



ANNEX II TO THE ESRB RISK DASHBOARD

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ESRB risk dashboard: description of the indicators

The ESRB risk dashboard is structured according to a set of risk categories comprising interlinkages and composite measures of systemic risk, macroeconomic risk, credit risk, liquidity and funding risk, market risk, and solvency and profitability risk. The indicators within each risk category are selected on the basis of the principles of (i) relevance for macro-prudential policies, (ii) availability of the data, and (iii) where possible the forward-looking nature of the indicator. This note describes each indicator in the dashboard as well as the information it provides from a systemic risk perspective.

Interlinkages and composite measures of systemic risk

This section of the risk dashboard comprises a set of synthetic indicators of systemic risk and measures of interlinkages across financial markets. First, the composite indicator of systemic stress (CISS, **indicator 1.1**) captures several symptoms of stress in different segments of the financial system, such as equity and bond markets, and foreign exchange and money markets; the contributions of each market to systemic stress are then combined to create a single indicator. The CISS hinges on the idea that financial stress is more systemic and thus more dangerous for the economy as a whole if financial instability spreads more widely across the whole financial system. It thus takes into account the time-varying cross-correlations between its subcomponents and puts more weight on situations in which stress prevails in several market segments at the same time. The value of this indicator is constrained to lie inside the unit interval: greater values indicate periods of higher financial distress, and they also capture lower preferences for holding risky or illiquid assets (flight to quality and flight to liquidity respectively)¹.

Moreover, the risk dashboard includes a specific indicator of systemic stress in the banking sector (**indicator 1.2**); this indicator shows the probability of simultaneous default by two or more large and complex banking groups (LCBG) within a horizon of one year. Based on CDS prices, in practice the indicator measures markets' perception of how fragile the banking system is to the default of one of its constituents.²

A additional indicator of overall financial distress is the CoVaR, which measures the average contribution of individual financial institutions to systemic risk (**indicator 1.3**): CoVaR is the value at risk (VaR) of the financial system conditional on other institutions being in distress. This indicator takes account of characteristics such as leverage, size, and maturity mismatch

¹ For further details, see Special Feature C "Systemic risk methodologies", *Financial Stability Review*, ECB, June 2011; and Hollo, D., Kremer, M. and Lo Duca, M., "CISS – a composite indicator of systemic stress in the financial system", *Working Paper Series*, No 1426, ECB, March 2012 (<http://www.ecb.int/pub/pdf/scpwps/ecbwp1426.pdf>).

² For further details on the indicator, see Box 8 in ECB, *Financial Stability Review*, June 2012.



in order to predict a single institution's impact on systemic risk. The average systemic risk contribution tends to be higher during periods of financial turbulence.³

Furthermore, an indicator based on co-movements of sovereign CDS markets is included in the dashboard (**indicator 1.4**). This indicator, based on a principal component analysis, tracks the co-movement of sovereign CDS spreads for 12 EU Member States and for two subsamples of countries. If these indicators are positive, there is an increased exposure to a common risk factor, e.g. a simultaneous increase in the countries' joint default risk, as perceived by CDS market participants.

Finally, in order to assess the interconnectedness of countries through the banking sector in the European Union, this section of the dashboard presents a network chart of EU banks' cross border claims (**indicator 1.5**). On a cross-sectional basis, this indicator depicts (i) the relevance of the total foreign claims of a country's consolidated banking sector (illustrated by the size of the bubbles), and (ii) bilateral foreign claims between each country's banking sector and borrowers in other countries (the arrows). The size of both the arrows and the bubbles is proportional to the total capital of the lending country's banking sector. The larger the bubble, the higher the cross-border exposure of the country's domestic banking sector vis-à-vis all non-domestic counterparties. The larger the arrow, the more significant is the individual country's exposure. Notably, intragroup positions are netted out (i.e. banks record only claims on non-affiliated counterparties), therefore only net cross-border exposures are used to measure interconnectedness via the banking sector.

Macro risk

This section of the dashboard uses primarily macroeconomic data to monitor the build-up of risks in the real economy. Indicators in this section include measures of real GDP growth, the credit-to-GDP gap, the fiscal position of the government sector, national trade positions, private sector leverage, the prices of some important raw materials and the results of economic sentiment surveys.

