Effectiveness of fiscal performance in the EU: Contributions of Propensity Score Matching

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Abstract
The financial crisis of 2008-2009 followed by the sovereign debt crisis has heightened the focus on public expenditures and on fiscal rules. The European Union and even more the Economic and Monetary Union, as a singular economic and political space, raise the issues related to the coordination of economic policies and sovereign debt. We propose to evaluate the effect of the national numerical fiscal rules on fiscal performance in the European Union between 2000 and 2013. The cyclically adjusted primary balance is only one tool to measure fiscal discipline. We therefore propose an unprecedented index to mesure the Global Fiscal Performance to capt others elements describing the situation of public finances. We take into account the presence of member countries of the Eurozone. We use the Propensity Score Matching approach which was recently used in Macroeconomic analysis, in particular by Lin and Ye (2007, 2009), Tapsoba (2012), Minea and Tapsoba (2014) and Guerguil et al. (2017). Our main results show that the national numerical fiscal rules adopted in the European Union make it possible to improve fiscal discipline and more largely fiscal performance. We found that depending on you take care the Global Fiscal Performance or only the structural primary budget balance, it is not the same rules that can have a positive effect. But fiscal performance is therefore more effective in countries that have adopted national numerical fiscal rules. The results also show that the Stability Pact is a sufficient rule and does not encourage countries to adopt duplicate or supplementary rules. It can also improve the effect of national rules on the Global Fiscal Performance. Finally, the effect of national numerical fiscal rules in the European Union depends on many structural factors including the strength of these rules.

Keywords
Public debt — Structural balance budget — Fiscal discipline — Fiscal Effectiveness — Stability and Growth Pact — Propensity Score Matching

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Introduction

The financial crisis of 2008-2009 followed by the sovereign debt crisis has heightened the focus on public spending and on fiscal rules. The birth of the Economic and Monetary Union, and its link with Mundell's Theory of Optimal Monetary Zones, largely raised the question of the desirable level of convergence as Jacques Delors pointed out. The prospects for a single Currency made necessary to put in place a fiscal framework at European level. The Stability and Growth Pact (SGP) was born in this context, in 1997. Through this Political Treaty, the Member States undertake to strengthen monitoring and coordination of national fiscal policies to respect the limits of public deficit and debt which are written in the Treaty of Maastrich (1992). Today, the recent speeches from national populism have used the Stability and Growth Pact as an argument against belonging to the Economic and Monetary Union. The rule of 3% on the public deficit and the 60% on the public debt provided for by the Treaty of Masstricht are found in the final version of the Stability and Growth Pact after its reforms of the Six-Pack and the Two-Pack, that followed the 2005 reform. Nevertheless, members

have often deviated from these rules. The sanctions provided by the Stability and Growth Pact have never been applied so Stability and Growth Pact seems to have lost all the credibility necessary for the constitution of an effective fiscal rule as defined by Kopits and Symansky (1998). There are national fiscal rules designed to guarantee healthy public finance and lead to compliance with the Stability and Growth Pact . In this context, it looks inevitable to evaluate the effectiveness of fiscal rules. So, we propose to evaluate the effectiveness of fiscal performance in the European Union between 2000 and 2013. Fiscal discipline is defined as "all ways implemented to ensure sound management of public finances". In this study we consider the establishment of national fiscal rules as a tool of fiscal discipline. Fiscal performance could be defined as all ways implemented to ensure a global sustainable fiscal situation. It's a larger definition that fiscal discipline which is finally a part of fiscal performance. We here also consider that fiscal rules are a tool to conduct a good fiscal performance.

Schwengler (2012) defines a fiscal rule as " a sustainable constraint on fiscal policy under the form of a numerical target on a key aggregate of public finances". Fiscal rules exist in most OECD countries. They do not apply with the same degree of rigor[1], nor the same degree of autonomy of governments submitted to the rules. When the degree of fiscal autonomy is limited (as in the United States), powerful federal mechanisms come to ensure fiscal functions, but this operation is absent in the Eurozone. There is no centralized mechanism for the amortization of economic shocks. Everywhere else there is this federal mechanism for the stabilization of shocks, which justifies our desire to focus on the European Union.

In the typology of fiscal rules, we retain the national numerical fiscal rules. This precise definition excludes Medium-Term Budgetary Frameworks (MTBFs) which do not have the same implementation conditions and time horizon as the numerical fiscal rules. MTBFs occur on longer horizons and can be more easily revised. MTBFs and fiscal rules may be complementary but can not be perfectly comparable because they do not correspond to the same definition. Huart (2011) returns to the definition of the ideal fiscal rule according to Kopits and Symansky (1998) [2], and concludes by explaining that "numerical rules are only effective if they rely on budgetary procedures that make them binding. ". It is also in this perspective that Reuter (2015) focuses on numerical rules to assess the net effect of compliance with the rules on fiscal policy. To avoid confusion, we will also focus on national numerical fiscal rules leaving MTBFs for separate analyzes. Some rules will therefore be excluded from our analysis if they are significantly different from the Kopits and Symanski's (1998) definition of a fiscal rule.

Finally, the numerical rules studied in our analysis are national and do not take into account the sub-national rules. Moreover, the strict definition of the numerical fiscal rules retains the 4 following targets: debt, budget balance, expenditures and revenues. We are therefore interested in the national rules which cover at least the central government and for most of all the public administrations. So we are talking about rules dealing with the public budget balance, the public debt, the public expenses or rules on public revenues.

We first propose to look at whether national numerical fiscal rules can improve the structural primary budget balance. We therefore resume an approach proposed by Tapsoba (2012) applied to developing countries. The structural primary balance is the cyclically adjusted budget balance and net of interest on the debt. It is commonly called " Cyclically Adjusted Primary Balance " (CAPB) and is often used as an indicator of fiscal discipline. But there is no consensus on the method to calculate the output gap (see (Barbier et al., 2018), Mathieu (2013).) Indeed the use of a Hodrick-Prescott filter or the production-function approach are two different methods to approach potential growth. Among Cyclically Adjusted Primary Balance measures using the production-function approach, the elasticity assumptions are very important and may modify the results (see Girouard and André (2005), Fedelino et al (2009), Bouthevillain et al (2001). We are the first to use 3 methods to calculate Cyclically Adjusted Primary Balance to ensure that our results are independent of the chosen method of calculation. In this first step, the effectiveness of fiscal discipline is approached by a structural primary balance improved from one period to another. The use of the Cyclically Adjusted Primary Balance precisely targets changes in the budget balance related to the voluntary behavior of public decision-makers and is therefore a measure of discretionary policy. Cyclically Adjusted Primary Balance is only one part of the effectiveness of fiscal policy. So, discretionary policy is a proxy for fiscal discipline but not for an overall view of public finances situation. We saw, in the Macroeconomic Imbalance Procedure (MIP) Scoreboard, that European Commission strengthened its oversight and is monitoring a broader set of macroeconomic aggregates to capture the risks of macroeconomic imbalances. These aggregates include not only Cyclically Adjusted Primary Balance but also other aggregates related to fiscal policy such as the current account, the debt, the external balance or the level of taxes collected. We therefore propose to observe if national numerical fiscal rules can have an effect on a more complete set of indicators related to the good management of public finances. Finally, we also observe the effect of national numerical fiscal rules on global fiscal performance of the EU countries. For this, we build a Global Fiscal Performance Index that we call GFPI [3]. So we extend our analysis from fiscal discipline to global

[1] The rigor of a rule is mesured by its strength. The strength of a rule is defined by a set of characteristics grouped in an index of the European Commission but also by the IMF. The Commission proposes a strength index for each type of fiscal rule (Fiscal rule strenght index or FRSI). These indices are also aggregated to provide a synthetic index for each country to assess the strength of the country (Standardized Fiscal Rules Index). The IMF proposes an Index of soundness of Fiscal Rules.

[2] Creel (2003) develops that according to Kopits and Symansky (1998) this rule should be well defined with respect to the constrained indicator, transparent, simple, flexible, adequate for their purpose, enforceable, consistent with the policy framework and macroeconomic rules. Finally, this rule must be supported by effective political action and must serve as a catalyst for budget reforms.

[3] Its construction is detailed in stylized facts and in the methodology

fiscal performance. Here, fiscal performance is described by an increase of the Global Fiscal Performance Index. In these two stages, we take into account the dates of entry into the European Union but also the membership or not to the Euro Zone because the members of Eurozone are subject to a supranational rule (Stability and Growth Pact with its possible sanctions for non-compliance) which corresponds to the rule definition of Kopits and Symansky (1998).

