power, as measured by the goodness-of-fit of the overall model can provide guidance on the suitability of the methodological approach. Table 2 shows the pair wise correlations between the crisis variable and the selected indicators; Table 3 provides a comparison of the goodness of fit of the multivariate model with thresholds and the univariate model.[41] In general, the multivariate logit model appears to perform better than the univariate model in terms of reducing false alarms, but both models perform equally well in predicting crises events. Overall, the error rate (the sum of missed crises plus false alarms as percent of total observations) on the multivariate model with thresholds is somewhat lower than in the univariate approach. A simple, univariate statistical method was nonetheless chosen to construct the vulnerability index. The univariate approach has the advantage of familiarity and the ability to include a larger number of indicators. The

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[40] Specifically, the weights of individual indicators are determined on the basis of the goodness of fit of the threshold. Defining: x_i = fraction of crises missed + fraction of non-crises misclassified, the methodology uses x_i = $(1 - x_i) / x_i$ as the indicator of the goodness of fit of the threshold rule. This information is used to weight indicators into an aggregate score. A binary variable D_i is assigned for each vulnerability indicator that takes a value of 1 if it lies in the crisis-prone side of the threshold rule and zero otherwise.

[41] The pair wise correlations between the indicators and the crisis variable indicate that all the selected indicators have the expected sign. Moreover, the correlation coefficients are relatively low for the selected indicators, suggesting that they do not capture redundant information.

model also performs relatively well, suggesting that, on balance, this might be the preferred approach.

63.   Table 3 shows the thresholds for the selected indicators using the univariate approach, as well as indicator weights. Selection of indicator thresholds was based on the minimum sum of errors decision rule described above. Raw indicator weights were defined as 100 minus the indicator's error sum, so that the weight of the indicators rises with its power to discriminate between crisis and non-crises cases. The indicator weights within a sector were normalized to sum to 1 in each sector. Sector weights were also determined by the goodness-of-fit of the relevant sectoral indicators in predicting growth crises. The threshold for the overall index (0.42) is the weighted average of the sectoral indices, estimated by minimizing the combined percentages of Type I and Type II errors.

64.   The sensitivity of the statistical results to other variations in the decision rule were also considered, including attaching significantly higher weights to missed crisis than to false alarms, and maximization of the signal-to-noise ratio, i.e., the ratio of percentage of correctly classified crises (signal) to the percentage of misclassified non-crises (noise). The former produced thresholds for certain indicators that were considered extreme. The latter produced thresholds characterized by very high percentages of missed crises and very low noise (false alarms). However, as can also be seen in Table 2, the thresholds identified by both the multivariate and the preferred univariate approach are virtually identical in most cases for all but two indicators: real export growth and real growth of government revenues for which the multivariate approach identifies a much higher threshold.

65.   Differences in the predictive power of indicator thresholds need to be interpreted cautiously. While a number of indicators miss over 40 percent of crisis (CPIA, reserve coverage, import cover, government balance), they are typically associated with lower false alarms. Other indicators miss fewer crises but they misclassify fewer non-crisis observations. These differences help create complementarities among the vulnerability indicators and help to improve their combined performance. The overall index yields 80 percent of the crisis cases being correctly called and 71 percent of the non-crises cases correctly classified.

Variable selection and model performance

66.   While a larger set of variables were initially considered, a number of indicators were excluded on the basis of model performance. In particular, a bootstrapping procedure was employed to construct a confidence interval for the optimal threshold for each indicator.[42] The empirical distribution of the threshold estimator—based on the bootstrap—was then examined. For example, the current account balance plus FDI was initially considered, but

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[42] This procedure consists of drawing with replacement from the original sample to construct 10,000 different samples from which a threshold is estimated. This approach also allows for the calculation of confidence intervals for all the estimated thresholds. Wide confidence intervals for variables can also indicate uncertainties surrounding point estimates.

the empirical distribution of the threshold was found to be bimodal over a large domain, implying that the data do not clearly identify a threshold (Figure 2). Similar sample uncertainty was ascertained when using the current account balance, inflation, and government expenditures as a share of GDP. This suggests that there is difficulty in precisely pinpointing thresholds for these variables, and, therefore, could be excluded from index.

