Assessing Country Risk: Selected Approaches[1]

E. Asset Price and Valuation Risks

I. House Price Misalignment [2]

Motivation

The main objective is to estimate the extent of misalignments in house prices relative to fundamentals and to evaluate the overall risk to the economy from the housing sector. If house prices are substantially misaligned, the potential correction represents vulnerability for the financial sector and the broader economy. The vulnerability will also depend on the indebtedness of the household sector and the characteristics of the mortgage market.

Methodology

Misalignments in house prices are estimated using a regression model and two standard valuation ratios, and summarized using dummy variables. The regression model is an error-correction model where changes in house prices serve as the dependent variable. The explanatory variables are meant to capture mainly demand-side factors, while supply is assumed to be relatively inelastic in the short run but has an impact on house prices in the long run. The regression takes the following form:

$$\begin{aligned} House\ price\ growth_t &= C + \theta\ affordability_{t-1} + \beta_1 income\ growth_t + \beta_2\ credit\ growth_t \\ &+ \beta_3\ short\ term\ rate_t + \beta_4\ long\ term\ rate_t + \ \beta_5\ stock\ price\ growth_t \\ &+ +\beta_6\ working\ age\ population\ growth_t \\ &+ \ \beta_7\ construction\ cost\ growth_t + \epsilon_t \end{aligned} \quad (1)$$

They include: changes in income per capita, short and long-term interest rates, credit growth, growth in equity prices, and growth in the fraction of working age population. The long-term equilibrium relationship is measured using the ratio of house prices to income (proxied by per capita GDP) which is a measure of affordability. In addition, construction costs serve as a proxy for supply-side factors. Data sources are shown in Table 1.

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

[2] Contributing author: Jihad Dagher (RES).

The level of house prices as of the corresponding quarter of the analysis in years from 1997 to 2001 are used as alternative base levels from which the fitted values of the house price increases are accrued.[3] The misalignment then is calculated as the average over these base years. The findings are summarized by a dummy variable that takes 1 if the average estimated overvaluation is at or above 10 percent of the equilibrium price. With regard to the valuation ratios, deviations from historical averages of the price-to-rental ratio and the price-to-income ratio are used as additional measures of misalignment.[4] The historical averages are calculated over the entire period for which data are available. Prices are considered overvalued if the ratio is at least one standard deviation above its historical average. For each valuation ratio, a dummy variable (that takes 1 if prices are considered overvalued) summarizes the findings.

The resulting set of misalignment estimates used to inform the assessment. The price misalignment is based on the three different methods described in the previous paragraph (one model based, and two valuation ratios). The overall price misalignment score is simply the sum or these three dummy variables.

In addition, countries' overall house price risk assessment also depends on their household indebtedness and their mortgage characteristics. Two additional indices are computed that go into the overall vulnerability score. First, a household indebtedness index is computed as an average of two separate measures that are function of the: level of household credit to GDP and the growth rate of household credit over the past two years. These levels and growth rates are compared with those country-periods that were considered to be boom phases that later ended in a bust. Second, countries are rated based on their mortgage market characteristics, specifically: LTV ratio, the share of variable rate mortgages, and recourse laws. Recent research suggests that higher LTVs, variable rates, and the absence of recourse laws are typically associated with higher risk of default (see, for example Cerutti and others (2015)).

[3]For example, if the analysis is done in the first quarter of 2009, the first quarter in years from 1997 to 2001 are used as alternative base levels.

[4]A present-value discounted model of housing prices (without the presence of bubbles) would imply that these valuation ratios are stationary variables and, hence, mean-reverting. See Campbell and Shiller (1987).

Table 2: Data sources

Variables	*Sources for OECD*	*Sources for EM*	*Notes*
House prices	OECD	Global property Guide	Quarterly
GDP	OECD	IFS and Haver	Quarterly
Short-term interest rate	OECD and Haver	Lending rate from IFS	Quarterly. Short term rates are either the three month interbank offer rate or the rate associated with 3 months Treasury bills.
Long-term interest rate	OECD and Haver	N/A	Quarterly. Long term (in most cases 10 year) government bonds.
Stock prices	IFS	N/A	Annual
Working-age population	OECD	IFS	Annual
Construction cost	Haver	N/A	Quarterly
Private Credit	IFS	IFS	Quarterly
Household Credit	BIS and national Sources	BIS and national Sources	Quarterly
Maximum Observed Loan-to-Value Ratio (LTV)	See footnotes	See footnotes	As of 2005
Interest Type	See footnotes	See footnotes	As of 2005. Whether interest rates are variable, fixed, or mixed.
Degree of Lender Recourse o	See footnotes	See footnotes	As of 2005. The rights of lenders to pursue a borrower's assets (other than the house securing the mortgage).

