A Comprehensive Scorecard for Assessing Sovereign Vulnerabilities

This paper presents a new framework for the early identification of sovereign vulnerabilities, based on a wide set of economic and financial indicators

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Abstract

This paper aims to contribute to the ESM's capacity to monitor sovereign vulnerabilities in the EFSF/ESM programme countries. The purpose is to early identify a build-up of sovereign vulnerabilities, which may threaten countries' repayment capacity. The assessment is based on a wide set of indicators comprising (i) government borrowing needs, conditions and debt structure, (ii) economic strength, (iii) fiscal position, (iv) financial sector and other contingent liabilities, (v) institutional parameters, and (vi) private sector leverage, credit flows and real estate developments. We apply a scoring system based on thresholds from the literature, where available, or derived from the historical distribution of a pool of OECD and EU countries. The aggregation scheme for an overall vulnerability score is informed by the available literature, correlation and principal component analyses, as well as expert judgement. The results of the framework as such are, however, free of judgement. We complement the numerical results with a system of traffic lights that allows assigning individual countries one of four broad categories reflecting degrees of their vulnerabilities.
The framework can be used for a real-time vulnerability assessment, for an analysis of the evolution over time, as well as for an identification of areas where policy action may be needed. Back-tests for the countries that eventually requested EFSF/ESM financial assistance show that, with the benefit of hindsight, the tool would have identified the build-up of vulnerabilities well ahead of the onset of the crisis. The assessment, summarised in the form of a heat map and a scorecard, can be regularly updated.

Keywords: Early warning system, sovereign risk, euro area crisis

JEL codes: E02, F34, G15, G24, H63

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1 Introduction

The economic and sovereign debt crisis provided many lessons for economic policies in the euro area and elsewhere. One of the most important lessons is the need to early identify and address the build-up of macroeconomic imbalances and to maintain sound economic positions that provide sufficient buffers against adverse economic shocks. At the same time, vulnerabilities may arise from a broad spectrum of areas. Recent experience shows that not only fiscal imbalances, but also financial sector vulnerabilities, loss of competitiveness or external imbalances may lie at the heart of countries' problems. Finally, in the context of a monetary union, deep financial and economic linkages bring a strong risk of contagion. In this situation, even seemingly peripheral problems may spill over to the whole currency block.

Taking these lessons into account in the euro area context, it appears essential to closely monitor vulnerabilities across a broad range of economic and financial areas, including institutional considerations, and in a systematic manner across countries. The aim of this paper is to build a comprehensive, yet easy to use, scorecard for assessing vulnerabilities of the EFSF/ESM programme countries. It should allow to early identify a build-up of vulnerabilities, which may endanger their repayment capacity.

The design of the scorecard is informed by previous literature, our own quantitative analysis and expert judgement. Beyond the setup of this cross-country and cross-time homogenous framework, the results are, however, free of any judgement.

The results indicate a more pronounced increase in vulnerabilities prior to the economic crisis in countries that subsequently experienced financing pressures or lost market access, compared to the control group of EU and OECD countries. While predicting financing distress and economic crises is always difficult, back-testing of the scorecard indicates that, with benefit of hindsight, it would have signalled emerging economic and financial problems well ahead of the onset of the crisis and the subsequent negative rating actions of credit rating agencies. The scorecard can be used to enhance the ESM's analytical capacity to identify potential sovereign weaknesses in a timely manner, as well as support the ESM's external policy line and advice.

2 Literature review

There is an abundant literature on early warning system (EWS) models, mostly focused on currency and banking crises. These empirical studies differ according to (i) the definition of crisis events, whether currency, banking or fiscal crises, (ii) the methodology adopted, with the two most widely used approaches being the non-parametric "signals approach" (or "indicators approach") and the multivariate regression approach based on probit or logit models, (iii) the set of indicators used, and finally (iv) the country and time period coverage.

The regression approach consists of panel models analysing the impact of a set of independent variables on crisis probability, with a binary dependent variable equal to one if a crisis occurs and zero otherwise. The impact of a set of determinants on the crisis probability is then derived by estimating the model and testing the coefficients' significance. Berg and Patillo (1999) use this approach to predict currency crises and find that the crisis probability increases with changes in the predictive indicators. As explained by Berti et al (2012), from a methodological point of view, this approach has the advantage of taking into account correlations between variables and testing for the statistical significance of the variables. The predicted probability of a crisis taking place within a pre-defined time frame is calculated using the latest values of the explanatory variables and the estimated coefficients from the probit or logit model. The signals approach on the other hand, pioneered by Kaminsky, Lizondo and Reinhart (1998) in a paper on the determinants of currency crises, analyses the historic behaviour of a set of relevant variables and, based on the observation that some variables tend to behave differently prior to crises/stress events compared to normal times, tries to capture signals sent by the variables prior to these events[1].

Early contributions on early warning indicators of fiscal risk have relied mainly on fiscal variables. Hemming, Kell and Schimmelpfennig (2003) find that the best fiscal indicators to assess risks of currency, debt and banking crises are short-term public debt, foreign-currency debt as well as other deficit measures. Manasse, Roubini and Schimmelpfennig (2003) focus on sovereign debt crises, and considering a wide set of variables, find that, ceteris paribus, countries with a high current account balance have a reduced probability of entering in a crisis.

More recently, Baldacci et al. (2011a) build a new index of fiscal stress that provides early warning signals of fiscal sustainability problems for advanced and emerging economies. They define fiscal stress events to capture crisis episodes that encompass public debt default and near-default events, as well as severe deteriorations in the fiscal solvency risk outlook leading to fiscal sustainability risks. Their fiscal stress index is based on a set of indicators that measure the risk of fiscal sustainability based on current fiscal variables, classified into basic fiscal variables, long-term fiscal trends, and asset and liability management. They also calculate thresholds that identify the likelihood of fiscal stress for a large set of fiscal variables, which are helpful for our own analysis.

In a follow-up paper, Baldacci et al. (2011b) calculate and propose an index of fiscal vulnerability and an index of fiscal stress to assess rollover risks based on a wider set of variables clustered around three themes: solvency based on current and expected future fiscal policies, long-term fiscal trends, and the characteristics of governments' assets and liabilities. The authors stress that the relationships between indicators and rollover risk are likely to be nonlinear and that these nonlinearities imply the existence

[1] Specifically, this approach entails using each potential indicator of crisis events separately, identifying critical thresholds that signal such events with the lowest prediction error, and then averaging the number of indicators exceeding this threshold into a composite index. This is based on weights proportional to the signalling power of each indicator. The approach is thus relatively simple and easily accommodates differences in data availability across variables. One limitation of this approach, however, is that individual predictive variables cannot be tested for their conditional statistical significance.

of thresholds for these indicators beyond which a crisis becomes significantly more likely. Since thresholds vary across countries and time, available estimates must be interpreted with caution. Hence, the paper complements an index of rollover risks based on a probabilistic approach, with an index based on "norms" for fiscal variables derived from historical averages across advanced and emerging economies.

Going beyond their analysis, Schaechter et al. (2011) present a range of indicators and analytical tools for assessing fiscal vulnerabilities and risks for advanced economies, including the risks emanating from shocks to baseline projections, market-based risk indicators, and spillover risks. To highlight related but conceptually distinct elements of fiscal risks and vulnerabilities, the six tools presented are organised mainly by their time horizon, covering key short-, medium- and long-term dimensions. Short-term pressures are captured by assessing (i) gross funding needs, (ii) market perceptions of default risk, and (iii) stress dependence among sovereigns. Medium- and long-term pressures are summarised by (iv) medium- and long-term budgetary adjustment needs, (v) susceptibility of debt projections to growth and interest rate shocks, and (vi) stochastic risks to medium-term debt dynamics.

In line with this more holistic approach, Berti, Salto and Lequien (2012) show the importance of incorporating fiscal, financial and competitiveness variables in an early warning system for fiscal stress, as such variables appear to be better "leading indicators" of fiscal stress than fiscal variables are. They find that financial-competitiveness variables have a higher predictive power of fiscal stress than that displayed by fiscal variables. Similarly, Bassanetti et. al (2016) show that the dynamics of the debt-to-GDP ratio plays a critical role for market access and consequently that the level of the debt ratio should not be the only fiscal metric to assess the complex relationship between public debt and debt defaults/market access. Finally, Bouabdallah et. al (2017) introduce a comprehensive government debt sustainability analysis (DSA) framework for euro area sovereigns based on a deterministic DSA, which embeds debt simulations under a benchmark and various narrative shock scenarios, a stochastic DSA, providing for a probabilistic approach to debt sustainability, and other relevant indicators capturing liquidity and solvency risks. This reflects the need to have a broad-based assessment, cross-checking information and perspectives from various sources with a view to deriving a robust debt sustainability assessment.

Our own analysis, which is focused on the EFSF/ESM programme countries, builds on the existing literature and draws from the European Commission's debt sustainability analysis (2014b) and Macroeconomic Imbalance Procedure as well as the IMF's Early Warning Exercise (2010). In the spirit of these exercises, we emphasise that our early warning system does not attempt "to predict crises" but rather aims at the early identification of economic vulnerabilities and tail risks that predispose a sovereign to a crisis, ideally to be better able to timely define risk-mitigating policies.