Table 2. Pair Wise Correlations of Crisis Variable and Vulnerability Indicators

	Crisis	OE CPIA	OE Real GDP growth %	ES Real export growth %	ES Reserves in months of import	FS Real growth of government revenue %	FS Fiscal balance % of GDP	FS Public debt % of GDP
Crisis	1							
OE CPIA	-0.27	1						
OE Real GDP growth %	-0.36	0.16	1					
ES Real export growth	-0.12	0.10	0.26	1				
ES Reserves in months of import	-0.12	0.13	0.09	0.04	1			
FS Real growth of government revenue %	-0.22	0.09	0.26	0.13	0.06	1		
FS Fiscal balance % of GDP	-0.12	0.08	0.24	0.09	0.27	0.16	1	
FS Public debt % of GDP	0.12	-0.16	-0.12	-0.05	-0.08	0.04	-0.28	1

1/ See Table 1 for indicator definitions. OE: overall economy; ES: external sector; FS: fiscal sector

Table 3. Growth Vulnerability Indicators: Thresholds and Model Performance

Variables	Direction to be safe	Multivariate logit with thresholds 1/			Univariate Model 1/				
		Thresholds	Confidence intervals (CI)		Thresholds	Weights	Noise to signal Ratio	Type I error	Type II error
			Lower CI	Upper CI					
Overall economy and institutions						**0.44**			
Real GDP growth	>	3.48	2.79	4.4	2.96	0.64	0.37	0.25	0.27
CPIA	>	2.75	2.19	3.94	3.00	0.36	0.37	0.46	0.20
External Sector						**0.25**			
Reserve coverage (months of imports)	>	2.2	0.38	2.99	2.30	0.58	0.59	0.44	0.33
Real export growth (G&S)	>	11.5	-17.66	31.51	1.77	0.42	0.63	0.52	0.30
Fiscal Sector						**0.31**			
Government balance (% of GDP)	>	-4.27	-9.35	1.71	-4.21	0.33	0.63	0.40	0.38
Public debt (% of GDP) 2/	<				65.32	0.19	0.85	0.05	0.80
Real government revenue (% change)	>	4.17	-8.06	22.47	1.73	0.48	0.50	0.42	0.29
Fit of the Model									
Overall Index threshold		**0.30**			**0.42**				
Proportion of Crises Missed		**0.20**			**0.20**				
Proportion of Non-crises mis-specified (false alarms)		**0.23**			**0.29**				
Overall error 3/		**0.23**			**0.27**				

1/ The thresholds are achieved by minimizing type I plus type II errors.
2/ Public debt variable is excluded from the multivariate logit model due to limited number of observations.
3/ Missed crises plus false alarms as percent of total observations.

Figure 2. Empirical Distribution of Variables Excluded from Index
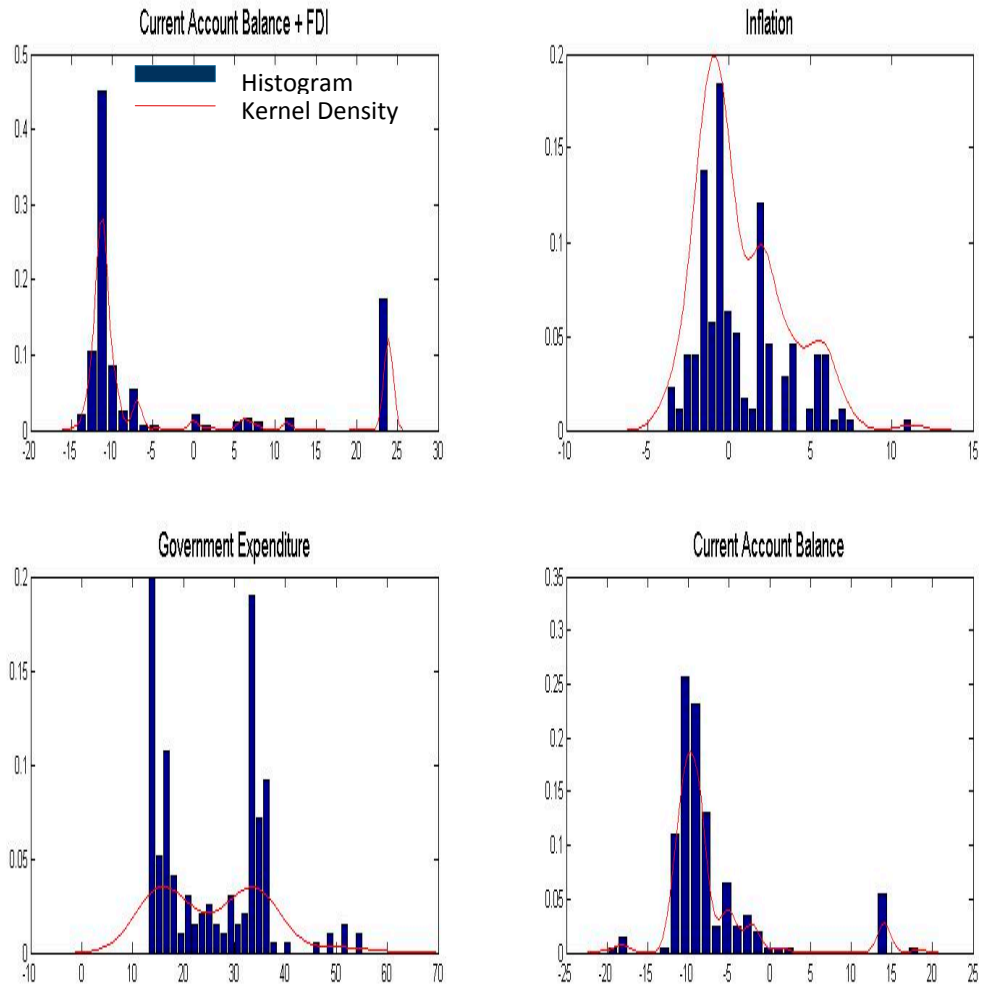
Note: Based on 10,000 bootstrapped samples of the original data. The kernel density is the non-parametric estimation of the probability density function of the variable.

