# Assessing Country Risk: Selected Approaches[1]

## A. External Risks

## I. Sudden Stops Model[2]

**The Sudden Stops Model is a tool that assesses economies with significant links to international financial markets, making a distinction between their *underlying vulnerabilities* and *crisis risks***. Indicators of underlying vulnerabilities seek to identify weaknesses in economic and financial fundamentals. This is a necessary but not a sufficient condition for a crisis. Crisis risk assessments are used to capture the likelihood of economic, financial, or political shocks, which, combined with sizable underlying vulnerabilities, could lead to a crisis.

### A. Identifying Sudden Stops

**The empirical analysis is based on a list of sudden stops event in emerging markets.** Crisis dates (years and countries) are identified by combining quantitative indicators with an analysis of the narrative record. An initial list of candidate crises is created based on sudden stops in net private financial flows if one of the following holds true in a given year: (i) private net capital flows are at least 1.5 standard deviations below their mean and have declined by at least 0.75 standard deviations from the previous year; (ii) private net capital flows have declined by at least 1.5 standard deviations from the previous year and by at least 0.75 standard deviation from two years before; (iii) private net capital flows have declined by at least 0.75 standard deviations from the previous year and by at least 1.5 standard deviations from two years before; or (iv) private net capital flows as a share of GDP have declined by at least 3 percentage points from the previous year and by 2 percentage points from two years before. This set of potential crises is then reviewed by the relevant IMF desk economists. This process helped to resolve ambiguities about crisis dates as well, both eliminating some spurious crisis events picked up by the indicators (for example, sharp drops in

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

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capital flows following the completion of a privatization program, not a crisis) and introducing some new dates that the indicator-based approach had missed.

## B. Underlying Vulnerability Indicators

**The assessment is derived from more than thirty indicators**—a fairly large set compared to traditional early warning exercise models.[3] The set includes external sector indicators, which appear to have played a role in all countries that experienced capital account crises. It also includes indicators for the public, financial, and real (corporate) sectors, which contributed in varying degrees to the vulnerabilities in these countries, as well as contagion measures. This relatively broad portfolio of indicators has three advantages: it provides an umbrella for monitoring a range of indicators that contain useful information individually; it limits the impact of potential measurement errors in individual indicators on the overall index;[4] and it limits the potential for large jumps in the index value inherent in the index methodology. The individual indicators for each sector is as follows:

- **External sector**: Current account balance, REER misalignment, external debt as share of exports, one-year change in external debt as share of exports, private sector external debt as a share of GDP, reserve coverage in percent of ARA metric, one-year chance in reserve coverage in percent of ARA metric.

- **Public Sector**: Gross public debt, primary balance gap, average maturity of debt, average effective interest rate, interest expense, gross financing needs, public debt exposed to rollover risk (short-term gross public debt), public external debt, public debt exposed to FX risk (foreign currency public debt as a share of GDP), and cyclically adjusted primary balance.

- **Financial Sector**: foreign liability as a share of domestic credit, capital adequacy ratio, return on assets, loan-to-deposit ratio, 3-year cumulative change in credit-to-GDP (percentage points), equity gap, loan-to-deposit ratio gap, credit-to-private sector gap, property prices gap. These gap measures are constructed using financial cycle indicators, as described in section C below.

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

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

- **Real Sector**: interest coverage ratio, real GDP growth, 3-year change in the ratio of foreign exchange denominated corporate debt, 3-year change in the ratio of total household debt to GDP, foreign exchange denominated debt as share of total corporate and household debt, non-investment grade debt securities as share of total stock of outstanding debt securities.

- **Contagion:** regional EMBI spreads, change in the growth rate of trading partners' demand, banking liabilities to BIS reporting banks (percent of GDP) interacted with the VIX, banking liabilities to BIS reporting banks (percent of GDP) interacted with the host country's real GDP growth, bilateral correlation of EMBI spreads interacted with the change in equity prices in other EMs, deviation from HP trend of total amount of banking liabilities to BIS reporting banks.

## C. Identifying Financial Cycles and Gaps

**The construction of financial cycle indicators is more involved than other off-the-shelf indicators.** First, peaks and troughs in financial sector variables are identified using the literature on dating business cycles. Second, the estimated cycle lengths obtained by applying the Christiano-Fitzgerald band-pass filter[5] are used to estimate financial gaps, or periods of slumps and overheating. Finally, a non-parametric methodology is used to identify thresholds above which financial overheating may precipitate a capital account crisis. The findings on the basic characteristics of financial cycles are consistent with the literature.[6]

**The analysis focuses on four financial sector indicators at quarterly frequency**: credit to the private sector, loan to deposit ratio, equity and real estate prices. The indicators are deflated with domestic CPI and seasonally adjusted.

**The algorithm introduced by Harding and Pagan (2002), which extends the so-called BB algorithm developed by Bry and Boschan (1971), is used to identify turning points in the log-level of the series.** The algorithm searches for maxima and minima over a given period of time. Then it selects pairs of adjacent, locally absolute maxima and minima that meet certain censoring rules, requiring a minimal duration for cycles and phases. In particular, the algorithm requires the duration of a complete cycle and of each phase to be at least five quarters and two quarters, respectively. These are the minimum thresholds; the identified cycles tend to be much longer. The algorithm identifies 242 turning points in credit cycles across the sampled countries, 131 turning points in property prices, 235 in equity, and 450 in the loan to deposit ratio.

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[5] "Christiano and Fitzgerald (2003)."

[6] Claessens et al. (2011a) and (2011b).

