Has Macroeconomic Imbalance Procedure managed to reduce imbalances and reduce economic crises in EU countries?

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The European Union has suffered a prolonged crisis episode due to the global financial crisis of 2008–2009, followed by an economic crisis and a sovereign debt crisis in various Member States. Robust, pre-crisis economic growth has failed to recover ever since and levels of unemployment have remained high, thus economic performance is struggling to reach pre-crisis levels in what is called periphery countries. Common institutions have been improved through several important changes in terms of fiscal and monetary policies as well, resulting in a preferable, more stable economic structure. To ensure balanced economic growth, the European Commission has launched a monitoring system containing 14 indicators and a corrective operation (Macroeconomic Imbalance Procedure) which aims to reduce economic imbalances in Member States. This tool, complementing the regulations of the Stability and Growth Pact, may help to reduce the evolution of further crises and to establish a more sustainable economic growth rate. However, Member States do not react the same way.

In this study, Macroeconomic Imbalance Scorecard data is examined to establish a connection between imbalances and economic growth. The study investigates whether all 14 indicators have relevance, or whether some indicators could be eliminated due to correlation within the data set. Then it also aims to identify those indicators which have greater relevance to estimate the probability of a crisis, in order to describe which imbalances lead to higher probability of a crisis event in the short term. Fighting these imbalances with the tools of the MIP could safeguard economic growth in the EU. In order to achieve all this, cross-correlation and logistic regression methods are suggested. In the future, having extended time-series database will probably allow the running of even more elaborate statistic examinations and achieving more complex results.

Keywords: economic crisis, eurozone, economic imbalance, recovery

1. Introduction

The global financial crisis of 2008–2009 has had a devastating effect on European economic integration, causing a severe, longer recession than in other developed economic regions, and leading to bigger setbacks in the field of economic growth and unemployment (Figure 1). There are plenty of explanations of why the EU's recession became more severe (for details, see Végh 2019), ranging from Optimum Currency Area theories, through institutional weaknesses, to fiscal and monetary crisis management failures. What is widely regarded as a fact is that the group of periphery countries (the terminology of which has been widely accepted in the economics literature as a distinction between core and periphery countries, see e.g. Mangone et al. 2016, Pelle et al. 2019), whose competitiveness weakened and current account problems were aggravated during the decade preceding the eruption of the crisis, became interconnected in terms of bond market risks and, at one point, the threat of

government defaults became imminent. Fortunately, only two Member States (henceforth: MSs) (Greece in 2012, and Cyprus in 2013) suffered a direct default, but several other MSs (namely, Portugal, Spain, and Ireland – therefore often labelled as PIGS countries) had to undergo international financial aid programs disposed of by the European Stability Mechanism and its predecessor institutions. Meanwhile, in terms of monetary policy, the European Central Bank also had to take an active role in crisis management: with several well-targeted programs (such as the Securities Market Program and the Outright Monetary Transactions) it placed direct pressure on secondary bond markets in order to lower default risk and to ensure the financing of MSs in peril. In the meantime, common EU institutions went through a gradual development: Stability and Growth Pact has been reformed in several steps (Six Pack regulation in 2011, Two Pack in 2013 and Fiscal Compact also in 2013), followed by the gradual formation of the Banking Union, initiated in 2012.

Figure 1 GDP (constant prices, trillion USD – left axis, thick) and unemployment (percentage of active population – right axis, dotted) in advanced economic regions, 2006–2016
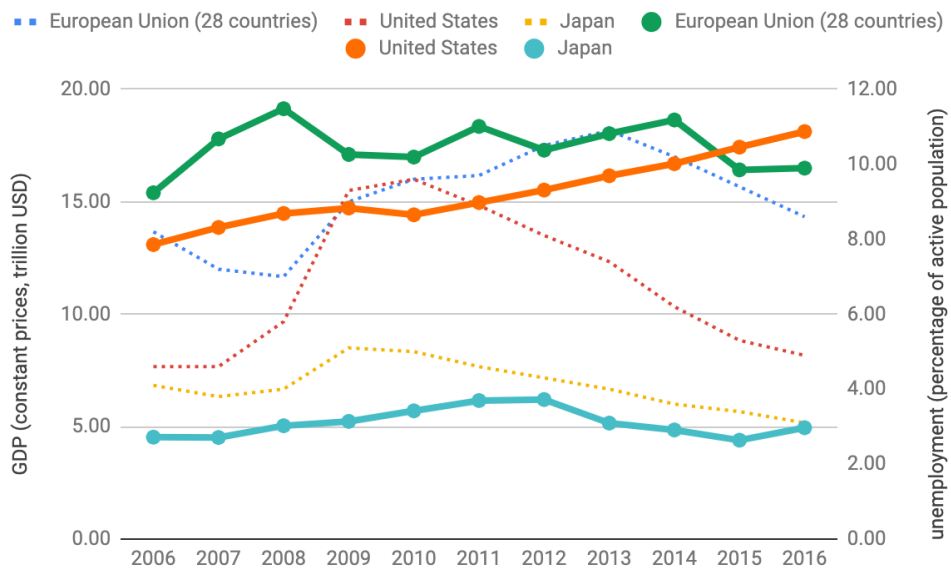
Source: own edition based on Eurostat (2019) and World Bank (2019)