3 Data and methodology

Our analysis of sovereign vulnerabilities is based on (i) a wide set of indicators categorised along six dimensions, (ii) a scoring system based on thresholds provided by the literature where available or determined by the percentiles from the historical distribution of a pool of OECD and non-OECD EU countries, (iii) an aggregation scheme, underpinned by principal components analysis and (iv) a traffic light system.

While we rely on annual data for all indicators, the assessment can, in principle, be updated at any point in time as data are updated and being revised throughout the year. All data are available from public sources with the exception of the ESM's Bank Viability Index (BVI). In case of publication, this indicator can be replaced by some of its publicly available components without significantly altering the overall results. Finally, the indicator is built on pseudo real-time data where time-series are lagged in order to ensure that the data chosen for a specific year are based on the data available at the beginning of that year. This is especially important for back-testing the signalling power of the tool. In this version, however, we used the currently available vintage of historical data for the back-testing, not data prior to subsequent revisions that were available at that time.

3.1 Dimensions

Sovereign vulnerability is assessed across the following six dimensions:

1. **Government borrowing needs, conditions and debt structure.** A country is assessed as more vulnerable the higher its financing needs and market perception of risk, and the lower the liquidity of its debt instruments traded in the market. Vulnerabilities can also arise depending on the structure of government debt, in particular, the composition of debt according to currency, maturity and holder, which may imply different exposure to interest rate or exchange rate risk or to shifts in the investor base. While the composition of debt certainly plays a role, it may have different implications for different countries and therefore it is assigned a relatively lower weight in the overall score.
2. **Economic strength.** Countries with stronger economic fundamentals and outlook are assessed as less vulnerable.
3. **Fiscal position.** Countries with a stronger underlying fiscal position, more favourable debt dynamics and better track record of fiscal performance are assessed as less vulnerable.
4. **Financial sector and other contingent liabilities.** In general, implicit or potential liabilities originating from the financial sector, government guarantees, accounts payable or adverse demographic trends are taken into account.
5. **Institutional parameters.** Countries with better institutional and political parameters are assessed to be better equipped to withstand any adverse developments.
6. **Private leverage, credit and real estate**. Countries where the private sector is less levered and where house prices and real estate activities are not growing or dropping excessively are assessed as less vulnerable.

Each dimension includes a set of indicators. The selection of the indicators is based on the related literature (see e.g. IMF 2010, 2011a, 2011b and 2012, and EC 2014a and 2014b) while taking into account results of the principal component analysis (Section 3.3). More details about data sources and definitions of individual indicators can be found in Annex 1.

3.2 Scoring and thresholds

The selected indicators are standardised to a homogenous scale. For each indicator, we define three time-invariant thresholds that allow per country and point in time to assign a 1 to 4 score. Where available, the thresholds for the scoring of the indicators were taken from the existing literature. Alternatively, the thresholds were set in line with quartiles of the historical distribution of OECD and EU countries in 2002-2016. The quartiles can be interpreted as follows: If a country is among the 25% of best-performers, it is assigned the score 4 (most resilient), countries in the second quartile are assigned the score 3, third quartile 2, while those among the 25% worst-performers are assigned the score 1 (most vulnerable).

For three indicators, which fall under the 'Leverage, credit and real estate' dimension, we diverge from this rule and instead assign scores based on quintiles, whereby the lowest and highest quintile are assigned the worst vulnerability score 1. The third quintile is assigned the best vulnerability score 4 and the second and fourth quintile are both assigned the score 2.5. This is to account for the fact that exceptionally high as well as negative credit and house-price growth increase a country's vulnerability, whereas modest positive growth is associated with low vulnerabilities.

A table summarising the thresholds used for each indicator can be found in Annex 2.

3.3 Aggregation and weights

The aggregate scores are calculated as a weighted average of scores of individual indicators. A stylised overview of the weights for our selected indicators can be found in Figure 1. The weights are based on expert judgement, informed by principal component analysis (PCA), correlation analysis and literature. This approach resulted into the following considerations:

- First, based on correlation analysis, we assign higher weight to indicators which are more strongly correlated to proxies of financial or economic stress, such as future GDP growth rates, rating actions or changes in government bond spreads.
- Based on the PCA, we identify groups of indicators within the dimensions, which follow similar trends and are thus deemed to explain the same underlying vulnerability. We then lower the weights of individual indicators in these groups to avoid overrepresentation of vulnerabilities captured by more individual indicators.
- As a result, the highest weights are assigned to vulnerability causes such as government borrowing needs, conditions and debt structure, followed by economic strength as well as private leverage credit and real estate.[2]

[2] For countries where a certain indicator is not recorded, all remaining indicators of that dimension are rescaled to sum up to 100%. For reconstructing historic vulnerability levels, shorter time series are assumed constant before the earliest available data point.

Figure 1: Overview of the approach and the aggregation scheme

Dimension	Weight	Indicator	Weight
Government borrowing needs, conditions and debt structure	25%	Gross financing needs (% of GDP)	20.0%
		Change in gross financing needs (p.p.)	10.0%
		10-year bond yield spreads to Germany (p.p.)	15.0%
		10-year bond yield volatility (std)	15.0%
		Credit rating and outlook (avg Moody's, S&P and Fitch)	0.0%
		Share of short-term debt (%)	15.0%
		Change in share of short-term debt (p.p.)	10.0%
		Share of debt held by non-residents	0.0%
		Share of foreign currency-denominated debt (%)	15.0%
Economic strength	20%	Potential GDP growth (%)	15.0%
		Real GDP growth (%)	10.0%
		Volatility of real GDP growth (std)	10.0%
		GDP per capita (PPS thousands)	15.0%
		WEF Competitiveness Index	10.0%
		Inflation volatility (std)	5.0%
		Current + capital account balance (% of GDP)	15.0%
		Unit labour cost (%)	15.0%
		Unemployment rate (%)	5.0%
Fiscal position	15%	Government debt-to-GDP ratio (%)	10.0%
		Government debt-to-government revenue ratio (%)	10.0%
		Change in government debt-to-GDP ratio (p.p.)	10.0%
		Net debt (% of GDP)	10.0%
		Interest-growth differential (p.p.)	10.0%
		Primary balance (% of GDP)	15.0%
		Structural balance (% of pot. GDP)	15.0%
		Longest period of positive primary balance (years)	10.0%
		Highest average structural balance over 8 years (% of GDP)	10.0%
Financial sector & other contingent liabilities	10%	ESM's Bank Viability Index	33.3%
		Increase in ageing costs (% of GDP)	16.7%
		Stock of government guarantees (% of GDP)	16.7%
		Net international investment position (% of GDP)	33.3%
Institutional parameters	15%	WB Governance Effectiveness	15.0%
		WB Regulatory Quality	15.0%
		WB Rule of Law	15.0%
		WB Doing Business Rank	25.0%
		Commission's fiscal rule index	15.0%
		OECD EPL	0.0%
		OECD PMR	0.0%
		TI Corruption perception index	15.0%
Private leverage, credit & real estate	15%	Non-financial corporations' debt (% of GDP)	20.0%
		Household debt (% of GDP)	20.0%
		Credit growth (%)	15.0%
		Credit flow to non-financial sector (% of GDP)	15.0%
		House price growth - nominal compensation growth (p.p.)	30.0%

NB. The ESM's Bank Viability Index assesses the fundamental strength of euro area banks and thus captures the potential risk posed by its banking sector for the respective sovereign.

As regards the PCA, we follow the methodology proposed in the OECD Handbook on Constructing Composite Indicators (2008):

- In a first step, we analyse the correlation structure of the data and indeed find strong correlation between certain indicators, justifying further principal component analysis.
- In a second step, we conduct PCA. We identify 11 latent factors that have associated eigenvalues larger than one in explaining the standardised scores across all indicators. If we run the analysis per dimension, we identify between two and four factors, under the same selection criterion.
- Next, we conduct varimax factor rotation in order to obtain a simpler structure while still maintaining the same explanatory power.
- Finally, for each indicator, we drop all but the largest factor loading, obtaining a 1-to-n association between factors and indicators. For presentational purposes, we rescale the loadings to sum to 100 per factor. The resulting numbers can be interpreted as weights for 'intermediate composite indicators' that constitute the identified factors.

This PCA and correlation analysis (Annex 3) exposed several patterns. Amongst those are the separation between stock and flow variables, the high interconnection between World Bank institutional indicators, as well as the uniqueness of real estate market developments.