Although the literature on the impact of the fiscal rules is abundant, the originality of our analysis is based on the use of the Propensity Score Matching method applied for the first time to the European Union. Our approach avoids the problem of self-selection of public policies. Moreover, the reverse causality between the numerical national fiscal rules and the primary structural public balance is totally contained by our approach. When assessing the impact of national rules on Cyclically Adjusted Primary Balance, it must be ensured that governments do not adopt rules because of bad structural budget balance. This is why we estimate the effect of the probability of adoption of national numerical fiscal rules. So, we avoid the problems of endogenetity pointed out by Heinemann and al. (2018) in many studies on impact of fiscal rules. Our originality is also in the precise definition of fiscal rules which excludes Medium Term Budgetary Frameworks. Moreover, we also propose an overall assessment of countries fiscal performance. The situation of public finances is described by many elements, so fiscal discipline can't just be reflected by the cyclically adjusted primary balance alone. To capt a larger view of the situation of public finances, we use a Global Fiscal performance Index. Moreover we give a real importance to the Stability and Growth Pact as the supranational fiscal rules in the European Union.

Finally, the question asked here is: " Can national numerical fiscal rules improve fiscal performance in the European Union ? " The article is organized as follows: First, we expose the relevant literature and our motivations to study this issue. Second, we present stylized about fiscal rules and public finance in the European Union. Next we present the Propensity Score Matching method and we conclude with our results and discussion.

1. Motivations and relevant literature

To justify the interest of our analysis, we first present its position relative to existing studies. Then, We expose the context that guided our analysis on this subject.

1.1 Literature review

The literature about fiscal rules is really large. A first part focus on the supranational rule as a coordinating instrument showing that SGP deal with optimum and credibility problem. Villieu (2003), Creel (2002) and Bonatti and Cristini (2006) for example, show that the SGP must ensure coordination of the fiscal policies delegated to the Member States and more precisely the SGP induces costs [4] which can be eliminated by coordination. We will undertake to verify that the SGP fulfills the functions it was criticized for having lost. An other part of the literature focus on the fiscal rules' macroeconomic stabilizing power. Bohn and Inman (1996), Sacchi and Salotti (2015), Debrun (2008), Guerguil et al. (2017), Combes, Minea and Sow (2018) showed that fiscal policy is counter-cyclical but also that there are non-linear effects because only certain fiscal rules can reduce the procyclicality of fiscal policy when debt is high.

Finally, the literature also focus on the respect of fiscal rules and their effect on fiscal discipline. National governments often have to arbitrate between respecting their national fiscal rules and their growth objectives. The objectives set by the SGP, as the target of the 3% deficit, can in particular constrain public investment. Reuter (2015) assessed whether fiscal discipline is degraded when there was non-compliance with fiscal rules. The general idea is to evaluate if the non-compliance in $t-1$ of the rule has influence on the respect of this same rule in t. The results show that in the 11 countries of the European Union studied, fiscal rules make it possible to improve fiscal discipline even if they are not respected. Thus, the non-respect of the rules does not necessarily imply that they are ineffective. However, this study does not take into account any index about the strength of the rule. The study is confined to 11 countries of the European Union and can not serve as a generality to the European framework. In addition, it is the "all-in" rules that are evaluated and not each fiscal rule type. The role of the supranational rule is also absent from the study. Reuter (2017), in another contribution, analyzes the determinants of the respect of 51 different national fiscal rules in 20 countries of the European Union from 1995 to 2015. The model used is a panel logistic regression where the dependent variable is a dummy variable taking the value 1 if country i has respected its fiscal rule in year t and zero otherwise. The results show that Expenditure Rules are more respected especially if they are written into agreements or into law. The probability of complying with the rule is 70% if it concerns a stock rather than a flow. In addition, independent oversight bodies reinforce compliance with the rule. Membership of the Economic and Monetary Union seems to have a negative effect on compliance with national rules while other variables such as strengthening the SGP have not changed the respect of the rules. For Reuters, the justification is in the expectation of a bailout, leading to less fiscal discipline from member countries. However, the non-bailout clause invalidates this explanation. On the other hand, it is possible that when countries choose to respect the supranational rule, they divert from potentially incompatible objectives set by their own national fiscal rules. Finally, only 51% of the 51 rules in the sample were, on average, respected over the period studied. Bergman et al. (2016) studied the impact of fiscal rules on the primary structural balance. The constitution of their sample does not allow them to estimate the advantage of adoption

section.

[4] These costs can be assessed by looking at the losses suffered by fiscal authority or by observing the deviations of the debt and the real interest rate.

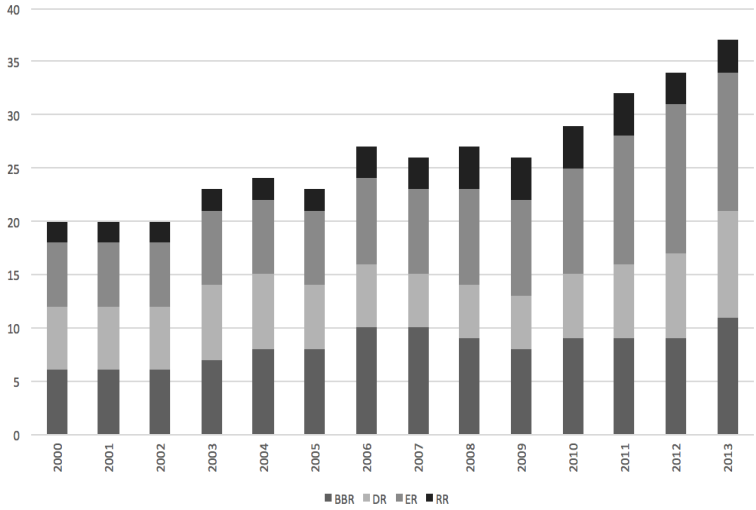
of a rule compared to the counterfactual scenario where the country would have not adopted it. The primary structural balance comes only from the calculations of the European Commission while its methods of calculation are numerous and subject to debate. To provide results independent of the choice of the calculation method, we propose several methods for calculating this balance. Also, in their study the rule is reflected by a weighted index of force, it is therefore not possible to evaluate the effect of the rule independently of its rigor and then to evaluate the effect of this rule according to its index of force by introducing an interaction term for example. In order to rule out the reverse causality bias (primary structural balances could influence the adoption of fiscal rules while we would like to observe the opposite), the authors check the impact of the balance on fiscal rules. The results are unrelated, whereas Calderón and Schmidt-Hebbel (2008), IMF (2009), Elbadawi et al. (2014), Tapsoba (2012) use the lagged value of the primary structural balance to obtain the probability of adoption of fiscal rules. Moreover, such conclusions seem contrary to the real scenario: countries in the European Union were forced to abandon their national fiscal rule(s) because of the situation of their public finances during the 2007-2008 crisis. Heinemann and al. (2018) used a meta-regression-analysis to evaluate the effect of fiscal rules from 30 different studies. They highlighted that the disciplining effect of the rules is nuanced because many studies did not sufficiently take into account the endogeneity bias thus providing uninterpretable results. This detail of major importance has guided us on the method of Propensity Score Matching. Finally, except Reuter (2015), the definition of the fiscal rules used in these studies does not take into account the differences between national numerical rules and MTBFs, which, however, have different definitions and therefore have a different impact on fiscal discipline.

1.2 Stylized facts

The place of fiscal rules in the EU and in the world During the last 20 years the number of fiscal rules has increased in Europe and in the World.

Indeed, Sacchi and Salotti (2015) point out that in 1990 only 5 countries in rhe world had a fiscal rule in force: Germany, Indonesia, Japan, Luxembourg and the United States. In 1991 only 2 countries in the current Euro Zone had a national fiscal rule. In fact, Germany adopted a balanced budget rule in 1969 and in 1982 a rule on public expenditures, while in 1990 Luxembourg adopted a rule on debt and a rule on public expenditures. In 2015, all the countries of the European Union had, at least, one national fiscal rule in order to guarantee the sustainability of their public finances and to ensure compliance with the SGP, which submitted the members of the Eurozone to sanctions. Due to the large number of fiscal rules in force in the EU nowadays, we must stop our study period in 2013. Indeed, after 2013, in front of the sovereign debt crisis and the pressure of speculation weighing on public spending, member countries of the European Union have adopted more national fiscal rules, making impossible to set up a control group necessary for the use of the Proprensity Score Matching method. In addition, Guerguil et al (2017) highlighted the rise in the number of flexible fiscal rules in the world. These flexible rules include, for example, rules that favor investment, rules that include escape clauses, and rules with adjusted cycle objectives. This trend reinforces our desire to verify that the rules are both compatible with the supranational framework but also with the flexibility necessary for cyclical adjustment.