ANNEX IV. THE VULNERABILITY INDEX METHODOLOGY FOR BANKING CRISES

67.   This annex provides details on the methodology used to construct the underlying vulnerabilities to systemic weaknesses in the banking system in LICs. The analytical framework builds on the approach in the growth decline model for the VE-LIC and recent work on identifying systemic banking distress in the VEE. The methodology abstracts from potential support from shareholders and governments, as its objective is to highlight pressures that could lead to support.

Banking crises episodes

68.   The dependent variable identifies systemic banking crisis in LICs and lower middle-income countries following Laeven and Valencia (2008).[43] The definition of a systemic banking crisis includes a large number of defaults in the corporate and financial sectors, a sharp increase in non-performing loans, depressed asset price, a sharp increase in interest rates, a slowdown or reversal in capital flows and bank runs. This allows for covering crises that are not just a result of weaknesses in the banking sector, but could also reflect feedback loops from other sectors in the economy. The total number of crisis episodes in the sample is 56.

Indicators of banking system stress

69.   The vast empirical literature on banking crises in developing countries provides guidance on variables that are relevant for capturing banking system stress.[44] These typically cover all sectors of the economy— external, fiscal, financial and corporate. However, due to lack of comprehensive data on the corporate sector and financial systems (including stock markets) in LICs, a subset of variables typically considered in the literature is included.

- Overall Economy and Public Sector: Real GDP growth; inflation; overall fiscal balance in percent of GDP.

- External Sector: Reserve cover (gross international reserves in months of imports); current account balance to GDP; real growth of exports of goods and services.

- Banking Sector: Annual change in credit-to-GDP ratio; share of non-performing loans (NPLs) in total loans; and capital adequacy ratios.

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[43] The sample consists of annual observations during 1985-2008 for 82 countries. Out of these, 60 are LICs and 22 are lower middle income countries (excluding China and India).

[44] Duttagupta and Cashin (2008) find that foreign currency risk, poor financial soundness, and macroeconomic instability (such as high inflation) are key vulnerabilities triggering banking crises. See also See Gaytan and Johnson (2002) and Demirgüc and Detragiache (2005), and Dabla-Norris et al., 2011b.

Methodology

70.   As with the growth decline model, the approach consists of examining a range of indicators (lagged values) one-by-one to identify thresholds that best separate banking crises from non-crises cases in a given dataset. This rule minimizes the sum of Type 1 errors (the number of missed crises expressed as a percentage of all crisis observations) and Type 2 errors (the number of false alarms expressed as a percentage of all non-crisis observations). These indicators are then aggregated into sectoral indices using weights that depend on the individual indicator's ability to discriminate between crisis and non-crisis cases.

71.   Table 1 summarizes the results from the statistical analysis. Two alternative estimation rules were considered: (i) attaching higher weights to missed crisis than to false alarms; and (ii) placing equal weights on missed crisis and false alarms. As can be seen from the table, the two decisions rules identify similar (in some cases identical) thresholds, except for indicators in the overall economy and public sector, where the estimated thresholds are more stringent in the former decision rule. As in the case of the growth vulnerability index, the indicators' weights reflect their explanatory power through the inverse of the loss function. The sector weights were constrained to give higher weight to the banking sector in both cases, and the weights for other sectors adjusted accordingly.