3.4 Traffic lights

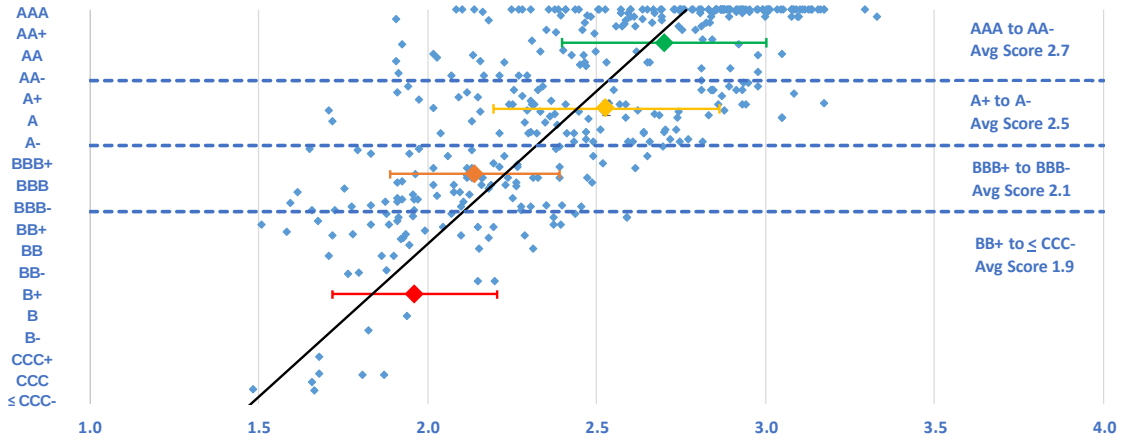
To improve visualisation, we complement the quantitative assessment with a system of traffic lights. Given uncertainty surrounding the calculations as well as limitations of any one-size-fits-all approach, our analysis should not be interpreted as an exact numerical exercise. Therefore, we opt to classify countries into four broad categories reflecting the severity of countries' vulnerabilities. The **system of traffic lights** indicates low vulnerability (green), moderate vulnerability (yellow), elevated vulnerability (orange) and high vulnerability (red). To identify the cut-off values for the scores, we decided to use the following rounded thresholds:

Figure 2: Traffic light percentiles

Score	≤ 2.0	2.0 to 2.5	2.5 to 3.0	≥ 3.0
Vulnerability	High	Elevated	Moderate	Low

To verify the validity of these thresholds, we compare our overall vulnerability score with the average ratings of the sovereigns assigned by Fitch, Moody's and S&P over the 2007-16 time period. We assume that the ratings were on average accurate, albeit sometimes with a delay. Figure 3 shows the average scores for rating ranges determined by the following thresholds: the ESM's General Eligible Asset List (AA-), the ECB's Credit Quality Steps 1&2 (A-), and the agencies' investment-grade status (BBB-).

Figure 3: Average sovereign rating vs vulnerability score



Source: Credit rating agencies, own calculations. Coloured lines show the average score and standard deviation for each of the four rating brackets.

As expected, we observe a strong positive correlation between our overall vulnerability score and the sovereign ratings. Specifically, sovereigns rated below investment grade (BB+ or below) have an average score of about 1.9 whereas those rated 'AA-' or above score around 2.7. Sovereigns rated between 'BBB-' and 'BBB+' score on average 2.1 whereas the vulnerability score of those rated between 'A-' and 'A+' is around 2.5. Respective histograms can be found in Annex 4.

Figure 4: Average vulnerability score according to sovereign rating threshold (2007-16)

Rating	≤ BB+	BBB- to BBB+	A- to A+	≥ AA-
Score	1.9	2.1	2.5	2.7

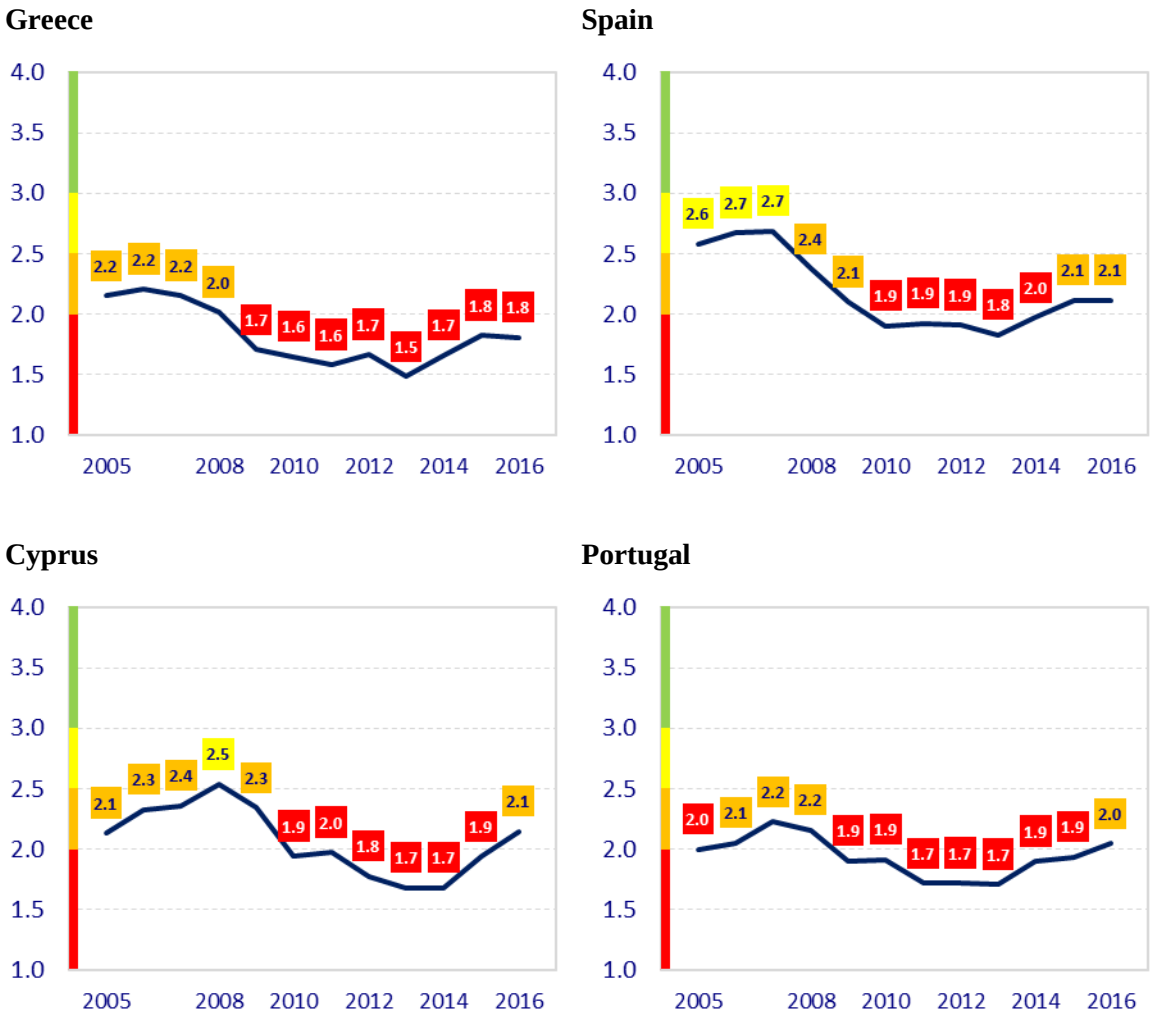
Source: Own calculations.

The thresholds of our traffic lights are therefore somewhat more conservative. We can argue that in our system, the country has to broadly outperform the average rating in the respective rating range to qualify for the corresponding vulnerability category.

4 Results

Our results are summarised in an overall vulnerability score ranging from 1 (very vulnerable) to 4 (very resilient). To assess the signalling power of the tool prior to the crisis, we look at the evolution of vulnerabilities over time. Figure 5 indicates that the scorecard would have identified in advance deterioration for those countries which subsequently experienced difficulties. Since 2005, Greece and Portugal would have been assessed as countries with elevated risk, and since 2009, high risk. Similarly, for Spain and Cyprus, the tool would have indicated sharp increases of vulnerabilities as early as 2008. The case of Ireland is explored in greater detail in section 4.3.

Figure 5: Evolution of vulnerabilities



Source: Own calculations. For Ireland, see Section 4.3.

Figure 6 provides an overall summary assessment in the form of a heat map that allows to visualise the ranking of countries, as well as the main sources of their strength and vulnerabilities. Compared to the situation prior to the euro area crisis, the EFSF/ESM programme countries improved their resilience in most dimensions, but, with the exception of Ireland, still remain below the unweighted average of other euro area countries.

Figure 6: Heat map for the sovereign vulnerability assessment

	2009						2016					
	Ireland	Greece	Spain	Cyprus	Portugal	Rest of euro area	Ireland	Greece	Spain	Cyprus	Portugal	Rest of euro area
Overall vulnerability score	2.1	1.7	2.1	2.3	1.9	2.4	2.7	1.8	2.1	2.1	2.0	2.7
1 Government borrowing needs, conditions and debt structure	2.3	2.3	2.6	2.8	2.5	2.8	2.9	1.5	2.1	2.0	1.7	2.7
2 Economic strength	2.2	1.5	2.2	2.4	1.9	2.2	3.3	2.0	2.5	2.0	2.3	2.6
3 Fiscal position	1.9	1.2	2.1	2.1	1.2	2.2	3.1	2.4	1.8	2.6	2.1	2.8
4 Financial sector and other contingent liabilities	1.3	1.7	1.8	2.0	1.8	2.5	2.2	1.8	2.3	2.3	2.0	2.9
5 Institutional parameters	3.1	1.2	2.1	2.2	1.8	2.4	3.5	1.3	2.2	2.2	2.4	2.7
6 Private leverage, credit & real estate	1.2	2.1	1.4	2.4	1.9	2.4	1.2	2.1	1.9	2.1	2.1	2.3

4.1 Case study: Prior to and after the EFSF/ESM programme intervention

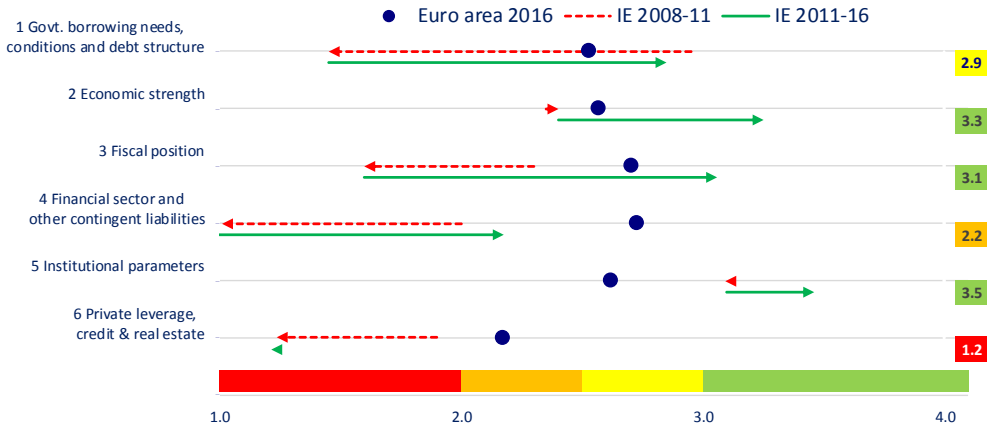
This section shows the development of sovereign vulnerabilities for the five countries which requested financial assistance from the EFSF/ESM for the period before and since the inception of the programme. Due to annual data, and in the case of Cyprus also due to the delay in negotiations, the first year of the intervention differs in some cases from the year of the request (Table 7).