In this study, I examine trends of macroeconomic imbalances, which is a new concept brought to life by the Six Pack regulation, aiming to identify macroeconomic disturbances. I investigate the possibility to estimate the probability of whether imbalance phenomena led to the evolution of further economic crises. First, I aim to reduce the number of indicators using cross-correlation method within the data set, then try to identify the relevant imbalance indicators which estimate the probability

of crisis events. In order to achieve that, I describe macroeconomic imbalances, review their background and discover their limitations, and I also revise some relevant studies aiming to measure imbalances and their effect. Finally, I present my own statistical analysis using logistic regression on a time series database consisting of each currently known member state (EU-28), based on previous achievements. I expect to reinforce the role of macroeconomic imbalance indicators in the prediction of economic crises within the European economic integration.

2. New era of economic governance

The recent reform package of the Stability and Growth Pact called Six Pack was ratified and accepted in December 2011, following a full year of negotiations. The legislation consisting of 6 fiscal rules was created in order to increase MSs' fiscal discipline without further modification of the existing SGP regulations. Furthermore, Six Pack introduces a macroeconomic prediction and monitoring system called Macroeconomic Imbalance Procedure (henceforth: MIP), which enables common institutions to monitor MSs' fiscal discipline and their other macroeconomic tendencies. The press conference (EC 2011A) introducing the Pack's five regulations and one directive emphasizes that in December 2011, 23 of 27 MSs were sanctioned by Excessive Deficit Procedure (henceforth: EDP), which definitely justifies the reinforcement of fiscal discipline. After the ratification of the Six Pack legislation, immediate sanctions come into force in case an MS does not implement measures to improve fiscal position, in case of excessive deficit, or in case of not implementing ECOFIN recommendations. Policy makers believed that new sanctions would result in more respect towards fiscal discipline regulations: volumes of these sanctions are assessed jointly by the Commission and the ECOFIN, and they come into force automatically, except due to a contrary majority vote of MSs. Budgetary deficit rules are followed by regulation concerning public debt: the new rules render EDP automatic if a government's debt volume exceeding 60% of GDP does not decrease by 1/20 of the surplus' volume per year (EC 2011A). Regarding the fact that the majority of MSs were under EDP by the time Six Pack was accepted, this implies a severe, prompt deleveraging process and widespread fiscal consolidation to most MSs, immediately blocking fiscal stimulus programs in the whole economic integration (Végh 2019). However, this viewpoint has been widely criticized by theoretical economists because the calming and stabilizing effect of the debt brake rule is not proven to be more significant than the lack of government interventions' destabilizing effect on bond markets.

Six Pack's innovations linked to the preventive arm of SGP are mostly concerning the system of macroeconomic imbalances. The preceding years clearly showed that not only unstable fiscal position can threaten the stability of the economic integration, but other imbalances as well. In order to increase fiscal discipline, Six Pack introduces automatic barriers to maximize expansion of government spending in countries not achieving their medium-term objectives; moreover, the regulation

establishes the maximized possible fine under EDP at a value of 0.2% of the MSs' GDP. This fine can be imposed after continuous disregard of necessary budgetary corrections, first as a non-interest-bearing deposit, later converting into an interest-bearing fine. In the field of macroeconomic imbalances, the regulation also introduces a new procedure, called Excessive Imbalance Procedure (henceforth: EIP) (EC 2011B). In addition, SGP's preventive arms were rendered as part of the European Semester to ensure the European Commission's (henceforth: EC) ability to monitor interconnected effects of MSs' budgets. This way, the EC can articulate direct recommendations concerning MSs' budgets (through Stability and Convergence Reports), which is a key innovation of the reform package. The corrective arms of the SGP also became stricter: EDP was rendered automatic in case of budget deficit exceeding 3%. In case any MSs' budget deficit is regarded as excessive, ECOFIN is entitled to formulate recommendations, deadlines to the desired results and also possible fines (Holler–Reiss 2011).

