Measures of financial stability – a review

Blaise Gadanecz and Kaushik Jayaram[1]

Introduction

Unlike price stability, financial stability is not easy to define or measure given the interdependence and the complex interactions of different elements of the financial system among themselves and with the real economy. This is further complicated by the time and cross-border dimensions of such interactions. However, over the past two decades, researchers from central banks and elsewhere have attempted to capture conditions of financial stability through various indicators of financial system vulnerabilities. Indeed, many central banks through their financial stability reports (FSRs) attempt to assess the risks to financial stability by focusing on a small number of key indicators. Moreover, there are ongoing efforts to develop a single aggregate measure that could indicate the degree of financial fragility or stress. Composite quantitative measures of financial system stability that could signal these conditions are intuitively attractive as they could enable policy makers and financial system participants to: (a) better monitor the degree of financial stability of the system, (b) anticipate the sources and causes of financial stress to the system and (c) communicate more effectively the impact of such conditions.

The approach to the development of these measures of financial system stability has changed over the years as the locus of concern moved from micro-prudential to macro-prudential dimensions of financial stability. From the analysis of early warning indicators to monitor the state of the banking system, particularly the risk of default of individual institutions, the focus has shifted to a broader system-wide assessment of risks to the financial markets, institutions and infrastructure. More recently, the analytical focus has further concentrated on the dynamics of behaviour, the potential build-up of unstable conditions as well as the so called transmission mechanisms of shocks. A key issue underlying these analytical developments is the need to bridge the data gaps in several areas. Clearly this is an ongoing debate and a work in progress.

This paper is a modest contribution to review the work done towards developing quantitative measures of financial stability and their use in published FSRs. The paper is structured as follows. In Section I, we look at definitions of financial stability and what they mean for identifying key variables, which we discuss in Section II. In Section III, we review how these individual variables might be combined into composite indicators for the purposes of monitoring key sectors of the economy and assigning critical values. In Section IV, we provide a comparative view of the main variables and indicators used in selected FSRs. In Section V we discuss recent attempts to construct a single aggregate measure of financial stability. The final section concludes.

I Definition and identification of key financial system vulnerabilities

Financial stability is difficult to define and even more difficult to measure. Strictly speaking, a financial system can be characterised as stable in the absence of excessive volatility, stress

[1] Monetary and Economic Department, Bank for International Settlements. The views expressed in this paper are those of the authors and do not necessarily reflect those of the BIS.

or crises. This narrow definition is relatively simple to formulate, but fails to capture the positive contribution of a well-functioning financial system to overall economic performance. Indeed, broader definitions of financial stability encompass the smooth functioning of a complex nexus of relationships among financial markets, infrastructures and institutions operating within the given legal, fiscal and accounting frameworks. Such definitions are more abstract but are more inclusive of the macro-economic dimension of financial stability and interactions between the financial and real sectors. From this perspective, financial stability can be defined as "a condition in which the financial system – comprising financial intermediaries, markets and market infrastructure – is capable of withstanding shocks and the unravelling of financial imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities" (ECB (2007)).

Given the imprecise nature of the broader view of financial system stability, most analysts concentrate on the risks and vulnerabilities of the financial system as these are relatively easy to understand and quantify. However, there are difficulties arising from the narrow definition too, insofar as a crisis is difficult to define. Different countries have been hit by different types of crises (banking crises, currency crises, debt crises, equity crises) over time and there are several ways of defining a crisis of each type, from purely binary indicators (failure of a bank, suspension of debt payments by a sovereign creditor) to other more quantifiable variables (eg number of insolvencies, magnitude of banking losses, GDP loss, magnitude of exchange rate fluctuation, decline of stock market index). Also important is the time horizon over which to measure a crisis. For instance Frankel and Rose (1996) define a currency crisis as a nominal depreciation of at least 25% that exceeds the previous year's change by a margin of at least 10 percentage points. Patel and Sarkar (1998) identify equity-market crises using an a hybrid volatility loss measure in a window of 1 to 2 years. The interpretation of, as well as the benchmarks for, financial stability measures depend on the definition of crises. Nevertheless, several attempts have been made in the literature to try to identify and predict crises.

II Key financial stability segments and variables

Policymakers and academic researchers have focused on a number of quantitative measures in order to assess financial stability. The set of Financial Soundness Indicators developed by the IMF (IMF (2006)) are examples of such indicators, as are the monitoring variables used in Hawkins and Klau (2000), Nelson and Perli (2005) and Gray et al (2007) which focus on market pressures, external vulnerability and banking system vulnerability.

Table 1 summarises the measures commonly used in the literature, their frequency, what they measure, as well as their signalling properties. The focus is on six main sectors.

Firstly, the *real sector* is described by GDP growth, the fiscal position of the government and inflation. GDP growth reflects the ability of the economy to create wealth and its risk of overheating. The fiscal position of the government mirrors its ability to find financing for its expenses above its revenue (and the associated vulnerability of the country to the unavailability of financing). Inflation may indicate structural problems in the economy, and public dissatisfaction with it may in turn lead to political instability.

Secondly, the *corporate sector's* riskiness can be assessed by its leverage and expense ratios, its net foreign exchange exposure to equity and the number of applications for protection against creditors.