Table 1. Banking System Stress Indicators: Thresholds and Model Performance

Variables	Direction to be safe	Alternative 1: Higher Weight on Missed Crises 1/, 2/		Type I error	Type II error	Alternative 2: Equally Weighted Loss Function 2/, 3/		Type I error	Type II error
		Thresholds	Weights			Thresholds	Weights		
Overall economy and institutions			**0.28**				**0.28**		
Real GDP growth (%)	>	3.97	0.27	0.35	0.47	-1.69	0.25	0.71	0.09
Fiscal balance (% of GDP)	>	-4.99	0.31	0.45	0.34	-6.42	0.30	0.57	0.20
Inflation (%)	<	5.59	0.42	0.14	0.61	12.66	0.44	0.43	0.30
External Sector			**0.28**				**0.28**		
Real export growth (%)	>	-2.30	0.36	0.52	0.22	-2.30	0.45	0.52	0.22
Current account balance (% of GDP)	>	-2.60	0.34	0.16	0.63	-2.32	0.20	0.21	0.64
Reserve coverage (GIR/Imports G&S)	>	2.99	0.29	0.31	0.50	2.98	0.34	0.29	0.50
Banking sector			**0.45**				**0.45**		
Annual change in credit-to-GDP ratio (%)	<	2.75	0.12	0.46	0.48	2.75	0.14	0.46	0.48
Non-performing loans (% of total loans)	<	8.98	0.45	0.17	0.57	8.98	0.42	0.17	0.56
Capital adequacy ratio (%)	>	12.00	0.43	0.29	0.47	12.00	0.44	0.29	0.47
Fit of the Model									
Overall Index threshold		0.52				0.51			
Proportion of Crisis Missed		0.15				0.35			
Proportion of Non-crises mis-specified		0.41				0.20			
Overall error 4/		0.40				0.20			

1/ The asymmetrically weighted loss function assumes a weight of (Type I + 0.9 Type II) for the loss function.

2/ Judgment based weights of 0.45 percent on the banking sector are imposed.

3/The thresholds are achieved by minimizing type I plus type II errors for the equally weighted loss function.

4/ Missed crises plus false alarms as percent of total observations.

ANNEX V. ILLUSTRATION OF VE-LIC: FINDINGS FROM THE DRY-RUN

72.   **This annex presents a summary of the main the findings from a dry run for the VE-LIC**. The downside scenario, based on RES's Global Projections Model (GPM), assumes that escalation of financial stress, particularly in the Euro area, and contagion prompted by rising concern over sovereign risk results in substantially lower global demand and growth in six regions of the world (USA, Euro Area, Japan, Emerging Asia, Latin America, and remaining GPM countries). Model simulations by RES translate the associated changes in global commodity prices into country-specific export and import prices.

73.   **Underlying vulnerabilities to a growth crisis have shifted from the external to the fiscal side, while risks from a global double-dip loom large for countries with already weakened policy buffers**.

Growth Decline Model

74.   Vulnerabilities to a growth crisis remained high during 2007-2010 as policy buffers were used up during the food and fuel price shocks and the global crisis. The aggregate index of underlying vulnerabilities for 2011 shows some easing from its recent peak in 2010, largely reflecting more buoyant external conditions. However, trends in underlying vulnerabilities vary across regions and country groups. Underlying vulnerabilities, as measured by the proportion of countries with high or medium index values, remain high for small islands, and a number of non-commodity exporters and fragile states, owing to their low reserve buffers, anemic growth, and large fiscal imbalances. While external sector and overall economy vulnerabilities have eased for most LICs in 2011, fiscal vulnerabilities have risen to the fore across all LIC regions, and well-above pre-crisis levels, reflecting weaker fiscal conditions in the wake of the crisis.

Growth Decline Overall Index
(proportion of countries)

