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The Macroeconomic Imbalance Procedure

From the Scoreboard and Thresholds to the decisions

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Contents

Abstract[1]

This study employs statistical methods to further develop the Macroeconomic Imbalance Procedure (MIP) Scoreboard in line with the European Parliaments regulation of 2011, so as to make it an even better information aggregation, decision making and communication tool. The contribution to the literature and ongoing policy debate is threefold. First, we synthesize the current empirical literature and show that the predictive power of the MIP Scoreboard has so-far been limited. Second, we apply the methodology of composite indicators, step-by-step on the European Statistical Office (Eurostat) MIP Database (2005-11, 28 Member States, 11 MIP Indicators). By doing so, we spotted few outliers in the headline database, recommended normalised measures (red flag analysis, distance-to-target) already advocated by the European Commission, and conducted multivariate analysis revealing that MIP indicators are only weakly collinear and it is unlikely that they share common factors. Still, when applying the signals approach, which is a standard technique used by earlier empirical studies, a composite measure of threshold breaches was the available second best indicator to signal crisis events in advance. Third, we found that introducing two sided thresholds could be an obvious choice for some flow variables in the MIP scoreboard to identify imbalances both ex-ante and ex-post (in accordance with the prevention and correction goals of the MIP). Such two sided thresholds have been already introduced for two MIP indicators: for the current account deficit and for the real effective exchange rate. Real house prices, unemployment and private sector credit flow could be further candidates to consider for two sided thresholds.

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1 MIP – RATIONALE AND IMPLEMENTATION

"The good ended happily,
and the bad unhappily."
THE IMPORTANCE OF
BEING EARNEST
Oscar Wilde

The European Commission introduced the Macroeconomic Imbalance Procedure (MIP) in 2011 as part of the "Six-Pack" legislation, so as to react to the Global Financial Crisis and to correct and prevent macroeconomic imbalances in the European Union (EU).

The rationale for supra-national surveillance in the EU builds on the possible spill-over effects of macroeconomic imbalances within the EU, which could compromise the proper functioning of the monetary union, its functioning and institutions (European Commission, 2016). The close interconnectedness of EU economies means that imbalances or other unfavourable developments in a given country may significantly impact other Member States. The Regulation (No 1176/2011) defines

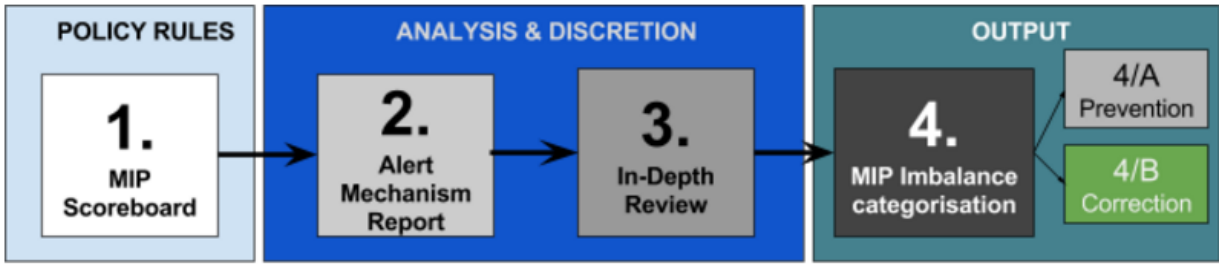
> ***'imbalances'*** *as any trend giving rise to macroeconomic developments which are adversely affecting, or have the potential adversely to affect, the proper functioning of the economy of a Member State or of the economic and monetary union, or of the Union as a whole;*
>
> ***'excessive imbalances'*** *means severe imbalances, including imbalances that jeopardise or risk jeopardising the proper functioning of the economic and monetary union.*

At the global level, the International Monetary Fund (IMF) oversees the international monetary system, highlights possible risks to stability and advises on needed policy adjustments. In this way, it helps the international monetary system serve its essential purpose of sustaining economic growth by facilitating the exchange of goods, services, and capital among countries, and ensuring the conditions necessary for financial and economic stability. Another prominent example for continental surveillance cooperation is the Macroeconomic Research Office (AMRO), which is the regional macroeconomic surveillance unit of the Chiang Mai Initiative Multilateralisation (CMIM) members[2] since 2009.

The MIP is integrated into the annual cycle of the EU's economic monitoring, the European Semester. The annual MIP procedure has four steps starting with the screening of countries on the basis of

- MIP Scoreboard,
- Alert Mechanism Report (AMR),
- In-Depth Review (IDR), and
- MIP Categorisation.

Figure 1. Flow chart of the Macroeconomic Imbalance Procedure



[2] CMIM Members: China and Hong Kong, Japan, South Korea, Indonesia, Thailand, Malaysia, Singapore, Philippines, Vietnam, Cambodia, Myanmar, Brunei Darussalam, Laos.

The quantitative information in Step 1, the so-called MIP Scoreboard (Box 1.) is complemented by additional quantitative and qualitative information contained in the Alert Mechanism Report (AMR) in order to identify the first list of member states with macroeconomic imbalances (European Commission, 2016), and finally by the In-Depth Reviews to select Member States with macroeconomic imbalances. The economic reading of the MIP scoreboard indicators is further complemented by auxiliary indicators for which no threshold has been calculated.

Box 1. MIP Scoreboard

Principles of the MIP scoreboard

(i) Summarize the most relevant dimensions of macroeconomic imbalances

(ii) Serve as a reliable signalling device

(iii) Support effective communication by using simple and straightforward measures

(iv) Ensure high statistical quality

11+3 Headline indicators and thresholds

The MIP Scoreboard is a set of headline indicators aiming at the assessment of macroeconomic risks (European Commission, 2012). It consists of 14 indicators currently. Initially, the MIP Scoreboard was built upon 11 indicators, which were augmented by additional 3 employment indicators (European Commission, 2015). However, these new headline indicators do not play a direct role in the identification of macro-financial risks and do not trigger by themselves steps in the MIP, hence this report does not cover them.

The headline indicators consist of *(I) five external imbalance indicators*, and *(II) six internal imbalance indicators* and *(III) employment indicators*. (Indicative upper and/or lower thresholds for the 14 headline indicators **are in parenthesis below**):

I. EXTERNAL IMBALANCE INDICATORS

Current account balance: in % of GDP, 3 years average (**+6%** and **- 4%**)

Net international investment position: in % of GDP (**-35%**)

Real effective exchange rate: 42 trade partners, 3 years % change

(**-/+5%** for euro-area countries and **- /+11%** for non-euro-area countries)

Export market shares: 5 years % change (**- 6%)**

Nominal unit labour cost index: 3 years % change

(**+9%** for euro-area countries and **+12%** for non-euro-area countries)

II. INTERNAL IMBALANCE INDICATORS

House price index, deflated: 1 year % change (**6%**)

Private sector credit flow: consolidated, in % of GDP (**15%**)

Private sector debt: consolidated, in % of GDP (**133%**)

General government sector debt: in % of GDP (**60%**)

Unemployment rate: 3 years average (**10%**)

Total financial sector liabilities: non-consolidated - 1 year % change (**16.5%**)

III. UNEMPLOYMENT INDICATORS (Unemployment indicators do not trigger steps in the MIP procedure.)

Activity rate (15-64 years): 3 year % point change (**0.2%**)

Long-term unemployment rate: 3 year % of active population in the same age group, % point change (**0.5%**)

Young people neither in employment nor in education and training: in % of total population, 3 year % point change (**2%**)

2 PRACTICAL CHALLENGES OF THE MIP

The general consensus about economic policy in the academia and amongst practitioners is that forward looking approaches can yield better economic results then adaptive ones. Although improved macroeconomic monitoring efforts have been always welcomed worldwide in the aftermath of the financial crisis situations, their implementation has still been subject to discussion. There are no ready-made and perfect solutions of macro surveillance systems yet. For example, targets of the surveillance and macroeconomic circumstances may influence the design of scoreboards and other types of information aggregation tools used. A critical question discussed in the next section is, for the MIP as well, whether it serves as an early warning or as a monitoring system or both.

2.1 Combining discretion and policy rules

The MIP combines (i) policy rules with (ii) discretion in decision making (**Figure 1**). The advantage of the former is its clarity, consistency, while its disadvantage is the lack of flexibility and discretion. Mellers et al. (1998) argued that application of rules or norms often minimizes effort and provides satisfying solutions that are "good enough," though not necessarily the best. On the other hand, when rules are ambiguous, people look for reasons to guide their decisions. Advantages of transparency, numerical targets and evaluation in central banking has been proved by empirical papers (Naszódi et al., 2016). Furthermore, numerical fiscal rules have been introduced by EU Member States. The Maastricht Criteria could be also considered (a) as a set of indicators and thresholds that have been used to evaluate ex-ante whether the macroeconomic situation of Member States is ready for the adoption of the single currency and (b) as a tool to monitor macro financial imbalances before Eurozone membership.

The MIP Scoreboard with its numerical thresholds is an example of explicit policy rules, while the Alert Mechanism Report and In-depth Reviews form a basis of discretion. According to the REGULATION (EU) No 1176/2011 of the European Parliament and the Council the MIP

> *"should be based on the use of an **indicative and transparent 'scoreboard' comprising indicative thresholds, combined with economic judgement.**"*

However, the MIP Scoreboard indicators are neither policy targets nor policy instruments and comments from the European Parliament, ECOFIN, ESRB, EPC, ECB are taken into account.

Such discretion or judgement, however, could imply that the European Commission's 'true model' of behaviour is uncertain as highlighted by Boysen-Hogrefe et al. (2015). Ironically, however, the MIP Scoreboard, which is clearly the most transparent and rule based element of the EU macroeconomic surveillance, has been often the key target of criticism since it was introduced.

2.1 Is the MIP an Early Warning System or a Penalty Bench?

The REGULATION (EU) No 1176/2011 sets out detailed rules for the detection of macroeconomic imbalances, with the double objectives of

(1) **to prevent imbalances** as an early warnings system (EWS) and

(2) **to correct persisting imbalances** (a *'penalty bench'*).

In other words, the MIP Scoreboard aims at identifying imbalances ex-ante during the run-up to crisis situations (so as to trigger pre-emptive actions) and also at monitoring imbalances ex-post (so as to trigger corrective actions). Flow variables may be better serve as Early Warning System, while stock variables are better for the ex-post monitoring of fading away imbalances. This duality of goals also mirrored by the Regulation (No 1176/2011)

'The scoreboard comprising the set of indicators, shall be used as a tool to facilitate early identification and monitoring of imbalances.'

The duality of goals, however, may introduce some inconsistency, as the same indicators could be read differently if the goal is the early detection of imbalances or if the goal is ex-post monitoring. For example, in case of real house prices, the official MIP threshold of +6% could be interpreted as part of the early warning system. On the other hand, no lower threshold exists for house price declines, which could signal a bust period and serve monitoring purposes (read more on two sided thresholds in Section **2.2.2**). Such cyclicality is a phenomenon of several indicators and in general of the macroeconomy, see in **Table 7**. As a result, symmetric threshold could be considered to filter out both boom period imbalances and bust period imbalances.