Thirdly, the *household sector*'s health can be gauged through its net assets (assets minus liabilities) and net disposable income (earnings minus consumption minus debt service and principal payments). Net assets and net disposable earnings can measure households' ability to weather (unexpected) downturns.

Table 1

Commonly used variables

Sectors	Measure	Frequency	What do they measure	Signalling properties
Real Economy	GDP growth	Q or A	Indicative of the strength of the macro-economy, GDP is a key measure especially used in conjunction with measures such as credit expansion, fiscal deficit.	Negative, or low positive values would indicate a slowdown; excessively high values may show unsustainable growth
	Fiscal position of government	A, Q or M	Ability of government to find financing, vulnerability of sovereign debtor to unavailability of financing	High deficit values relative to GDP can mean unsustainable government indebtedness and vulnerability of the sovereign debtor
	Inflation	M or A	Rate of increase of various price indices	High levels of inflation would signal structural weakness in the economy and increased levels of indebtedness, potentially leading to a tightening of monetary conditions. Conversely, low levels of inflation could potentially increase the risk appetite in the financial markets.
Corporate sector	Total debt to equity	Q or A	Corporations' leverage	Excessively high levels may signal difficulties in meeting debt obligations
	Earnings to interest and principal expenses	Q or A	Corporations' ability to meet payment obligations relying on internal resources	Excessively low levels of liquidity may signal inability to meet debt obligations
	Net foreign exchange exposure to equity	Q or A	Currency mismatch	High levels of this ratio may signal difficulties in the corporate sector arising from adverse currency moves
	Corporate defaults	Q or A	Insolvencies in the corporate sector	High values can signal future problems in the banking sector, if insufficiently provisioned
Household sector	Household assets (financial, real estate[1])	A, Q or M	Assets and debt can be used to compute net household assets	Net household assets and disposable income can measure households' ability to weather (unexpected) economic downturns
	Household debt	A, Q or M		
	Household income (labour income, savings income)	A, Q or M	Income, consumption and debt service payments can be combined to compute net disposable income	
	Household consumption	A, Q or M		
	Household debt service and principal payments	A, Q or M		

Table 1 (cont)

Commonly used variables

Sectors	Measure	Frequency	What do they measure	Signalling properties
External sector	(Real) exchange rates	D	Over-/undervaluation of a currency	Over- or undervaluation of currency can trigger a crisis (capital outflows, massive inflows or loss of export competitiveness)
	Foreign exchange reserves	D	Ability of country to resist external shocks	Reserves below short-term foreign debt, or below three months' worth of exports can signal problems
	Current account/capital flows	A, Q or M	Trade position of country	Significant trade deficits require large capital inflows in order to be financed; this raises sustainability issues about such inflows
	Maturity/currency mismatches	A, Q or M	Disparity in the currency/maturity composition of assets and liabilities	Maturity and currency mismatches can expose the economy to adverse shocks in case of adverse currency movements or sudden reversals of capital inflows
Financial sector	Monetary aggregates	M	Transactions, saving, credit	Excessive growth can signal inflationary pressures
	(Real) interest rates	D	Cost of credit, ability to attract deposits sustainability of debt.	Real interest rates above a threshold likely to exceed the trend rate of economic growth, making debt/GDP ratios explosive; negative real rates may mean banks will struggle to attract deposits
	Growth in bank credit Bank leverage ratios, NPLs Risk premia (CDS); credit risk component of 3 month LIBOR – OIS spreads	M Q or A Q or A D	Riskiness of the banking sector	Very rapid loan growth has often accompanied declining loan standards/greater risk. Excessively high loan losses, leverage ratios and risk premia can foreshadow a banking crisis. Loan losses/GDP can measure cost of a banking crisis for economy
	Capital adequacy	Q or A	Banks' capital cushion size to address expected or unexpected losses	Excessively low levels of this ratio points to potential defaults and can be a forerunner of a banking crisis
	Liquidity ratio	Q or A	Ratio of banks' readily available short-term resources that can be used to meet short-term obligations	Excessively low levels of this ratio can lead to a systemic crisis
	Standalone bank credit ratings	Irregular	Individual strength of banks, after the effect of government or other guarantees has been taken into account	Possible coincident indicator of banks' condition, likely to influence their future funding costs

Table 1 (cont)

Commonly used variables

Sectors	Measure	Frequency	What do they measure	Signalling properties
Financial sector (cont)	Sectoral/regional concentration, systemic focus	Q or A	Concentration or diversification of banks' lending strategy	Can proxy for speed of propagation of shocks in the economy
Financial markets	Change in Equity Indices	D	Net worth of, present value of future cash-flows of firms comprising the index	Above-trend growth in index, or very high levels of market to book value can be indicative of an equity price bubble
	Corporate bond spreads	D	Riskiness of debt compared to risk-free instruments	Spikes in spreads can suggest higher levels of risk, changes in risk appetite, changes in the incorporation of news into prices by the market
	Market liquidity (Government bonds, liquidity risk component of 3m LIBOR – OIS spreads)	D	Price attached by the market to the ease with which liquid instruments can be traded	Spikes in these premia can reflect disruptions in market liquidity
	Volatility	D	Intensity of price movements on markets Ease of trade on the market	Low volatility can be indicative of a calm market, but also of failings in the price discovery process. High volatility can mirror a disruption of market liquidity.
	House prices	Q, A or M		House price bubble, consumption boom fuelled by equity withdrawals, potential losses to financial sector in case of downturn in prices

Note: A = annual Q = quarterly M = monthly D = daily. Data available with a high frequency may sometimes be used with a lower frequency for FS monitoring.