The aim of EIP is that economic phenomena causing disturbance and instability among MSs can be identified by the Commission and ECOFIN in due time, in order to launch preventive measures. These undesired imbalances can take various forms such as a sudden increase of real estate prices, current account deficits or surpluses, or chronic indebtedness of the private sector (for the indicator scoreboard, see Table 1).[1] In practice, all this takes place in a way that the corrective arm of the SGP can be activated if common institutions launch EIP against an MS. In these cases, EC obliges the MS at issue to present a blueprint of countermeasures. In the case of it being eligible, this blueprint is accepted by the Commission with the following logic: not adhering to the blueprint will entail a smaller amount of non-interest-bearing deposit as fine (maximized in 0.1% of MS's GDP), which can be later converted into an interest-bearing fine.

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[1] In some cases, different thresholds were established for non-Eurozone MSs. In regard of ongoing development of economic relations, the set of indicators and the thresholds can be changed in the future, or even the volume of indicators can be increased.

Table 1 List of MIP indicators and the indicative thresholds (MIP scoreboard)

Type	Indicator	Threshold
external imbalances and competitiveness	3-year average of the current account balance as a percentage of GDP (CAB)	6% and –4%
	net international investment position as a percentage of GDP (NIIP)	–35%
	5-year percent change of export market shares measured in values (EMS)	–6%
	3-year percent change in nominal unit labor cost (NULC)	9% for euro area countries and +12% for non-euro area countries
	3-year percent change in real effective exchange rates (REER)	–/+5% for euro area countries and –/+11% for non-euro area countries
internal imbalances	private sector debt (consolidated) as a percentage of GDP (PSD)	133%
	private sector credit flow (consolidated) as a percentage of GDP (PSCF)	15%
	year-on-year percentage change in deflated house prices (HIP)	6%
	public sector debt as a percentage of GDP (GGD)	60%
	year-on-year percent change in total financial liabilities of the financial sector (TFSL)	16.5%
social indicators	3-year average of the unemployment rate (UR)	10%
	3-year change of the activity rate (AR)	–0.2 pp
	3-year change of the long-term unemployment rate (LTUR)	0.5 pp
	3-year change of the youth unemployment rate (YUR)	2 pp

Source: author's creation based on EC (2011B)

3. A critical approach to MIP

There are various theoretical and practical concerns in relation to the development of economic governance which need to be answered by the EU institutions. While it can be observed that the monitoring of MSs' macroeconomically risky performance is based on an increasingly detailed and specified set of indicators, the complexity of the detailed rules eventually makes the economic performance of the MSs less transparent (Kiss 2010). Therefore, MSs' political actors are less accountable to their voters and to the public. In addition, the behavior of compliance with the numerical limits imposed by the common institutions does not fundamentally reflect fiscal compliance habits and practices of MSs. In political cultures prone to opportunism, automatic tracking of numerical fiscal rules (such as complying with MIP regulations) can occur at the expense of other, unregulated, but important and practical indicators (Farkas 2012, Bánfi 2018); other factors determining long-term competitiveness (such as education, health, or digital literacy) may easily suffer damage in such cases (Domonkos et al. 2017). As a result, in multiple cases, competitive disadvantages will be revealed only in the coming decades, mostly in the fields of absence of investment and growing current account deficit. In other, less opportunistic, rule-abiding political cultures, respect of fiscal discipline standards can also be achieved by respecting competitiveness indicators as well. In other words, indicator-based standards do not reflect the qualitative indicators of governance, and the time-inconsistency problem of economic policy-making may push short-term interests of a non-responsible political elite forward. As a result, we can conclude that the culture of numerical rule-following does not serve the objectives of cohesion policy as a common policy since it does not directly contribute to real convergence between MSs. The EU institutions should therefore – in addition to quantitative indicators – introduce qualitative analysis and monitoring of structural reforms in order to achieve a greater emphasis on convergence objectives (Halmai 2015, Kengyel 2016, Boros 2017). However, this may prove impossible without giving up additional fields of sovereignty at the MS level or by ceasing asymmetric information-based demagogic political culture (Halmai 2018). It can also be stated that one MS's fiscal discipline is fundamentally dependent on the internal commitment of its political elite while the evolution of the common fiscal and monetary rules reveals the heterogeneity of this commitment (Csaba 2018).

The definite advantages of the new economic governance practices are that the 'one-size-fits-all' approach is getting more distant (though it does prescribe strong numerical constraints), and the implementation and suspension of imbalance procedures is now a multi-staged and sophisticated process, with the participation of the MSs and the common institutions. 'One-size-fits-all' crisis management was one of the frequent criticisms concerning EU crisis management after the eruption of the global economic crisis that began in 2008 (Blyth 2013, Győrffy 2013, Pisani–Ferry 2014), which set similar structural reforms as a condition of financial assistance, disregarding economic, institutional, infrastructural, and cultural characteristics of the specific MSs. The process of adopting reform packages was difficult in many cases

(e.g. Greece or Portugal) and reforms only moderately gained political legitimacy or social support. Although MIP allows for a much more sophisticated approach to fiscal discipline, social support of these reforms still remains questionable. However, the Fiscal Compact debt brake rules continue to operate under the 'one-size-fits-all' principle, i.e. they require a common debt relief process for over-indebted MSs, thus losing leeway for dealing with their MS-specific economic issues (Kertész 2014).