2.2.1 Early Warning Capacity of the MIP headline indicators

Early warning could be equated with an alarm bell that rings well before disaster strikes to allow response. Numerous empirical studies on the MIP applied the so-called signals approach (Boysen-Hogrefe et a.l, 2015; Knedlik, 2014 and Csortos-Szalai, 2013). The idea of the signals approach is that an indicator or a system of indicators can forecast a financial crisis, whenever it exceeds or falls below a certain threshold in a given forecast horizon (**Box 2**). Such identification of the best performing early warning indicators could be advantageous, because it could help design an optimal scoreboard or composite measure.

Empirical works have concluded so far that the predictive power of the MIP Scoreboard Indicators is low (Boysen-Hogrefe et al., 2015; Knedlik, 2014 and Csortos-Szalai, 2013). Furthermore, the difficulty of early warning in case of macroeconomic surveillance is confirmed by the fact that different studies identified different indicators useful as alarm bells (**Table 1**). Csortos-Szalai (2013) showed that only in the cases of the current account deficit and the unemployment rate were the prediction ratios better than the ratios of false alarms to alarms total. Boysen-Hogrefe et al. (2015) found that house prices, private sector debt, and private sector credit flow are the best early warning indicators of crisis events. Furthermore, export market shares, private sector credit flow and private debt were best predictors of MIP classification. Knedlik (2014) showed that the usefulness is the highest for the current account, net international investment position and nominal unit labour costs. Domonkos et al (2017) found that in the short run private sector debt is the best performing indicator amongst the headline indicators, complemented by current account balances in the long term.

Table 1. Best indicators to signal crisis events and MIP classification

Study	Target Variable	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities
Csortos-Szalai (2013, 2014)	Crisis event (cycl. GDP gap)	■									■	
Boysen-Hogrefe et al. (2015)	Crisis event (syst., banking, sov. debt, currency)						■	■	■			
Boysen-Hogrefe et al. (2015)	IDR and imbalance classif. (ord. prob.)				■					■		
Domonkos et al.(2017)	Crisis event (cycl. GDP gap)	■							■			
Knedlik (2014)	Crisis event (debt crisis)		■			■						

A possible explanation for the differences in the results could be that the target/dependent variables were derived from different concepts. Csortos-Szalai (2013) similar to our analysis (see in Section **3.8**) used the cyclical GDP, Boysen-Hogrefe et al.

(2015) analysed financial crisis events (including systemic, banking, sovereign debt and currency crisis events) and the IdR classification and Knedlik (2014) the debt crisis events.

Knedlik (2014) also remarked that some indicators perform differently as early warning indicators in different countries. For instance, ULC performs excellently in Central and Eastern European countries but poorly in the Eurozone. Public sector debt is a very important indicator for the Eurozone but not for the rest of the European Union; the unemployment rate and export market share are relevant early warning indicators in the Eurozone but not in Central and Eastern European countries.

The European Commission (2016) compendium gave empirical evidence that stock variables were the ones displaying a significant impact on MIP categorisation so far. A possible interpretation is that, the MIP categorization was rather based on the correction of the latest crisis and on the slow correction of stock variables, rather than on the prevention of the next crisis and quicker improvements in flow variables in a number of countries. The MIP procedure has been regressed on Country-Specific Recommendations (CSR) progress indicator and also synthetic indicator of economic conditions, in flows and in levels (pp81), showing the influence of the latter.

Another difficulty in using MIP as early warning signal is potential endogeneity, since the European Commission plays both the role of the economist and of the institutional actor who can influence evolutions. Hence, paradoxically, to take a polar case, if the European Commission identifies an imbalance with an associated flash in the scoreboard, issues a recommendation that is followed by a country, and implemented with full progress, hence the signal will appear as "false alarm" since no crisis appears whereas the procedure, in this case, is 100% efficient on its preventive side.

Finally, different explanations could be given as to why establishing effective early warning systems is a difficult analytical and policy challenge. First, vulnerabilities are time and place dependent. Second, early warning indicators may fail to trigger action in due time (and in many cases they did fail in practice in the past), because policy makers were resistant to act on vague warnings in good times. The MIP is definitely subject to these challenges.

Box 2. Signals Approach

Basic methodology

The signals approach uses indicators and thresholds for forecasting crisis events, therefore can be easily applied on the MIP Scoreboard (see the empirical analysis of MIP signals in Section **33.8**). An indicator signals a crisis, if it exceeds or falls below a certain threshold. Overall, there are four cases (A, B, C, D) depending on whether a crisis signal or the absence of a crisis signal was correct or incorrect.

A equals the number years, in which the indicator **CORRECTLY** provides **signal.**

B equals the number of years, in which the indicator **INCORRECTLY** provides **signal.**

C equals the number of years, in which the indicator **INCORRECTLY** provides **NO signal**.

D equals the number of years, in which the indicator **CORRECTLY** provides **NO signal.**

		Crisis	
		YES	NO
Signal	YES	A	B
	NO	C	D

Signal performance evaluation

The less binding the thresholds, the more crises are correctly predicted (A) but at the same time the number of incorrect signals (B) and, thus, the number of 'false alarms', eg. type II errors increases. In the same vein, a higher threshold increases the number of cases, in which one correctly predicts that no crisis occurs (D) but it also increases the number of crises without any preceding signal (C) and, thus the number of type I errors. The Commission aimed at striking a healthy balance when setting MIP thresholds at prudent levels, in order to avoid both excessive numbers of *'false alarms'*, and on the other hand also unacceptable delays of signals. (European Commission, 2012).

Correct crisis signals $\frac{A}{A+C}$

Type I error $\frac{C}{A+C}$**,** the share of crisis events, when the early warning system failed to give signal.

Type II error $=\frac{B}{B+D}$**,** share of events, when the early warning system incorrectly signalled crisis (*'false alarms'*).

Noise-to-Signal Ratio: $= \frac{\frac{B}{B+D}}{\frac{A}{A+C}}$ **,** is calculated as the share of incorrectly signalled crises in number of years.

Usefulness: $\boldsymbol{U} = \min[\theta; 1-\theta] - L = \min[\theta; 1-\theta] - \theta\frac{C}{A+C} - (1-\theta)\frac{B}{B+D}$

Empirical evaluations of early warning indicators are frequently based on a **usefulness function *U*** that in turn is based on a loss function L. In the loss function certain weights θ and (1 − θ) are explicitly assigned to the share of type I errors (C/(A + C)) and type II errors (B/(B + D)).

An early warning indicator is the more useful, **the lower the NSR** and **the higher the value of U** is and is generally considered useful if U > 0.

Source: authors, Boysen-Hogrefe et al., 2015

2.2.2 Setting (two sided) thresholds

The European Commission (2012) derived MIP thresholds for many indicators from the distribution of indicators observed in the past and equated the thresholds to lower and /or upper quartiles. Most indicators have only one threshold, and an argumentation in favour of the necessity of two sided thresholds could also be based on the distribution of indicators for flow variables in the MIP scoreboard, which is in most cases symmetric (not skewed). (See the distribution of MIP indicators in **Figure 3**, and the 1st and 3rd quartiles in **Annex 2.**)

Several empirical works used the signalling approach to establish optimal thresholds by changing the standard assumption about the preferences of policy makers with regard to the trade-off between correct signals for crisis periods and wrong signals for non-crisis periods (Boysen-Hogrefe et al., 2015; Knedlik, 2014 and Csortos-Szalai, 2013). Knedlik (2014) also concluded that the thresholds of the Commission's Scoreboard are rather tight (resulting in more alarm signals), as compared to a neutral stand, and the usefulness of official thresholds is negative for all indicators. All these could have political economy consequences.

In this report, we argue that the lack of two sided thresholds in case of some indicators may raise doubt about whether the thresholds are consistent and optimal. For example, in case of house prices the +6% current official one sided threshold could be interpreted as an early warning threshold, while the 10% current official threshold for unemployment as an ex-post indicator of fading away crisis and imbalances. Also, in case of export market shares the minus 6% threshold can help to identify loss of competiveness and imbalances ex-post.

Two sided thresholds could be an obvious choice for many indicators to identify imbalances both ex-ante and ex-post. For example, unemployment rates below the so-called natural rate may be a sign of a boom period and serve as an early-warning indicator. **Table 7** shows that average unemployment rate in Member States dropped below 7 percent, which may be close to the natural level (See the 1st quartile of the distribution in **Annex 2**, which equals 6.4 percent). A drop in the real house price index or limited credit flows to the private sector could be an indicator of adjustments. Such two sided thresholds has been already introduced for two variables: the current account deficit and for the real effective exchange rate.

Boysen-Hogrefe et al. (2015) argued that the MIP was introduced after the final crises of the years 2008 and 2009, hence, it was mainly concerned with addressing macroeconomic consequences of these crises ex-post. All in all, establishing two sided thresholds for other indicators could be worth considering to enable the MIP Scoreboard to serve its double goals (prevention and correction of imbalances).

3 APPLYING THE OECD-JRC METHODOLOGY

Composite indicators (Cis) can help summarize multifaceted information for such complex and versatile concepts as macroeconomic imbalances. They compare country performance and recognised as a practical tool for analysis and communication (OECD-JRC, 2008). Furthermore, the reduction of dimensions can result in more straightforward communication based on CIs in accordance with the principles of the MIP (**Box 1**). Opponents, however often draw attention to the drawbacks of ill-designed composite indicators, which could generate misbeliefs that policy issues are simple and can be automatized.

Csortos-Szalai (2013) concluded that if the MIP Scoreboard indicators are examined together, i.e. in certain combinations, the results are much better than the ones shown by individual indicators.

Christensen and Li (2014) argued that one straightforward way of capturing the fragility of the economy prior to a financial stress event is to keep track of the number of signals being issued in the different sectors of the economy. The information provided by all the indicators can be then combined to assess the likelihood of an upcoming financial stress event. They considered three composite indicators based on normal and extreme thresholds.

Finally, this step-by-step procedure could be an alternative way to understand macroeconomic imbalances, and see what are differences/similarities between the conclusions based on In-depth Reviews and based on simply the scoreboard (See **Figure 1**). In other words, different ways of aggregation of the scoreboard signals can also support crosschecking the conclusions based on the AMR and IdR.

3.1 Data

The analysis in this report was based on the MIP dataset of European Statistical Office (Eurostat) for the 28 EU Member States and 11 MIP headline indicator that were considered for the AMR (**Box 3**). There are 308 observations for each indicators for the period between 2005 and 2015 (except for real house prices for which we had 305 observations) summing to 3385 observations (11 Indicators X 28 Member States X 11 years – 3 missing values).

The great advantage of the dataset is that it combines observations form the pre- and post-crisis (boom and bust) periods. Hence, the database and the statistical analysis is less subject to possible biases of economic cyclicality. Annex 2 provides summary statistics (mean, skewness, quartiles etc.) table for the MIP Scoreboard indicators.

Box 3. Data details and sources

KEY DATA CARACHTERISTICS

Time: yearly data 2005-2015, 11 years

Cross section: EU member states

Source of data: EUROSTAT

2017 MIP dataset (data for 2006-2015)

2016 MIP dataset (data for 2005)

TREATMENT OF MISSING VALUES

19 missing values have been replaced by the values of the latest MIP dataset in which the data could be found.