Distribution of Overall Vulnerability Indices by Country Group
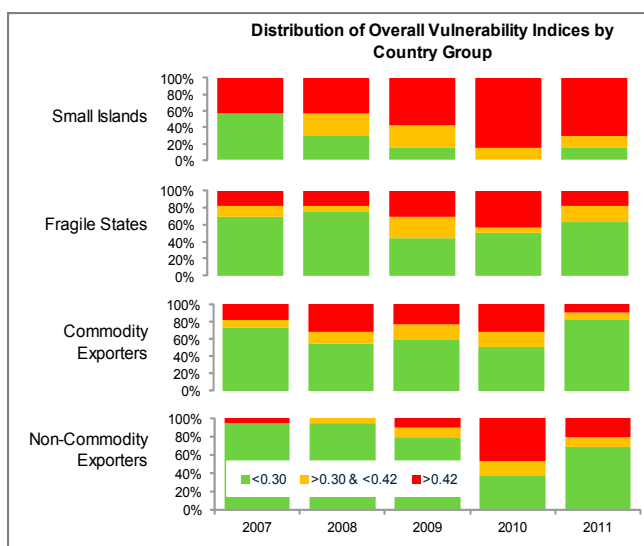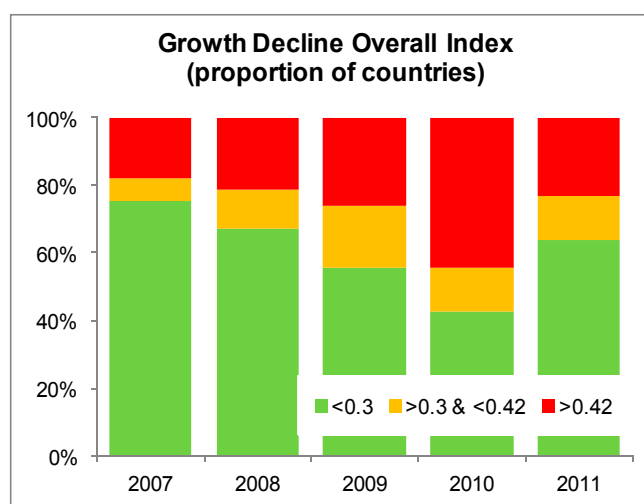
Note: These figures show the proportion of countries with high, medium, and low vulnerability ratings.

Fiscal Sector Overall Index

(percentage of countries with high or medium fiscal vulnerabilities)
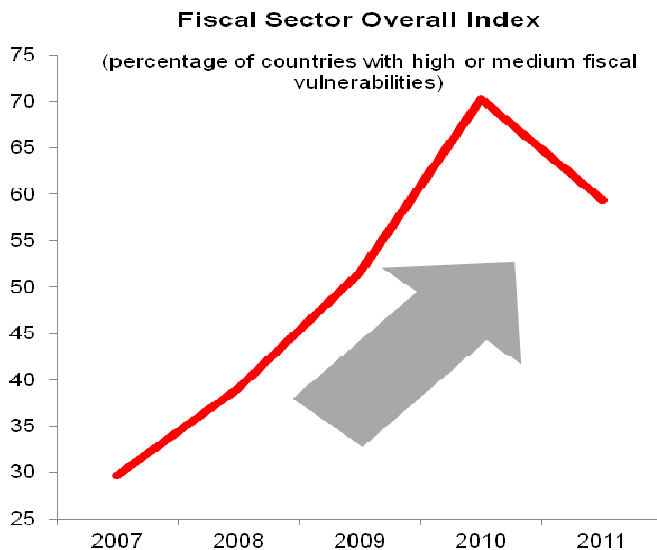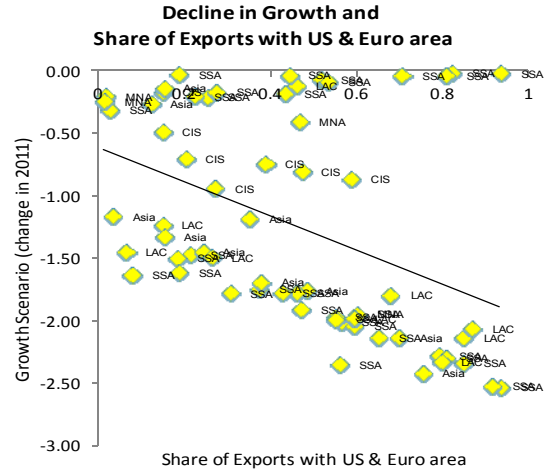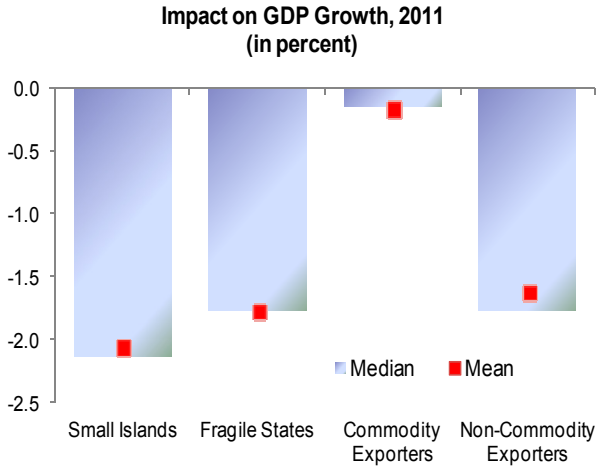

Banking System Stress

75.   Overall banking system vulnerabilities remain moderate mirroring developments in the real economy. Even though the proportion of LICs with low banking system vulnerabilities would slightly increase in 2011, reflecting improvements in the real economy, banking sector risks associated to higher growth rates of credit to the private sector and NPLs would remain moderate or elevated in most regions.