Footnotes: The table shows variable sources used in the analysis. Regression (1) includes some variables that are not commonly available for EMs, and thus the EM version of the regression omits these variables. For most OECD countries Data are available since the early 1970s, while the availability of data varies significantly amongst the EMs. Countries are excluded from the exercise if data on house prices are not available at least since 2000. Data on mortgage characteristics (LTV, interest type, recourse) come from a variety of sources including: Gattee et al (2004), IMF (2011), Crowe et al (2011), Hofinet, European covered bond council, Cerutti et al (2015)

References

Campbell, John Y. and Robert J. Shiller, 1987, "Cointegration and Tests of Present Value Models." *Journal of Political Economy,* Vol. 95, No 5, pp. 1062-1088.

Cerutti, Eugenio M., Jihad Dagher and Giovanni Dell'Ariccia, 2015, "Housing Finance and Real-Estate Booms; A Cross-Country Perspective," IMF Staff Discussion Note 15/12, International Monetary Fund http://www.imf.org/external/pubs/cat/longres.aspx?sk=42982.

II. Equity Price Misalignment[5]

Motivation

Potential equity market corrections are usually associated with large observed deviations of equity prices from their fundamental values. Such corrections can have considerable adverse implications for macrofinancial stability in view of the direct or indirect equity market exposures of various sectors in an economy. For example, a sustained drop in equity prices can affect adversely both the household sector via negative wealth effects, and the financial and corporate sectors via

[5] Contributing author: Jesse Eiseman, based on work by Ivailo Arsov, Anna Ilyina and Silvia Iorgova.

higher cost of capital. The detection of equity market misalignments is, thus, an important aspect of gauging potential financial sector risks.

Approaches

This tool determines equity market misalignments based on two approaches, which represent complementary aspects of equity valuation.:

- *Equity Valuation Multiples (EVM)*: Equity misalignments are determined on the basis of the deviation of current equity valuation metrics from long-term historical averages (i.e. their z-scores).

- *Arbitrage Pricing Model (APM)*: Observed equity prices are compared to fundamentals-based values to determine the degree of an equity price misalignment relative to the model.

Model specifics

Equity Valuation Multiples (EVM)

The EVM approach determines the degree of equity market misalignments based on the deviation of backward- and forward-looking equity valuation metrics from their own historical paths. The backward-looking valuation metrics include: (i) price-to-earnings ratio (P/E); (ii) price-to-book ratio (P/B); (iii) dividend yield (DY); and (iv) price-to-cash flow ratio (PCF), and thus reflect the dynamics of equity prices relative to various accounting measures of corporate performance. The 12-month price-to-forward earnings ratio (P/FE) is used a measure of expected valuation one year from the date of the analysis.
The z-score of each valuation metric—i.e. the number of standard deviations (or the "valuation multiple") of the metric from its long-run average—is used to establish its 'fair value':

(1) $$z_{M_i} = \frac{(M_i - \overline{M_i})}{\sigma(M_i)}$$

Where M_i is each of the valuation metrics P/E, P/B, DY, PCF and P/FE,

Z-scores larger than one indicate overvaluation risks, while those less than -1 point to low risks. Risks are color-coded in the spectrum of red to dark green (from overvalued to lowest risk, based on the severity of the risk. Risks color-coded in yellow represents moderate risks.
The overall measure of equity misalignment in the EVM approach is an equally-weighted average of the aggregate backward-looking and forward-looking z-scores, where the backward-looking z-score is itself an average of the z-score of the four backward-looking indicators:

(2)

$$\text{under/overvaluation} = \frac{1}{2} \times \left(\frac{z_{P/E} + z_{P/B} + z_{DY} + z_{PCF}}{4} + z_{P/FE} \right)$$

The model is estimated based on data from Datastream.

Arbitrage Pricing Model (APM)

The APM is based on the presumption that equity price movements are driven by surprises due to shocks in various fundamental variables.[6] The model estimates a 'fair value' for each country's equity index by accruing the fitted monthly equity returns associated with the observed surprises in market and macroeconomic fundamentals. The model-based equity returns are computed for the period since 1990, based on parameters estimated over the period 1990 to June 2007 in the following specification:

$$XRET_t = \alpha_i + \sum_{i=1}^{N} \beta_{i,j} F_{jt} + \varepsilon_{it} \qquad (3)$$

where $XRET_i$ is the monthly excess return of each country's stock market index (the MSCI Country Index in local currency terms) over the country's short-term (3-month) risk-free rate, and F_{jt} are the surprises embedded in various fundamental variables (risk factors). The surprise in each fundamental variable is measured as its deviation from long-term historical average or long-term trend (up to the global financial crisis). The fundamental variables vary across countries, and capture each of the following risks:

- **Investor Confidence Risk:** the month-on-month change in the VIX index;
- **Time Horizon Risk:** the spread between the yield on long-term (10-year) and short-term (3-month) government bonds;
- **Business Cycle Risk:** the month-on-month change in the industrial production index;
- **Inflation Risk:** the month-on-month change in the CPI;

[6] The APM is based on the Arbitrage Pricing Theory (APT), Ross, S., 1976, Unlike the single-factor capital asset pricing model (CAPM), which assumes that systematic risk of an equity (or a portfolio of equities) is only related to broad market movements, the APT takes the view that equity returns are influenced by multiple systematic risk factors. These factors are not explicitly specified in the APT (and are often extracted via principal components analysis), but most practitioners use *unanticipated changes* in economic and financial fundamentals as systematic risk factors. For example, a well-known model—the Burmeister, Ibbotson, Roll and Ross (BIRR) model—uses unexpected changes in measures of investor confidence, interest rates, inflation, real business activity and market timing as basic risk factors.