- Denmark, Current account balance -	(2006)	source: 2015 MIP
- Denmark, Export market shares	(2006, 2007, 2008, 2009)	source: 2016 MIP
- Greece, General gov. debt	(2005)	source: 2014 MIP
- Hungary, House price index, deflated	(2006, 2007)	source: 2013 MIP
- Malta, Export market shares	(2006, 2007)	source: 2016 MIP
- Poland, House price index, deflated	(2006, 2007, 2008)	source: 2013 MIP
- Romania, House price index, deflated	(2006, 2007, 2008)	source: 2013 MIP
- Slovakia, House price index, deflated	(2006)	source: 2013 MIP
- Slovakia, Export market shares	(2006, 2007, 2008)	source: 2016 MIP

1 missing value has been replaced by a value from an external data source

- Hungary , House price index, deflated	(2005)	source: FHB bank

Missing values (not estimated)

- Poland, House price index, deflated	(2005)	MISSING
- Romania, House price index, deflated	(2005)	MISSING
- Slovakia, House price index, deflated	(2005)	MISSING

3.2 Next steps in building composite indicators

The overarching objective of building composite indicators is not the end result of a streamlined composite indicator. More importantly, the composite indicator methodology is a rigorous step-by-step procedure to structure discussion about indicators, about their relationship with each other and with the underlying concept.

Each step of the composite indicators methodology can deliver important results and contribute to the development of the MIP Scoreboard as a monitoring, decision making and communication tool in line with the MIP's principles (**Table 1Table 2**). The first two steps have been already taken, as there exist a theoretical framework (see the detailed literature review in European Commission, 2012), a carefully selected set of indicators and high quality official data (Eurostat database). In the following, we discuss further steps: treatment of missing data and outliers, multivariate analysis, normalisation, weighting and aggregation, uncertainty analysis and visualisation.

Table 2. Key steps of building composite indicators and results for MIP Scoreboard

Steps	Checklist	Section in this report
Theoretical framework	✓	
Data selection	✓	
Missing data and outliers	✓ ☒	**3.3**
Multivariate analysis (grouping of indicators)	☒	**3.4**
Normalisation	☒	**3.5**
Weighting and aggregation	☒	**3.6**
Uncertainty analysis	☒	Error! Reference ource not found.
Visualisation	✓ ☒	**3.10**

Source: OECD-JRC (2008)

3.3 Treatment of missing and outlier data

Box 2 reports on the missing values that have been replaced by values published in earlier MIP datasets. There remain 3 missing values on real house price index for Poland, Romania and Slovak Republic in 2005. Because house prices were very volatile in Central and Eastern European countries due to the economic transformation during the previous decades, and other data sources (statistical offices, central banks, BIS database) also did not offer an alternative source, these three values have not been replaced. The number of missing values was almost negligible (3/3385 <0.1%), hence our choice is not likely to affect the results of the statistical analysis.

Outliers can introduce spurious variability in the data and undesired biases into decision making. To identify outliers in the database, we used simple rules of thumb recommended in the empirical literature (Saisana – Torreiro – Vertesy, 2016) and applied a combined threshold for skewness and kurtosis (absolute value of skewness > 2 and kurtosis >3.5). Three indicators were identified with this method: (i) nominal unit labour cost, (ii) private sector credit flow and (iii) total financial liabilities (**Figure 2**).

We opted for a straightforward and well-known method to treat outliers, called Winzorization, and used the next observed value in our database for the indicator. Four values have been subject to winzorisation (Cyprus-2008-Total financial sector liabilities, Latvia-2007-2008-Nominal unit labour costs, Luxembourg-2007-Private sector credit flow).

3.4 Multivariate analysis

3.4.1 Consistency and adequacy tests

The Cronbach–alpha (C-alpha) is regarded as a metric of internal consistency and reliability for indicators aiming at describing a complex phenomenon. It measures the portion of total sample variance due to the correlation of individual indicators. If no correlation exists and individual indicators are independent, then C-alpha is equal to zero, while if individual indicators are perfectly correlated, C-alpha is equal to one.

The reliability of MIP Scoreboard, measured by the Cronbach-alpha value, is relatively low at 0.39 for the external imbalance pillar of MIP scoreboard indicators and 0.15 for the internal imbalance pillar, both well below the 0.7 threshold for a reliable aggregate.

The Kaiser-Meyer-Olkin (KMO) measure is another measure of adequacy, which takes values between 0 and 1, and principal component analysis is not recommended if the measure is below 0.5. The KMO total for the MIP dataset is 0.67 which is above the minimum threshold, although classified as *'mediocre'*, not very good.

3.4.2 Correlation analysis

Correlation analysis can show whether there are highly or weakly related to indicators, or if some correlations do not have the expected sign. The absolute values of pairwise correlations are out of the standard thresholds (0.4 and 0.9) recommended for composites in most cases within external and internal dimensions of the MIP Scoreboard. This confirms the conclusions based on the Cronbach-alpha that consistency of MIP indicators is limited. Because the correlation between indicators is weak, it is unlikely that they share common factors. This confirms the conclusions based on the Cronbach-alpha that consistency of MIP indicators is limited.

As the variance of stock variables is low, some of them show only weak correlation with other indicators. For example, the net international investment position correlates well only with current account as the current account is a key driver of NIIP, and with unemployment. Similarly, private sector debt correlates well only with export market shares.

Table 3. Pearson correlation coefficients of MIP Scoreboard indicators

	MIP Indicators	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities
External Imbalance indicators	Current account balance	1										
	Net international investment position	0.55	1.00									
	Real effective exchange rate	-0.37	-0.05	1.00								
	Export market shares	-0.42	-0.16	0.52	1.00							
	Nominal unit labour cost	-0.47	0.01	0.45	0.5	1.00						
Internal Imbalance indicators	House price index, deflated	-0.02	0.18	0.20	0.32	0.04	1.00					
	Private sector credit flow	-0.12	0.08	0.14	0.18	0.17	0.30	1.00				
	Private sector debt	0.27	0.05	-0.24	-0.42	-0.17	-0.14	0.17	1.00			
	General government sector debt	0.05	-0.14	-0.34	-0.55	-0.47	-0.25	-0.25	0.11	1.00		
	Unemployment rate	-0.15	-0.54	-0.08	0.00	-0.37	-0.07	-0.23	-0.18	0.37	1.00	
	Total financial sector liabilities	-0.24	0.07	0.19	0.33	0.26	0.48	0.35	-0.04	-0.33	-0.22	1.00

*Correlation coefficients are calculated for the entire sample. Coefficients are highlighted in **orange cell colour**, if the absolute value was in the recommended range [0.3;0.9].

The correlation coefficient is also dependent on whether the entire sample or only selected years have been used for the calculation. The dispersion of correlation coefficients estimated for annual subsamples was about 20-30 percentage points for most indicator pairs.

The direction of indicators influences the sign of calculated correlation coefficients. In case of several MIP Indicators there is no preferred direction, because both too high and too low values could be problematic, except perhaps some stock variables (general

government debt, private sector debt). This is the reason why lower and upper thresholds are introduced in case of current account deficit and real exchange rate evolution. Again, this leads back to the discussion in **Section 2** about the duality of goals (prevention and correction) and to the need for two sided thresholds.

To investigate, whether the different MIP indicators signal problems in the same time the association of the official MIP threshold breaches were analyzed. We used the Phi coefficient to measure association of threshold breaches, because it better suits the analysis in our case with binary variables than the Spearman, Pearson or the Kendall tau correlation measures (MIP threshold breaches are coded into 0 and 1 values in our analysis). The Phi coefficient is similar to the correlation coefficient in its interpretation.

The Phi coefficient matrix (**Table 4**) reveals that the association within dimensions and even within the entire set of scoreboard indicators became positive. This suggests that the MIP scoreboard indicators and thresholds are consistent. Still, Phi coefficients are very low, although significant in most cases. A practical consequence of moderated association is that if the scoreboard gave usually vague warning signals, e.g. only few but not necessary all or not the majority of indicators gave signals at the same time, then policy makers were more likely to become resistant to act.

Table 4. Phi coefficient matrix of red flags

	MIP Indicators	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities
External Imbalance indicators	Current account balance											
	Net international investment position	0.23										
	Real effective exchange rate	0.15	0.17									
	Export market shares	0.14	0.33	0.11								
	Nominal unit labour cost	0.28	0.23	0.12	0.29							
Internal Imbalance indicators	House price index, deflated	0.18	0.06	0.08	0.21	0.06						
	Private sector credit flow	0.26	0.04	0.05	0.12	0.21	0.36					
	Private sector debt	0.09	0.35	0.02	0.36	0.04	0.05	0.11				
	General government sector debt	0.15	0.21	0.03	0.43	0.31	0.28	0.20	0.09			
	Unemployment rate	0.07	0.48	0.07	0.09	0.13	0.01	0.16	0.17	0.04		
	Total financial sector liabilities	0.29	0.08	0.04	0.20	0.16	0.49	0.45	0.04	0.21	0.03	

Phi- coefficients are highlighted in **orange cell colour*, if the absolute value was in the recommended range [0.3;0.9].

3.5 Normalisation

The practical use of the MIP Scoreboard might be impeded by the different measurement units of headline indicators. In this report, common normalisation methods are applied together with methods based on the guidance provided by DG ECFIN of the European Commission about the interpretation of the scoreboard[3]:

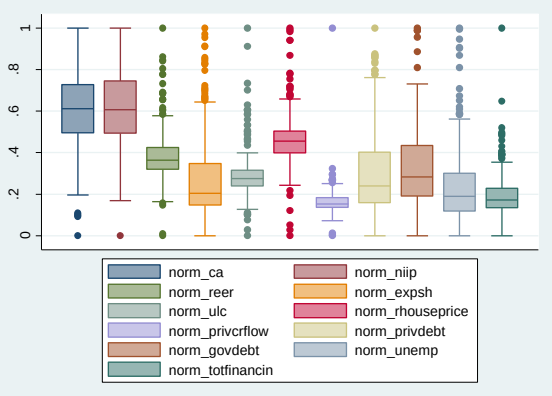
- Min-max normalisation: comparison of actual values to the observed range of the indicator. $\frac{x_{ij}-min(x_i)}{max(x_{ij})-\min(x_{ij})}$, where x_{ij} is the value of the indicator *i* in country *j* *across all years (**Section 3.5.1** of the report)*.
- Red flag analysis based on thresholds: a comparison of actual values to the official thresholds results in a simple statistics how frequently the alarm bell rings for indicators and countries, which converts indicator values into a binary indicator (the transformed indicator takes up the value of 1 if the headline indicator is above the threshold, and 0 otherwise, see **Section 3.5.1**.of the report)
- Distance to target: is a ratio of the absolute difference between the actual value and threshold in percent of the threshold to measure *"the severity of a breach of a threshold"* (**Section 3.5.3** of the report);
- Dynamic analysis : the scoreboard should be *"read also over time"* :not only the scoreboard values for the last year are important (**Section3.5.4** of the report)
- Ranking: converting headline figures into rankings to compare relative performance of countries (**Section** Error! Reference source not found.. of the report)

3.5.1 Min-max normalisation

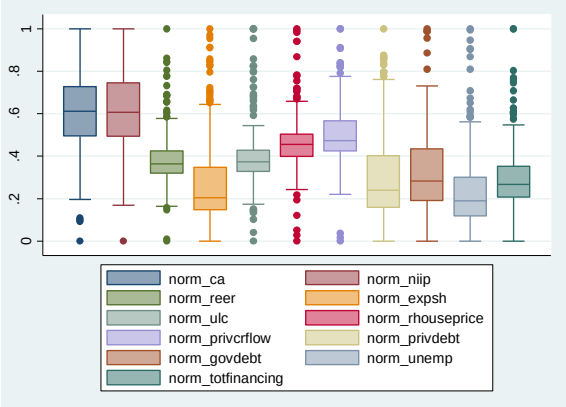
The commonly used method for normalisation is the so-called min-max normalisation that converts variables into a 0-1 scale. **Figure 2**. compares values of indicator thresholds to sample means and to the standard deviation of indicators (all normalized). Mean of those indicators that rang alarm bells most frequently are close to thresholds.