Figure 1. Evolution of the number of fiscal rules in the EU* between 2000 and 2013



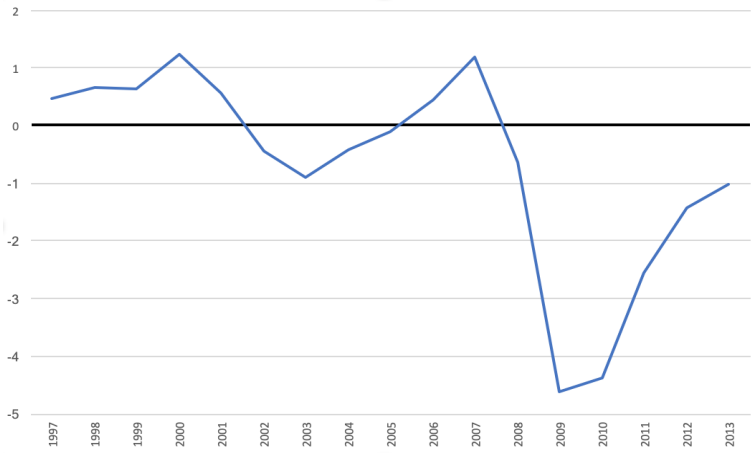
* We observe the evolution of the number of fiscal rules for the 28 countries of the current EU. This allows us to study trends even for countries that were not yet members in 2000. This implies that in 2000, 2001, 2002, 2003 we also counted the the Budget Balance Rule of Estonia, the Debt Rule of Slovenia-Lithuania-Poland. For 2006 we counted the Bulgaria's Budget Balance Rule and Expenditure Rule, in 2003,2004,2005, 2006 its Debt Rule. For 2009, 2010, 2011 we counted the Debt Rule of Croatia. Finally for 2012 we have also conserved Expenditure Rule, Budget Balance Rule, Debt Rule from Croatia.

By carrying out a finer analysis excluding the MTFBs from our analysis, we find that in 2000, 12 countries in our sample had at least one national numerical fiscal rule covering all public administrations: Denmark, Estonia , Finland, France, Germany, Lithuania, Luxembourg, the Netherlands, Poland, Slovenia, Sweden, the United Kingdom. Between 2000 and 2013, 8 countries did not adopt national fiscal rules (the public balance rule in Austria is considered as a MTFB and not a numerical rule). In 2013, the date of the last EU accession [5], yet 8 countries had no national numerical fiscal rule despite the passage of the economic crisis. The Appendix 1 presents the rules excluded from our study by the definition we have chosen. We also find that the targets covered by the numerical rules are more often defined in nominal terms. This raises a significant difference since some targets are defined as a percentage of GDP, so when there are forecast errors related to inflation the results can be directly affected. A nominal target appears to be more transparent and encourages governments to be more stringent and efficient in terms of fiscal adjustment when inflation is higher than its expected value.

[5]The Brussels Treaty entered into force on 1 July 2013 and marked the entry of Croatia into the EU

Public finance indicators Finally, we check wether the fiscal rules affect the structural balance (and so fiscal discipline) and global fiscal performance (which is a more comprehensive measure of the situation of public finances, intrinsically including fiscal discipline).

Figure 2. Mean Primary Balance in the UE (in % of GDP)



By comparing the Figure 1 with the Figure 2, we can suppose that the increase in the number of fiscal rules in the European Union is linked with the evolution of the primary balance. Except during the peaks of financial crises and sovereign debt crisis, the primary balance increased as the number of fiscal rules. Because of this observation we want to get into the details of this possible disciplining effect of the rules. Figure 3 below presents the evolution of the structural primary balance in each country of European Union between 2000 and 2013. We notice that, in average, Cyclically Adjusted Primary Balances (CAPB) are stable. Some countries that have adopted rules like France started with a very low structural primary balance in 2000 and improved it over the study period. The United Kingdom had a slight but progressive and continuous rise. We can therefore verify that these improvements observed in countries that have adopted rules may be due to fiscal rules.

As explain in the introduction, CAPB is only one part of fiscal discipline and couldn't reflect the global fiscal performance of a country. To approach this overall performance we build an index"GFPI" (Global Fiscal Performance Index). Our approach is inspired by CEFT (2016) which constructed a Composite Index of Fiscal Performance for India.

To obtain a clear, understandable and coherent indicator, we focus on Primary Indicators as a reflection of countries public finance situation: Total budget deficit, growth of public debt and interest (on debt) growth rate , the decrease in public administrations revenues, the external deficit. These Primary Indicators and standardized to construct Level 2 Indices. The standardization step used to obtain our the First Level Indices is conformed to the approach of the Competence Centre on Composite Indicators and Scoreboards (COIN) of European Commission: "For each indicator the average value and the standard deviation across countries are calculated.

Table 1. Steps for GFPI construction

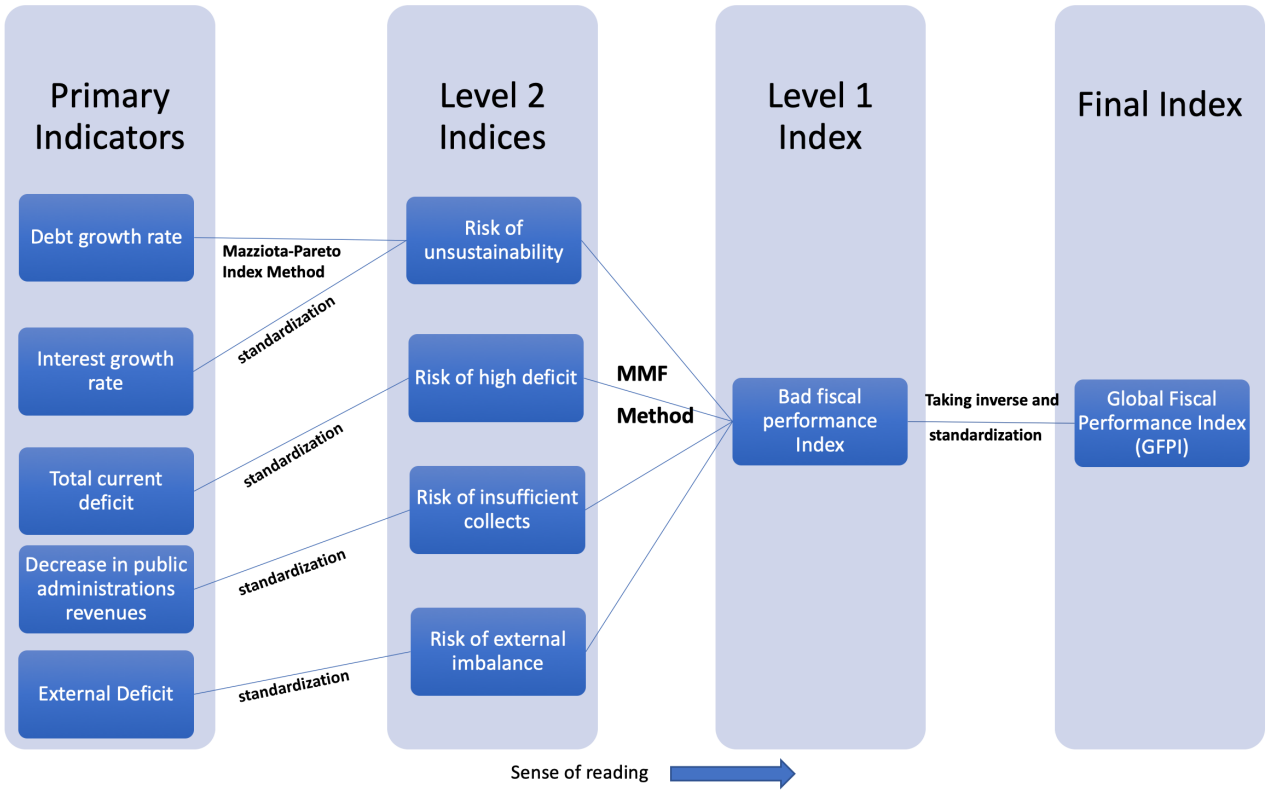
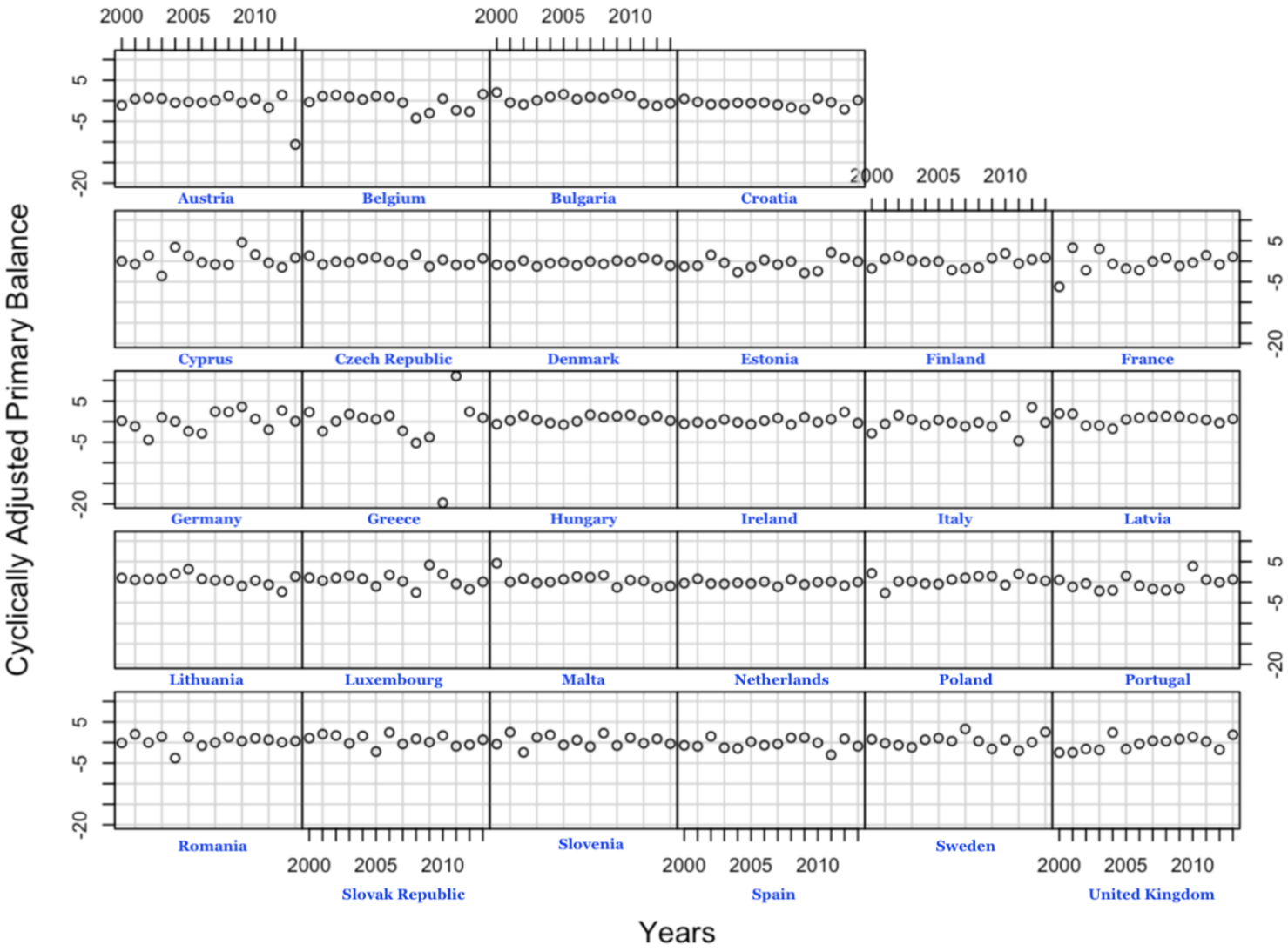