Figure 7: Dates of request for EFSF/ESM financial assistance

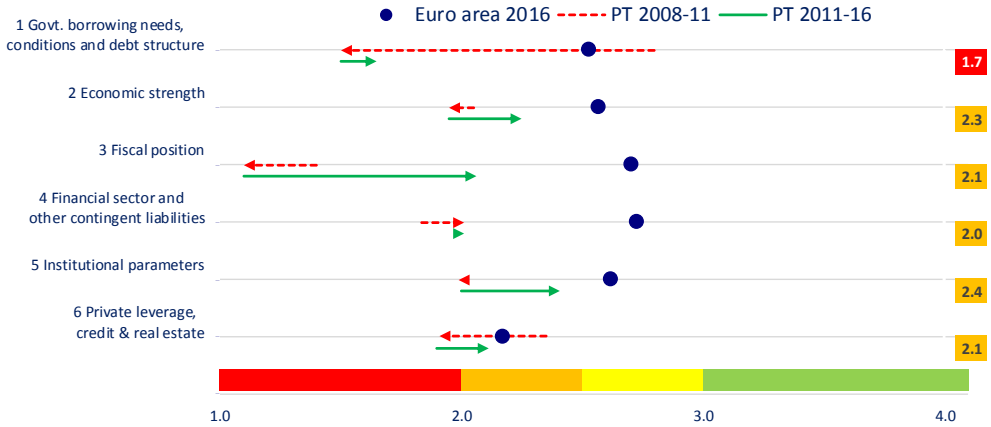
Country	Programme request	Year of intervention (analytical purposes)
Ireland	December 2010	2011
Portugal	May 2011	2011
Greece (2nd program)	February 2012	2012
Cyprus	June 2012	2013
Spain	July 2012	2013

As can be observed in the charts below, the developments in terms of vulnerability before the EFSF/ESM intervention were unfavourable in all the five countries according to most vulnerability dimensions and improved following the programme intervention. The two exceptions in the post-intervention period are the borrowing conditions for Greece, driven mostly by the increasing share of short-term debt, which were not offset by a decline in government bond yields, and Spain's slightly weakened institutional parameters as measured by the World Bank.

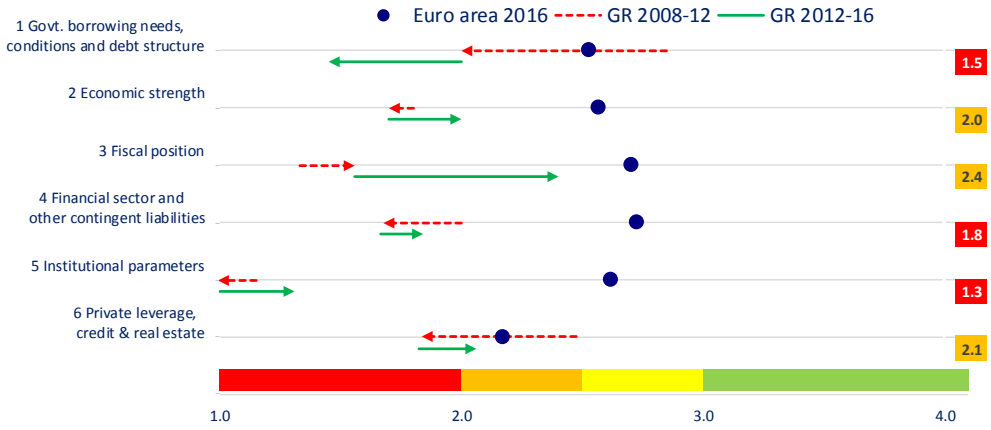
Ireland



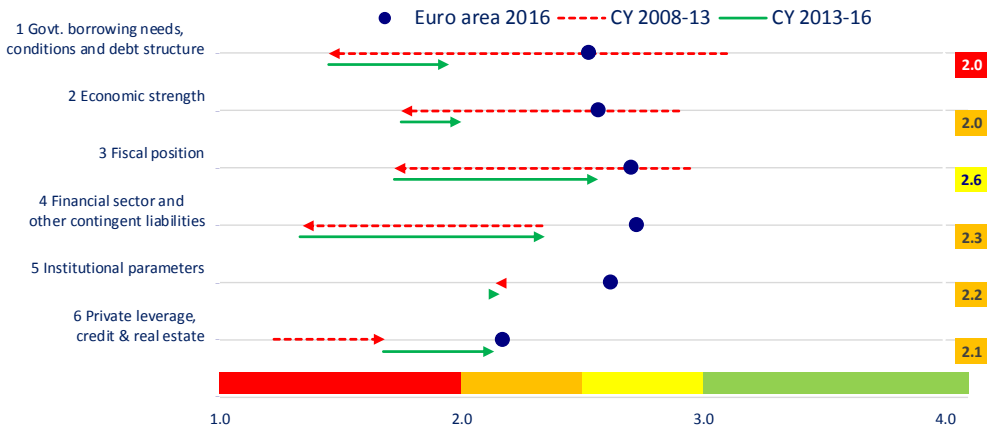
Portugal



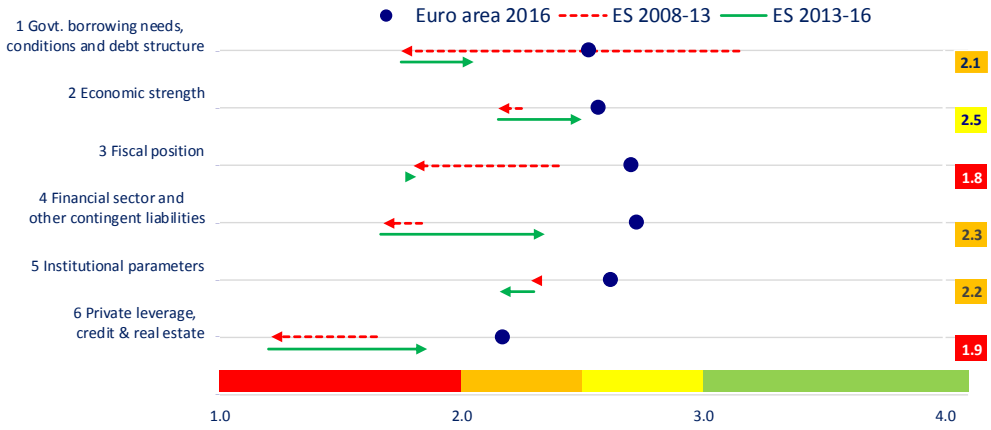
Greece



Cyprus



Spain



4.2 Comparison with credit rating agencies

Sovereign ratings are the Credit Rating Agencies' (CRA) synthesised assessment of a central government's ability and willingness to service its non-official debt in full and on time, in accordance with the conditions agreed with creditors at the time of issuance. To assess sovereign creditworthiness, CRAs look at a combination of macroeconomic, public finance, external finance as well as institutional factors. Even though the methodological approaches, variables and the weights are not the same, and further, even though the rating assessment of agencies varies between an estimate of the probability of default (S&P and Fitch) and the expected loss (Moody's), the key factors analysed by Moody's, S&P and Fitch are very similar (Figure 8).