First, real GDP growth (**indicator 2.1**), as a general measure of economic activity, signals whether an economy is in a period of prolonged low growth (compared with its past performance), or in recession. From a forward-looking perspective, the European Commission's forecast of GDP growth allows country-specific or EU-wide future economic downswings to be anticipated. Subdued growth or a contraction in the economy may have negative implications for the stability of the financial sector. Major risks such as credit risk and solvency risk tend to amplify during a recession, with economic agents finding it more difficult to repay existing debt and investors demanding higher premia for access to capital.

Second, the domestic credit-to-GDP gap (**indicator 2.2**), a measure of the amount of credit in relation to the performance of the underlying economy, offers an early warning signal of the possible emergence of a credit bubble in the economy, in particular during the upswing phase of the economic cycle. The credit-to-GDP gap is computed as the deviation of the

³ See Adrian, T. and Brunnermeier, M.K., "CoVaR", *Federal Reserve Bank of New York Staff Reports*, No 348, 2011



standard credit-to-GDP ratio from its trend;⁴ this measure hence focuses on business cycle fluctuations of the standard credit-to-GDP ratio around its long-term trend. High levels of credit-to-GDP gap signal excessive amounts of credit in the economy, potentially fuelling a credit bubble; from a systemic risk perspective, the credit-to-GDP gap has therefore an important forward-looking dimension. In fact, important policy recommendations aimed at preventing the build-up of systemic risk may be based on the evolution of this indicator.⁵

Statistics on the current account balance (**indicator 2.3**), which reflects the trade position of a country, allow to monitor the economic imbalances caused by prolonged periods of external deficits funded through capital inflows. This, in turn, monitors the economy's ability to sustain a sudden stop of credit inflows as well as its loss of competitiveness vis-à-vis other economies. In addition, a high unemployment rate (**indicator 2.4**), can have systemic risk implications; unemployment negatively affects households' available income, thus reducing, for instance, their ability to save, which undermines a major source of funding for financial institutions, and the ability of households to repay loans, which lowers the quality of banks' loan books. As a consequence, the solvency and profitability of financial institutions are weakened. In this regard, the risk dashboard also includes the European Commission's forecast of the unemployment rate, which provides an indication of the future conditions of the labour market.

In addition, the risk dashboard includes a set of indicators about the financial health of the government sector in the EU. This sector plays a crucial role in ensuring financial stability in the economy. First, by issuing public debt, governments and government-sponsored agencies provide investors with safe and liquid assets. Second, governments may provide insolvent institutions with a financial backstop in the event of default. On the other hand, prolonged periods of deficit and/or high levels of debt can become unsustainable and damage financial stability. Measures of sovereign indebtedness and the financial position at various time horizons help gauge the soundness of public finances. The dashboard contains data on four such indicators: the debt-to-GDP ratio (**indicator 2.5**), the deficit-to-GDP ratio (**indicator 2.6**), CDS premia on sovereign debt (**indicator 2.7**) and forthcoming sovereign debt redemptions of marketable securities (**indicator 2.8**). Of these indicators, those with forward-looking connotations are forecasts of indicators 2.5 and 2.6 (both issued by the European Commission), as well as indicator 2.8. More specifically, forecasts of government deficit-to-GDP and debt-to-GDP ratios look at future levels of stocks and flows of public sector debt, thus providing an indication of the future sustainability of current fiscal policies given a prediction of the underlying economic activity. Moreover, the indicator on forthcoming sovereign debt redemptions shows the expected schedule of repayments (with reference to tradable debt securities only) owed by the government to the private sector in the next 12

⁴ The data are detrended with a recursive Hodrick-Prescott filter (see Alessi, L. and Detken, C., "Quasi real time early warning indicators for costly asset price boom/bust cycles: a role for global liquidity", *European Journal of Political Economy*, Vol. 27 (3), 2011).

⁵ The current version of this indicator does not however have a direct link to macro-prudential instruments such as the counter-cyclical capital buffer. Furthermore, in a downturn credit-to-GDP gaps should be interpreted with particular care, as a recession increases the credit-to-GDP ratio and the gap vis-à-vis its trend, even when credit is stagnant.



months. High volumes of redemptions by countries subject to liquidity constraints increase both liquidity risks and solvency risks, impacting the required yields and consequently putting pressure on the sustainability of their overall debt positions. Finally, CDS premia on sovereign debt represent the cost that investors are willing to pay to hedge against a sovereign default: this indicator is therefore an informative measure of the markets' perception of systemic risk stemming from fiscal imbalances.