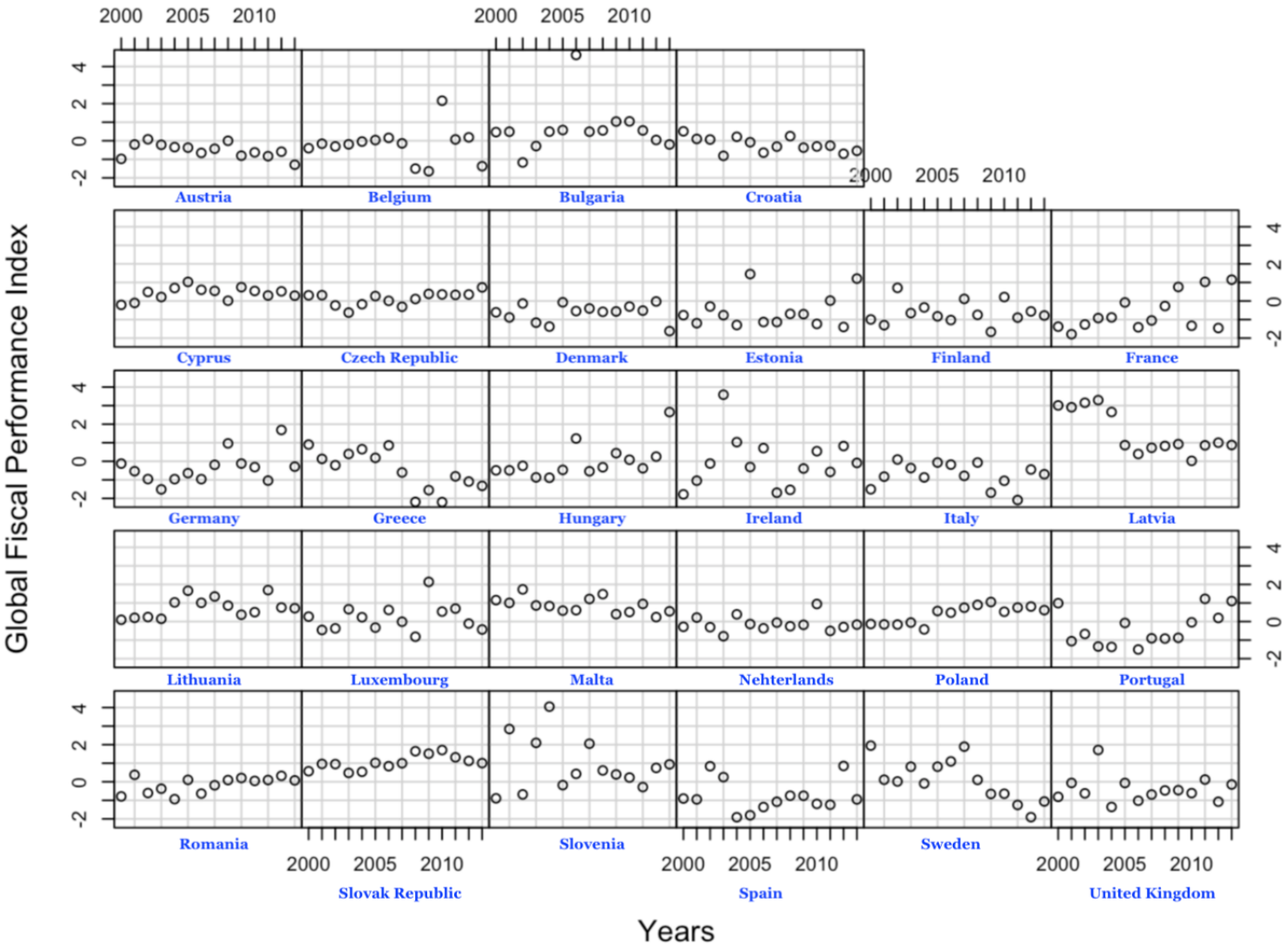
Figure 3. Structural Primary Balance (Hodrick-Prescott Filter used)



The normalized indicator value for a country is then calculated as the ratio of the difference between the raw indicator value and the average divided by the standard deviation." The Level 2 Indices obtained reflect respectively: risk of high deficit, risk of unsustainability, risk of insufficient collects and risk of external imbakance. To construct the unsustainability index we use Mazziotta-Pareto index method (see methodology section for technical details about this method). Indicators included in this index are growth of public debt and interest (on debt) growth rate (we didn't have enough value to use rate spread). We then proceed to the aggregation of these 4 Level 2 Indices using the " Mean-Min Function (MMF) " method (see methodology section for technical details about this method) and we obtain the Level 1 Index. We thus obtain an aggregation of indicators called Level 1 Index which reflect a poor fiscal performance (for example, more larger the debt is, more larger the indicator is). We therefore take the opposite sign of this Level 1 Index and normalize the values, allowing us to obtain an index between -2 and 4. This index is precisely the Global Fiscal Performance Index (GFPI). The countries with the highest indices have a stronger global fiscal performance. This approach is done for each year and Table 1 above resumes steps to obtain our Global Fiscal Performance Index (GFPI).