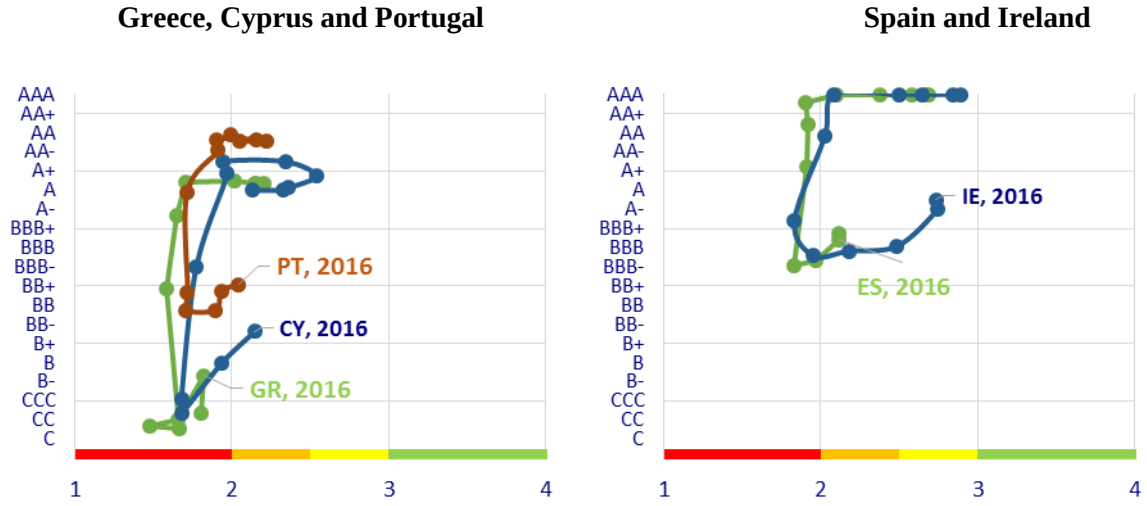
Figure 8: Stylized sovereign rating methodologies

Moody's (2015)	S&P (2014)	Fitch (2016)
Economic strength	Economic structure and growth prospects	Macroeconomic performance, policies and prospects
Institutional strength	Institutional effectiveness	Structural features
Fiscal strength	Fiscal flexibility and performance, combined with debt burden	Public finances
Susceptibility to event risk	External liquidity and international investment position	External finances
	Monetary flexibility	

Source: Credit rating agencies.

In this context, sovereign ratings serve as a useful benchmark to assess the signalling power of our indicator. One of the aims of our tool is to allow early detection of adverse developments. As CRAs are often criticised for reacting to the deterioration in sovereign creditworthiness with a delay, we take comfort in the fact that, in the vast majority of cases, the tool would have indicated a deterioration in vulnerabilities well ahead of the rating actions of the CRAs (Figure 9).

Figure 9: Comparison of the vulnerability score with credit rating agencies (2005-16)



Source: Own calculations and CRAs.

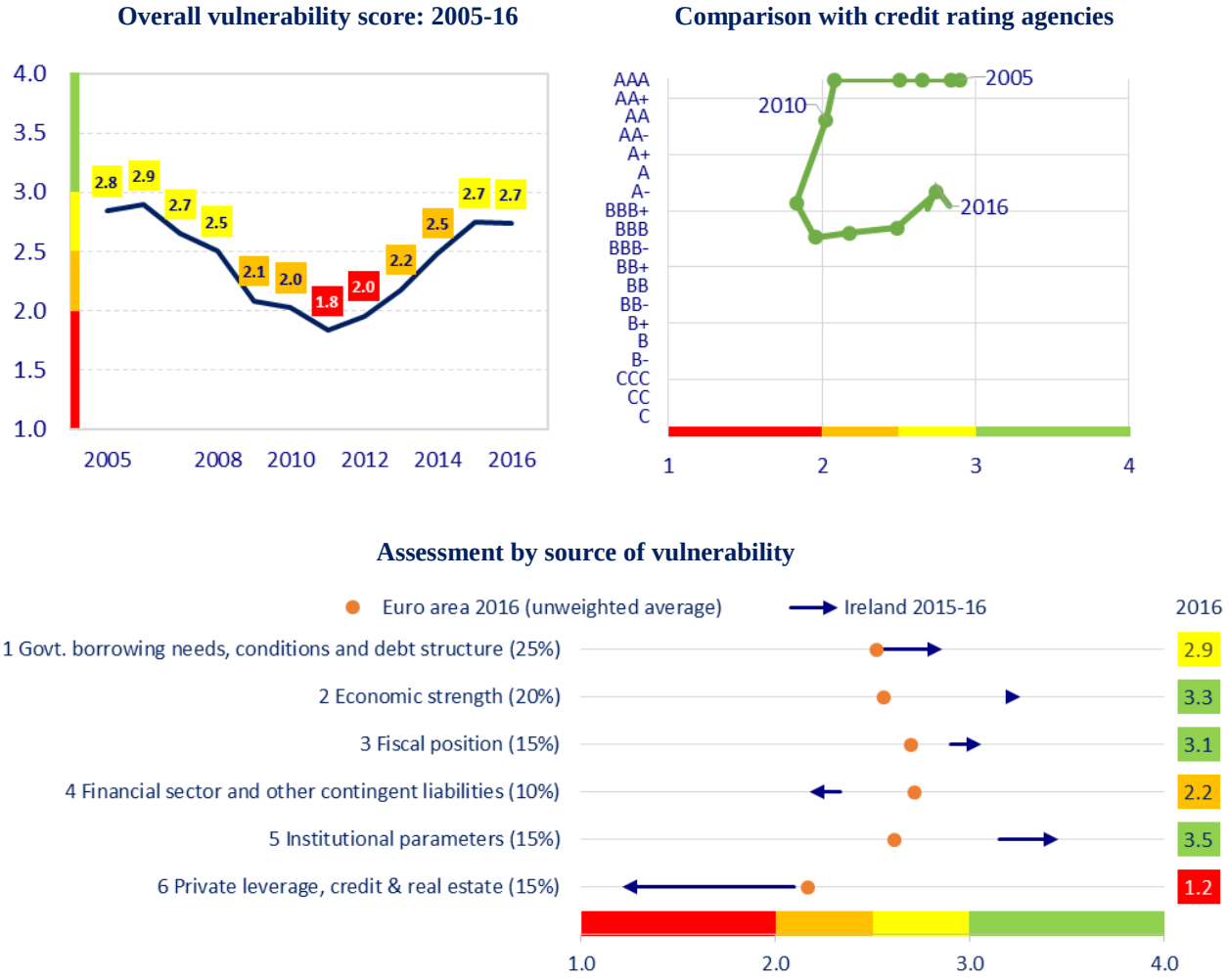
4.3 Case study: Ireland

We demonstrate the assessment for an individual country on the example of Ireland. The overall score indicates that Ireland is currently subject to moderate vulnerabilities. It continues to be subject to risks from high private- and public-sector indebtedness, as well as susceptibility to credit and housing bubbles. However, this is compensated by considerable economic strength and a sound underlying fiscal position, including a strong historical fiscal discipline.

Regarding the evolution over time, Ireland observed a rapid deterioration of its sovereign resilience starting already in 2007, which was followed by a remarkable recovery from the economic crisis. Currently it ranks above the euro area average in most dimensions.

There is room for further improvement in the area of explicit and contingent liabilities. It should also be noted that overall high volatility of macroeconomic indicators and, in particular, recent major shifts in national accounts call for extra caution when assessing Ireland's economic situation.

Figure 10: Vulnerability score of Ireland and comparison with credit rating agencies



Ireland: Overview of the vulnerability assessment

Indicator	Weight	Value	Euro area rank	Trend since 2005 and score in 2016	
Overall vulnerability score	**100.0**		**7/19**		**2.7**
1 Government borrowing needs, conditions and debt structure	**25.0**		**4/19**		**2.9**
Gross financing needs (% of GDP)	20.0	3.9	3/19		4
Change in gross financing needs (p.p.)	10.0	-6.1	3/19		4
10-year bond yield spreads to Germany (p.p.)	15.0	0.7	10/18		2
10-year bond yield volatility (std)	15.0	1.1	14/18		1
Credit rating and outlook (avg Moody's, S&P and Fitch)	0.0	13.5	10/19		3
Share of short-term debt (%)	15.0	2.1	5/19		4
Change in share of short-term debt (p.p.)	10.0	-1.2	9/19		3
Share of debt held by non-residents	0.0	70.3	10/19		1
Share of foreign currency-denominated debt (%)	15.0	7.8	16/19		2
2 Economic strength	**20.0**		**1/19**		**3.3**
Potential GDP growth (%)	15.0	2.7	4/19		3
Real GDP growth (%)	10.0	4.1	2/19		4
Volatility of real GDP growth (std)	10.0	8.5	19/19		1
GDP per capita (PPS thousands)	15.0	50.6	2/19		4
WEF Competitiveness Index	10.0	5.1	8/19		3
Inflation volatility (std)	5.0	1.7	12/19		2
Current + capital account balance (% of GDP)	15.0	25.7	4/19		4
Unit labour cost (%)	15.0	-19.6	1/19		4
Unemployment rate (%)	5.0	8.5	10/19		2
3 Fiscal position	**15.0**		**4/19**		**3.1**
Government debt-to-GDP ratio (%)	10.0	75.9	10/19		2
Government debt-to-government revenue ratio (%)	10.0	277.8	16/19		1
Change in government debt-to-GDP ratio (p.p.)	10.0	-34.3	1/19		4
Net debt (% of GDP)	10.0	67.0	9/13		1
Interest-growth differential (p.p.)	10.0	-8.2	1/19		4
Primary balance (% of GDP)	15.0	1.3	7/19		4
Structural balance (% of pot. GDP)	15.0	-1.5	11/19		3
Longest period of positive primary balance (years)	10.0	13.0	4/19		4
Highest average structural balance over 8 years (% of GDP)	10.0	1.1	4/19		4
4 Financial sector and other contingent liabilities	**10.0**		**16/19**		**2.2**
ESM's Bank Viability Index	33.3	58.4	6/14		3
Increase in ageing costs (% of GDP)	16.7	2.3	13/19		3
Stock of government guarantees (% of GDP)	16.7	13.3	13/19		2
Net international investment position (% of GDP)	33.3	-208.0	19/19		1
5 Institutional parameters	**15.0**		**4/19**		**3.5**
WB Governance Effectiveness	15.0	1.6	5/19		3
WB Regulatory Quality	15.0	1.8	3/19		4
WB Rule of Law	15.0	1.8	6/19		4
WB Doing Business Rank	25.0	17.0	4/19		3
Commission's fiscal rule index	15.0	2.4	8/19		4
OECD EPL	0.0	2.1	2/17		4
OECD PMR	0.0	1.5	11/19		3
TI Corruption perception index	15.0	18.0	7/19		3
6 Private leverage, credit & real estate	**15.0**		**19/19**		**1.2**
Non-financial corporations' debt (% of GDP)	20.0	250.9	18/19		1
Household debt (% of GDP)	20.0	58.5	12/19		2
Credit growth (%)	15.0	57.3	19/19		1
Credit flow to non-financial sector (% of GDP)	15.0	51.4	19/19		1
House price growth - nominal compensation growth (p.p.)	30.0	24.5	19/19		1