Another aspect is that, although the 'no-bailout-clause' is the primary guarantee of MSs' fiscal discipline, in a default situation, EU-level financial assistance institutions such as the European Stability Mechanism significantly expand the fiscal opportunities of MSs (be it due to their own irresponsibility or for reasons beyond their control). However, applying for financial assistance requires a partial suspension of economic sovereignty, which may reduce the tendency to fiscal indiscipline. However, the first historic attempt to overcome the EDP in 2005 by loosening its sanctions was driven by the MSs with the most economic power (Germany and France) while that series of events presents a worrying precedent (Authers 2013). The power of regulation to enforce fiscal discipline can be dealt with by a similar, loosening legislative process. On the other hand, the slow, deliberate rule-making procedure provides an opportunity to incorporate debates, experiences, and theoretical considerations on this topic in the development of the fiscal discipline regulatory area.

4. How to measure macroeconomic imbalances?

Measuring macroeconomic imbalances and launching procedures based on them implies a new era in terms of economic coordination among the MSs of the EU, even though the effectiveness of these efforts can be questioned. There are several methods to measure MSs' aggregated position based on macroeconomic imbalances, also linking imbalance indicators and indicators of economic growth. In this section, three methods will be discussed from the wide range of economic literature. First, Csortos–Szalai (2014) establish an early-warning system for ten Central and Eastern European Countries in order to predict financial crises based on macroeconomic imbalance indicators. They aim to find the strongest set of indicators predicting a crisis by adding together successful predictions, also nuancing with false alarms and misses (by introducing an 'average-noise-to-signal' approach). The authors use annual Eurostat data, defining a crisis event when a country's GDP year-on-year change diverges from the country's trend by the sample's standard deviation (–1.68%) but they use only 6 macroeconomic imbalance indicators with standardization by 'gap measures' (thus examining Credit-to-GDP gap, Credit growth gap, Investment gap, Real exchange rate gap, Capital flows gap, Global variable gap). They also measure the strength of the predictions on three-time horizons (1 year, 2 years and 3 years). Their key findings are that (1) prediction indicators are crucial to preventing the build-up of significant imbalances, (2) largest downturns are preceded by credit boom, investment boom and severe capital flows as well, and (3) the gap of the global variable, the real exchange

rate gap and the capital flow gap were proven the most efficient predictors. The authors conclude by stating that these prediction indicators can be a powerful tool for central banks. Since the European Commission is also aiming to improve the MIP set of indicators further, this type of analyses has great importance.

Another article (Domonkos et al. 2017) provides a slightly different approach to investigating the effects of imbalances: first, they did not use all 14 MIP indicators either but applied autocorrelation calculations to reduce the number of relevant indicators from 14 to 11. The authors here also defined crisis events in a simpler way, running the tests when year-on-year GDP change was lower than –2.5%, –2% and –1.5% indicating an MS is suffering an economic crisis. Moreover, they also used annual data, and ran the calculations on the same time horizon as Csortos and Szalai (2014) (i.e. 1, 2 and 3 years), also using linear regression to show the connection between the variables. However, Domonkos et al. (2017) introduced a factor analysis to create complex indicators predicting the crisis with the easier explanation. The best descriptive factors were named 'Labour–Capital Nexus', 'Competitiveness and Catch-up Effect' and 'Real Estate Bubble', pointing out that factor analysis can further simplify the possible prediction of a crisis event. The authors also emphasize that such early warning systems need further research because false signals (be they positive or negative) can imply great societal and economic costs for MSs, possibly also harming other countries since MSs' economies are greatly interconnected in the EU (Pelle 2018).

Another composite-indicator-creating method was introduced by Bobeva–Atanasov (2017) who define the Integral Macroeconomic Imbalance Indicator (IMII), aiming to compare the level of imbalances between the countries and groups of countries in a simple way. IMII indicator is a standardized average on the imbalances compared to the threshold, observed in a specific MS or group of countries, also based on annual data. This less statistically sophisticated methodology has clear advantages and disadvantages: country data are easily comparable, and also country groups such as hierarchical clusters can be analyzed. On the other hand, measurement of an imbalance is distorted by many factors such as mild and serious imbalances evening out each other, or relative excess of an imbalance value is subject to the original threshold estimation. Despite all this, as the authors clearly point out, an accumulation of imbalances can be clearly shown, peaking 3–4 years after the eruption of the crisis, transforming into a mildly descending tendency. Still not surprisingly, periphery MSs accumulate higher imbalances while countries performing well during the years of crisis obtain lower scores. All these results imply that further observation of imbalances and their effects is necessary, and new models can be developed to interpret crisis procedures better. A summary of the previous methodological approaches is given in Table 2.