Figure 2. Normalized values of headline and winzorized MIP Scoreboard indicators*

Headline indicator distributions



Winsorised indicator distributions



*Normalized with min-max normalization. Abbreviations:.ca = Current Account Deficit, niip = Net International Investment Position, reer = Real Effective Exchange Rate, expsh = Export Market Share, ulc = Nominal Unit Labour Cost, rhouseprice = Real House Price, privcrflow = Private Sector Credit Flow, privdebt = Private Sector Debt, govdebt = General Government Sector Debt, unemp = Unemployment Rate, totfinancin = Total Financial Sector Liabilities.

Source: Eurostat, 2016

[3] European Commission, 2016: *The MIP indicator scoreboard,* 14th Annual meeting of Community of Practice on Composite Indicators and Scoreboards:, Joint Research Centre of the European Commission, Ispra, 26-28 September 2016 https://ec.europa.eu/jrc/sites/jrcsh/files/20160929-cop-macroeconomicimbalancesprocefureindicatorscoreboard.pdf

3.5.2 Thresholds and MIP Scoreboard red flags

The official MIP thresholds serve as benchmarks to group indicator values into acceptable and unacceptable ranges. **Table 5** shows the number of *red flags*** by year and by MIP indicators. Similar kind of red flag analysis based on the MIP Scoreboard headline indicators and thresholds were incorporated in the Commission analysis, without being the only or main determinant of the AMR outcomes (European Commission, 2016).

The use of the scoreboard is not limited to the number of red flags (or flashes). Figures by themselves, combined with other indicators, in the scoreboard or not, may be used to identify imbalances. Combination of indicators is not the only way to go further in the use or refinement of the scoreboard. Other treatments such as the splitting (private debt into households and non-financial corporations debt for example) may be a way to identify imbalances. Of course, the European Commission has to strike a healthy balance between the principles of the MIP scoreboard, namely between the statistical quality, timeliness and communication role.

Table 5. Number of MIP scoreboard red flags* by indicator and by year**

	Current account balance	Net international investment pos	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities	AVERAGE of MIP 11 indicators
2005	16	12	9	4	9	15	8	9	10	9	19	**10.9**
2006	17	12	4	9	7	19	11	10	9	5	12	**10.5**
2007	18	14	4	8	9	15	17	11	9	3	14	**11.1**
2008	18	16	9	11	11	4	11	12	9	2	4	**9.7**
2009	17	16	10	11	23	0	0	14	11	3	1	**9.6**
2010	13	16	4	16	11	1	0	14	12	8	0	**8.6**
2011	8	16	3	16	5	0	3	13	15	10	1	**8.2**
2012	9	16	10	20	1	0	2	13	15	11	0	**8.8**
2013	5	16	0	19	3	2	0	13	16	14	0	**8.0**
2014	5	16	1	18	3	5	1	13	17	12	2	**8.5**
2015	5	15	5	11	4	6	1	13	17	12	0	**8.1**
AVERAGE (2005-2015)	12	15	5	13	8	6	5	12	13	8	5	

*Grey cell colour marks indicators that signalled imbalance most frequently in our sample.
** Number of red flags equals the number of countries per indicator which were sorted into the unacceptable range, i.e. exceeding upper thresholds or falling below lower ones.

Source: Eurostat, 2016, authors calculations

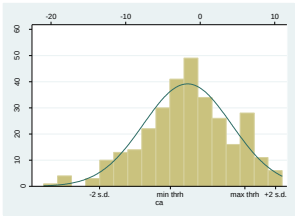
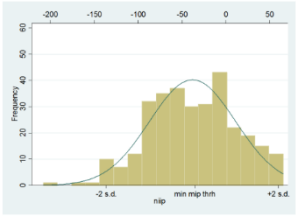
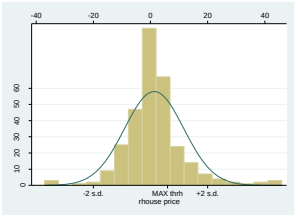
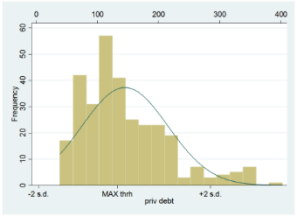
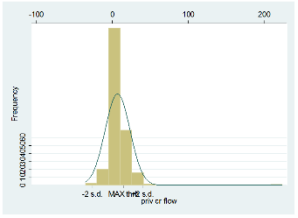
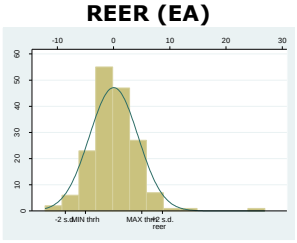
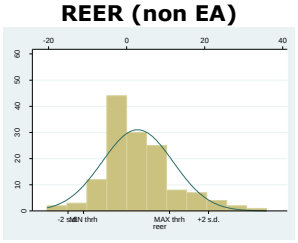
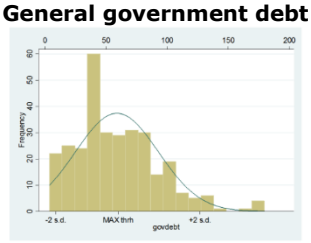
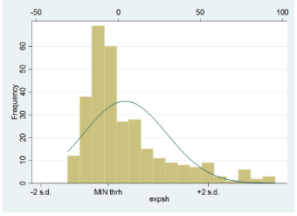
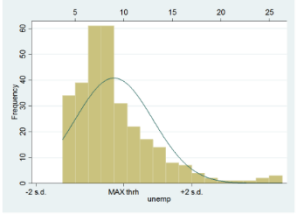
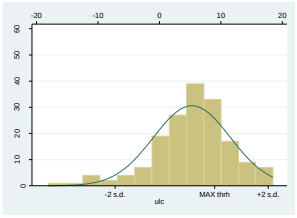
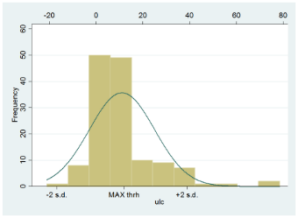
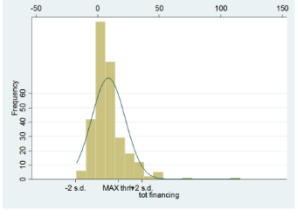
Current account balance, net international investment position, export market shares, private and general government debt were the key factors that came up as red flags most frequently in the MIP Scoreboard. On average 15 Member States were flagged every year for the net international investment position, and approximately 11-13 for current account balance, export market shares, private sector debt and general government debt. It is not surprising that many of these variables are stock variables, because the adjustment of these is more difficult. On the other hand strong private sector credit flow, fast growing house prices was problematic in few Member States and only before the crisis.

The number of red flags decreased over time gradually between 2005 and 2015 as the economic situation consolidated in the aftermath of the crisis. On average 11 Member States were flagged for each indicator in the period between 2005-2009, and only 8 in 2015.

The European Commission (2012) established MIP thresholds for many indicators from the observed distribution of indicators and equated the thresholds to lower/upper

quartiles. The argumentation of this practice (introduction of both upper and lower thresholds) could be based on theoretical arguments (see **Section 2.2.2**) supported by a statistical approach that values in both tails of the distribution could be differentiated. Histograms of most indicators are not skewed to either side, therefore a preferred *"normal"* range could be identified and the pair of the current one sided thresholds could be set as the first or third quartile on the other side of the distribution. Such symmetric thresholds have been introduced for the current accounts and for real effective exchange rates, and this approach could be applied to some of the flow variables in the MIP Scoreboard.

Figure 3. Histograms and thresholds of some MIP indicators* (%)

EXTERNAL IMBALANCE INDICATORS		INTERNAL IMBALANCE INDICATORS
CA 	**NIIP** 	**Real House Prices** 
Private sector debt 		**Private sector credit flow** 
REER (EA) 	**REER (non EA)** 	**General government debt** 
Export market shares 		**Unemployment rate** 
Nominal Unit Labour Cost (EA) 	**Nom. Unit Lab. Cost (non EA)** 	**Total financial sector liabilities** 

* Measures in % according to MIP definition in **Box 1**

3.5.3 Distance to thresholds

An alternative way to measure the severity of imbalances can be based on the absolute distance between actual values and MIP headline indicator thresholds in percent of the threshold. Such a metric could signal not only the breach of the threshold but also the magnitude of deviation, which is a relevant factor taken into account in the MIP categorisation by DG ECFIN.

The last column in **Table 6**, which averages the absolute distance to thresholds does not seem to mirror the run up to the 2008-2009 crisis, rather it can be used to evaluate the situation ex-post.

Deviation from thresholds for flow variables exhibited a clear adjustment path in the aftermath of the crisis, suggesting that the MIP thresholds, which are although not policy targets, could have supported adjustments in Member States and anchoring short term macroeconomic outcomes. Stock variables (NIIP, debt variables) remained above or below threshold and the correction has only started recently.

Table 6. Absolute distance to thresholds (in % of the MIP official threshold, average country values)*

	Current account balance	Net international investment pos	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities	AVERAGE of MIP 11 indicators
2005	34%	29%	19%	11%	22%	64%	20%	13%	10%	9%	57%	55%
2006	52%	36%	8%	33%	21%	141%	30%	15%	9%	6%	35%	73%
2007	67%	44%	13%	30%	42%	115%	77%	22%	8%	3%	35%	55%
2008	83%	55%	18%	54%	59%	13%	13%	25%	10%	1%	31%	18%
2009	60%	71%	29%	39%	58%	0%	0%	29%	16%	1%	0%	41%
2010	29%	76%	8%	66%	21%	0%	0%	26%	21%	7%	0%	93%
2011	14%	75%	3%	70%	3%	0%	10%	27%	27%	15%	3%	223%
2012	11%	77%	17%	151%	0%	0%	4%	29%	31%	19%	0%	104%
2013	5%	76%	0%	111%	1%	1%	0%	26%	36%	21%	0%	66%
2014	6%	78%	0%	94%	5%	11%	1%	27%	37%	23%	4%	21%
2015	6%	72%	3%	39%	7%	9%	2%	27%	35%	20%	0%	0%
(2005-	33%	63%	11%	63%	22%	32%	14%	24%	22%	11%	15%	

Source: Eurostat, 2016*, authors calculations*

*Grey cell colour marks indicators that signalled imbalance most frequently

As regards distance to thresholds metric, again one should be cautious. Indeed, it is a factor that should be considered, but some economic factors may justify a high distance to threshold, without any potential imbalance. For example, if consolidated private debt does not consolidate international intra-group debt, it may explain why debt of non financial companies and (and thus also private debt) remains high for countries such as Ireland, Belgium or Luxembourg for example.