**The baseline setup for the identified cycle range is the estimated mean plus/minus two standard deviations, based on the country sample averages.** For credit, cycles range between 5 and 40 quarters, 2 and 27 quarters for property prices, 8 and 18 quarters for equity, and 8 and 22 for loan to deposit ratio. Some robustness analysis is done by looking at cycles in the range of mean +/- 0.5 and 1 standard deviation, and also at gaps identified with the HP filter and deviation from quadratic time trend.

## D. Crisis Risk Assessment

**A signal extraction approach similar to that in Kaminsky, Lizondo, and Reinhart (1998) is employed**, by relating the indicators from section B to crisis incidence (also described in Box 1 of the reference note). To estimate thresholds, all vulnerability indicators used are annual, with a one-year lag, to be consistent with the data that would be available in real time. The main differences of this methodology from Kaminsky, Lizondo, and Reinhart (1998) were adopting a common level of the threshold for all countries (as opposed to a common country-specific percentile) and the loss function. In this approach, values of the indicator above (or below) a threshold are assumed to signal a crisis, and values below (or above) to signal a non-crisis. The level of this threshold is common for all countries in the sample, and its value is chosen by minimizing the sum of the percentage of missed crises and the percentage of non-crises misclassified (false alarms). Note that by defining the loss function in terms of the percentages of crises and non-crises, the model makes missing a crisis observation much more costly than issuing a false alarm (e.g., if crises are 5 percent of the sample, missing one crisis is as costly as issuing 19 false alarms). In practice, this is equivalent to setting the threshold at a level such that the distance between the cumulative distribution functions (CDFs) of the crisis sample and non-crisis sample is the largest. To reflect the information content of each indicator as a signal, the weights on individual indicators are set to be proportional to their signal-to-noise ratio and sum up to 1 in each sector.[7]

**An overall risk index is computed as the weighted sum of threshold breaches.** The weighted sums of the zeros and ones indicating threshold breaches are first aggregated at the sectoral level to give a sense of each sector's contribution to sudden stop risk. The overall index is a summary measure (weighted average) of underlying vulnerabilities across sectoral indices, ranging from zero

[7] Signal to noise ratio is defined as (1-z)/z, where z is the sum of the fractions of false alarms and missed crises.

(low risk) to one (high risk). The focus of the index is to assess the risk of a capital account crisis in the next 12 months.

**References**


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## II. Overvalued Exchange Rate[8]

### Motivation

**This tool aims to track the extent of world exchange rate misalignment,** as an indicator of external imbalances and to gauge the potential for disorderly exchange rate adjustments.

### Methodology

**Individual countries' exchange rate and current account misalignments are calculated based on the Fund's EBA methodology.[9]** Individual country assessments take the average misalignments across the level and index real effective exchange rate misalignments as assessed in EBA as well as the exchange rate misalignment implied by the current account misalignment using conventional elasticities.

### Data sources

**The source for the misalignment estimates is the latest EBA estimates**, which cover 49 major advanced and emerging economies, and are constructed using WEO, Haver, World Bank and UN data.

### References

Philips, S., et al., 2013, "External Balance Assessment (EBA) Methodology" IMF Working Paper 13/272. (http://www.imf.org/external/pubs/ft/wp/2013/wp13272.pdf)

## III. International Balance Sheets[10]

**This tool examines potential signaling indicators for financial crises, by applying a non-parametric approach to balance sheet analysis on sectoral foreign assets and liabilities.** The dating of financial crises follows Laeven and Valencia (2008), covering both systemic banking crises and currency crises.

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[8] Contributing authors: Mitali Das, Jair Rodriguez, and Clara Galeazzi.

[9] EBA was developed in the IMF to assess current account positions and exchange rate levels in a multilaterally consistent manner. EBA assessments are based on three complementary approaches: the regression-based CA approach, the regression-based real effective exchange rate (REER) approach and the model-free external sustainability (ES) approach (which remains unchanged thus far from CGER). The EBA methodology is described in Philips and others (2013) IMF WP 13/272.

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**The methodology, similar to the empirical crisis probability model (see Box 1 in the reference note), first identifies a threshold of each suggested indicator signaling which crises are more prevalent.** To determine the optimal cut off value, the percentage sum of crises in the "safe" zone, and non-crises in the "risky" zone, is minimized. For instance, a value $X_i$ of indicator $i$ such that $X_i \geq X_i^*$ predicts a crisis. The value of $X_i^*$ is selected to minimize the sum of the fraction of noncrises called as crises and the fraction of crises missed. The fit value is calculated as one minus the minimized sum.

**Data sources**

**Data are collected from the Balance of Payment Statistics and International Investment Position Statistics, focusing on sectoral breakdowns.** The sectors are divided into Monetary Authorities, Banks, General Government and Other Sectors. In addition, WEO data on aggregate net asset positions is also used. Those balance sheet variables are shown below.

**List of Variables and Sources**

| Definition | Database | Coverage |
|---|---|---|
| ASSETS - Other investment | | |
| Central bank | BPTSTSUB | 1985-2015 |
| Debt instruments - deposit taking corporations, excluding the central bank | BPTSTSUB | 1985-2015 |
| Debt instruments - general government | BPTSTSUB | 1985-2015 |
| Debt instruments - other sectors | BPTSTSUB | 1985-2015 |
| LIABILITIES - Other investment | | |
| Central bank | BPTSTSUB | 1985-2015 |
| Debt instruments - deposit taking corporations, excluding the central bank | BPTSTSUB | 1985-2015 |
| Debt instruments - general government | BPTSTSUB | 1985-2015 |
| Debt instruments - other sectors | BPTSTSUB | 1985-2015 |
| Net other investment, stock | | |
| Other investment, net | WEO | 1985-2015 |

**References**

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