The level of indebtedness of the non-financial private sector is indicated by the non-financial corporations' non-consolidated debt-to-GDP ratio (**indicator 2.13**) and the households' debt-to-gross disposable income ratio (**indicator 2.9**). An overly indebted private sector may face difficulties in meeting its debt servicing obligations, for example in the event of a recession, leading to the materialisation of systemic risk. However, differences in fundamental financial and economic structures across countries complicate the use of these two ratios to make direct comparisons between EU Member States.⁶

The dashboard incorporates the Economic Sentiment Indicator of the European Commission (**indicator 2.10**), an important survey-based indicator, characterised by a significant forward-looking component. As a composite indicator of confidence in different economic sectors, this measure is an informative signal of the diverse economic environment that various businesses and industries expect to face in the near future. Economic sentiment is therefore a leading indicator of future developments in economic fundamentals, which, in turn, shed light on the performance and stability of financial markets. More specifically, values below 100 (set as the long-term average) signal a negative general economic outlook.

Furthermore, two widely used leading indicators of economic activity are also included in the dashboard: the global Purchasing Managers' Index (PMI, **indicator 2.11**), based on data collected from a panel of 2,000 private sector firms worldwide, and the global Industrial Production Index (also **indicator 2.11**), which measures the physical output from factories, mines and utilities. These figures help market analysts ascertain whether industrial production is rising or falling, a valid proxy for activity in the overall economy.

Finally, the prices of some important raw materials (**indicator 2.12**) can also have implications for financial stability. Gold, for example, is typically used to gauge risk aversion in the markets, as investors flee to safe assets during periods of turmoil in the financial markets or during an overall economic slowdown, thus pushing up prices. High and volatile oil prices are a risk for the real economy, as they can stoke inflation and affect the level of economic output; furthermore, heavy dependence on oil imports increases the impact of an oil price shock on overall economic activity.

Credit risk

Credit risk is the risk of losses owing to the inability of counterparties to fulfil their contractual obligations. This section of the dashboard looks at the ability of the non-financial private sector (households and non-financial corporations) to repay its debt and obtain financing at sustainable costs. It also monitors factors which could increase credit risk at the systemic

⁶ For example, fiscal rules or national accounting practices.



level, e.g. the presence of high levels of foreign currency lending or overvalued real estate markets.

Regarding credit risk in the household sector, countries that feature a combination of overvalued residential property markets (**indicator 3.1**) and a highly indebted household sector may well be heading towards a credit bubble. They may face a systemic crisis if banks are not sufficiently capitalised to face a surge in non-performing loans, as well as a recession induced by depressed domestic consumption after a housing bubble bursts.⁷ Another aspect considered in the dashboard is the share of lending in foreign currencies over total lending, as unexpected sharp movements in exchange rates may affect repayments of debt denominated in foreign currencies. This is a particular concern in the case of unhedged borrowers (i.e. those with no income in the currency of denomination of the debt – typically households). The first of the two indicators monitors stock and flow developments (**indicator 3.2.a**) – with countries featuring both a large stock and a positive annual growth rate being most at risk – while the second provides a breakdown by borrowing sector (**indicator 3.2.b**), with households being the more vulnerable sector.⁸

Regarding the cost of financing, the dashboard focuses on two indicators: corporate bond yields, broken down by rating class (**indicator 3.3**), and bank lending margins (**indicator 3.4**), which reflect the spread between interest rates charged by banks on new loans and the corresponding swap rate. While indicator 3.3 is relevant for large firms with direct access to capital markets, lending margins represent a good barometer of the cost of credit for small and medium-sized enterprises (SMEs) with no access to the bond market and for households. High levels of lending margins adversely affect the ability of the corporate sector to access credit, especially in countries with a large share of SMEs. On the other hand, very low margins may facilitate excessive borrowing.