[1] Measuring the financial assets of households is complicated by the measurement issues related to house price measures and the treatment of owner-occupied housings. These issues were discussed at an IFC conference held in August 2006 in Basel. The conference proceedings have been published in IFC Bulletins 25 and 26.

Source: compiled by the authors.

Fourthly, the conditions in the *external sector* are reflected by real exchange rates, foreign exchange reserves, the current account, capital flows and maturity/currency mismatches. These variables can be reflective of sudden changes in the direction of capital inflows, of loss of export competitiveness, and of the sustainability of the foreign financing of domestic debt.

Fifthly, the *financial sector* is characterised by monetary aggregates, real interest rates, risk measures for the banking sector, banks' capital and liquidity ratios, the quality of their loan book, standalone credit ratings and the concentration/systemic focus of their lending activities. All these proxies can be reflective of problems in the banking or financial sector and, if a crisis occurs, they can gauge the cost of such a crisis to the real economy.

Lastly, variables relevant to describe conditions on *financial markets* are equity indices, corporate spreads, liquidity premia and volatility. High levels of risk spreads can indicate a loss of investors' risk appetite and possibly financing problems for the rest of the economy. Liquidity disruptions may be a materialisation of the market's ability to efficiently allocate surplus funds to investment opportunities within the economy.

Typically financial stability analysis would use several sectoral variables either individually or in combinations. The use of such measures including the financial soundness indicators as key indicators of financial stability depends on the benchmarks and thresholds which would characterise their behaviour in normal times and during periods of stress. In the absence of benchmarks, the analysis of these measures would depend on identifying changes in trend, major disturbances and other outliers (Worrell (2004)).

III Composite indicators

A financial system consists of a number of key sectors, and interactions[2] between these sectors. The situation is further complicated by the non-linearities that can affect the propagation of shocks and their transmission from one sector to another (White (2004), ECB (2005)). For instance, there are links between monetary and financial stability, as monetary conditions will be affected by asset prices and vice versa. For all intents and purposes, it is not enough to focus on deviations from benchmarks in individual sectors for an overall assessment of financial stability. Whilst individual variables and indicators are useful in analysing the functioning of the financial systems, various studies have attempted to develop composite indicators which would better signal or predict the onset of financial distress. Beginning with the studies on early warning indicators attempts are ongoing to develop leading indicators which would signal conditions of stress. When multiple indicators are available, it would be necessary to combine them in ways that would best capture the interactions between relevant individual indicators. Composite indicators are such combinations of the individual variables (eg bank credit related to GDP) which can be

[2] For instance, problems in the *real sector* can affect the household sector (through job losses, loss of income, inability of the government to provide social benefits), the external sector (through loss of foreign investor confidence), the corporate sector (through reduced demand) and the financial sector (through its exposures to defaults in the corporate and household sectors). A sudden reversal of *external capital flows* can negatively affect all sectors of the economy. Difficulties in the *financial sector* can hit all sectors of the economy adversely by reducing the availability of funding. Problems in the *corporate sector* can translate into an economic downturn, can create losses in the financial sector through exposures and directly affect households through changes in remuneration and employment levels. A *household sector* in bad health can adversely influence the real economy (through reduced consumption) and the financial sector (through losses on household exposures). Lastly, disruptive *financial market* conditions can directly affect the health of the financial sector, to the extent that financial institutions are market participants. Households can also be negatively affected by adverse financial asset price movements insofar as they invest on financial markets or own real estate.

assigned benchmark or threshold values for the purposes of monitoring key sectors of the economy and serving as leading indicators of crises.

A number of studies applied the early warning indicator methods initially developed in the literature for currency and balance of payments crises to banking crises. Earlier work includes, among others, Calvo et al (1993), Eichengreen et al (1996), Turner and Goldstein (1996) Frankel and Rose (1996). Demirgüç-Kunt and Detragiache (1997) use a multivariate Logit approach to identify determinants of banking crises in a large panel of developing and industrialised countries: slow GDP growth and high inflation, vulnerability to sudden capital outflows, low liquidity in the banking sector, a high share of credit to the private sector, past credit growth, explicit deposit insurance and weak institutions. Kaminsky and Reinhardt (1999) identify early warning indicators of twin (banking and balance of payments) crises, such as credit and equity prices, by looking at the ability of such variables to predict crises 12 or 24 months ahead, while minimising the noise[3] to signal ratio. Borio and Lowe (2002) and Borio and Drehmann (2009) build on the techniques developed by Kaminsky and Reinhardt (1999). Like the latter, they define threshold values for the indicators, but unlike them, they look at cumulative processes rather than just growth rates over one year, they use ex ante information (ie information which was available to the policymaker prior to the crisis) and, for the first time, they consider combinations of indicators and look at multiple time horizons.