Table 2 Methodological summary of presented imbalance measurement methods

publication	Csortos and Szalai (2014)	Domonkos et al. (2017)	Bobeva and Atanasov (2017)
scope of investigation	10 CEE member states	EU28 countries	EU28 countries
number of indicators	6 macroeconomic imbalance indicators with standardization by 'gap measures'	reduced to 11 utilizing autocorrelation methods	all 14 indicators
crisis event defined as	year-on-year GDP change exceeds from the country's trend by the sample's standard deviation (–1.68%)	year-on-year GDP change being lower than –2.5%, –2% and –1.5%	year-on-year GDP change below zero
methodology	'average-noise-to-signal' approach	factor analysis (creating 3 compound factors) and linear regression	compound indicator (Integral Macroeconomic Imbalance Indicator, IMII) based on standardized means of imbalance indicators
time horizon	1 year, 2 years and 3 years	1 year, 2 years and 3 years	none

Source: author's own creation

5. Statistical analysis

In this section, my aim is to develop the aforementioned methods further, in a way that utilizes the advantages of previously discussed imbalance measurement approaches. To begin with, I make a comparison between the two imbalance procedures (EDP and MIP) by comparing the results. Since measuring the effectiveness of these procedures would probably be overambitious, we examine MIP scoreboard further: at first, I aim to reduce the number of necessary indicators to have a more accessible way to measure MSs imbalance performance, then we carry on with the observation of which indicators have the strongest meaning in terms of estimating the probability of economic crises. I will present results of a logistic regression model on a time series database of each currently known member states (EU-28), to have a clearer view on the usefulness and effectiveness of MIP indicators.

5.1. Comparison between financial discipline procedures

In order to examine fiscal discipline procedures, it is worth comparing the lessons of EDP and MIP. Analyzing the two procedures, it is obvious to try to establish a pattern of fiscal discipline (if it can be identified), for certain countries or groups of countries. Since EDPs became widespread in 2010 (striking 25 MSs out of 27), it is difficult to deduce any conclusion on MSs' behavior concerning fiscal discipline from this indicator. Thus, on the one hand, the number of years spent by a specific MS under EDP between 2002 and 2018 can be defined as a relevant indicator, such as the number of years spent under the EDP before the crisis (from 2002 to 2007). However, both indicators should be interpreted correctly, proportionately to the number of years spent in EU membership. Examining these indicators, we find that, concerning the relative time spent under the EDP, among the worst performing countries we find MSs from the core countries (e.g. France which was 15 years under EDP out of the 17 years since 2002, with a 'relative time spent under EDP' ratio of 88.24%), recently joined countries (such as Croatia and Poland, with 83.88% and 80% ratios, respectively) and countries from the periphery (e.g. Greece or Portugal, under EDP for 14 years and 13 years, expressed as a ratio of 82.35% and 76.47%, respectively). During the entire time period (2002–2018), no EDP was initiated against Estonia or Sweden, and only one against Luxembourg, in 2010, which was resolved within a year. A more relevant indicator of fiscal discipline may be the relative time spent under EDP in the pre-crisis time period (2002–2007): nevertheless here, among the worst performers, we also find core MSs (Germany) and newcomers (Poland, Malta, Hungary and Slovakia). Among the MSs unaffected by the EDP in this period, we can find peripheral countries (Spain and Ireland), core countries (Austria, Belgium, Denmark, Finland, Luxembourg, and Sweden), as well as new entrants (Slovenia, Czech Republic, Latvia, Lithuania, and Estonia). So, based on this data, it is hard to establish a trivial pattern of fiscal discipline along aforementioned country groups. However, the data can be examined further.

The macroeconomic imbalance indicators date from 2011 and the procedures indicating imbalances or excessive imbalances naturally reflect the lessons of the Eurozone crisis phenomena. Even though no strict EIP has been launched against any of the MSs up to the present, during the seven years' period of 2012 to 2018, some imbalances have been registered in 9 MSs: the Eurozone periphery countries, and Bulgaria, France and Sweden in addition. Only 8 MSs did not experience any imbalance in this time period; these countries are partially core countries (e.g. Austria and Luxembourg), and partially recently joined Central and Eastern European countries (e.g. Czech Republic, and Estonia). However, by limiting the investigation on excessive imbalances, the overall picture is more subtle: we can see from the examination of the figures that there are persistent excessive imbalances mostly in the periphery countries (with the exception of Ireland and Spain where, within 1 or 2 years, the excessive imbalances were resolved). Excessive imbalances within the core countries have only endured in France and for only 3 years. The Commission has a direct influence on the economic policies of the MSs rescued by the ESM's assistance programs; however, as the data show, imbalances could persist in the long run.