Finally, this section includes two further indicators on changes to credit standards applied to (i) mortgage loans to households (**indicator 3.5**) and to (ii) loans to large enterprises (**indicator 3.6**) derived from bank lending surveys in the EU and the United States. These indicators have important systemic risk implications, as they capture the banking sector's response to developments in economic activity. On the one hand, a thriving economy might increase profit opportunities for banks and hence induce them to lower credit standards, potentially fostering a credit bubble; on the other hand, during economic downturns credit institutions might prefer to hedge against uncertainty and reduce the volume of lending by tightening credit standards. This pro-cyclical behaviour amplifies risk in economic upturns and further depresses the economy during downturns.

⁷ Nevertheless, it should be noted that national specificities should be taken into account when assessing house price levels across countries. They may include structural aspects of the housing markets, bankruptcy procedures, social security safety net, etc.

⁸ Indicator 18.a also takes into consideration the specificities of countries with fixed exchange rate regimes (Bulgaria, Denmark, Latvia and Lithuania), which are also presented in terms of lending in foreign currencies other than the euro. Denmark, Latvia and Lithuania participate in ERM II, Denmark participates with a narrow band ($\pm 2.25\%$). Bulgaria is under a currency board arrangement.



Liquidity and funding risk

This section of the dashboard comprises a number of price-based indicators to measure funding and liquidity conditions in the financial sector. In the case of the money markets, the EURIBOR-OIS interbank rate spread (**indicator 4.1**) reflects the risk premia banks charge to lend to each other. This indicator is regarded as a very good thermometer of tensions in the short-term interbank markets: a wide spread means that the interbank money markets have become less liquid.⁹ This indicator is complemented by a synthetic measure for financial markets liquidity measure (**indicator 4.2**), which proxies the ability of market participants to undertake securities transactions without triggering large changes in their prices. This measure monitors liquidity across several markets, covering foreign exchange, equity and bond markets, along three separate dimensions of market liquidity including tightness, depth and resiliency as well as estimates of liquidity premium.¹⁰ A low level of this indicator reflects overall less liquid and stickier financial markets. The dashboard also includes the EUR/USD cross-currency basis swap spread (**indicator 4.3**), an indicator of tensions in the US dollar funding market. As this spread decreases, swapping euro for US dollars becomes increasingly expensive; banks with large refinancing needs in US dollars and little or no access to other sources of dollar funding (e.g. deposits) are most vulnerable to fluctuations in this spread.¹¹

Owing to the nature of their business, banks are more vulnerable to liquidity risk than other financial sector entities (e.g. insurers); a number of banks' balance sheet indicators can help evaluate the funding structures of banks and hence identify structural vulnerabilities. Three indicators have been selected for the dashboard: the loan-to-deposit ratio, MFIs' liability structure and reliance on central bank funding. Banks with high loan-to-deposit ratios (**indicator 4.4**) rely more on wholesale funding markets, which are usually more volatile and unstable than retail deposits, and are hence more vulnerable and exposed to liquidity risk. The liability structure of the Credit Institutions sector (**indicator 4.5.a**) shows the contribution by instrument to the growth rates of banks' total liabilities in the euro area.¹² High growth rates of banks' total liabilities may indicate an increase in the leveraging of the sector, while the decomposition by instrument sheds light on current changes in the funding model (e.g. reduced funding from the interbank market and an increase in deposits). A box-plot graph (**indicator 4.5.b**) provides a cross-country comparison of the latest data – i.e. the growth rate of Credit Institutions liabilities by country – and of the distribution of historical values.

⁹ The three-month Euro Interbank Offered Rate (EURIBOR) is the interest rate at which banks borrow unsecured funds from other banks in the wholesale money market for a period of three months, therefore reflecting both liquidity risk and credit risk; on the other hand, banks entering into an Overnight Indexed Swap (OIS) are only entitled to receive a fixed rate of interest on a notional amount (called the OIS rate) and pay a floating rate. As these contracts do not involve any initial cash flows, an OIS has little exposure to default and therefore no credit risk.

¹⁰ For further details see Box 9 in *Financial Stability Review*, ECB, June 2007.

¹¹ When the value of this spread is negative, holders of euro are willing to pay a premium (the cross-currency swap) to swap euro with US dollars and vice-versa when the spread is positive.

¹² Expressed in annual cumulated flows. For data-related reasons it is not possible to compute this indicator for the whole EU.