Figure 4 below presents the evolution of our GFPI (Global Fiscal Performance Index) over the period 2000 - 2013. The appearance of its evolution is different from the evolution of CAPB. GFPI isn't stable for all countries and we note very significant disparities between countries. For exemple, Austria showed some stability of its indicator while France fluctuated a lot. Countries such as Greece, Ireland or Sweden presented a decrease in this indicator during the 2007 crisis, while Slovak Republic remained more stable in front of the shock. Sweden which had a stable CAPB around 0% of GDP, presents fluctuations in the GFPI with high value at the begining of the period and bad value at the end. Slovenia also presented stablized situation for CAPB but many fluctuations in his GFPI. It therefore seems interesting to see the impact if

Figure 4. Global Fiscal Performance Index



national numerical fiscal rules could also have on the GFPI index. When there are significant fluctuations (as for France of Sweden), it also amounts to assessing whether the situation would have been worse without a fiscal rule.

2. Methodology

Studies have already addressed the issue of fiscal discipline by using the Propensity Score Matching method, which is also widely used in medicine and biology in the context of randomized experiments. Nevertheless our approach will be the first to apply this method to the framework of the European Union and we extend the analysis from fiscal discipline to global fiscal performance. In addition, we attach high importance to the supranational framework. The interest for us is to verify, precisely, if the national fiscal rules in force in the European Union and especially in the member countries of the Eurozone, allow to improve the fiscal performance which is covered by the Stability and Growth Pact. The Propensity Score Matching method eliminates the problem of self-selection, in order to estimate the effects of the treatment which is the adoption of national fiscal rules.

2.1 Data

Construction of dependant variables First, we want to check if the national numerical fiscal rules have an effect on the Cyclically Adjusted Primary Balance (CAPB), which is a proxy variable for the discretionary policy. Because it is not directly observable we must proceed to its estimate. We use 3 estimated series of the CAPB to ensure that the results do not depend on a particular method. First, like Tapsoba (2012), we calculate the CAPB with the residual approach of Fatás and

Mihov (2003, 2006):

$$PBB_{i,t} = \alpha + \beta PBB_{i,t-1} + \gamma GAP_{i,t} + \varphi W_{i,t} + \eta_t + \varepsilon_{i,t} \quad (1)$$

Where $PBB_{i,t}$ is the primary budget balance, $PBB_{i,t-1}$ the delayed value of the primary budget balance, $GAP_{i,t}$ is the output gap. The output gap is the difference between the logatihm of real GDP and the logarithm of the trend extracted using econometric filters. There are many methods for estimating potential output, trend and output gap. We propose estimates using a Hodrick-Prescott filter with a smoothing parameter 100 (as commonly used in the literature). We also perform the estimates using a filter with trigonometric bases (Fourier approach).

$\varepsilon_{i,t}$ is the error term and is the residual of the primary budget balance after extracting cyclical elements. It is therefore the CAPB. η_t is the time effect. $W_{i,t}$ includes control variables: inflation, terms of trade [6]. The price of raw materials [7] is captured by the time fixed effect. The $GAP_{i,t}$ is instrumentalised by its own lagged value to avoid an endogeneity problem. To take into account the dynamic panel issues raised by Nickell (1981) and Kiviet (1995), we use the GMM system estimator to process very self-correlated series. The one-step method is considered sufficient here.

Another source of bias in the estimates of the CAPB is in the residual method itself. Andersen (2013), Farina & Ricciuti (2006) point out that the residual method may be biased because errors and "noise" are found in the measure of the CAPB. Even using the most robust estimators possible, volatility can not be contained permanently. To ensure that our results are not biased by the residual approach, we apply the Propensity Score Matching method on the CAPB calculated by IMF. This serie is estimated according to the production-function approach (see Fedelino et al., (2009) or Girouard and André (2005)).

In a second step we want to check if these same rules have an effect on the overall fiscal performance of the countries. Our approach inspired by CEFT (2016) was presented in stylized facts. In this section we develop technicals details for agregation and construction of the GFPI. As a reminder, we focus on few Primary Indicators as a reflection of countries public finance situation: Total budget deficit, growth of public debt and interest (on debt) growth rate, the decrease in public administrations revenues, the external deficit. With these Primary Indicators we obtains Level 2 Indices (table 1 described steps of GFPI construction in stylized facts section) by standardization. Two Primary Indicators are subject to a transformation different from the others because they are linked so they are used together: Growth of public debt and interest (on debt) growth rate are used to construct the unsustainability index using Mazziotta-Pareto approach. Mazziotta-Pareto method can be explained as follow:

If $X = \{x_{ij}\}$ is a matrix with n units (rows) and m indicators (columns), M_{x_j} is the mean for the indicator j and St_{x_j} his standard deviation. The normalized matrix $Z = \{z_{ij}\}$ is calculated by:

$$z_{ij} = 100 \pm \frac{x_{ij} - M_{x_j}}{St_{x_j}} 10 \quad (2)$$

$\pm$ give the polarity of the indicator j. Here j can be Growth of public debt or Interest growth rate. Each of them has a positive polarity (if the Growth of public debt increases $Z = \{z_{ij}\}$ increases). Now if we call M_{z_i} the mean of standardized values for the unit i and St_{z_i} the standard deviation of standardized values for the unit i, the Mazziotta-Pareto Index (MPI) can be written as follow:

$$MPI_i^{\pm} = M_{z_i} \pm St_{z_i} cv_i \quad (3)$$

with $cv_i = St_{z_i}/M_{z_i}$ is coefficient of variation for unit i. Positive index is an increasing index. If the index increases, the phenomem of one interest has a positive variation. Here MPI precisely corresponds to our risk of unsustainability index. So if the MPI for a country in a given year is hihgly positive, his risk of unsustainibility is high.

All the other indicators give Level 2 indices directly by standardization procedure[8]. Finally we obtain four Level 2 Indices that reflect respectively: risk of high deficit, risk of unsustainability, risk of insufficient collects and risk of external imbakance. We proceed to the aggregation of these four Level 2 Indices using the " Mean-Min Function (MMF) " method described as follow:

The matrix of our 4 normalized indices z_{ij} is written in the following way: $Z = z_{ij}$ where i denotes the country and j the index considered. With M_{z_i} the average of the standardized values, we obtain our aggregated index by:

$$MMF_i = M_{z_i} - \alpha \left(\sqrt{(M_{z_i} - \min_j \{z_{ij}\})^2 + \beta^2} - \beta \right) \quad (4)$$

where $0 \leq \alpha \leq 1$ sets the intensity of penality for imbalances and $\beta \geq 0$ gives the intensity of the complementarity between the indicators. This index is independent of the choice of the indicator normalization procedure and avoids compensation ($\alpha = 0$ corresponds to the arithmetic mean which allows compensation that we want to avoid in order to capture the effect of each indicator). We checked beforehand if these variables are not too strongly correlated, to avoid the

[6] based on Turner (2006) recommendations. The terms of trade index comes from the World Bank (source: United Nations Conference on Trade and Development Statistics)

[7] Villafuerte and Lopez-Murphy, (2009) highlight the importance of taking into account the price of raw materials in the calculation of the CAPB, inflation taking into account only Consumption

[8] As explained by Competence Centre on Composite Indicators and Scoreboards (COIN) of European Commission: "For each indicator the average value and the standard deviation across countries are calculated. The normalized indicator value for a country is then calculated as the ratio of the difference between the raw indicator value and the average divided by the standard deviation."

risk of counting some effects several times by aggregating them (see Appendix 3 for the correlation matrix).

As explain in the stylized facts, we thus obtain a Level 1 Index with this aggregation that reflect a poor fiscal performance. We therefore take the opposite sign of our indicator and normalize the values, allowing us to obtain an index between -2 and 4. This index is the GFPI. Finally, The countries with the high indices have a stronger GFPI and so a better fiscal performance.

Identification of Treated Group et Control units To describe each type of fiscal rules, the following notations will be used: a rule on the public balance budget takes the BBR notation for the " Budget Balance Rules ", a public expenditure rule takes ER notation for " Expenditure Rules ", a rule on the public debt takes notation DR for " Debt Rules " and a rule on public revenue takes RR notation for "Revenue Rules ". Finally, the FR notation for" Fiscal Rules " groups all the rules together. In our use of Propensity Score Matching, the effect of the treatment we are trying to estimate is the adoption of national numerical fiscal rules. They are modeled by the FR (" Fiscal Rules ") variable which is a dummy variable taking the value 1 if, in a given country for a given year, a numerical constraint exists on the national public finances aggregates. BBR, ER and DR are also binary variables that take the value 1, if in a given country in a given year, a numerical constraint concerns only the budget balance, public expenditure or public debt respectively. We will not study the effect of revenue rules independently because only three countries have adopted them over our study period[9].