Goodhart et al (2006) state that financial crisis monitoring can effectively be done with an indicator of banking sector profitability as well as the probability of default. Gerdrup (2003) uses banking indicators (number of banks, balance sheet indicators) and market indicators (asset prices) as determinants of the Norwegian crisis, controlling for non-financial sector indebtedness and macroeconomic factors. It has also been recognised in the literature (Nelson and Perli (2005), ECB (2005), Van den End (2006)) that in addition to balance-sheet based information, there is need for market information, not least because of the interactions between bank- and non-bank financial intermediation.[4]

Illing and Liu (2003) and Van den End (2006) provide a good descriptions of how one might attempt to build a composite indicator of financial stability. To begin with, relevant variables need to be selected. The choice is most often based on the early warning indicators literature (Demirgüç-Kunt and Detragiache (1998), Kaminsky, et al (1998), Bordo and Schwartz (2000)) and typically covers the banking system, the foreign exchange market and the equity market. Risk spreads and market liquidity are the two concepts most often used. Obviously, the choice of variables must also reflect the structure of the country's financial system. For instance, more importance should be attached to banking system indicators in countries where bank intermediation is more significant than market financing (ECB (2007)). Then, the single aggregate measure is calculated as a weighted average of the variables previously identified, each with a suitable lag. One important aspect of the weighted average construction is the weights. These can be determined in five different ways. Firstly, common

---

[3] Failure to predict a crisis or a false alarm.

[4] A number of desirable properties of a good composite indicator can be noted. It must be internationally comparable, if the analysis is conducted on several countries. Geršl and Heřmánek (2006) underline that differences in national accounting standards do not allow full cross-country comparison for some of the core set of the IMF's Financial Soundness Indicators. Furthermore, as pointed out in Čihák (2007), a good indicator must be easy to calculate, as well as to interpret; the assumptions that support it have to be robust, its theoretical underpinnings clear. For instance, backing out risk aversion measures from prices observed on the market rests on the assumption that prices can be observed on the market at all times. This assumption of market liquidity is not necessarily robust in the sense that liquidity can evaporate in times of stress. Lastly, although formalising the outcomes of tail events is important, a composite indicator has to be a useful measure of stress (eg it has to measure the build-up of imbalances) in the system even in the absence of extreme events.

factors analysis can be performed.[5] Secondly, a weight representing the importance (size) of the market which it proxies for can be assigned to each factor. Thirdly, sample cumulative distribution functions can be estimated.[6] Fourthly, the results of economic simulations with a macro-economic model can be used to determine the weights.[7] Fifthly, the variance-equal method can be chosen. This latter approach is the one most commonly used in the literature and consists of normalising each variable and then assigning equal weights.

IV Use of indicators and variables in financial stability reports

Most analyses of financial stability as reflected in the financial stability reports[8] (FSRs) extensively focus on various market segments and the variables listed in Table 1. However, the use of composite indicators is not very widespread in published financial stability reports. Table 2 provides a summary of the key indicators used by selected central banks in their FSRs. The selected sample represents a mix of industrial and emerging market economies with a diversified geographical distribution. Included in the list are a number of institutions whose reports compute composite measures in one form or the other.[9]

Key sectors and variables

When it comes to specific variables used in the FSRs, there are several common areas. Not surprisingly, the focus depends on the specific conditions in the economy and areas of observed and perceived vulnerabilities. Past episodes are also a guide. Many emerging market economies extensively focus on capital inflows, the balance of payment situation and exchange rate movements, while industrial countries focus on their banks' exposure to emerging markets. Banking ratios are extensively analysed in most reports although there are differences. Some reports tend to concentrate on the banks' performance and risks in considerable detail, while the others include insurance, hedge funds and other forms of non-bank financial intermediation. Where banking is the main form of intermediation, the available information would also depend on the level of supervisory input in preparing the report. Appropriately, many FSRs focus on systemically important banks as well as regions or sectors. For instance, the Austrian FSR has a strong focus on the developments in eastern European markets while the HKMA report extensively analyses the developments in south east Asia and China. With some exceptions, the FSRs reviewed here do not discuss monetary policy variables. A likely explanation is that central banks use other channels such as monetary policy statements or Inflation Reports for that purpose.

---

5 Such analysis consists in extracting weighed linear combinations of a number of variables, maximising the variance of each linear combination, while minimising the variance around it. The purpose of the exercise is to reduce the number of variables and detect the structure in the relationships between variables.

6 Each variable is transformed into percentiles, so that the highest (lowest) levels of stress are characterised by the 99th (first) percentile. Then, the transformed variables are averaged using chain linked arithmetic and geometric means.

7 Using a backward-sloping IS curve, Van den End (2006) estimates the impulse of changes in financial soundness indicators on GDP is estimated to determine weights.

8 Over 40 central banks regularly publish financial stability reports either annually or bi-annually.

9 The institutions/countries included in Table 2 represent an eclectic sample merely to illustrate typical use and is not intended as an exhaustive coverage of all published reports.