Double-Dip Scenario

Impact on growth

76.   The analysis points to a variegated impact of a global double-dip on LIC growth prospects. Depressed external demand in advanced countries would lower LIC growth prospects, shaving off around 2 percentage points from baseline growth projections for a quarter of LICs, although overall growth is expected to remain positive in almost all LICs. Risks are concentrated among non-commodity exporters, and small island economies with strong trade and tourism links with the U.S. and the Euro area.
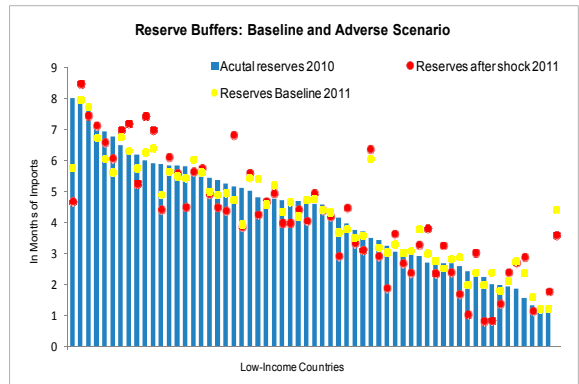
Impact on GDP Growth, 2011
(in percent)

- Median
- Mean

Small Islands Fragile States Commodity Exporters Non-Commodity Exporters

Decline in Growth and
Share of Exports with US & Euro area

Growth Scenario (change in 2011)
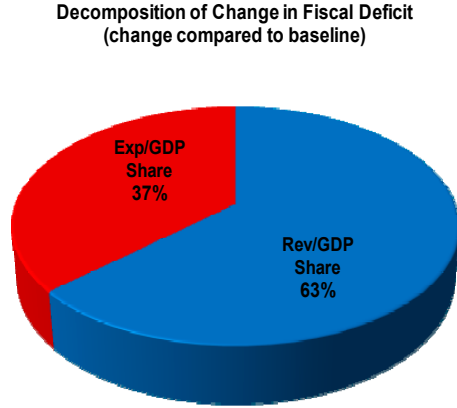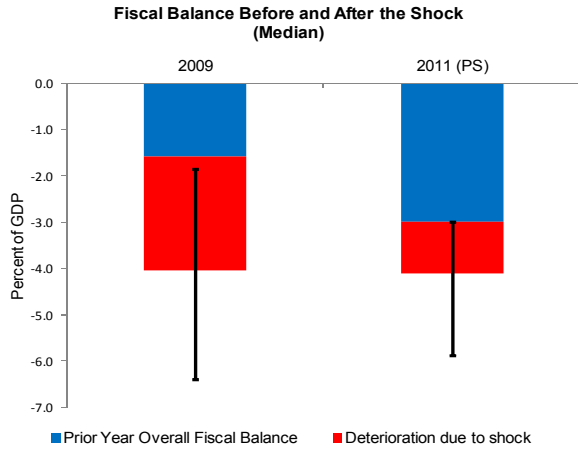
Share of Exports with US & Euro area

External module

77. Under the adverse scenario, financing needs would emerge in all regions (totaling around US$19.4 billion in 2011). This result is largely driven by lower bilateral remittances and FDI flows from the U.S. and the Euro area and, to a lesser extent, lower export receipts. The fall in tradable prices associated with the downside scenario is not expected to significantly impact external positions, with 78 percent of LICs exhibiting an improvement in their terms-of-trade. International reserves in around 30 percent of LICs would fall below three months of imports, in part reflecting low existing buffers, heightening risks of import compression in several countries.

Total External Financing Gap (US $ billions)

SSA	12.6
MNA	1.5
LAC	1.1
CIS	1.7
Asia	2.4
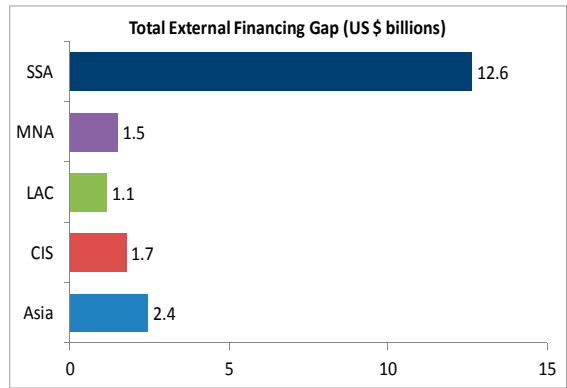
Fiscal module