3.5.4 Dynamic analysis

The current MIP practice requires that the scoreboard should be read also over time, and not only for the last year available. Some indicators existing on a quarterly basis could be used when available, for example, to signal as soon as possible potential adjustments or need for adjustment.

Headline figures show how the indicators behaved before and after the financial crisis, i.e. during the run-up period leading to crisis and during the correction. After the mid2000s dynamic private credit flow, expanding financial sector liabilities, increase in private and government debt levels, current account deficit accumulation, growing house

prices, surging unit labour cost and dropping unemployment rates signalled gradual overheating of the EU Single Market. Since the crises, flow variables, such as the current account deficit or the credit flow have corrected, similarly to price variables (real exchange rates, nominal unit labour costs, real house prices), while debt indicators (NIIP, private and public debt) and unemployment rate have kept on increasing.

Table 7. Evolution of headline indicators across years (average in Member States)

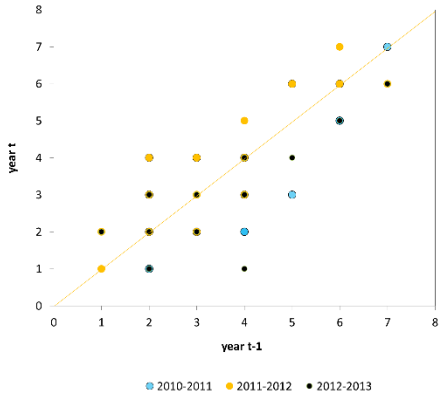
	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities
2005	-2.3	-25.9	5.4	22.8	9.4	8.7	12.7	118.4	46.6	8.7	24.8
2006	-3.1	-30.3	2.9	14.6	8.8	13.3	16.3	124.6	44.9	8.3	18.6
2007	-4.0	-36.4	3.7	17.5	12.2	11.0	24.4	139.9	43.0	7.5	19.7
2008	-4.6	-38.1	6.2	12.1	15.7	1.7	12.2	148.1	46.1	6.8	11.2
2009	-3.7	-44.3	5.4	6.8	16.4	-0.5	0.1	156.4	55.0	7.3	2.8
2010	-2.4	-43.9	0.0	-0.3	9.8	2.9	1.7	153.8	60.8	8.5	3.7
2011	-1.1	-41.3	-2.6	-1.5	3.5	3.1	4.7	153.4	65.1	9.7	3.9
2012	-0.6	-41.6	-4.3	-10.7	1.5	4.4	2.6	154.1	68.7	10.4	3.0
2013	0.3	-41.0	-0.8	-8.8	3.7	1.4	0.1	150.1	72.3	10.7	-1.2
2014	1.1	-39.1	-0.7	-5.9	3.9	1.9	0.8	149.5	73.6	10.8	5.8
2015	1.8	-36.2	-1.1	0.0	1.9	3.2	1.9	148.0	71.9	10.4	3.4

Source: Eurostat, 2016, authors calculations

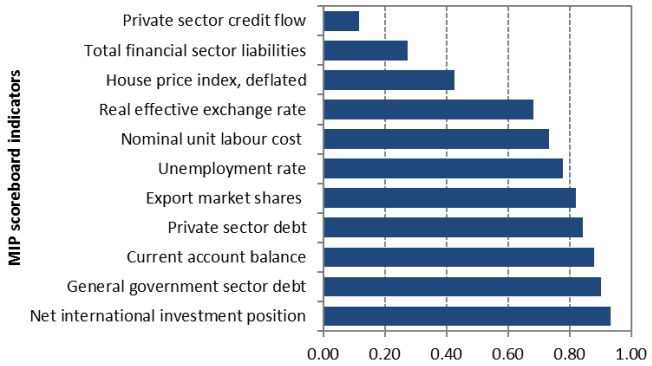
Figure 4 exhibits the strong autocorrelation of both the total number of red flags by year and of the underlying MIP indicators. Annual trendlines are close to the 45°degree line for red flags, implying that imbalance signals fade away only in the medium term, however, the slope of trendlines flattened as the situation improved. Autocorrelation is a phenomenon of stock indicators (debt, unemployment or market share), flow indicators and prices are less persistent.

Figure 4. Autocorrelation of MIP number of red flags and individual indicators

Number of red flags per Member States in year (t) and year (t-1)



First order autocorrelation of indicator values



3.6 Weighting and aggregation

The MIP Scoreboard, similarly to other scoreboards, is designed to give equal importance to each of the 11 headline indicators. Most composite indicators also rely on equal weighting schemes because this method is easy to understand and to communicate.

One method to check the suitability of equal weights can be based on the principle component analysis. Kaiser-Meyer-Olkin (KMO) measure for the MIP dataset is 0.67, which can be classified as *'mediocre'*, not very good for principal component analysis. The variables in the MIP dataset are not sufficiently related to each other, their correlations are low, and hence it is unlikely that they share common factors.[4] Statistical weights that were estimated with the principal component analysis vary between 7% and 11 % for the 11 MIP indicators, which support the acceptance of equal importance.

Another method to check whether equal weighting is acceptable is to analyse the results of previous empirical studies (see **Table 1**.). There seems to be currently a disagreement in the literature on which MIP indicators perform best as early warning indicators. And the lack of consensus could be an argument in favour of an equal weighting scheme.

3.7 Uncertainty analysis of the MIP evaluation

The MIP aims at identifying the macroeconomic imbalance in Member States, and its main output is the MIP categorisation of countries according to their exposure to imbalance risks (See Figure 1. Flow chart of the **Macroeconomic Imbalance Procedure**).

To assess the uncertainty of MIP evaluation to methodological choices we randomised

(a) the indicators [red flags or distance to threshold]

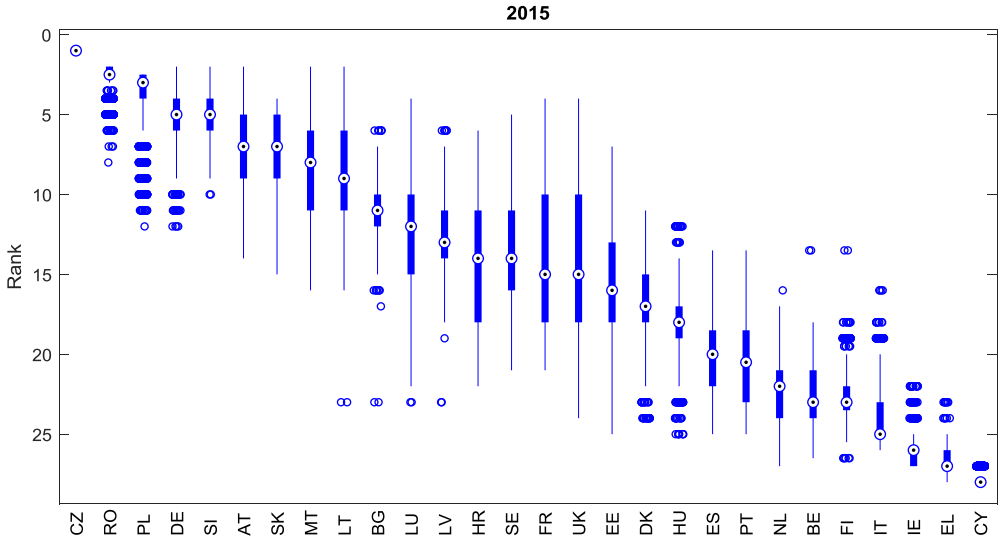
(b) the aggregation method[arithmetic or geometric mean]

(c) the weights [Gaussian noise on the weights, $\sum w_i = 1$.]

Uncertainty of MIP ranks is relatively low especially at the bottom and top, however for middle ranked Member States variability of rankings is relatively high (difference between minimum and maximum can be as high as 5-20 ranks). (**Figure 5**). This result implies that the selection of worst and best performers is robust to the methodological choices investigated.

[4] An earlier analysis of the JRC about European Systemic Risk Board's country heat map also revealed that bivariate correlations of risk indicators are very low.

Figure 5. MIP Rankings based on different methodological choices (year of observations = 2015)



Ranks have not substantially changed for most Member States in terms of MIP Scoreboard red flags over time (**Table 8**). Member State's absolute ranks changed by 6 places on average, meaning that countries were likely to jump only to a neighbouring quartile or remain in the same between 2005 and 2015. The ranking of Latvia and Bulgaria improved the most between 2005 and 2015 (by 17 and 14 places, respectively), while the Netherlands and United Kingdom's position worsened the most (by 17 and 11 places, respectively).

Table 8. MIP rankings based on the number of red flags

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change in ranking (2015-
Czech Republic	1	1	7	6	1	1	1	1	3	1	1	0
Austria	2	2	2	1	1	1	3	2	3	4	4	2
Belgium	2	9	11	13	13	12	18	10	9	6	8	6
Finland	2	4	1	2	13	12	18	10	9	6	8	6
Germany	2	4	2	2	6	1	3	18	9	6	4	2
Netherlands	2	4	4	6	1	1	18	23	21	20	19	17
Slovenia	2	2	7	6	6	1	1	2	9	6	4	2
Italy	8	4	4	2	6	1	3	10	9	6	8	0
Poland	8	19	18	13	6	1	13	2	3	1	2	-6
United Kingdom	8	4	11	13	13	18	13	10	9	24	19	11
Croatia	11	19	25	13	6	18	18	18	21	20	8	-3
Denmark	11	9	7	13	1	1	3	10	9	6	19	8
France	11	9	4	2	1	1	13	18	9	20	8	-3
Romania	11	27	25	6	6	12	3	2	1	1	2	-9
Sweden	11	9	11	13	13	18	3	2	3	6	8	-3
Hungary	16	13	14	13	13	1	13	18	21	6	19	3
Lithuania	16	19	18	6	13	1	3	2	3	6	8	-8
Luxembourg	16	15	7	6	6	12	18	18	1	6	8	-8
Malta	16	19	18	6	13	18	18	10	9	6	8	-8
Portugal	16	13	14	24	20	25	26	24	24	20	19	3
Slovakia	16	15	18	22	20	23	13	10	3	4	4	-12
Bulgaria	22	15	18	24	20	12	3	10	9	6	8	-14
Cyprus	22	19	25	24	20	23	26	28	28	27	28	6
Estonia	22	15	14	22	20	18	3	2	9	6	19	-3
Ireland	25	19	14	28	27	28	28	24	24	28	27	2
Latvia	25	19	18	13	20	12	3	2	9	6	8	-17
Greece	27	19	18	13	20	25	24	24	24	24	26	-1
Spain	28	28	25	24	27	25	24	24	24	24	19	-9

3.8 Signals Approach and an MIP composite metric

We combine the signals approach of empirical studies (**Box 2**) and the composite indicator methodology to provide a new method for evaluating the performance of the MIP Scoreboard. Such method has been proposed by the empirical study by Christensen and Li (2014) to capture the fragility of the economy prior to a financial stress event most efficiently. ESRB (2017) results on the newly established financial crisis database also confirm that multivariate methods can improve upon univariate signalling models.