Table 2

Data including composite indicators in selected FSRs

Sector/Indicators	AT	AU	BR	CA	CH	CZ	ES	GB	HK	HU	ID	SE	TR	ECB[1]	IMF
Composite index								++[2]			+[3]				+[4]
Banking index					+[5]	+			+				+		+[6]
Financial conditions index						+[7]		+[8]		+				++[9]	+[10]
Monetary conditions index									+						
Real sector															
GDP	+		+	+, St	+	+	+	+	+	+	+		+	+	+
Fiscal deficit			+			+				+	+	+	+	+	
Inflation	+			+, St		+		++	+	+	+	++	+	+	
Household finance	++	++		+		++	++	++	+	++	+	++	++	+	+
Corporate finance	++	++		+	+	+		++	+	++	+	++	++[11]	+	++
Policy rate[12]	+	+		+, St				+	+	+			+		+
Monetary aggregates						+		+	+		+	+	+		++
External sector															
FX rates	Vo		Vo, St	+	Vo	Vo	+	++	Vo	+, Vo	Vo		Vo	Vo, Vi	Vo
FX exposures			++, Vo				+		+	+	+		+		++
BOP	+					+		+	+	+	+		+	+	++
Capital flows	+		+	+				+	+	+	++		+	+	++
Reserves			+					+	+		++		+	+	++
Financial sector[13]															
Profitability	+	++	+	+	+	+	++	+	+	+	+	+	+	+[14]	+[15]
Capital ratios	+, St	+	+	+	+	+	++	+	+	+	+	++, St		+	+

Table 2 (cont)

Data including composite indicators in selected FSRs

Sector/Indicators	AT	AU	BR	CA	CH	CZ	ES	GB	HK	HU	ID	SE	TR	ECB[1]	IMF
Credit (Loans)	+	++	+		+	+	+	+	+	++	+	++	++		+
Liabilities (deposits)	+	++	+		+	+	+	+	+	++	+	+	+		+
Liquidity	+, St	+						+	+	+, St	++	++, St	++	+, St	+
Credit Risk	+	++	+, St	+	++		+, Vo	+, St	+,St	+, St	+	+, St	+, St	+, St	++
Market risk	+	++	+, St		VaR					+	+, St		+, St		++
Interest rate risk	+		+, St		+[16], St				+	+	+, St	St			++
Asset quality[17]	++	+	++	+	+	+[18]	++	++	+	++	+	+	+	+	
Sectoral/Regional	+	+	++				++	++	+	+	+	+	+	+	+
Systemic focus	+		++		+	+	++	++	+		+	+		+	++
Financial Markets															
Government Bonds	Y		Y	Y, St		Y				Y	Y	Y, Sr	Y, Sr	Sr, Y, Vi	Y, Sr
Corporate Bonds	Sr, Vo	Sr, Vo	+	Y, Sr	Sr	Sr, Vo		S, Vo, V		Sr, Vo, Y	Y, Sr, R	Sr, Vo, Vi	Sr	Sr, Vi, Vo, Sr	Sr, Y
Money markets	Vo	Sr, Vo	Vo	Sr	Sr, Vo	Y[19]		S, Vo, Vi	Sr	Sr, Vi, Y	Y, Sr	Sr, Vo	Sr	Vi, Vo	Sr, Sr
Equity prices	Vo	Vo	Vo	Vo	Vo	Vo	Vo, Vi	Vo, Vi	Vo	+, Y	Vo	Vo, Vi	Vo	Vo	Vo, Vi
Real estate prices	Vo	Vo		Vo	Vo	Vo	+	Vo	Vo	+		Vo			Vo

Notes: R – ratings, St – Stress test based, Sr – riskiness and liquidity spreads, Vo – observed volatility, Vi – implied volatility, VaR – Value at risk, Y – Average yield, + denotes the use of one indicator, ++ denotes the use of several indicators.

[1] Euro area indicators as well as global comparisons. [2] Qualitative assessment based on sources, likelihood and impact of tail risks on six key vulnerabilities in the financial system. [3] Single aggregate index of financial stability. [4] Global financial stability map summarising risks and prospects of macro–financial environment. [5] Stress index for Swiss banks. [6] Separate composite indices for volatility and trading and market liquidity. [7] Separate indexes for creditworthiness and market liquidity. [8] A composite financial market liquidity index. [9] Multiple composite measures are used to estimate credit/equity/GDP gaps, financing gaps for non-financial companies and composite inter–bank liquidity indicator. [10] Banking stability index. [11] Including a Real Sector Confidence index. [12] CB monetary policy rate. [13] In most cases these indicators refer to Banking Sector only. [14] Large complex banking groups. [15] Including estimates of losses from write-downs of exposures. [16] 10 day VaR figures. [17] Typically includes non-performing loans, observed and estimated default rates and loss provisioning. [18] NPL and doubtful assets to gross loans. [19] 1 Yr yield average.

Source: compiled by the authors, based on Central Banks' FSRs.

Four sets of specific variables are used at the ECB (ECB (2007)). Firstly, the banking sector's balance-sheet (reflecting the continued significance of bank-based financial intermediation in the euro area), especially profitability, asset quality and capital adequacy. Particular attention is devoted to large and complex banking groups (LCBGs). Secondly, major sources of risk to the financial sector. This would include an assessment of competitive conditions in the banking sector, credit growth and banking exposure concentrations. More generally, it would cover asset price developments, business cycle and monetary conditions as well as measures of financial fragility in the counterpart sectors to banks (primarily households and non-financial corporations). Thirdly, the resilience of the financial sector based on its risk-absorption capacity (market-based and qualitative). Fourthly, forward-looking measures derived from securities prices (option implied risk-neutral distributions, direct default risks for LCBGs based on Moody's KMV, bid-ask spreads for EONIA swaps as a proxy for liquidity in the euro area money market, historical and implied volatilities, shape of the yield curve, term premia, options-implied skewness coefficient for German ten-year bonds).