78. Under the shock scenario fiscal balances are expected to weaken by an additional 1 percentage point of GDP for the median LIC relative to the baseline, and total new budget financing needs for all LICs are estimated to be close to US$14 billion in 2011. This assumes that nominal expenditures plans in 2011 budgets are not revised as a result of the shock, while revenues decline. While the increase in the fiscal deficit for the median country is smaller than what was observed during the recent crisis, pre-shock deficits are higher than those prevailing before the crisis. This results in a post-shock fiscal deficit of 4 percent of GDP, a level comparable to the median deficit at the peak of the crisis.

Reserve Buffers: Baseline and Adverse Scenario

- Acutal reserves 2010
- Reserves after shock 2011
- Reserves Baseline 2011

In Months of Imports

Low-Income Countries

Fiscal Balance Before and After the Shock (Median)

Decomposition of Change in Fiscal Deficit (change compared to baseline)

■ Prior Year Overall Fiscal Balance   ■ Deterioration due to shock

79.   The shock impacts are uneven across country groups: relative revenue declines are larger in countries that are net commodity importers and in fragile conditions, while countries

with weaker initial fiscal conditions (high debt levels and limited fiscal space) also tend to face larger deteriorations in fiscal balances. This points to potential vulnerabilities both in countries with high initial public debt (which could limit access to non-concessional financing sources) as well in countries with market access that have exhausted their fiscal space. In particular, a high level of current expenditure to tax revenue prior to the shock is associated with a higher risk of experiencing a large fiscal deterioration

under the adverse scenario. These countries may be forced to limit spending, potentially jeopardizing key infrastructure projects and other priority spending.
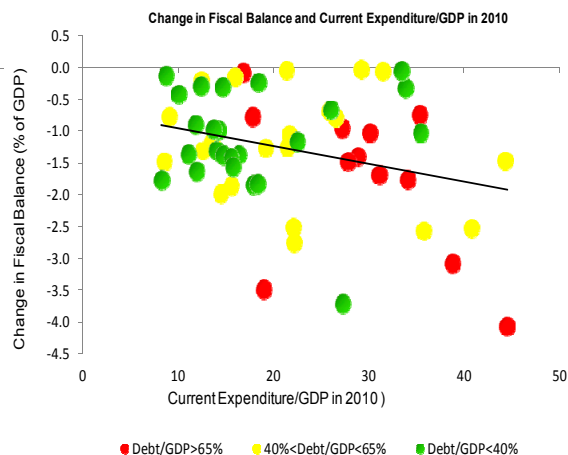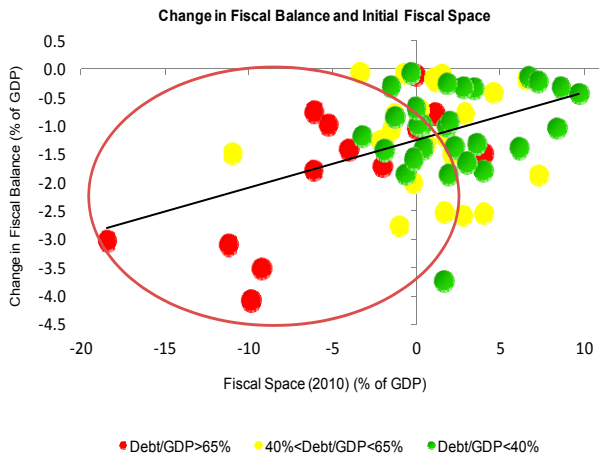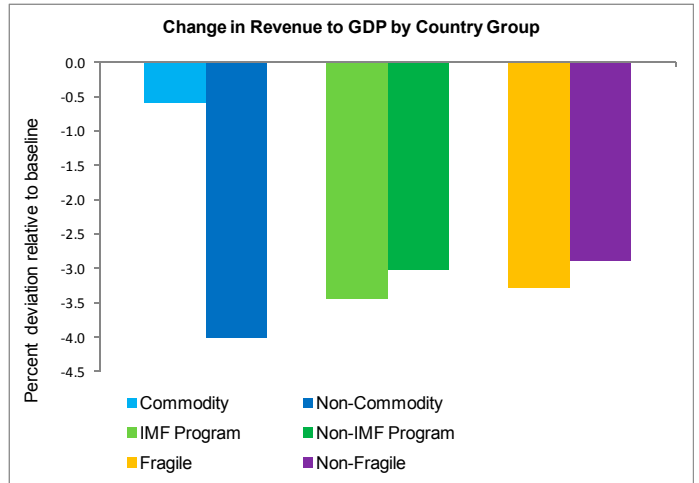
Methodological note for illustration

80.   The methodology for the growth vulnerability and banking system stress indices are presented in Annex III and IV, respectively. This section describes the methodology for the scenario analysis.