Thus a country that has adopted a budget rule is a FRer (belongs to the treated group), and the non-FRs constitute the control group.

Given our definition around national numerical fiscal rules we can define FRers and non-FRers. Table 2 shows countries that have adopted a rule corresponding to the definition of a national numerical rule as we have mentioned (excluding MTBFs) over our study period (2000-2013). Table 3 shows countries that have not adopted any rule on our study period. Because we use panel data, we get a different report from 20 countries versus 8 countries (Table 3 isn't the Control group for all type of fiscal rules all over the period but only present country never treated all over the period). In the results you can see the proportion of control units and treated units.

2.2 Propensity Scores and Matching estimates

The Average Treatment Effect on the Treated (ATT) is defined as followed:

$$ATT = E[(Y_{i1} - Y_{i0})|FR_i = 1] \tag{5}$$

$$ATT = E[Y_{i1}|FR_i = 1] - E[Y_{i0}|FR_i = 1] \tag{6}$$

[9]This restriction to only three countries thus appears to be isolated cases. These three countries are: Denmark (from 2000 to 2011), lithuania (from 2008 to 2013) and the Netherlands (from 2000 to 2013).

FR_i is the dummy variable FR in country i. Y_{i1} is the result variable when country i has adopted the fiscal rule FR and Y_{i0} is observed if this country didn't adopte a budget rule.

In the first step of our study, Y_i corresponds to the CAPB. The literal translation of equation (3) is that the ATT corresponds to the difference in the CAPB for a country that has adopted a national fiscal rule in relation to the case where the same country would not have adopted the rule. In the second step of our study, Y_i is our Global Fiscal Performance Index (GFPI).
$Y_{i0}|FR_i = 1$ is the dependent variable that would have been observed if a treaty country (having adopted a FR) did not adopt the FR rule, and $Y_{i1}|FR_i = 1$ corresponds to the result value observed on the same country that has adopted the FR rule. However, there is a problem of identification because it is not possible to observe what would have happened if this country had not adopted the fiscal rule (we can not observe $Y_{i0}|FR_i = 1$). To solve this problem it is necessary to compare the average result of the sample of the treated group with that of the control group, in the context of an aleatory assignment of the treatment:

$$E[Y_{i1}|FR_i = 1, X_i] - E[Y_{i0}|FR_i = 0, X_i] \tag{7}$$

So, we compare two identical countries apart from the effect of the treatment in order to observe the differences induced solely by the treatment (here by the adoption of a fiscal rule). However, as Lin and Ye (2007) have already pointed out, there is a problem of self-selection because fiscal rules (" FR ") can be correlated with a set of observable variables that also affect the outcome variable. As Lin & Ye (2007), to address this selection problem, we use Propensity Score matching methods. The estimates could be biased if the decision of the treatment is not random, if this choice is correlated with observable variables which also affect the results, one would then obtain results with a problem of self-selection. Thus, the assumption needed to apply the matching method is the conditional independence assumption. We want to associate the treated units to the control unirs having X values very close (having the same characteristics). The more number of covariates X increases, the more condition of conditional independence is difficult to respect. To solve this problem, Rosenbaum and Rubin (1983) propose to match the units treated and the control units to their Propensity Scores which are their probabilities of adoption of the treatment (in this case the probability of adoption of a fiscal rule) conditionally to X_i (control variables). This step corresponds to the estimate of Propensity Scores that we calculate with a probit model. Here the Propensity Scores correspond to the probabilities of each country adopting FR, conditional on observable covariates X_i:

$$p(X_i) = E[FR_i|X_i] = Pr(FR_i = 1|X_i) \tag{8}$$

Also, the Common Support hypothesis ($p(X_i) < 1$), which translates the existence of some comparable control units for each treated unit, must be verified (see Appendix 2.1, Appendix 2.2 , Appendix 2.3 and Appendix 2.4 for the Common

Table 2. National numerical fiscal rules in force between 2000 and 2013 in EU countries

Treated Group	FR (All Fiscal Rules)	BBR (Budget Balance Rules)	DR (Debt Rules)	ER (Expenditure Rules)
Bulgaria	2003-2013	2006-2013	2003-2013	2006-2009 – 2012-2013
Croatia	2009-2013	2012-2013	2009-2013	2012-2013
Danmark	2000-2013	2000-2013	-	2000-2013
Estonia	2000-2013	2000-2013	-	-
Finland	2000-2013	2000-2013	2000-2006 – 2010-2013	2003-2013
France	2000-2013	-	-	2000-2013
Germany	2000-2013	2000-2013	-	2000-2009 – 2012-2013
Greece	2010-2013	-	-	2010-2013
Hungary	2004-2011	2004-2011	-	2010-2011
Latvia	2013	2013	2013	-
Lituania	2000-2013	-	2000-2013	2008-2013
Luxembourg	2000-2013	-	2000-2013	2000-2013
Netherlands	2000-2013	-	-	2000-2013
Poland	2000-2013	-	2000-2013	2011-2013
Romania	2010-2013	2013	2013	2010-2012
Slovak Republic	2012-2013	-	2012-2013	-
Slovenia	2000-2004	-	2000-2004	-
Spain	2006-2013	2006-2013	-	2011-2013
Sweden	2000-2013	2000-2013	-	2000-2013
United-Kingdom	2000-2008 – 2010-2013	2000-2008 – 2010-2013	2001-2008 – 2011-2013	-

Table 3. EU countries that have not adopted a national numerical fiscal rule over the period 2000-2013

Austria Belgium Cyprus Czech Republic Ireland Italy Malta Portugal

(Source : autors)

Support region of each fiscal rules treatment). Finally our final specification using Propensity Score matching is:

$$ATT = E[Y_{i1}|FR_i = 1, p(X_i)] - E[Y_{i0}|FR_i = 0, p(X_i)] \quad (9)$$

In order to calculate the Propensity Score, we first include the lagged value of CAPB derived from our calculations (2 methods but also from a serie of the IMF). In the same way as Calderón and Schmidt-Hebbel (2008), IMF (2009), Tapsoba (2012) we expect that countries with sound public finances will adopt fiscal rules. We are therefore waiting for a positive relationship. We also include the stability of the government according to the approaches of Guerguil et al. (2017), Debrun et al. (2008), Tapsoba (2012). The sign for the link between government stability and probability of fiscal rules is ambigous. Indeed, stable government could adopt fiscal rules to help themselves to conduct their planes. But it is also possible that, because they are really stable, they could conduct their policy without including many fiscal rules. We can think that unstable governments are more likely to use the rules to ensure sound management of public finances. We then include dependency ratio and expect a positive relationship with fiscal rules probability of adoption because we expect that countries make efforts in front of "old age risk" in the European Union. Inflation is included and we wait for a negtative relationship. The lagged value of the logarithm of the debt ratio to real GDP. We can find a negative link because highly indebted countries can not constrained to much themselves. The growth rate of real GDP per capita is finally included. Then, we include a dummy variable indicating if the country is a member of the European Union or not, in order to capture the effect of EU accession on the adoption of national rules. Finally, we also include a dummy variable to capture the impact of the Stability and Growth Pact on countries in the Eurozone. This variable takes the value 1 since the member state of the European Union has joined the Eurozone and until the end of our study period. In order to capture the effect of the supranational rule established by the Stability and Growth Pact, we must consider all the years in which the Eurozone member countries are subject to the Pact and the sanctions it provides. Debrun (2008), IMF (2009), Tapsoba (2012) explained that the relation between probability of fiscal rules adoption and supranational fiscal rules must be positive because the supranational could be a catalyst for fiscal rules adoption. But if the SGP is a great and sufficient rules, we could find a negative sign for budget balance rules and debt rules because countries want to respect SGP et will not introduce national fiscal rules which could that may not be consistent with SGP.

After estimating the Propensity Score, we proceed to the Matching of the countries on the basis of these Propensity Score. There are several Matching methods (see Caliendo and Kopeinig 2005, 2008). We propose 3 methods to ensure that our results are stable from one method to another. We retain Nearest Neighbor Matching (with a caliper to avoid poor matching), Radius Matching, Full Matching. We allow replacement for each of these methods.