5 Conclusion and limitations

The sovereign vulnerability scorecard represents a simple, yet relatively comprehensive tool for an assessment of sovereign vulnerabilities. First, it allows assessing a country's present vulnerability in comparison to other countries or to historical periods. Second, it can be used to assess the evolution over time and identify adverse trends in underlying factors that may lead to a heightened vulnerability risk. Finally, the tool allows for the identification of main sources of vulnerabilities pointing to areas where a policy action may be needed.

Our results show that the tool has a meaningful signalling power in assessing sovereign vulnerabilities. This was also confirmed by back-testing to the period prior to the crisis as early as 2005, showing that for the countries which requested EFSF/ESM financial assistance, our tool would have identified the build-up of vulnerabilities well ahead of the negative rating actions of credit rating agencies. However, it should be stressed that this is possible with the benefit of hindsight. At the same time, the framework does not represent an exact exercise. While the results are judgement-free, a careful interpretation is needed to draw policy conclusions.

The framework may benefit from further improvements in several areas. The principal component analysis indicated that a better distinction between flow and stock variables may be warranted. In the same vein, a more elaborate distinction between short-term and medium- to long-term indicators may improve prediction power over different time horizons. In addition, using infra-annual data, in particular for short-term indicators, promises a better grasp of the latest developments. Finally, the prediction power may be further improved by testing the aggregation scheme using conditional weights across the six vulnerability dimensions.

6 References

Baldacci, E., I. Petrova, N. Belhocine, G. Dobrescu, and S. Mazraani (2011a), "Assessing Fiscal Stress", IMF Working Paper 11/100.

Baldacci, E., J. McHugh and I. Petrova (2011b), "Measuring Fiscal Vulnerability and Fiscal Stress: A Proposed Set of Indicators", IMF Working Paper 11/94.

Bassanetti, A., Cottarelli, C., Presbitero, A. (2016), "Lost and Found: Market Access and Public Debt Dynamics", IMF Working Paper 16/253

Berg A., and C. Pattillo (1999) "Predicting currency crises: the indicators approach and an alternative" Journal of International Money and Finance Vol. 18 (August), pp. 561-86.

Berti, K., M. Salto, M. Lequien (2012), "An early-detection index of fiscal stress for EU countries", European Economy Economic Paper 475.

Bouabdallah O., C. Checherita-Westphal, T. Warmedinger, R. de Stefani, F. Drudi, R. Setzer, A. Westphal, "Debt sustainability analysis for euro area sovereigns: a methodological framework", ECB, Frankfurt, forthcoming Occasional Paper, 2017.

Chechetti et al (2011), "The real effects of debt", BIS Working Paper 352

European Central Bank (2014a), "Early warning indicators for fiscal stress in European budgetary surveillance", Monthly Bulletin November 2014, pp 91-105.

European Commission (2014b), "Assessing Public Debt Sustainability in EU Member States: A Guide", European Economy Occasional Paper 200.

Fitch (2014) 'Sovereign Rating Criteria: Master Criteria', 18 July 2016.

Hemming R., M. Kell, and A. Schimmelpfennig (2003) "Fiscal vulnerability and financial crises in emerging market economies" IMF Occational Paper 218.

IMF (2010), "The IMF-FSB Early Warning Exercise: Design and methodological toolkit", September 2010.

IMF (2013), "Staff Guidance Note for Public Debt Sustainability Analysis in Market-Access Countries", May 2013.

Kaminsky G.L., S. Lizondo, and C.M. Reinhart (1998) "Leading indicators of currency crises" IMF Staff Papers Vol. 45, No. 1.

Manasse P., N. Roubini, and A. Schimmelpfennig (2003) "Predicting sovereign debt crises" IMF Working Paper 03/221

Moody's (2015), "Sovereign Bond Ratings", Rating Methodology, December 2015.

OECD (2008), "Handbook on Constructing Composite Indicators"

Schaechter, A.,C. Emre Alper, E. Arbatli, C. Caceres, G. Callegari, M. Gerard, J. Jonas, T. Kinda, A. Shabunina, A. Weber (2012), "A Toolkit to Assessing Fiscal Vulnerabilities and Risks in Advanced Economies", IMF Working Paper 12/11.

Sharma, R. (2016) 'The Rise and Fall of Nations'. W. W. Norton

Standard & Poor's (2014) 'Sovereign Rating Methodology', December 23, 2014.

Annex 1: Definition of indicators

If not mentioned otherwise, indicator source is the latest AMECO database vintage from the European Commission. For indicators with forecasts available and where we are capturing evolvements over time (through moving averages, moving sums or moving standard deviations), in general we include one forward-looking observation, thus one year of forecast for the most recent figure. Thresholds for transforming values to the standardised discrete 1 to 4 scale refer to quartile-bounds considering the sample of observed data on annual frequency for the available OECD and non-OECD EU countries from 2002 to 2015. For backward aggregation, data is assumed constant before the first available data point.

1. Government borrowing needs, conditions and debt structure

Gross financing needs (% of GDP).

Definition: A sum of the consolidated debt with residual maturity of less than one year and the primary deficit one-year ahead. Source: ECB, IMF.

Change in gross financing needs (p.p.).

Definition: Change in gross financing needs over two years. Source: ECB, IMF.

10-year bond yield spreads to Germany (p.p.).

Definition: One year spread to the Bund. Source: ECB.

Threshold: Literature for worst case.

10-year bond yield volatility (%).

Definition: Standard deviation of monthly 10-year bond yield over last three years. Source: ECB.

Long-term foreign currency rating.

Definition: Linear transformation of average rating and outlook of the three rating agencies' ratings. Source: Moody's, Fitch, S&P.

Threshold: Judgement for each risk category: AA-, BBB+, BBB-.

Share of short-term debt (%).

Definition: Share of government debt securities with residual maturity up to 1 year in total government debt securities. Average over the last three years. Source: Eurostat.

Threshold: Literature for worst case.

Change in share of short-term debt (p.p.).

Definition: A change in the share of short-term government debt securities over two years. Source: Eurostat.

Threshold: Literature for worst case.

Share of debt held by non-residents (%).

Definition: Share of government debt held by non-residents in total government debt. Latest available annual figure. Source: BIS.

Threshold: Literature for worst case; Judgement for other risk categories.

Share of foreign currency-denominated debt (%).

Definition: Share of government debt denominated in foreign currencies in total government debt. Average over last two years. Source: ECB.

Threshold: Literature for worst case.

2. Economic strength

Potential GDP growth (%).

Definition: Three year centred moving average of potential GDP growth.

Real GDP growth (%).

Definition: Real GDP growth for current year.

Threshold: Literature for worst case.

Volatility of real GDP growth (std).

Definition: Standard deviation of real GDP growth over last ten years.

GDP per capita (PPS thousands).

Definition: Three year centred moving average of GDP per capita on a purchasing power basis.

Threshold: Literature for best case.

World Economic Forum Competitiveness Index.

Definition: Latest available competitiveness score. Source: World Economic Forum.

Inflation volatility (std).

Definition: Standard deviation of HICP growth over last ten years.

Current + capital account balance (% of GDP).

Definition: Five-year sum of the current account and capital account balance in % of GDP.

Threshold: Literature for worst case.

Unit labour cost (%).

Definition: Percentage change in unit labour costs over three-year period.

Threshold: Literature for worst case.

Unemployment rate (%).

Definition: Three-year centred moving average of unemployment rate. Source: European Commission.

Threshold: Literature for worst case.

3. Fiscal position

Government debt-to-GDP ratio (%).

Definition: Three-year centred moving average of debt as % of GDP.

Threshold: Literature for worst and medium case.

Government debt-to-government revenue ratio (%).

Definition: Three-year centred moving average of government revenues as % of GDP.

Change in government debt-to-GDP ratio (p.p.).

Definition: Five-year change in the government debt-to-GDP ratio.

Threshold: Judgement for best case.

Government net debt-to-GDP ratio (%).

Definition: Government net debt as % of GDP.

Threshold: Literature for worst case.

Interest-growth differential (p.p.).

Definition: Three-year centred moving average of the interest-growth differential.

Threshold: Literature for worst case.

Primary balance (% of GDP).

Definition: Three-year centred moving average of primary balance in % of GDP.

Threshold: Judgement for worst case.

Structural balance (% of GDP).

Definition: Three-year centred moving average of structural balance in % of GDP.