To progress further, we can compare the relative time spent under EDP and the relative time spent with macroeconomic imbalances in all the MSs concerned. If we spot these phenomena on a scatter plot (Figure 2), a trend line can be drawn although with high variance and weak correlation. Nevertheless, the data suggests that MSs where no imbalances occurred in the MIP procedures have been affected by an EDP of only 36.81% on average. In the case of MSs where some imbalances occurred over the seven-year period, this ratio is 54.91%. When examining excessive imbalances, the difference is even more striking: while MSs not subject to such a procedure (a total of 17) spent an average of 42.17% of their EU membership in the EDP process while for MSs experiencing excessive imbalances this ratio will rise to an average of 61.44%.

*Figure 2* Relative occurrence of imbalances and relative time spent under EDP
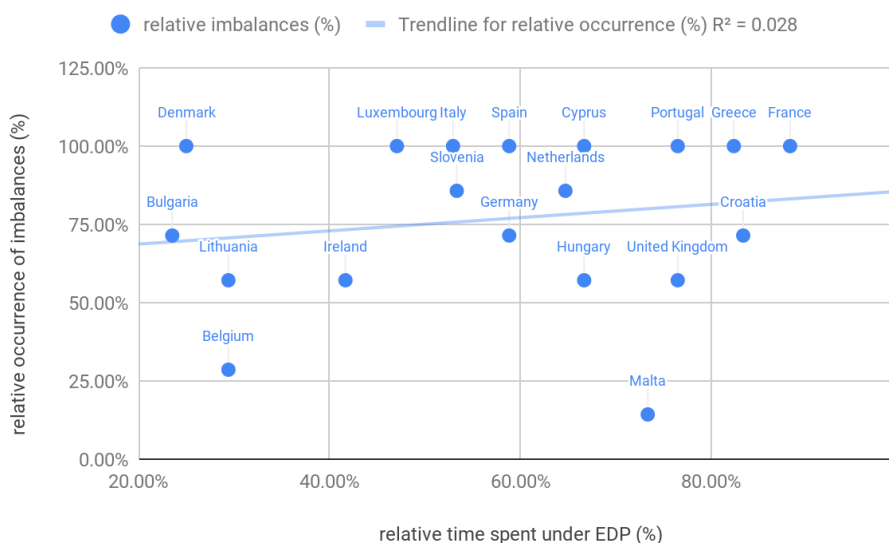
Source: own calculations based on EC (2019)

The above figures suggest that there is a slight overlap between countries sanctioned by EDP and the MIP. This can be interpreted such that the two procedures mainly sanction similar countries, i.e. the disciplinary effect of economic governance – although the years of crisis have had a significant impact – can be considered at least half-sided. However, it can be highlighted that the Commission is now in a better position to monitor macroeconomic imbalances and influence MSs' budgets with the aid of the European Semester and the ESM than before 2012. Nevertheless, this only nuances the fact that there is an overlap between pre-crisis and post-crisis disciplinary behavior, which shows that fiscal discipline primarily remains a matter for MSs' willingness (see also Végh 2019). All this implies that the importance of deficit and imbalance procedures should not be overestimated; MS governments and central banks should improve to recognize and handle their own imbalances in order to prevent future crises.

5.2. Elimination of correlating MIP indicators

Before measuring MIP data, first I examine whether all 14 indicators are relevant in the field of our investigation. To this end, I observed imbalance data for all 28 MSs between 2002 and 2017, using Pearson's correlation in order to identify any kind of (positive or negative) correlation between the variables in all 16 data sets. To describe the results: I have found 179 correlating indicator pairs within the complete data set at a 5% significance level (and a total of 98 correlating pairs at a 1% significance level). I have presented the most often correlating indicator pairs on a scatter plot, as shown in Figure 3. Not surprisingly, indicators related to unemployment show significant correlation in many cases, meaning that the various unemployment indicators (as described in Table 1) change similarly. Nominal unit labor cost also shows significant correlation with the previously mentioned unemployment indicators, which makes sense from an economic point of view: rising unemployment often coincides with decreasing labor costs. The indicator of net international investment position is also frequently observed among the correlation pairs (explained typically by current account balance, which is also a logical deduction). As a result of these observations, to progress further, we decided to omit 4 indicators from the data set: net international investment position (NIIP), Long-term unemployment rate (LTUR), Youth unemployment rate (YUR), and Nominal unit labor cost (NULC). By this step, we can focus on only 10 indicators and construct a better regression model.