Another indicator of banks difficulties in accessing traditional sources of funding is a high dependence on central bank funding (**indicator 4.6**); this indicator computes the share of funding obtained from national central banks over total liabilities. **Indicator 4.7** looks at the level of central bank reserves in the euro area (decomposed into (i) current accounts covering the minimum reserve system and (ii) the marginal deposit facility) vis-à-vis the evolution of the interbank money market, as measured by the volume of overnight transactions between banks (EONIA volumes).

The maturity profile of EU banks' debt redemptions (**indicator 4.8**) provides an overview of the evolution of banks' term structure. By comparing historical data with the latest data, this indicator shows whether the EU banking sector is moving towards a shorter or a longer maturity profile of its debt. Any shift towards short-term funding increases the frequency at which the banking sector needs to obtain refinancing, thereby exposing banks to more liquidity risks; in fact, banks that rely more heavily on wholesale markets increase their exposure to opportunistic and speculative behaviours by market agents, hence posing a systemic risk for financial stability.

Market risk

Market risk is the risk of losses owing to adverse movements in financial market prices and/or to excessive volatility. This section of the dashboard therefore focuses on measures of market movements and investor risk appetite.

The first indicator in this section is the global risk aversion indicator (**indicator 5.1**), a summary of five indicators of risk aversion compiled worldwide; a rise in the indicator denotes an increase in investors' risk aversion.

In order to identify periods of distress in equity market valuations, the risk dashboard monitors equity indexes at the global level (**indicator 5.2.a**), which include major corporations listed in American, Asian and European stock markets, as well as sector-specific indexes (**indicator 5.2.b**) for EU-based banks, insurance companies, industrial firms and building materials corporations.

Furthermore, an indicator of equity markets' implied volatility (**indicator 5.2.c**), as a measure of uncertainty about the future evolution of prices, is included in the risk dashboard. Implied volatility can be observed at different time horizons (from one year and up to ten years) and is derived from at-the-money options observed in the market. In the case of the equity market, the risk dashboard includes the Chicago Board Options Exchange Volatility Index (CBOE VIX Index) for the US market and the VSTOXX index for the euro area, both of which are based on the weighted average of the implied volatilities for a wide range of strikes.¹³ Recent studies show that the CBOE VIX Index has a powerful explanatory power as regards

¹³ The CBOE VIX Index is calculated using Standard & Poor's 500 Index option bid/ask quotes, while the VSTOXX index is based on EURO STOXX 50 Index options.



co-movements of EU government bond spreads, which, in turn, may signal the presence of union-wide financial contagion.¹⁴

Another closely monitored indicator of equity market valuations is the price/earnings ratio (**indicator 5.3**), which indicates the relationship between a company's market value and its profitability (measured on the basis of its annual earnings). When the level of this ratio is high, it means that investors are willing to pay more for the income deriving from the ownership of the stock. Extremely high values, may indicate market overvaluation, which raises the probability of a significant price correction. To allow for price/earnings differences across industries, the risk dashboard includes indicators calculated for distinct panels of EU banks, insurers and non-financial corporations.

Interest rate implied volatilities are also presented for the major global currencies (EUR, USD and GBP), to reflect market uncertainty about the level of interest rates. This indicator is split between short-term (volatility in interest rates for maturities between three months and one year, **indicator 5.4**), and long-term (volatility in interest rates for maturities between one and ten years, **indicator 5.5**). In addition, exchange rate implied volatility (**indicator 5.6**) is reported in the risk dashboard to account for currency risks in the markets for major currencies. Exchange rate fluctuations have been observed to increase in times of currency and balance of payments crises; as a consequence, monetary authorities consistently target its volatility in order to ensure stability in currency markets.

Profitability and solvency risks

This section of the dashboard focuses on the financial performance and solvency of the EU banking and insurance sectors; it contains basic indicators on banks and insurance companies based on supervisory reporting to the European Banking Authority (EBA) and the European Insurance and Occupational Pensions Authority (EIOPA).