Threshold: Literature for worst case.

Historical performance of primary balance (years).

Definition: Longest period of sustained primary surpluses.

Historical performance of structural balance (% of GDP).

Definition: Largest average structural balance for 8 years.

4. Financial sector and other contingent liabilities

ESM Banking Viability Index.

Definition: Micro-founded composite index. Source: ESM.

Threshold: Judgement for worst case.

Increase in ageing costs (% of GDP).

Definition: Projected change in pension and health expenditure over the period 2013-60. Source: European Commission, Ageing Reports.

Data: Linear interpolation between actual data for years 2009, 2012 and 2015.

Stock of government guarantees (% of GDP).

Definition: Stock of guarantees provided by the general government. Latest available stock. Source: Eurostat.

Net international investment position (% of GDP).

Definition: Latest available net international investment position of total economy. Source: Eurostat.

Threshold: Literature for worst case.

5. Institutional parameters

WB Governance Effectiveness.

Definition: Point estimate; Latest available assessment. Source: World Bank.

WB Regulatory Quality.

Definition: Point estimate; Latest available assessment. Source: World Bank.

WB Rule of Law.

Definition: Point estimate; Latest available assessment. Source: World Bank.

WB Doing Business Rank.

Definition: Latest available assessment. Source: World Bank.

Commission's fiscal rule index.

Definition: Standardised fiscal rule index. Latest available assessment. Source: European Commission.

OECD EPL.

Definition: Employment protection legislation. Latest available assessment. Source: OECD.

OECD PMR.

Definition: Product market regulation. Latest available assessment. Source: OECD.

TI Corruption perception index.

Definition: Latest available assessment. Source: Transparency International.

6. Private leverage, credit & real estate

Non-financial corporate debt (% of GDP).

Definition: Latest available non-financial corporation outstanding consolidated loans and debt securities. Source: Eurostat.

Threshold: Literature for worst case.

Household debt (% of GDP).

Definition: Latest available household and NPISH outstanding loans. Source: Eurostat.

Threshold: Literature for worst case.

Credit growth (%, 3Y).

Definition: Three-year growth rate of credit to private sector (non-financial corporates and households). Source: Eurostat.

Thresholds: Based on quintiles, whereby the lowest and highest are assigned the high vulnerability score 1. The third quintile is assigned the low vulnerability score 4 and the second and fourth quintile are both assigned the score 2.5.

Credit to non-financial sector growth (% of GDP, 5Y pp change).

Definition: 5-year increase in credit to private sector as % of GDP. Source: Eurostat.

Thresholds: Based on quintiles, whereby the lowest and highest are assigned the high vulnerability score 1. The third quintile is assigned the low vulnerability score 4 and the second and fourth quintile are both assigned the score 2.5.

House price and compensation growth differential (%).

Definition: Three-year growth differential between growth in residential property prices and compensation per employee. Source: BIS, European Commission.

Thresholds: Based on quintiles, whereby the lowest and highest are assigned the high vulnerability score 1. The third quintile is assigned the low vulnerability score 4 and the second and fourth quintile are both assigned the score 2.5.

Annex 2: Thresholds for indicators

Dimension	Indicator	Thresholds			EA countries per score in 2016			
		Worst	Middle	Best	1	2	3	4
Government borrowing needs, conditions and debt structure	Gross financing needs (% of GDP)	19	11.7	6.6	6	4	5	4
	Change in gross financing needs (p.p.)	3.1	-0.5	-2.9	1	4	6	8
	10-year bond yield spreads to Germany (p.p.)	2.3°	0.5	0.2	2	7	7	2
	10-year bond yield volatility (std)	0.7	0.5	0.4	12	6	0	0
	Credit rating and outlook (avg Moody's, S&P and Fitch)	10.0°	13.0°	16.0°	3	3	6	7
	Share of short-term debt (%)	16.0°	8.5	3.9	2	3	7	7
	Change in share of short-term debt (p.p.)	2.8°	-0.5	-3.2	1	7	8	3
	Share of debt held by non-residents	49.0°	43.5°	27.5°	15	2	1	1
	Share of foreign currency-denominated debt (%)	29.8°	1.8	0.4	0	10	2	7
Economic strength	Potential GDP growth (%)	1.1	1.8	3	6	7	5	1
	Real GDP growth (%)	-0.9°	2.4	3.8	0	12	5	2
	Volatility of real GDP growth (std)	3.3	2	1.4	10	7	2	0
	GDP per capita (PPS thousands)	17.5	24.9	31.2°	0	8	4	7
	WEF Competitiveness Index	4.4	4.8	5.2	4	7	5	3
	Inflation volatility (std)	1.9	1.1	0.7	4	11	4	0
	Current + capital account balance (% of GDP)	-20.0°	-5.6	14.8	0	2	10	7
	Unit labour cost (%)	12.7°	7	3.2	1	2	3	13
	Unemployment rate (%)	10.0°	7.2	5.2	7	6	5	1
Fiscal position	Government debt-to-GDP ratio (%)	90.0°	60.0°	37.4	7	7	2	3
	Government debt-to-government revenue ratio (%)	184.5	132.8	80.2	7	6	4	2
	Change in government debt-to-GDP ratio (p.p.)	15.9	5.5	0.0°	5	4	6	4
	Net debt (% of GDP)	58.1°	29.9	7.5	7	5	0	2
	Interest-growth differential (p.p.)	3.6°	2.6	1	0	0	8	11
	Primary balance (% of GDP)	-1.0°	-0.3	1.1	3	2	7	7
	Structural balance (% of pot. GDP)	-3.1°	-2.6	-0.9	0	2	10	7
	Longest period of positive primary balance (years)	3	6	10	1	7	6	5
	Highest average structural balance over 8 years (% of GDP)	-3.3	-1.9	-0.6	3	4	7	5
Financial sector & other contingent liabilities	ESM's Bank Viability Index	40.0°	49.5	58.5	0	3	6	5
	Increase in ageing costs (% of GDP)	5.4	3.3	0.8	0	6	5	8
	Stock of government guarantees (% of GDP)	16.1	8.6	2.6	5	5	5	4
	Net international investment position (% of GDP)	-50.1°	-13.5	-0.4	7	5	1	6
Institutional parameters	WB Governance Effectiveness	0.7	1.3	1.8	2	9	6	2
	WB Regulatory Quality	0.9	1.2	1.6	6	6	1	6
	WB Rule of Law	0.8	1.3	1.7	3	7	3	6
	WB Doing Business Rank	47.8	28	13	3	7	8	1
	Commission's fiscal rule index	-0.4	0.1	1.1	1	0	6	12
	OECD EPL	2.7	2.3	2.1	7	6	2	2
	OECD PMR	1.7	1.5	1.4	1	5	5	8
	TI Corruption perception index	47	25	11	3	7	5	4
Private leverage, credit & real estate	Non-financial corporations' debt (% of GDP)	90.0°	75.9	51.3	7	3	6	3
	Household debt (% of GDP)	84.0°	48.7	29.9	2	11	3	3
	Credit growth (%)	> 56.4 < 4.5	2.5: > 28.2 & < 56.4 > 4.5 & < 14.8	> 14.8 < 28.2	8	8		3
	Credit flow to non-financial sector (% of GDP)	> 39.4 < 1.4	2.5: > 25.8 & < 39.4 > 1.4 & < 14.6	> 14.6 < 25.8	12	6		1
	House price growth - nominal compensation growth (p.p.)	> 17.7 < -9.6	2.5: > 5.7 & < 17.7 > -9.6 & < -1.4	> -1.4 < 5.7	5	8		6

Notes: Countries that on a certain indicator for a point in time perform worse than the "worst" threshold are given the score 1, falling between "worst" and "middle" corresponds to score 2, between "middle" and "best" to score 3, and performing better than threshold "best" is assigned the top score of 4. Thresholds indicated with "°" are literature derived or based on own analysis. The remaining thresholds correspond to the 25th, 50th and 75th percentiles of the observed historical distribution from OECD and EU countries in the years 2002 to 2015. The last three credit and house price-related variables are assessed taking into consideration that extreme positive and negative values (the highest and lowest quintile) are associated with high vulnerabilities thus being assigned the lowest score 1. Modest positive growth is assigned the highest score 4.