Global Double-Dip Scenario

Growth Module

81.   The analysis was carried out in two stages. First, the elasticity of LICs growth to its main trading partners (both advanced and emerging market countries) was estimated using a growth spillover regression for a panel of commodity and non-commodity exporters. Second, alternative projections for the global economy and six relevant regions, based on RES's Global Projections Model (GPM), along with alternative country-by-country projections for terms-of-trade (TOT) based on model simulations by RES, were used to estimate the potential downside growth impacts for LICs. This calculation makes use of information on trading patterns taken from the IMF's Direction of Trade Statistics (DOTS).

Impact on the External Sector

82.   The GPM scenario of lower world growth is assumed to affect the balance of payments of individual LICs through four spillover channels (exports, remittances, imports, and FDI) affecting both the current account and the financial account. Three indicators of fiscal vulnerability are constructed along with an associated heatmap that classifies countries into low, medium or high fiscal vulnerability. The main assumptions for the scenario are summarized as follows:

- Changes in export (of goods and services) prices and in import prices affect the dollar value of exports and imports with an elasticity of 1. Country-specific changes in export and import prices are obtained from model simulations by RES.

- A reduction in partner country growth affects the external demand facing each LIC, with the elasticity of export volumes to external demand equal to 3.[45] The change in external demand is computed using weighted averages of trade partners' real GDP growth, where the weights are based on the 2008 DOTS exports flows.

- Lower growth in source countries affects remittances outflows with an elasticity of 1.5.[46] Partners' growth is computed using the weights from bilateral remittances data (2006 World Bank remittances flows and OECD data).

- Lower growth in source countries affects FDI outflows with an elasticity of 21 the year of the shock.[47] Partners' growth is computed using weights derived from bilateral FDI data (OECD data).

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[45] Based on Dabla-Norris et al., 2011a.

[46] Based on Lueth and Ruiz-Arranz, 2008.

83.   The effect of the shock on the overall balance of payments is then analyzed using three metrics (i) financing gap (difference in the overall balance of payments between the scenario and the baseline external balances, in percent of GDP); (ii) reduction in reserves (level of reserves (NIR) after the shock, in months of imports); and (iii) potential for import compression (change in imports divided by GDP that would compensate for the financing shortfall in order to maintain reserves at 3 months of imports).

Fiscal Module:

84.   **The fiscal module for the double-dip recession scenario estimates the budget impact of the adverse GPM scenario**. Three indicators of fiscal vulnerability are constructed along with an associated heatmap that classifies countries into low, medium or high fiscal vulnerability.

Three fiscal indicators are used:

1) *Change in Fiscal Balance***:** defined as the overall fiscal balance in 2011 under the shock scenario minus the baseline projected (pre-shock) 2011 balance. This indicates the additional net financing needs to maintain the baseline nominal expenditure plans. It is based on revenue buoyancy rates using historical data for the sample of LICs. Revenue declines associated with changes in the terms-of-trade and growth are estimated separately and used to project revenue under the shock scenario.

2) *Revenue/GDP Growth Rate:* this is the relative change in the revenue/GDP ratio after the shock compared to the 2011 baseline (in percent). It indicates how severe the impact of the shock is on a country's revenue/GDP ratio, adjusting for severity of underlying shock, and the degree of fiscal rigidity in the budget.

3) *Initial Fiscal Space:*[48] this is defined as the difference between the baseline 2010 primary balance as a ratio to GDP and the constant primary balance ratio that is needed to achieve a target debt/GDP ratio of 40 percent in 2030.[49] It is an indicator of initial vulnerability intended to capture how much flexibility authorities may have in employing countercyclical fiscal policy when hit by a negative shock. The calculation assumes that effective *real interest rates on public debt* and *real growth* are constant at their 2011-15 average for each country.

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[47] Based on Dabla-Norris et al., 2010.

[48] See Escolano (2010), "A Practical Guide to Public Debt Dynamics, Fiscal Sustainability, and Cyclical Adjustment of Budgetary Aggregates," *Technical Note and Manual,* Fiscal Affairs Department.

[49] The rank correlation is high between this indicator and an alternative indicator using a 65 percent of GDP target in 2030.

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