As regards the banking sector, basic indicators of profitability included in the dashboard are: return on equity (ROE, **indicator 6.2.a**), the cost-to-income ratio (**indicator 6.2.b**) and net interest income to total operating income (**indicator 6.2.c**). ROE is the most commonly used indicator of the profitability of a business and measures how well management uses shareholders' funds to generate income. On the other hand, a high ROE may also be a signal of excessive risk-taking. Net interest income to total operating income shows developments in banks' ability to generate profits from the traditional credit intermediation business. This ratio is highly dependent on interest rate movements and economic cycles; a higher level of this ratio is typical of retail-oriented banks. On the other hand, a lower level of this ratio suggests that banks rely more on other sources of income, such as trading or fees, which are more dependent on market volatility. The cost-to-income ratio measures a company's costs (administrative and fixed costs, such as salaries and property expenses, but

¹⁴ As evidence for the crisis period, see, for instance, Arghyrou, M.G. and Kontonikas, A., "The EMU sovereign debt crisis: Fundamentals, expectations and contagion", *Journal of International Financial Markets, Institutions & Money*, 2012.



not loan loss provisions and write-offs) in relation to its income; the lower the ratio the more profitable a bank is.¹⁵

Furthermore, an indicator depicting the slope of yield curves in different currencies (**indicator 6.1**) is included in the dashboard. Besides its traditional interpretation as an indicator of expected changes in economic activity, the slope of the yield curve plays a crucial role in the expected profitability of the banking business. In fact, when the yield curve is steep, banks are able to extract more profits from their traditional maturity transformation activity (by gaining the difference between borrowing at short-term rates or floating rates and lending at the long end). Conversely, a flat yield curve limits the profitability of this core banking activity.

Indicators of banks' solvency are Tier 1 capital to total assets (**indicator 6.3.a**) and impaired loans and past due loans (>90 days) to total loans (**indicator 6.3.b**). Tier 1 capital is based on the definition of capital set out in the Basel agreement and it offers a commonly used measure of the capitalisation of a banking sector. A banking sector with low levels of Tier 1 capital poses a systemic risk to the whole financial sector as even small losses on assets could have a significant impact on the solvency of banks.¹⁶ Furthermore, a standard measure of the materialisation of credit risk, such as the share of impaired or past due loans over total loans, can provide some insights into the evolution of credit costs. High levels of non-performing loans indicate an on-going deterioration in the quality of banks' assets, harming both the solvency and the profitability of banks.

With regard to the insurance sector, a set of insurance-specific indicators of solvency and profitability are included in the risk dashboard. In the same way as for banks, a major indicator of profitability for insurance corporations is the return on equity (ROE, **indicator 6.4.a**). Other indicators of profitability are also closely monitored, for example the combined ratio for non-life business (**indicator 6.4.b**). Similar to the cost-to-income ratio for banks, the combined ratio measures the evolution of costs (operating expense plus insurance-related claims) over net premiums; a ratio above 100 indicates that the sector's core business is not profitable as its costs exceed the value of premiums collected.¹⁷ Furthermore, the risk dashboard includes data on the annual growth rates of premiums collected for both life and non-life insurances (**indicators 6.4.c** and **6.4.d**). Premiums represent the main source of revenue for insurance companies; declining premiums are a symptom of shrinking business for insurers, with possible consequences for their profitability.

The solvency ratio of an insurance company is defined as the available solvency capital over the required solvency capital, the latter being set by the regulators in accordance with the "Solvency I" framework for insurers operating in the EU. The ratio is calculated for life insurance (**indicator 6.5.a**) and non-life insurance (**indicator 6.5.b**) separately to take

¹⁵ Except when the ratio is negative owing to a negative denominator (negative income, i.e. an operating loss).

¹⁶ Tier I capital to assets could also be seen as a measure of leverage, i.e. by swapping the numerator with the denominator. The general considerations in terms of systemic risk would however remain unchanged as a leveraged banking sector is vulnerable to solvency risk.

¹⁷ Usually non-life insurers cannot compensate actuarial losses with high returns on their capital investments.



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account of the substantial differences between the two types of business. A declining ratio is a worrying sign of increasing solvency risk; normally supervisors take action well before the ratio reaches the critical level of 100%, below which an insurance company is in danger of insolvency.

Finally, the retention ratio (**indicator 6.6**), computed as net premiums over gross premiums written, measures how much risk is being passed to reinsurers. A declining retention ratio means that insurance companies are increasingly ceding underwriting risk to reinsurers for hedging purposes.