Annex 3: Indicator statistics

Table: Pairwise correlation of indicator-scores within dimension and explanatory power

		GBY+1	RAT+1	YER+1	GFN	DGFN	GBY	GBYV	RAT	STDe	DSTD	NRD	FCD
Gross financing needs (% of GDP)	GFN	0.10	0.03	0.22	1.00								
Change in gross financing needs (p.p.)	DGFN	0.09	0.09	0.03	-0.03	1.00							
10-year bond yield spreads to Germany (p.p.)	GBY	0.87	0.72	-0.16	0.10	0.06	1.00						
10-year bond yield volatility (std)	GBYV	0.36	0.50	-0.22	-0.05	0.04	0.39	1.00					
Credit rating and outlook (avg Moody's, S&P and Fitch)	RAT	0.67	0.97	-0.22	0.00	0.04	0.71	0.53	1.00				
Share of short-term debt (%)	STDebt	0.26	0.26	-0.06	0.39	0.00	0.26	0.06	0.25	1.00			
Change in share of short-term debt (p.p.)	DSTDebt	-0.09	-0.15	0.13	-0.01	0.34	-0.16	-0.23	-0.18	-0.27	1.00		
Share of debt held by non-residents	NRD	0.17	0.18	0.03	-0.21	0.19	0.15	0.22	0.17	-0.09	0.00	1.00	
Share of foreign currency-denominated debt (%)	FCD	0.13	0.27	-0.26	-0.01	-0.02	0.18	0.24	0.30	0.27	-0.16	0.27	1.00

		GBY+1	RAT+1	YER+1	YET	YER	VYER	GDPC	GCI	HIC	CCB	ULC	URX
Potential GDP growth (%)	YET	0.05	0.01	0.54	1.00								
Real GDP growth (%)	YER	0.03	-0.08	0.50	0.63	1.00							
Volatility of real GDP growth (std)	VYER	0.38	0.60	-0.19	-0.03	-0.15	1.00						
GDP per capita (PPS thousands)	GDPC	0.48	0.70	-0.24	-0.28	-0.24	0.38	1.00					
WEF Competitiveness Index	GCI	0.62	0.75	-0.16	-0.13	-0.14	0.42	0.72	1.00				
Inflation volatility (std)	HIC	0.52	0.59	-0.30	-0.29	-0.28	0.60	0.59	0.53	1.00			
Current + capital account balance (% of GDP)	CCB	0.43	0.30	-0.09	-0.26	-0.12	0.06	0.46	0.43	0.36	1.00		
Unit labour cost (%)	ULC	0.15	0.14	-0.11	-0.34	-0.10	0.10	0.27	0.25	0.28	0.34	1.00	
Unemployment rate (%)	URX	0.38	0.51	-0.05	0.17	0.05	0.35	0.49	0.49	0.35	0.30	-0.05	1.00

		GBY+1	RAT+1	YER+1	GGD	GGDT	DGGE	GGNI	IGD	GPB	GBS	GPBH	GBSH
Government debt-to-GDP ratio (%)	GGD	-0.03	-0.10	0.33	1.00								
Government debt-to-government revenue ratio (%)	GGDTR	0.05	-0.05	0.30	0.90	1.00							
Change in government debt-to-GDP ratio (p.p.)	DGGD	0.30	0.20	0.23	0.41	0.40	1.00						
Net debt (% of GDP)	GGND	-0.04	0.01	0.18	0.75	0.77	0.33	1.00					
Interest-growth differential (p.p.)	IGD	0.24	0.04	0.46	0.16	0.21	0.12	0.13	1.00				
Primary balance (% of GDP)	GPB	0.34	0.28	0.13	0.11	0.18	0.54	0.20	0.16	1.00			
Structural balance (% of pot. GDP)	GBS	0.35	0.15	0.18	0.20	0.31	0.27	0.46	0.34	0.63	1.00		
Longest period of positive primary balance (years)	GPBH	0.33	0.39	-0.25	-0.26	-0.14	0.10	0.17	-0.03	0.33	0.41	1.00	
Highest average structural balance over 8 years (% of GDP)	GBSH	0.38	0.36	-0.03	0.31	0.41	0.16	0.52	0.22	0.24	0.51	0.58	1.00

		GBY+1	RAT+1	YER+1	BVI	AGE	GGG	NIP
ESM's Bank Viability Index	BVI	0.27	0.26	0.22	1.00			
Increase in ageing costs (% of GDP)	AGE	-0.08	-0.11	-0.07	-0.11	1.00		
Stock of government guarantees (% of GDP)	GGG	-0.33	-0.44	0.15	-0.01	0.08	1.00	
Net international investment position (% of GDP)	NIP	0.30	0.33	0.00	0.11	-0.06	-0.29	1.00

		GBY+1	RAT+1	YER+1	WGIG	WGIR	WGIR	DBI	FRI	EPL	PMR	TICPI
WB Governance Effectiveness	WGIGE	0.57	0.77	-0.18	1.00							
WB Regulatory Quality	WGIRQ	0.43	0.69	-0.13	0.80	1.00						
WB Rule of Law	WGIRL	0.49	0.74	-0.17	0.89	0.82	1.00					
WB Doing Business Rank	DBI	0.33	0.54	-0.10	0.65	0.63	0.62	1.00				
Commission's fiscal rule index	FRI	0.27	0.33	-0.14	0.34	0.36	0.32	0.38	1.00			
OECD EPL	EPL	-0.13	0.08	0.06	0.23	0.37	0.27	0.54	0.06	1.00		
OECD PMR	PMR	0.09	0.35	-0.19	0.39	0.55	0.44	0.47	0.40	0.29	1.00	
TI Corruption perception index	TICPI	0.51	0.77	-0.18	0.89	0.82	0.90	0.69	0.41	0.32	0.43	1.00

		GBY+1	RAT+1	YER+1	NFD	HFD	CRG	CRP	RPPI
Non-financial corporations' debt (% of GDP)	NFD	-0.15	-0.25	0.30	1.00				
Household debt (% of GDP)	HFD	-0.28	-0.36	0.36	0.71	1.00			
Credit growth (%)	CRG	0.27	0.39	-0.09	-0.21	-0.28	1.00		
Credit flow to non-financial sector (% of GDP)	CRP	0.02	0.15	0.03	0.22	0.14	0.21	1.00	
House price growth - nominal compensation growth (p.p.)	RPPINC	0.25	0.22	-0.07	-0.11	-0.23	0.12	0.00	1.00

		GBY+1	RAT+1	YER+1	G1	G2	G3	G4	G5	G6	VUL
1 Govt. borrowing needs, conditions and debt structure	G1	0.58	0.42	-0.02	1.00						
2 Economic strength	G2	0.63	0.73	-0.03	0.20	1.00					
3 Fiscal position	G3	0.29	0.23	0.24	0.53	0.20	1.00				
4 Financial sector and other contingent liabilities	G4	0.13	0.10	0.09	-0.07	0.08	0.15	1.00			
5 Institutional parameters	G5	0.49	0.77	-0.17	0.30	0.68	0.40	0.00	1.00		
6 Private leverage, credit & real estate	G6	0.13	0.09	0.05	0.05	0.09	-0.07	0.08	-0.06	1.00	
Overall vulnerability score	VUL	0.63	0.73	0.01	0.68	0.68	0.67	0.20	0.75	0.32	1.00

Table: Principal component analysis

	retain factor with latent score >= 1; enforce score >= 0															1st fact	
	Across all indicators											per dimension				All	Dim
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F1	F2	F3	F4	F1	F1
Gross financing needs (% of GDP)		22											50			48	29
Change in gross financing needs (p.p.)									59					57		0	0
10-year bond yield spreads to Germany (p.p.)			18									34				79	76
10-year bond yield volatility (std)			17									30				36	64
Credit rating and outlook (avg Moody's, S&P and Fitch)			15									36				67	81
Share of short-term debt (%)	7												50			23	46
Change in share of short-term debt (p.p.)									41					43		0	0
Share of debt held by non-residents								23							71	0	24
Share of foreign currency-denominated debt (%)								5							29	0	33
Potential GDP growth (%)										8			43			18	0
Real GDP growth (%)										30			33			12	0
Volatility of real GDP growth (std)			18											60		13	41
GDP per capita (PPS thousands)						22						28				64	71
WEF Competitiveness Index	17											27				87	66
Inflation volatility (std)			17											40		45	66
Current + capital account balance (% of GDP)								10				31				69	54
Unit labour cost (%)	11											14				6	30
Unemployment rate (%)											49		24			44	39
Government debt-to-GDP ratio (%)		25												2		24	46
Government debt-to-government revenue ratio (%)		25										2				35	56
Change in government debt-to-GDP ratio (p.p.)			10									36				51	48
Net debt (% of GDP)		28											12			37	62
Interest-growth differential (p.p.)										52				98		33	36
Primary balance (% of GDP)			4									41				51	44
Structural balance (% of pot. GDP)										9		21				77	67
Longest period of positive primary balance (years)						27							44			34	25
Highest average structural balance over 8 years (% of GDP)						22							44			85	51
ESM's Bank Viability Index							100						12			49	0
Increase in ageing costs (% of GDP)				28								56				0	80
Stock of government guarantees (% of GDP)											15	44				0	97
Net international investment position (% of GDP)								22					88			54	0
WB Governance Effectiveness	19											28				100	64
WB Regulatory Quality						12						21				100	66
WB Rule of Law	19											27				90	65
WB Doing Business Rank	14												34			58	49
Commission's fiscal rule index				36										51		29	37
OECD EPL						18							66			1	18
OECD PMR				36										49		42	44
TI Corruption perception index	13											25				86	61
Non-financial corporations' debt (% of GDP)								23				55				0	100
Household debt (% of GDP)								16				45				0	88
Credit growth (%)					46								45			37	0
Credit flow to non-financial sector (% of GDP)					54								55			7	31
House price growth - nominal compensation growth (p.p.)											36			100		35	0

This table contains factor loadings for four type of principal component (PCA) exercises:

- PCA across all indicators: the model identified 11 factors, which individually have a latent score larger or equal than one. Next, we conduct varimax factor rotation and then per indicator only keep the factor-association for which it has the highest loading. Finally, we rescale for columns to sum to 100.
- PCA per dimension: same as above but performing the exercise by dimension. Depending on the dimension, the model identified between two and four factors.
- PCA first factor across all indicators: of the 11 identified factors we only retain the first. We truncate negative factor loadings and rescale such that the maximum equals 100.
  PCA first factor per dimension: same as above but performing the exercise by dimension.

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