2.3 Robustness and heterogeneities tests

Robustness tests Several robustness tests have been developed in order to check the quality of Propensity Score Matching. Rosenbaum and Rubin (1985) discussed the statistical conditions needed to ensure that balancing between FRers and non-FRers is sufficient. To ensure that the conditional independence assumption is valid (otherwise formulated that there are no significant differences between the observable characteristics of the " FRers " and the " non-FRers ") the absolute standardized mean difference (ASMD) must be less than 0.1. There is no consensus on the threshold value but Rubin and Thomas (2000), Stuart et al. (2013) or Austin (2009) estimate that 0.1 is an acceptable and sufficient value. We will present the T-Test on this ASDM, so we test if the mean difference (Standardized bias) is significative between the two-groups after matching (if the matching is efficient there will be no difference and the p-value will accept the absence of significant difference). We also report the standardized difference in Propensity Score to check if the Matching is correct. If the standardized difference between propensity scores of Control and propensity scores of Treated Group is under 0.05 we can consider that matching is based on really similar units (Caliendo and Kopeinig (2008)). The Propensity Score is not initially known. In order to avoid that the reliability of the estimators depend on the correct specification of the Propensity Score we have to check if the specification is strong. The Kolmogorov-Smirnov and Cramer-von Mises tests test the null hypothesis that the Propensity Score is correctly specified, but results of these tests are really related to weight function the projection is based on. In the same objective, Tapsoba (2012), Minea & Tapsoba (2014) test the sensitivity of the results to a set of alternative specifications. This traditionnal control approach is less criticized than first and more used. So, in the Appendix 7, we also introduce control variables in our probit estimates to verify that the Propensity Score specification is stable[10].

Control for Heterogeneities The Propensity Score Matching approach alone does not capture the effect of structural factors that can modify (amplify or reduce) the impact of a fiscal rule on the CAPB or on GFPI index. The estimation of a control regression is necessary to evaluate such heterogeneity in the ATT. This control step is used by Lin and Ye (2009), Tapsoba (2012), Tapsoba and Mina (2014), Guerguil et al. (2017). The specification tested is:

$$\begin{aligned} Y_{i,t} = \alpha + \beta FR_{i,t} + \gamma\, logPScore_{i,t} + \varphi X_{i,t} \\ + \delta(FR_{i,t} * X_{i,t}) + \varepsilon_{i,t} \end{aligned} \quad (10)$$

where $Y_{i,t}$ corresponds to either the CAPB (first step) or the GFPI (second step).
After entering the dummy variable indicating the presence of a fiscal rule (FR for " all rules ", BBR for " Budget Balance

[10] Among the control variables we test in particular the sensitivity of the probability of rules' adoption to the decrease of revenue, to the lagged value of the external deficit and to the lagged value of total deficit. This makes it possible to check that there is no endogeneity bias when we evaluate the effect of the rules on the GFPI index.

rules“, ER for “ Expenditure Rules ”), which captures the effect of the treatment of fiscal rules on the CAPB (or on the GFPI), we introduce the Propensity Scores estimates as a control variable to control the self- selection. To control heterogeneities in treatment effect on CAPB, week look at heterogeneities in FR (All Fiscal Rules) treatment because CAPB is affect by different types of rules. We used probit in Propensity Score estimations. As robustness check for this approach, we report in Appendix 6 the heterogeneities in FR treatment on CAPB, using logit for Propensity Score to make sure that our results don't depend on the method choose for Propensity Scores estimates. We do this heterogeneities control step also for the impact of All Fiscal Rules (FR) on GFPI. Finally, we need to introduce variables that may lead to heterogeneity in the effects of treatment by fiscal rules. Potential sources of macroeconomic heterogeneity are: real GDP per capita, lagged value of the debt (in percent of GDP). Among the macroeconomic factors, we also control the presence of the financial crisis in our study period by including a binary variable taking the value 0 when there has not been a major economic crisis, and taking the value 1 during the financial crisis (2007-2008) and the sovereign debt crisis (2010-2011). Indeed, the crisis has deteriorated public deficits, led some countries temporarily abandoned their fiscal rule (this was particularly the case of the United Kingdom in 2009). The political factors that can introduce heterogeneity are the stability of the government, the mode of election, the electoral cycles (binary variable reflecting the presence or absence of presidential or legislative elections in country i for year t). Indeed, it is possible for public actors to put in place provisional measures during elections to improve fiscal discipline and present sound public finances in order to be re-elected. Finally, the environment created by the fiscal framework can introduce heterogeneities. Rule-related factors that may introduce heterogeneity are: the presence of a supranational fiscal rule, number of years a national rule has been in force, the number of rules in force. Finally, we must also consider the “ characteristics ” of the rules, including their strength. The Synthetic Rule Strength Index published by the European Commission (which captures the effect of all weighted characteristics) is not present in studies using Propensity Score Matching to assess fiscal behavior in the face of the rules. But we can not neglect the complementary effect of the rules' characteristics according to their weighting (European Commission, (2010, Ch.3)). This is why we introduce the index of strength of rules calculated by the European Commission. We also control the role of the rules' characteristics independently of the others: the flexbility of the rule (cyclically adjusted and/or rules which exclude public investment), the presence of an independent institution in charge of of the fiscal discipline monitoring. [11]

[11] These institutions are specific to national numerical fiscal rules. The variables are from the FMI Fiscal Rules Database.

3. Results and Discussion

3.1 Results

3.1.1 Results of Propensity Scores estimations

Table 4 presents the results of Propensity Scores estimates whose CAPB calculations use a Hodrick-Prescott filter. Results (and values) are very similaire from one method of calculation of the CAPB to another (Appendix 4 presents the results of the Propensity Scores using the CAPBs calculated with a trigonometric filter and then Appendix 5 uses the serie of the FMI with the production-function approach). Thus, our results on are not biased by the chosen technique. Moreover, in the set of specifications and for the 3 calculation methods of the CAPB, the Propensity Scores (probability of adoption of fiscal rules) depend significantly on the past primary structural balances. This increases justifications to use the Propensity Score Matching approach.

We first find that the dependency ratio has major importance in the countries of the European Union. Indeed, the aging rate of the population and the ”old age risk” are a very topical subject and it is easy to understand that countries are adopting national fiscal rules in front of rising old-age spending. Entry into the European Union doen't affect the adoption of national fiscal rules, highlighting that efforts to comply with the Maastricht criteria were made before the entry. Then, membership of the Euro Zone also has a significant effect. Thus, the supranational rule (SGP) has a negative and significant effect (robust to the introduction of covariates) only on debt rules and budget balance rules. The Stability and Growth Pact is therefore a sufficient rule, not influencing countries to introduce new Budget Balance Rules and Debt Rules. We also find a negative sign for inflation and the real GDP growth rate. Government stability presents two aspects: governments with only national expenditure rules are the most stable. Indeed, the greater the stability of governments, the more likely these governments are to adopt significant expenditure rules. On the other hand, the general effect shows that stable governments tend to fend for themselves without adopting new rules. Stable governments therefore tend to reinforce the adoption of expenditure rules only, not debt and budget balance rules.

3.1.2 Results of Matching

Tables 5, 6, 7 and 8 present the results of Matching on the CAPB and then on the global fiscal performance (GFPI). [12] When we look at the national numerical fiscal rules effect on CAPB: the amplitude of the estimated ATT ranges from 0.192 (Radius Matching with r=0.025) to 0.641 percentage points of GDP (1-Nearest-neighbour Matching). It suggests that, on average, the adoption of FR enhances the CAPB by

[12] As for Propensity Scores, the results are similar from one method of calculating the CAPB to another. Appendix 8 shows similar results when trignometric filter is used for CAPB and logit is used instead of probit for propensity-scores. More Matching robustness check results are available upon request from the authors.

Table 4. Propensity Scores Results (HP filter is used to calculate cyclically adjusted primary balance CAPB)

Dependent variable	[1] FR	[2] BBR	[3] ER	[4] DR
Intercept	-5.736***	-7.472***	-8.990***	-0.210
	(1.020)	(1.160)	(1.209)	(1.039)
$CAPB_{t-1}$	0.109***	0.087**	0.071*	0.025
	(0.044)	(0.047)	(0.046)	(0.048)
Debt $ratio_{t-1}$	-0.024***	-0.017***	-0.014***	-0.022***
	(0.003)	(0.003)	(0.003)	(0.004)
Real GDP growth	-0.037	-0.031	-0.081***	0.005
	(0.023)	(0.020)	(0.021)	(0.020)
Dependency ratio	0.163***	0.174***	0.184***	0.013
	(0.022)	(0.024)	(0.025)	(0.021)
Inflation rate	-0.085***	-0.058**	-0.014	-0.062**
	(0.029)	(0.030)	(0.027)	(0.032)
Government stability	-0.343**	-0.217	0.413**	0.200
	(0.168)	(0.180)	(0.182)	(0.196)
SGP	-0.221	-0.516***	0.228	-0.446***
	(0.171)	(0.175)	(0.178)	(0.178)
Dummy EU membership	0.272	0.232	0.262	0.258
	(0.396)	(0.415)	(0.479)	(0.387)
Adjusted R^2	0.360	0.321	0.359	0.234
Number Observations	392	392	392	392

Note: Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. FR = All Fiscal Rules, BBR = Budget Balance Rules, ER = Expenditure Rules, DR = Debt Rules.