Crisis events were defined on the basis of the cyclical GDP gap similarly to earlier studies (Domonkos, et al. 2017; Szalai-Csortos, 2013) as follows. The real GDP of each country has been filtered by the HP-filter. To calculate the GDP gap, the difference between the basic time series and trend has been taken. We determined the threshold of the critical difference at minus 2 per cent, as proposed by the studies referred in this report.

We defined a composite measure as the sum of the red flags (or signals) based on official thresholds. We set 3 as a starting value for the threshold of the composite measure. (Reminder: on average 4 indicators were flagged in member states during the run-up and aftermath of the 2008-2009 crisis.) The number of red flags were incorporated in the Commission analysis, without being the only or main determinant of the AMR outcomes (European Commission, 2016). However, the thresholds for the total number of red flags have never been communicated yet by the European Commission.

According to the Usefulness metrics the nominal unit labour cost performed best as forecasting indicator for crisis events (U =0.21). Furthermore, the current account and

net international investment position were also a relatively good indicators (U =0.12) compared to other MIP indicators, on average performing as weak indicators (average U =0.02).

Importantly, the simple composite of red flags performed second best (U =0.14) in the baseline scenario shown in **Table 1**. (forecast horizon = 4 Y, threshold for the number of red flags, >3).Taking into account that decisions can not be based on sole indicators, using the *second best* composite measure could be an option to be considered by decision makers.

Table 9. Summary of the signals approach metrics for individual indicators and composite (forecast horizon = 4 Y, threshold for the number of red flags ;> 3)

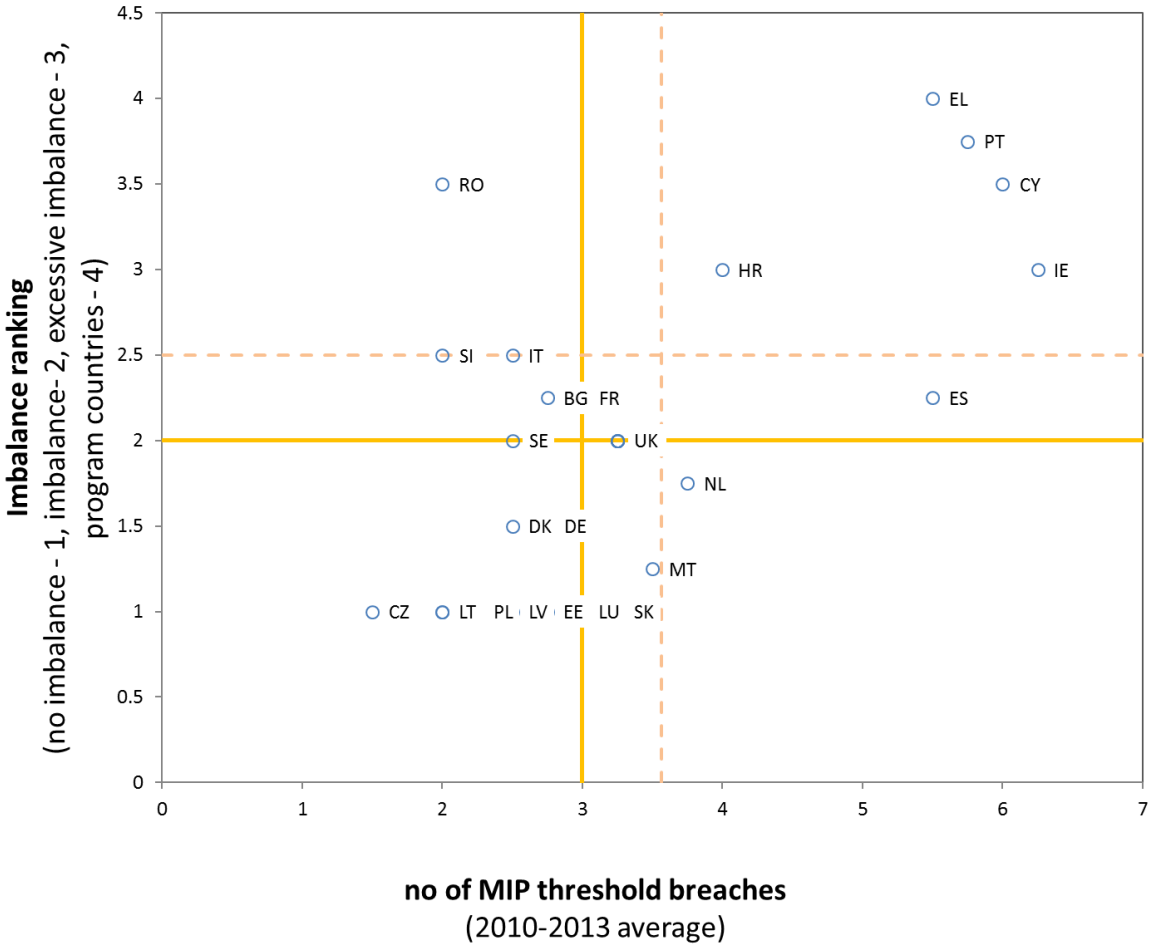
	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities	COMPOSITE (No of red flags >3
A -CORRECT SIGNALS (CRISIS OCCURS AS IT IS FORECASTED)	65	62	25	37	58	28	26	44	30	17	29	**66**
B - wrong signal (NO crisis occurs, but forecasted)	42	40	18	38	17	26	24	39	45	23	22	**40**
C - wrong signal (crisis occurs but NOT forecasted)	32	35	72	60	39	69	71	53	67	80	68	**31**
D - CORRECT SIGNAL (CRISIS NOT OCCURS & NOT FORECASTED)	57	59	81	61	82	73	75	60	54	76	77	**59**
Correct forecasts (A+D)/(A+B+C+D)	62%	62%	54%	50%	71%	52%	52%	53%	43%	47%	54%	**64%**
Share of correct crisis signals (A/(A+C)	67%	64%	26%	38%	60%	29%	27%	45%	31%	18%	30%	**68%**
type I error (C/(A+C))	33%	36%	74%	62%	40%	71%	73%	55%	69%	82%	70%	**32%**
type II error (B/(B+D))	42%	40%	18%	38%	17%	26%	24%	39%	45%	23%	22%	**40%**
NSR - Noise to signal ratio (B/(B+D)/A/)A+C)	0.63	0.63	0.71	1.01	0.29	0.91	0.90	0.87	1.47	1.33	0.74	**0.59**
Usefulness (min[θ;1-θ]-θC/)A+C)-(1-θ)B/(B+D)	0.12	0.12	0.04	0.00	0.21	0.01	0.01	0.03	-0.07	-0.03	0.04	**0.14**

3.9 Linking MIP Categories to the Scoreboard

There exists only an indirect link between the MIP Scoreboard (first step of the MIP procedure) and MIP Categorisation (last step). The scatter plot of the imbalance ranking and the number of MIP threshold breaches shows, however, that the association is positive as expected, and many program countries could be identified on the bases of threshold breaches (**Figure 6**.).

We also ran logistic regressions between imbalance rankings and MIP threshold breaches to test statistically which of the scoreboard variables have an impact on the final MIP categorisation. DG ECFIN estimated similar regressions, however the MIP indicators were grouped into one indicator, and the total effect of this grouped indicator have been estimated, not individual effects by all MIP Indicators. Also, the MIP procedure has been regressed on Country-Specific Recommendations (CSR) progress indicator and also synthetic indicator of economic conditions, in flows and in levels, showing the influence of the latter. It must be also remarked, that the MIP dataset is 'backward looking' and the decisions on imbalance takes into account latest information, economic forecasts as well. It is a question, however, whether the scoreboard could be updated and published more frequently to increase transparency and help decision makers and the public find better solutions. The MIP Scoreboard is a key element of country categorization because macroeconomic imbalance shows strong positive autocorrelation and statistical facts are more certain than forecasts.

Figure 6. Imbalance ranking and the number of MIP threshold breaches (2010-2013 averages)*



*Yellow lines indicate the median values and dotted yellow lines the 75% percentiles.

The independent variable of the regressions was an ordinary variable of MIP Categorisation (1. No imbalances, 2. Imbalances, 3. Excessive imbalances, 4. Program countries) and the explanatory variables consisted of either the breach of thresholds (red flags) or the absolute distance to threshold (in % of the threshold, if the threshold was breached) or the min max normalized variables in our specification.

To test whether alternative MIP indicator thresholds do exist in line with our hypothesis (discussed in **Section 2.2.1**) at the other side of the indicator distributions, we used dummy variables. Such dummies have been created for the net international investment position, export market shares, nominal unit labour costs, real house prices, private sector credit flow and unemployment taking the value of 1 if the underlying indicator was above/below the alternative threshold (1st or 3rd quartile of the indicator on the other side of distribution). Similar dummies have not been used for the government sector debt, private sector debt and for the total financial sector liabilities, as alternative thresholds, because in case of these indicators these alternative thresholds would not have been effective for most countries in our post-crisis sample.

The results show that only few of the MIP indicators have a significant impact on the MIP imbalance categorisation at standard confidence levels. Only nominal unit labour costs turned out to be significant in all specifications (red flags and distance to threshold, respectively), and in some specifications export market shares and government debt. The results are, in general, in line with the results of Boysen-Hogrefe et al. (2015) showing the significant impact of export market shares, private sector debt and government debt

on IDR classification (**Table 1**). Most of the coefficient signs are in line with the logic of the scoreboard, even if the coefficients are not significant. Breaches of thresholds increase the probability of worse MIP categorisation for stock variables, unemployment, but surprisingly real house prices have a negative effect. This may confirm the argumentation that not only too fast but too slow real house price growth could be problematic.

Furthermore, the alternative threshold for the private credit flow had a significant negative sign, suggesting the existence of an alternative implicit threshold. In other words, the MIP categorisation was worse for those Member States, where credit to private sector grew less than the threshold set at the 1st quartile of the sample. This may mean that the speed of deleveraging in the financial sector was somehow taken into account during the second and third step of the MIP, in the Alert Mechanism Report (AMR) and in In-depth Review (IdR), respectively. In particularly, because the monitoring and correction was perhaps a more important goal of the MIP in the post-crisis period then the early warning goal. However, this evidence confirms our suggestion based on theoretical concepts that the one sided official thresholds could be reconsidered in certain cases. Especially, because the indicators based on official thresholds turned out to be insignificant in many cases.