Figure 3 Correlating MIP indicator pairs (Pearson-correlation) (number, 2002–2017)
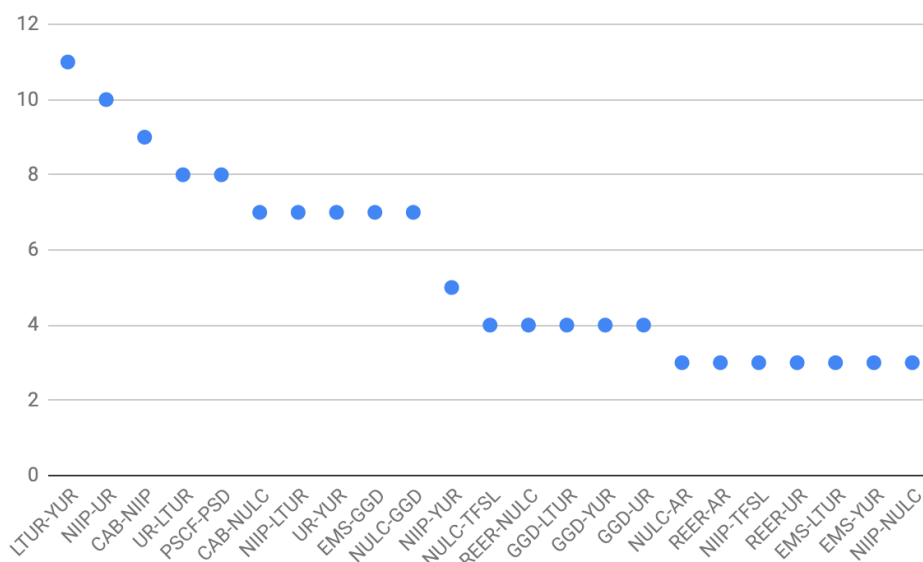
Source: own calculations based on Eurostat (2019). Correlation is significant at the 0.05 level (2-tailed)

5.3. Which indicators estimate the probability of economic crises the best?

To test the predictive power of MIP indicators, I have chosen to set up a binary logistic regression model, which is very useful to estimate the probability of membership of two categorical outcomes. As an independent variable, we have chosen MIP data of the 10 indicators (reduction of relevant number of indicators is similar to the approach of Domonkos et al. 2017), from the time period 2002-2017, which is the broadest dataset currently available. We also used a standardization procedure, similar to Bobeva and Atanasov's (2017) method: when there is no imbalance, the value is set to 0, when there is an imbalance, the value is set by the following equation:

Function 1. Standardization of MIP indicators

$$N_i^j = \frac{I_i^j}{I_{threshold}}$$

Source: author's own creation

where N_i^j is the normalized value of imbalance, I_i^j is the value of MIP indicator and $I_{threshold}$ is the threshold value of the imbalance variable. For the dependent variable, I have chosen a binary indicator whether in that specific year, the GDP output gap was above the sample's current yearly average ('no crisis') or below ('crisis'), similarly to Csortos–Szalai (2014)'s approach. I also claim that it is useful to calculate and compare results for multiple time horizons, namely for t=0 year, 1 year and 2 years, also similarly to Csortos–Szalai (2014) and Domonkos et al. (2017). However, the binary logistic regression approach is completely my own, and this examination brings results in the field of MIP indicators' predictive power forecasting economic crisis. The function I applied is the following

Function 2. Binary logistic regression function of MIP indicators

$$Y_n = \beta_0 + \beta_1 * CAB_n + \beta_2 * REER_n + \beta_3 * EMS_n + \beta_4 * HIP_n + \beta_5 * PSCF_n + \beta_6 * PSD_n + \beta_7 * GGD_n + \beta_8 * UR_n + \beta_9 * TFSL_n + \beta_{10} * AR_n + \varepsilon_n$$

Source: own edition

where Y_n is the outcome, βn is the regression coefficient of the corresponding indicator value (MIP variable) and ε is the error of the estimation[2]. Results are shown in Table 3, where Exp(B) values are beta-coefficients of the regression analysis – the model is capable of estimating the occurrence of crisis events correctly in 72.1% of occasions in the t=0 time horizon. However, it has not shown significant results or

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[2] Stationarity was tested by Augmented Dickey-Fuller (ADF) test, on significance level of 1%. Results have shown that within the database, neither time series is stationary.

successful estimation rates on the other time horizons examined. In the t=0 analysis, beta-coefficients are only to be claimed relevant on a significance level of 5%, therefore multiple indicators have been omitted from the final regression function due to too high significance values, such as real effective exchange rate (REER), public sector debt (PSD) and change in total financial liabilities (TFSL).