Other central banks (BoE, Riksbank, Bank of Canada) also look at various components of financial stability through specific variables. In terms of their usage of market data, these central banks are fairly consistent with one another by their focus on equity prices, corporate and sovereign credit risk spreads, liquidity premia and volatility. As far as the real sector is concerned, GDP forecasts, incoming portfolio investment, official interest rates and sub-prime mortgage delinquency rates versus foreclosure rates are monitored.

In relation to the financial market turbulence that started in the summer of 2007, industrial economies' central banks have followed the market for mortgage backed securities. In particular, they have monitored issuance volumes, together with the maturity-related characteristics (in particular, duration and convexity) of such securities in order to estimate by how much long-term interest rate shocks are likely to be amplified by mortgage-related hedging flows. The BoE carries observed and market-expected losses on sub-prime mortgages and asset backed securities, in addition to house prices and a range of housing market activity measures (site visits, net reservations, new buyer enquiries net balances, sales to stock ratio and number of loan approvals fore house purchases).

Data on individual financial institutions are based on surveys and supervisory returns, as well as market data such as CDS spreads or indices. In order to monitor funding conditions for systemically important banks, several industrial economies' central banks look at the difference between three-month interbank rates relative to expected policy rates. That difference can then be further decomposed into liquidity and credit risk premia. Aggregate balance sheets of the national banking systems are typically published, broken down by geography, sector, maturity, riskiness. A number of additional measures of the banking system are analysed, eg annual write-off rates, customer funding gaps, intraday liquidity buffers, funding sources, profitability, capitalisation, equity returns, income mix (fees vs spreads), cost efficiency, share price volatility. Common large exposure counterparts are flagged. Some central banks also monitor funds' (eg hedge funds', pension funds') performance and trading events. The systemic importance of such funds, given the size of the assets under their management and the fact that they are counterparties to large systemically important banks (which act as prime brokers for them) arguably warrants this kind of monitoring.

In their monitoring of non-financial corporations in industrial and emerging economies, many industrial economies focus on CDS spreads, together with corporate finance data and default probabilities computed from Moody's KMV model. Using these individual default probabilities, multiple default probabilities can be calculated, which presumably do a better job of identifying market-wide distress than individual default probabilities.

Aggregate measures

The use of aggregate measures in some of the FSRs listed in Table 2 is very recent and in many cases not more than one or two years old. It is early as yet to make an assessment of their performance.

Of the composite measures used, the Czech National Bank (CNB), the Swiss National Bank (SNB), and the Hong Kong Monetary Authority (HKMA) use an aggregate measure to reflect banking stability or fragility. The SNB stress index for the banking sector is calculated from market data, balance sheet figures and non-public data from the supervisory authority. This continuous indicator measures stress in terms of deviation from the historical trend. The HKMA has developed a Probit model[10] to estimate early warning indicators of banking distress. It uses quarterly panel data on macroeconomic fundamentals, estimates of default risk of individual banks and non-financial companies, asset price movements and contagion factors. The HKMA also computes a monetary conditions index which would reflect the monetary aggregates in the economy.

The CNB computes a banking stability index using weighted average of sub-indicators of banking sector soundness including capital adequacy, profitability, balance sheet liquidity, asset quality, credit and currency risk. The constructed index of financial ratios is expressed in terms of the standard deviation from its historical average. Additionally, the CNB also computes composite indices of financial conditions to reflect liquidity and creditworthiness of non-financial companies.

The Central Bank of Turkey calculates a financial strength index as a weighted average of partial indicators of the financial soundness of banks. The index combines six areas of financial soundness indicators, viz capital adequacy, profitability, liquidity, asset quality, interest rate risk and exchange rate risk.

The ECB computes a composite indicator of financial market liquidity in the euro area, similar to the market liquidity indicator of the BoE. The ECB indicator combines several measures covering four different markets and three different dimensions of market liquidity (tightness, depth and resilience) as well as liquidity premia. The National Bank of Hungary also calculates a liquidity index along these lines.

The IMF is developing a banking stability index. For this purpose, it considers the banking system as a portfolio, and based on the market-based probability of default of each individual bank it estimates the joint default probabilities, ie the expected number of bank defaults in the system, given that at least one bank defaults (see IMF (2008)).

Most such indexes are constructed as a series going back over several years; the Czech Index, for instance, goes back to 1997 whilst the SNB stress index goes back to 1987. These indices correlate well with past episodes of financial stress and reflect the risks that have already materialised. What is not clear, however, is their ability to predict the onset of a crisis. Given that the banking sector is predominant and the construction of the index depends on the use of balance sheet data, it is likely that exposures not reported in the balance sheet might not be fully reflected. On the other hand, a more broad based measure of financial conditions such as market liquidity or market risk which relies on market data would be better able to signal conditions of stress in the short term.

[10] The model draws on a number of earlier studies including Kaminsky and Reinhart (1999) and Demirgüç-Kunt and Detragiache (1998).