- **Exchange Rate Risk:** the month-on-month change in the nominal exchange rate;
- **Commodity Price Risk:** the percentage change in the commodity price index;
- **Market Liquidity Risk:** the monthly volatility of daily equity returns;
- **Global Market Timing Risk:** the variation in the global market risk premium (the MSCI World Index return minus the risk-free rate) that is not explained by global risk versions of the factors above (i.e., it is measured by the residuals from the APM).

The inclusion of a global market timing risk factor in this global version of the APM model allows assessing the sensitivity of countries' equity market index returns to unexpected changes in both domestic and global fundamentals.

Equity market misalignments (under- and overvaluations) are calculated as the difference between the 'fair value' and the observed realizations of each index. The initial level of the 'fair value' index is calibrated as to ensure no average equity market misalignment over the estimation period.
The model is estimated based on data from Bloomberg and Haver.

References

Ross, S., 1976, "The Arbitrage Pricing Theory of Capital Asset Pricing", Journal of Economic Theory, Vol. 13, No. 3, pp. 341-360.

III. Corporate Sector Risk[7]

Motivation

Information from corporate sector balance sheets could reflect vulnerabilities and the potential depth of recessions. In some occasions, they may signal risks of a macroeconomic crisis. A comprehensive measure of vulnerability is the probability of expected default. The most widely-used such measure is derived from market prices. Market prices, however, do not necessarily reflect underlying corporate sector vulnerability, especially in periods of financial distress and in "boom" periods leading up to stress. Moreover, when government support for the financial system and large companies is in place or anticipated by investors, market prices will be distorted. Combining market prices with corporate account filings data can provide a better understanding of underlying trends in vulnerabilities, including balance sheet risks, international business cycle risks, external financing risks, overall default risks, and investment inefficiency.

Methodology

[7] Contributing author: Hui Tong

This analytical tool focuses on three dimensions of corporate risks: indebtedness, liquidity, and profitability. For each dimension, typical measures are:

- *Indebtedness:* Debt-to-asset ratio (D/A) as a measure of leverage. A high leverage level compared to historical data suggests that a deterioration in the financing environment (e.g., increase in interest rates) could trigger a crisis.
- *Liquidity:* Interest coverage ratio (ICR) as a typical measure of liquidity. This ratio compares earnings before interest and taxes to interest payments. When this ratio is less than one, a firm is in arrears on its interest payments.
- *Profitability:* Return-on-asset (ROA) is a representative measure of profitability. Continual decline of country-wide profitability could eventually lead to a crisis in the corporate sector.

Data sources

Thomson-Reuters Worldscope: provides data for over 70 items pertaining to market values and annual corporate account filings, including balance sheets, income statements, and cash flow statements, for more than 60,000 publicly-listed firms. The tool also incorporates macroeconomic data from IFS, WEO, and the S&P Global Stock Market Factbook.

IV. Financial Vulnerability in Low-income Countries (LICs)

The risk assessment described here is part of a broader assessment framework for LICs. This includes the growth decline vulnerability index, scenario analysis, the food decline vulnerability index, and an assessment of financial vulnerabilities for frontier markets, each described in its own appendix [hyperlinks]. This methodology is documented in an IMF Board paper (IMF 2011a) and Working Paper (Dabla Norris and Bal Gunduz, 2012).[8]

Financial Vulnerability Index[9]

Motivation

There has been significant financial development in many LICs in recent years, bringing new risks to financial systems. Financial deepening and broadening has proceeded, foreign investors are investing in domestic capital markets, and governments have undertaken sovereign bond issues in international capital markets. Frontier market economies have seen the largest changes in these areas.

Methodology

[9] Contributing author: Kevin Greenidge.

For frontier markets, whose financial systems share characteristics with emerging markets, a financial vulnerability index (FVI) is taken from the financial sector aggregate in the sudden stops model for emerging markets. Five variables are considered: capital adequacy ratio, return on assets, bank credit over bank deposits, cumulative three-year growth of credit over GDP, and foreign liabilities measured as cross border loans and deposits over domestic credit. Other potential risk indicators, such as non-performing loans (NPLs) of the banking sector or provisioning thereof are excluded as they are often not sufficiently standardized across frontier economies. The FVI is assessed using the same thresholds and weights as in the sudden stops model.

Data sources

BankScope; BIS; World Bank; and IMF staff estimates.

References

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

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

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