After comparing values of scoreboard variables to thresholds, possible interactions could be also taken into account during the European Commission's deliberation in the Alert Mechanism Report. To test whether the simultaneous influence of two indicators is not additive, interaction terms have been also tested. Some combinations of macroeconomic challenges were more frequent than others (European Commission, 2016), which has influenced the selection of indicator pairs for interaction tests. The following interactions have been tested: current account and general government debt, private debt and general government debt, export market share and nominal unit labour cost, real house prices and private sector credit flow, total financial sector liabilities and net international investment position, though only the current account and general government debt interaction term had a significant coefficient. One explanation could be the 'twin deficit theory'[5]. Twin deficits are common situations, when the general government budget and current account worsen in the same time. Although budget deficit is not amongst the MIP indicators, it is one of the key drivers of general government debt in the short run.

Table 10. Results of logistic regressions (dependent variable: MIP Imbalance categories)

Explanatory variables		No of redflags			ABS Distance to threshold			Min Max		
		Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Lag. dep. Var.	L(MIP_class)	3.4	6.04	0.00	3.23	5.77	0.00	3.53	5.66	0.00
MIP official thresholds	Current account balance	-.72	-0.49	0.62	0.07	0.02	0.98	5.53	1.24	0.22
	Net international investment position	-.46	-0.44	0.66	0.38	0.70	0.49	-4.05	-1.12	0.26
	Real effective exchange rate	-.02	-0.03	0.98	-2.61	-1.82	0.07	-2.57	-0.53	0.60
	Export market shares	.81	0.77	0.44	0.70	2.15	0.03	-9.62	-2.15	0.03
	Nominal unit labour cost	2.49	2.56	0.01	5.22	2.15	0.03	29.94	3.47	0.00
	House price index, deflated	-2.32	-1.40	0.16	-1.11	-0.66	0.51	-13.18	-1.47	0.14
	Private sector credit flow	.56	0.32	0.75	0.09	0.04	0.97	4.67	0.91	0.36
	Private sector debt	.83	0.55	0.58	0.09	0.07	0.94	1.02	0.40	0.69
	General government sector debt	1.48	1.23	0.22	1.69	1.66	0.10	6.58	2.37	0.02
	Unemployment rate	.62	0.79	0.43	0.52	0.41	0.69	2.90	1.14	0.25
	Total financial sector liabilities	.34	0.19	0.85	0.08	0.02	0.98	0.02	0.00	1.00
Alternative upper/lower threshold	DUMMY (NIIP> 3rd quartile)	-1.87	-1.84	0.07	-0.95	-1.04	0.30	-1.53	-1.23	0.22
	DUMMY (EXPSH> 3rd quartile)	.6	0.49	0.62	0.49	0.44	0.66	3.23	1.90	0.06
	DUMMY (ULC<1st quartile)	-.2	-0.26	0.80	-0.52	-0.60	0.55	1.33	1.29	0.20
	DUMMY (RHOUSEPRICE<1st quartile)	.82	1.12	0.26	0.87	1.23	0.22	-0.24	-0.24	0.81
	DUMMY (PRIVCRDFLOW<1st quartile)	-1.79	-2.13	0.03	-2.21	-2.81	0.01	-2.43	-2.53	0.01
	DUMMY (UNEMP <1st quartile)	-.87	-0.61	0.54	-1.06	-0.72	0.47	-1.36	-0.80	0.43
Interactions	DUMMY (GOVDEBT & CA> thresholds)	3.58	1.96	0.05	3.74	1.69	0.09	3.34	2.32	0.02

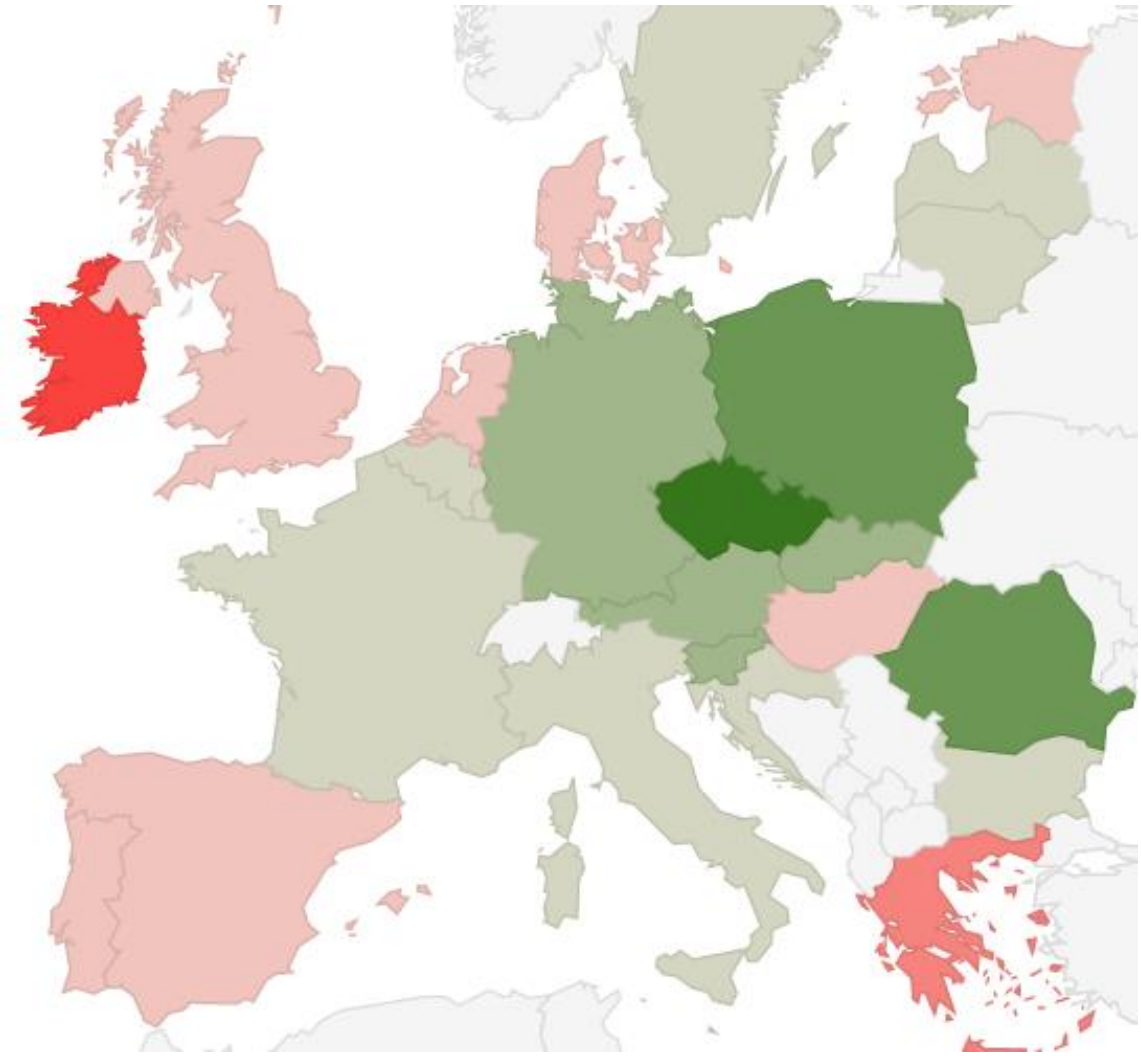
3.10 Visualisation and transparency

The MIP scoreboard has an important communication role (European Commission, 2012). This is the reason, why only a limited number of indicators were integrated in the final Scoreboard. For transparency reasons, the Commission made the scoreboard indicators publicly available on its website. Furthermore, the Commission has taken steps to improve the communication of its MIP-relevant analysis.

[5] Cavalo (2005) argues that higher budget deficit implies in economic theory less national saving, which is the sum of private saving plus the government fiscal balance. By definition, when national saving falls below domestic investment—that is, when a country lacks sufficient saving to finance its investment, and hence borrows from abroad—the current account is in deficit.

The MIP Scoreboard is presented currently as a table, in which threshold breaches are highlighted (**Annex 2**). Both decision makers and the wider public could benefit from improved data visualisation solutions. For example, adjustable mapping tools allowing the simultaneous modification of all dimensions of the dataset (from indicators to countries, time or statistical aggregation methods, etc.) could help to look at the MIP dataset from different angles in an efficient and meaningful way and to make better policy or private decisions. Similar solutions are introduced in practice in many policy fields.

Figure 7. MIP – number of red flags by country (2015)



4 CONCLUSIONS

This report aimed at developing the Macroeconomic Imbalance Procedure and its MIP Scoreboard in line with its principles, so as to make it an even more reliable monitoring tool for decision making and effective communication.

In this report, we argued in favour of two sided thresholds for MIP indicators. Setting thresholds on both sides could be an obvious choice for many flow indicators in the MIP Scoreboard to identify imbalances both ex-ante and ex-post (in accordance with the prevention and correction goals of the MIP). Two sided (upper and lower) thresholds have been already introduced for two MIP indicators: the current account deficit (+6% and -4% compared to the Gross Domestic Product) and for the real effective exchange rate (-/+5% for euro-area countries and **-** /+11% for non-euro-area countries). Also, the European Commission (2012) derived MIP thresholds for many indicators from the observed distribution of indicators and equated the thresholds to lower or upper quartiles. The argumentation to introduce both upper and lower thresholds could be based on theoretical arguments (see **2.2.2**) and on a statistical approach that values in both tails of the distribution should be differentiated. For example, in case of house prices the +6% current official threshold could be interpreted as an early warning (prevention) threshold, while the +10% threshold for unemployment as an ex-post (correction) indicator of fading away crisis and imbalances. Setting two sided thresholds could be an obvious choice for many other indicators in the MIP Scoreboard to identify imbalances both ex-ante and ex-post. For example, a new lower threshold for unemployment rates set below the so-called natural rate may help to identify an excessive boom period and serve as an early-warning indicator. The average unemployment rate in Member States dropped below 7 percent before the financial crisis, close to the natural level, which could have been a signal of overheating. Similar second thresholds could be considered for real house prices or private sector credit flows.

We showed in this paper that each step of the OECD-JRC composite indicator methodology can deliver important insights and can contribute to the development of the MIP Scoreboard. The first two steps have been already taken, because there exists a theoretical framework (see the detailed literature review in European Commission, 2012) and well structured, high quality official data is available in the Eurostat database. In this report, we discuss further steps: treatment of missing data and outliers, multivariate analysis, normalisation, weighting and aggregation, uncertainty analysis and visualisation.

Our outlier analysis identified three MIP indicators as potentially problematic: (i) nominal unit labour cost, (ii) private sector credit flow and (iii) total financial liabilities. We opted for a straightforward and well-known method to treat outliers, called Winzorization.

The practical usage of the MIP Scoreboard might be impeded by the different measurement units and distribution of headline indicators. Therefore, we applied standard normalisation methods together with methods based on the guidance provided by DG ECFIN of the European Commission about the interpretation of the scoreboard (a) min-max normalisation, (b) ranking, (c) red flag analysis, which is a comparison of actual values to the official thresholds, and (d) distance to target metrics (Section **33.5**).