V Towards a single aggregate measure of financial stability

As described in the previous section, some central banks have started developing aggregate measures that reflect the conditions of a key sector such as banking or key financial market conditions. There are very few instances of a single overarching aggregate measure of financial stability. However, some institutions have begun to present a consolidated view of the risks and prospects qualitatively through charts, heat maps or assessment grids. There also instances of single quantitative indexes.

The IMF has started publishing a global financial stability map which presents an assessment of the risks and the underlying conditions for the global financial system. The shifting contours of credit risk, market and liquidity risks, as well as the macro-financial conditions from the previous period reflect the IMF's view of the risks and prospects ahead. Quantitative analysis underpins the construction of this map although the final positioning is based on judgement. Leading indicators in six broad areas are considered: monetary and financial conditions in leading industrial countries, risk appetite in global financial markets, macro-economic risks in G3 and OECD countries, emerging market risks credit risks and market risks (IMF (2008)).

The BoE presents its assessment of the outlook and prospects, presented in qualitative terms, which are underpinned by quantitative modelling of the key vulnerabilities of the UK financial system. As such, an overview of the financial system is presented in the form of an assessment based on the sources, likelihood and impact of tail risks on six key vulnerabilities in the financial system. In addition, a composite financial market liquidity index is computed (which is a simple unweighted average of nine liquidity measures, normalised on the period 1999–2004). Prospects for the UK financial system, as well as the corollary risk mitigation, are assessed.

Along the lines described in Illing and Liu (2003) and Van den End (2006), respectively, the Bank of Canada and the Nederlandsche Bank construct single aggregate measures of financial stability (albeit not published in their FSRs). Illing and Liu (2003) argue that their single aggregate measures compare favourably in their ability to flag crises with composite partial measures commonly used in the literature. Van den End (2006) notes that by combining market and balance sheet information on financial institutions, the Financial Stability Conditions Index of the Netherlands Bank appears to make a significant contribution beyond a traditional financial conditions index which might only look at one sector.

Bank Indonesia computes a broad based financial stability index which, in addition to the banking sector indicators uses leading macro-economic and external sector indicators on a monthly basis to reflect the financial system stability more generally.

Although the Board of Governors of the Federal Reserve System does not publish a financial stability review, it has an index of financial fragility, constructed in two steps (Nelson and Perli (2005)). First, the information contained in 12 individual variables[11] is reduced to 3 summary statistics, their rate of change and their correlation. Second, a Logit model is estimated to obtain the probability that, at any given time and based on the three summary

[11] Based on interest rates and asset prices, a number of market liquidity proxies are monitored: bid-ask spreads, trading volumes, liquidity premia (difference in spread between highly liquid and less liquid securities). Risk spreads are also followed, in particular swap spreads (proxies for the credit quality of the banking sector and market liquidity), agency spreads and commercial paper spreads. Equity premia are analysed, although interpreting them is difficult, as it is difficult to disentangle economic information changing agents' earnings expectations, changes in certainty about economic outcomes and changes in risk appetite. Finally, implied volatilities derived from option prices, bearing in mind that risk-neutral PDFs contain market participants' risk aversion.

statistics, the behaviour of financial markets is analogous to that of high stress events (eg 11 September 2001).[12]

Conclusion

In theory, composite indicators of financial stability are better suited for the definition of threshold or benchmark values to indicate the state of financial system stability than individual variables. Moreover, they are useful measures of stress (eg they can be used to gauge the build-up of imbalances) in the system even in the absence of extreme events. However, as Geršl and Heřmánek (2006) point out, the construction of a single aggregate measure of financial stability is a difficult task given the complex nature of the financial system and the existence of complex links between various sectors. In the absence of an overarching aggregate, partial composite measures such as a banking stability index or a market liquidity index are used in several FSRs. Regardless of whether a single aggregate measure of financial stability is constructed or not, FSRs would need to analyse key variables in the real, banking and financial sectors as well as variables in the external sector.

There is some diversity in construction and use of the key indicators. For broader cross-country comparisons it would be useful to have an appropriate template and methodology for such indicators, although countries' individual circumstances make such an exercise difficult (due, notably, to the varying relative importance of individual financial system components and to differing degrees of openness of the economies concerned). If one goes a step further and tries to compute a single aggregate measure of financial stability, the weightings of the different variables that constitute such an aggregate measure have to reflect this accordingly. For instance, a maturity mismatch between short-term liabilities and long-term assets may have to be assigned a low weight, because maturity transformation is a common feature of the banking business and banks can successfully manage part of this risk using interest rate derivatives. Likewise, the fact that low volatility on a market can mean stable conditions as well as failings in the price discovery process should be considered when assigning a weight to market volatility.

Although some central banks have experimented with computing single aggregate measures of financial stability, no such measures can be used without knowledge and use of other – quantitative or qualitative – instruments. Moreover, although single aggregate measures reflect the financial system conditions well post facto, it is not yet clear how well they would perform in signalling the onset of financial stress.

[12] The private sector has also made attempts at computing single aggregate measures of financial stability. Illing and Liu (2003) note that the Bank Credit Analyst produces a monthly stress index which incorporates major banks' share price performance, credit spreads, private sector indebtedness, stock market leverage, overall stock market performance, consumer confidence, the slope of the yield curve and stock and bond issuance. Bordo, Dueker and Wheelock (2000) construct a financial instability index with lags, incorporating bank failures, non-financial business bankruptcies, an ex post real interest rate and an interest rate quality spread. Commercial and investment banks produce indices, such as the JP Morgan Liquidity, Credit and Volatility Index, the Credit Suisse First Boston Emerging Markets Risk Indicator, the Deutsche Bank Alarm Clock and the Goldman Sachs GS-Watch.