Table 3 Results of the binary logistic regression analysis

						Results of logistic regression	
		B	S.E.	Wald	Df	significance	Exp(B)
Step 1a	01CAB	0.093	0.029	10.430	1	0.001	1.097
	03REER	0.017	0.022	0.607	1	0.436	1.017
	04EMS	−0.015	0.008	3.945	1	0.047	0.985
	06HIP	−0.061	0.021	8.627	1	0.003	0.941
	07PSCF	−0.048	0.019	6.183	1	0.013	0.953
	08PSD	0.005	0.002	5.002	1	0.025	1.005
	09GGD	−0.005	0.005	1.354	1	0.244	0.995
	10UR	0.130	0.039	11.054	1	0.001	1.139
	11TFSL	−0.001	0.015	0.002	1	0.964	0.999
	12AR	−0.214	0.099	4.656	1	0.031	0.807
	constant	−1.090	0.552	3.897	1	0.048	0.336

Source: own calculations with SPSS v21

Results of the remaining indicators (as seen in Function 3) can be interpreted in the following way:
- current account balance (CAB) indicator's aggravation of 1 percentage point over the threshold results in the increase of probability of crisis event by 9.7%;
- private sector debt in the ratio of GDP (PSD) indicator's escalation of 1 percentage point over the threshold leads to increase crisis event's probability by 0.5%;
- unemployment rate (UR) indicator's upsurge of 1 percentage point over the threshold results in the increase of probability of crisis event by 13.9%.

Trivially, the model has statistical limitations. Change of export market share (EMS) indicators aggravation of 1 percentage point over the threshold obviously does not decrease the chance of occurrence of a crisis event in an economic sense, but from a statistical point of view it suggests that this indicator – similarly to the other indicators

with beta-coefficients between 0 and 1, such as change in deflated house prices (HIP), private sector credit flow as a percentage of GDP (PSCF) and activity rate (AR) – predicts economic crises with lesser accuracy then indicators with beta coefficients over 1, at least based on the best-fitting regression model. Results can be displayed as show in Function 3. [3]

Function 3 Results of the binary logistic regression analysis

$$P\ (crisis)\ =\ 0.336\ +\ 1.097\ \beta\ _{CAB}\ +\ 0.985\ \beta\ _{EMS}\ +\ 0.941\ \beta\ _{HIP}\ +\ 0.953\ \beta\ _{PSCF}\ +\ 1.005\ \beta\ _{PSD}\ +$$
$$+\ 1.139\ \beta\ _{UR}\ +\ 0.807\beta\ _{AR}$$

Source: own calculations with SPSS v21

6. Summary

The aim of this article has been to bring additional value to the Macroeconomic Imbalance Scorecard in order to predict and prevent future economic crises within the EU, based on historical data in the 2002–2017 time period. To achieve this, first I introduced the economic governance mechanism currently in force in the EU, i.e. the Macroeconomic Imbalances Procedures as a supplement of the Stability and Growth Pact's regulations. Since 2011, the European Commission has been monitoring the progression of 14 specific indicators in each member state in order to predict economic crises, restrain harmful cross-border effects, and propose corrective measures. This complex data set is examined and supervised by the European Commission under the European Semester. The structure of the scoreboard is not fixed in the sense that both the number of indicators and the values of the thresholds are up to debate; however, economic literature examining the effects of these indicators are not at all abundant.

The previous fact led to the urge to examine the existing statistical models with the aim to construct a new one, with the latest time series data. While trying to utilize the results of previous investigations, I came up with a new model, using binary logistic regression to estimate the probability of economic crises in multiple time horizons (t=0 year, 1 year, 2 years). Prior to that, I eliminated 4 indicators due to cross-correlation, and standardized the MIP indicator values, expressing them in proportion of the excess compared to the indicator threshold. I have managed to construct a model with a 72.1% success rate of estimation of crisis events, which highlighted that current account balance (CAB), private sector debt (PSD) and unemployment rate (UR) are the best-fitting indicators to estimate the occurrence of a crisis event (defined as a larger output gap in the current year then the EU-28 country group's average) on the t=0 time horizon (other time horizons did not bring significant results). MS-level and Commission-level economic policy-makers should be urged to focus on these

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indicators in particular; nevertheless, our results also show that other forms of quantitative analysis should be advised as well since fiscal compliance is still mostly based on an MSs' own internal commitment to the fiscal discipline rules. However, further investigations with different methodological approaches should be presented in order to gain a deeper understanding of crisis dynamics within the EU.

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