The multivariate analysis showed that the MIP Scoreboard indicators are only weakly collinear within the external and internal imbalance pillars of the MIP Scoreboard and it is unlikely that they share common factors. To investigate, whether the different MIP indicators signal problems in the same time the association of the official MIP threshold breaches was analysed. The Phi coefficient matrix suggests that the MIP scoreboard indicators and thresholds are consistent. Still, the Phi coefficients are very low, although significant in most cases. A practical consequence of moderated association is that if the scoreboard gave usually vague warning signals, e.g. only few but not necessary all or not the majority of indicators gave signals at the same time, then policy makers were more likely to become resistant to act.

We combine the signals approach of empirical studies (Section **33.8**) and the composite indicator methodology to provide a new method for evaluating the performance of the MIP Scoreboard. Such method has been proposed by the empirical study of Christensen and Li (2014) to capture the fragility of the economy prior to a financial stress event most efficiently. According to the Usefulness metrics the nominal unit labour cost performed best as forecasting indicator for crisis events (U =0.21). Furthermore, the current account and net international investment position were also a relatively good indicators (U =0.12) compared to other MIP indicators, on average performing as weak indicators (average U =0.02). Importantly, the simple composite of red flags performed second best (U =0.14) in the baseline scenario. Taking into account that decisions can not be based on sole indicators, using the *second best* composite measure could be an option to be considered by decision makers.

Finally, we ran logistic regressions to test statistically, which of the scoreboard variables may have an impact on the MIP Categorisation, e.g. between the first and last steps of the MIP procedure. The results show that only few of the MIP indicators have a significant impact at standard confidence levels. To test whether alternative MIP indicator thresholds do exist for flow variables in line with our hypothesis (discussed in section **2.2.2**) at the other side of the indicator distributions, we used dummy variables. The results confirm that the alternative threshold for the private credit flow could have already existed as an alternative implicit threshold. To test whether the simultaneous influence of two indicators is not additive, interaction terms have been also used, though only the current account and general government debt interaction term had a significant coefficient, confirming that the risks of "twin-deficit" situations could have been taken into account by the European Commission during the AMR and IdR phases of the MIP procedure.

The MIP Scoreboard is presented currently as a table, in which threshold breaches are highlighted. Both the decision makers and the wider public could probably benefit from increased transparency and improved data visualisation solutions.

Future research could consider how the definition of the crisis event effects on the results of the signals approach. Also, cluster analysis could help to identify groups of countries, and, inside these groups of countries, to see how the indicators can be combined.

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List of abbreviations and definitions

AMR	Alert Mechanism Report
AMRO	ASEAN Macroeconomic Research Office
CA	Current Account
CIs	Composite Indicators
CSR	Country-Specific Recommendations
ECFIN	Directorate-General for Economic and Financial Affairs of the Commission
EA	Euro Area
EC	European Commission
ECA	European Court of Auditors
EMU	Economic and Monetary Union
EU	European Union
EUROSTAT	European Statistical Office
EWS	Early Warning System
GDP	Gross Domestic Product
IDR	In-Depth Review
JRC	Joint Research Centre of the European Commission
MF	International Monetary Fund
MIP	Macroeconomic Imbalance Procedure
NEER	Nominal Effective Exchange Rate
NIIP	Net International Investment Position
NSR	Noise-to-Signal Ratio
REER	Real Effective Exchange Rate
ULC	Unit Labour Cost

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ANNEXES

Annex 1. Descriptive statistics of the MIP Scoreboard Indicators

	Current account balance	Net international investment position	Real effective exchange rate	Export market shares	Nominal unit labour cost	House price index, deflated	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities
Mean	-1.71	-38.00	1.29	4.23	7.89	1.30	7.04	145.11	58.91	9.00	8.71
Median	-1.45	-42.15	0.10	-4.77	6.30	0.60	4.40	126.80	53.50	8.00	5.55
Mode	-0.70	-55.60	1.80	-9.60	10.30	-1.30	3.00	126.40	65.10	6.90	10.20
Standard Deviation	5.91	49.08	7.00	25.37	10.81	10.42	16.34	70.40	34.02	4.00	13.56
Kurtosis	0.02	-0.31	4.17	1.75	10.79	4.92	100.54	1.19	0.84	3.80	13.68
Skewness	-0.33	-0.11	1.33	1.46	2.35	0.89	7.71	1.14	0.82	1.71	2.55
Minimum	-21.00	-208.00	-20.40	-30.80	-21.00	-37.10	-35.20	39.10	3.70	3.70	-17.20
Maximum	11.00	65.20	35.90	95.60	78.50	46.00	223.60	402.30	179.70	26.30	115.70
No of observations	308	308	308	308	308	305	308	308	308	308	308
1st quartile	-5.20	-73.38	-2.50	-12.33	2.80	-4.00	0.28	97.05	37.28	6.40	0.70
3rd quartile	2.25	-4.45	3.50	13.03	10.30	4.70	12.33	185.13	80.20	10.50	13.08

Source: Eurostat, 2016, authors calculations

Annex 2. The MIP Scoreboard 2015

Table 1.1: MIP Scoreboard 2015

	External imbalances and competitiveness					Internal imbalances						Employment indicators[1]		
Year 2015	Current account balance - % of GDP (3 year average)	Net international investment position (% of GDP)	Real effective exchange rate - 42 trading partners, HICP deflator (3 year % change)	Export market share - % of world exports (5 year % change)	Nominal unit labour cost index (2010=100) (3 year % change)	House price index (2010=100), deflated (1 year % change)	Private sector credit flow, consolidated (% of GDP)	Private sector debt, consolidated (% of GDP)	General government gross debt (% of GDP)	Unemployment rate (3 year average)	Total financial sector liabilities, non-consolidated (1 year % change)	Activity rate - % of total population aged 15-64 (3 year change in pp)	Long-term unemployment rate - % of active population aged 15-74 (3 year change in pp)	Youth unemployment rate - % of active population aged 15-24 (3 year change in pp)
Thresholds	-4/6%	-35%	±5% (EA) ±11% (Non-EA)	-6%	9% (EA) 12% (Non-EA)	6%	14%	133%	60%	10%	16.5%	-0.2 pp	0.5 pp	2 pp
BE	-0.2	61.3	-1.2	-11.3	1.5	1.3p	4.5	166.3	105.8	8.5	-1.0	0.7	1.0	2.3
BG	0.6	-60.0	-4.1	12.8	14.9p	1.6bp	-0.3	110.5	26.0	11.2	7.0	2.2	-1.2	-6.5
CZ	0.2	-30.7	-8.0	0.1	0.5	3.9p	0.9	68.6	40.3	6.1	7.7	2.4	-0.6	-6.9
DK	8.8	39.0	-1.5	-8.8	4.9	6.3	-3.3	212.8	40.4	6.6	-2.0	-0.1	-0.4	-3.3
DE	7.5	48.7	-1.4	-2.8	5.7	4.1	3.0	98.9	71.2	4.9	2.8	0.4	-0.4	-0.8
EE	0.9	-40.9	6.4	8.5	14.4	6.8	3.3	116.6	10.1	7.4	8.1	1.9	-3.1	-7.8
IE	4.7*	-208.0*	-5.9	38.3*	-18.1	8.3	-6.7	303.4	78.6	11.3	9.5	0.8	-3.7	-9.5
EL	-1.2	-134.6	-5.5	-20.6	-11.1p	-3.5e	-3.1	126.4	177.4	26.3	15.7	0.3	3.7	-5.5
ES	1.3	-89.9	-2.9	-3.5	-0.7p	3.8	-2.7	154.0	99.8	24.2	-2.1	0.0	0.4	-4.6
FR	-0.7	-16.4	-2.7	-5.4	2.5p	-1.3	4.4	144.3	96.2	10.3	1.8	0.8	0.6	0.3
HR	2.7	-77.7	0.1	-3.5	-5.0	-2.4	-1.3	115.0	86.7	17.0	2.1	2.9	0.1	0.9
IT	1.5	-23.6	-2.2	-8.9	1.5	-2.6p	-1.7	117.0	132.3	12.2	1.7	0.5	1.3	5.0
CY	-4.1	-130.3	-6.2	-16.8	-10.5p	2.9bp	4.4	353.7	107.5	15.7	2.8	0.4	3.2	5.1
LV	-1.8	-62.5	3.1	10.5	16.0	-2.7	0.7	88.8	36.3	10.9	12.2	1.3	-3.3	-12.2
LT	0.9	-44.7	4.0	15.5	11.6	4.6	2.2	55.0	42.7	10.5	6.7	2.3	-2.7	-10.4
LU	5.3	35.8	-0.5	22.9	0.6	6.1	24.2	343.1	22.1	6.1	15.5	1.5b	0.3	-1.4
HU	3.0	-60.8	-6.9	-8.0	3.9	11.6	-3.1	83.9	74.7	8.2	0.4	4.9	-1.9	-10.9
MT	4.3	48.5	-0.2	-8.8	3.9	2.8p	5.4	139.1	64.0	5.9	1.3	4.5	-0.7	-2.3
NL	9.1	63.9	-0.6	-8.3	0.2p	3.6	-1.6p	228.8p	65.1	7.2	3.2p	0.6	1.1	-0.4
AT	2.1	2.9	1.8	-9.6	6.1	3.5	2.1	126.4	85.5	5.6	0.6	0.4	0.5	1.2
PL	-1.3	-62.8	-1.0	9.7	-0.4p	2.8	3.2	79.0	51.1	8.9	2.4	1.6	-1.1	-5.7
PT	0.7	-109.3	-2.8	2.8	0.0e	2.3	-2.3	181.5	129.0	14.4	-1.6	0.0	-0.5	-6.0
RO	-1.0	-51.9	2.7	21.1	0.5p	1.7	0.2	59.1	37.9	6.9	4.1	1.3	0.0	-0.9
SI	5.4	-38.7	0.6	-3.6	-0.6	1.5	-5.1	87.3	83.1	9.6	-3.4	1.4	0.4	-4.3
SK	1.1	-61.0	-0.7	6.7	2.2	5.5	8.2	81.4	52.5	13.0	4.5	1.5	-1.8	-7.5
FI	-1.0	0.6	2.3	-20.5	3.6	-0.4	9.5	155.7	63.6	8.8	1.5	0.6	0.7	3.4
SE	5.0	4.1	-7.9	-9.3	3.6	12.0	6.5	188.6	43.9	7.8	2.3	1.4	0.0	-3.3
UK	-4.8	-14.4	11.3	1.0	1.7	5.7	2.5	157.8	89.1	6.3	-7.8	0.8	-1.1	-6.6

Flags: b: break in time series. e: estimated. p: provisional.

Note: * The level shift is due to relocation to Ireland of balance sheets of large multi-national enterprises and inclusion of corresponding transactions in the Irish BoP and IIP statistics. § See page 2 of the AMR 2016. 2) House price indexe = source NCB of EL. 3) The level of TFSL in Greece is higher than would otherwise have been recorded, due to the improved treatment of banks' holdings of short-term debt securities issued by banks.

Source: European Commission, Eurostat and Directorate General for Economic and Financial Affairs (for Real Effective Exchange Rate), and International Monetary Fund

Source: AMR 2017

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