References

Bank of England (2008), Financial Stability Report, no 23, April.

Bordo, M and A Schwartz (2000): "Measuring real economic effects of bailouts: historical perspectives on how countries in financial stress have fared with and without bailouts." NBER Working Paper, no 7701.

Bordo, M, MJ Dueker and DC Wheelock (2000): "Aggregate price shocks and financial instability: an historical analysis", NBER Working Paper, no 7652.

Borio, C and M Drehmann (2009): "Assessing the risk of banking crises – revisited", BIS Quarterly Review, March.

Borio, C and P Lowe (2002): "Asset prices, financial and monetary stability: exploring the nexus", BIS Working Papers, no 114, July.

Calvo, GA, L Leiderman and CM Reinhart (1993): "Capital inflows and real exchange rate appreciation: the role of external factors", International Monetary Fund Staff Papers, no 40, vol 1, pp 108–51, March.

Čihák, M (2007): "Systemic loss: a measure of financial stability", Czech Journal of Economics and Finance, no 57, vol 1–2, pp 5–26.

Demirgüç-Kunt, A and E Detragiache (1997): "The determinants of banking crises – evidence from developing and developed countries", IMF Working Papers 97/106, International Monetary Fund.

_____ (1998). "The Determinants of Banking Crises in Developing and Developed Countries." International Monetary Fund Staff Papers, no 45, vol 1, pp 81–109.

Eichengreen, B, A Rose and C Wyplosz (1996): "Contagious currency crises", NBER Working papers, no 5681.

Eichengreen, B and AK Rose (1999): "The empirics of currency and banking crises", a non-theoretical study of financial crises), NBER Reporter, December.

European Central Bank (2005): "Measurement challenges in assessing financial stability", ECB Financial Stability Review, December.

_____ (2007): "Progress towards a framework for financial stability assessment", speech by José-Manuel González-Páramo, Member of the Executive Board of the ECB, OECD World Forum on "Statistics, Knowledge and Policy", Istanbul, 28 June.

Frankel, J and A Rose (1996): "Currency crashes in emerging markets: empirical indicators", Journal of International Economics, vol 41, pp 351–66.

Gerdrup, KR (2003): "Three episodes of financial fragility in Norway since the 1890s", BIS Working Papers, no 142, October.

Geršl, A and J Heřmánek (2006): "Financial Stability Indicators: advantages and disadvantages of their use in the assessment of the financial system stability", Czech National Bank Financial Stability Review.

Goodhart, C, O Aspachs, M Segoviano, D Tsomocos and L Zicchino (2006): "Searching for a metric for financial stability", LSE Financial Markets Group Special Paper Series, Special Paper no 167, May.

Gray, DF, RC Merton and Z Bodie (2007): "New framework for measuring and managing macrofinancial risk and financial stability", NBER Working Paper no 13607, November.

Haim, Y and R Levy (2007): "Using the balance sheet approach in financial stability surveillance: analyzing the Israeli economy's resilience to exchange rate risk", Bank of Israel Discussion Papers no 1/07, January.

Hawkins, J and M Klau (2000): “Measuring potential vulnerabilities in emerging market economies”, BIS Working Papers, no 91, October.

Illing M and Y Liu (2003): “An index of financial stress for Canada”, Bank of Canada Working Paper no 2003–14, June.

International Monetary Fund (2006): Financial Soundness Indicators: Compilation Guide, March.

International Monetary Fund (2008): Global Financial Stability Report, April.

Irving Fisher Committee (2007a): Proceedings of the IFC Conference on “Measuring the financial position of the household sector”, vol 1, IFC Bulletins no 25, March.

_____ (2007b): Proceedings of the IFC Conference on “Measuring the financial position of the household sector”, vol 2, IFC Bulletins no 26, July.

Kaminsky, G, S Lizondo and C Reinhart (1998): “Leading indicators of currency crises”, IMF Staff Papers 45(1), pp 1–48.

Kaminsky, GL and CM Reinhart (1999): “The twin crises: the causes of banking and balance-of-payments problems”, The American Economic Review, vol 89, no 3, pp 473–500, June.

Nelson, W R, Perli, R (2005): “Selected indicators of financial stability”, 4th Joint Central Bank Research Conference on “Risk Measurement and Systemic Risk”, ECB Frankfurt am Main, November.

Patel, S and A Sarkar (1998): “Crises in developed and emerging stock markets”, Financial Analysts Journal, vol 54–6, pp 50–9, November–December.

Sveriges Riksbank (2008), Financial Stability Report, no 2008:1, June.

Turner, P and M Goldstein (1996): “Banking crises in emerging economies: origins and policy options”, BIS Economic Papers, no 46, November.

Van den End, JW (2006): “Indicator and boundaries of financial stability”, DNB Working Paper no 97, March.

White, WR (2004): “Are changes in financial structure extending safety nets?”, BIS Working Papers, no 145, January.

Worrell, D (2004): “Quantitative assessment of the financial Sector: an integrated approach”, International Monetary Fund Working Papers, no 153.