0.192 and 0.641 percentage points of GDP respectively. It is essentially the budget balance and Expenditure Rules that explain the effect of national numerical fiscal rules on CAPB (Tables 6, 7 and 8). Debt rules have no significant effect on discretionary policy. These results are according to other studies which restrain control auto-selection and endogenerity bias (as Tapsoba (2012)). One possible explanation is that all the countries of the Union are already subject to the 60% debt rule provided for by Maastricht (and even more for the Eurozone member countries subject to the Stability Pact and growth) so they don't really care about their nationale debt rules. But the most probably reaison is that many member countries have significantly exceeded this threshold, the debt rules are not much respected so they have no real disciplining effect over 2000-2013. In 2010-2011, the sovereign debt crisis highlighted particularly high levels of indebtedness that led to speculation in the markets, leading many European countries to adopt new fiscal rules, particularly with regard to debt, in order to give credibility to their fiscal situation.

When we look at the national numerical fiscal rules effect on GFPI: the amplitude of the estimated ATT now ranges from 0.090 (Radius Matching with r=0.01) to 0.331 percentage points of GDP (1-Nearest-neighbour Matching). We can see that the average effect of rules (for each types of rules) is bigest on CAPB than for GFPI. It is not suprising because CAPB which reflects fiscal discipline is, finally, only one part of the global fiscal performance of a country, and it is easier to constrain a little than the overall fiscal performance. Nevertheless, when we extend the analysis to the global fiscal performance we note that all rules (debt rules also) have an effect on Global Fiscal Performance. This highlights the importance of the definition used for fiscal discipline and fiscal performance, so the choice of the indicators to reflect public finances. Countries which adopted fiscal rules, significantively improved their global fiscal performance. These results make it possible to reconcile studies that clash with each other: some studyes like Debrun (2008) or Reuter (2015) didn't fine an effect of ER on CAPB. Others, like Bergman and al (2015) or Tapsoba (2012) found effects. There is also no consensus on the effect on debt rules. But, the results of these studies really depend on the variable "FR": some construct an index to represent the fiscal rule variable, this kind of approach can affect the results because we cannon't see only the effect of the adoption of the rule. Moreover, this approach can't let see the heterogeneity effect of near environment and

characteristic variables because rules are precisely defined by all these characteristics.

Our results show that it is possible to study the needs of each country on a case-by-case basis. A country whose fiscal performance is bad because of the structural balance is not interested in adopting a new debt rule, for example. On the other hand, the adoption of an expenditure rule or flexible budget balance rule would allow to rectify a bad structural budget balance. On the other hand, if the entire fiscal situation is affected, it may be useful to use the 3 types of rules.

3.1.3 Results of robustness tests

Variables that can introduce heterogeneity into the effect of the rules on the CAPB or the global fiscal performance index are often the same but not always.

Table 9 and Table 10 present the results of the heterogeneities in the effect of the treatment of all fiscal rules (treatment variable FR) on the CAPB calculated using a Hodrick-Prescott filter and on the GFPI respectively. Appendix 6 presents similar results for the effects of all Fiscal Rrules (FR) treatment on CAPB when logit is used instead of probit for propensity score estimates. The Propensity Scores variable, used as control variable, appears significant in the results, which justifies controlling the bias of self-selection and the use of the Propensity Score Matching method.

Among macroeconomic factors, lagged value of the debt ratio has a negative impact on the effect of rules on CAPB and on GFPI. In fact, for very high debt ratios, countries make an arbitrage between respect the rule and their growth objectives. Thus, countries are led to be less disciplined when it seems difficult to respect their rule in the presence of a high debt. Periods of poor economic conditions also reduce the effect of national numerical fiscal rules on CAPB. Fiscal discipline is les restrained by fiscal rules during crisis. During the 2007-2008 financial crisis deficits widened, and during the sovereign debt crisis of 2010-2011 the debts reached very high levels in the European Union. Thus we find explanations similar to the particular case of the past debt ratio.

The stability of the government seems to have introduced heterogeneity into the effects of fiscal rules (FR) treatment. Stable and sustainable governments can more easily carry out their budget program and apply the rules with less difficulty. Election cycles affect CAPB. It shows that government in place make effort on discretionary policy to be re-elected. But this behaviour can't affect the Global Fiscal performance. It is easy to understand that it is difficult to raise the tax sharply or drastically reduce the debt in the short-time.

The Stability and Growth Pact doesn't have an impact on the CAPB but a an effect on the Global Fiscal Discipline. The SGP can't affect discretionary policy but can affect a largest part of the fiscal discipline. Finally, SGP doesn't renforce the effect of FR on CAPB but help them with other variables which count for fiscal discipline. Our results show the importance to consider different level of fiscal discipline.

We also find that the number of years a rule has been in force improves the effect of the rules. In addition to a signal effect, the efficiency of the rules seems to improve with its duration of implementation. Monitoring institution have led to better performance of national numerical fiscal rules over the period 2000-2013. The supervisory framework of the European Union therefore appears efficient. This is confirmed by the positive and significant effect of the interaction between national numerical fiscal rules and the presence of independent institutions in charge of budget forecasts and / or budget monitoring.

The European Commission's strength index doesn't appear significant, highlighting that countries which have several elements of budgetary framework and rigor appears better for fiscal discipline but these elements doens't interact together on the fiscal rules effects. The number of rules in force improves the effect of national numerical rules on CAPB and on GFPI. As recommended by the European Commission (2010, chapter 3), taking into account complementarities between rules appears important. Fiscal Rules are more effective when there are different rules in force so it shows that there are complementarities between fiscal rules. . Finally, rules with stabilizing power improve fiscal discipline. These rules have a cyclically adjusted numerical objectives or exclud public investment. This result shows that some flexible rules could have a stronger fiscal disciplining effect and fiscal performing effect.

This revives the debate on the arbitration between rule and discretion but especially the dosage of the harshness of the rule. The free play of automatic stabilizers and the release of public investment seems to make it possible to reinforce fiscal performance, particularly with a feedback effect on growth and thus on the public budget balance and the public debt.

3.2 Recommendations and possible extensions

Finally we showed that the application of Propensity Score Matching to the European framework was effective and contained biases which are difficult to control with an other method. Our results are stable regardless of the method chosen for the calculation of the CAPB, making our results robust. We showed that lagged value of CAPB is a key element in the adoption of rules. The supranational rule, the SGP, appears to be a sufficient rule because Eurozone member countries are not encouraged to multiply the Debt and Budget Balance Rules once they are subject to SGP. Moreover it reinforces the effect of fiscal rules on the Global Fiscal Performance (even if SGP can't impact only the structural balance). A very important result is in the Matching step: when we look at a single element of fiscal discipline like CAPB, we observe that at least two types of rules can have a disciplining effect, the Budget Balance Rules and Expenses Rules. On the other hand, when we look at global fiscal performance, all rules can present a significative and positive effect. This suggests analyzing fiscal discipline in detail in order to put in place effective measures targeting the right elements. If the pri-

Table 5. Matching Results with FR (All fiscal Rules) as treatment variable. (HP filter is used to calculate cyclically adjusted primary balance CAPB)

	Nearest-neighbor Matching		Full Matching	Radius Matching		
	$N=1$	$N=2$		$c=0.01$	$c=0.025$	$c=0.05$
Dependant variable: $CAPB_{i,t}$ (Hp Filter Method)						
[1] ATT	**0.641*****	**0.464****	**0.507****	**0.332*****	**0.192***	**0.275****
	(0.240)	**(0.223)**	**(0.221)**	**(0.117)**	**(0.104)**	**(0.131)**
Number of treated observations	190	190	190	190	190	190
Number of control observations	180	180	180	180	180	180
Dependant variable: $GFPI_{i,t}$						
[2] ATT	**0.331****	**0.321****	**0.275****	**0.090***	**0.211*****	**0.271*****
	(0.158)	**(0.145)**	**(0.111)**	**(0.051)**	**(0.072)**	**(0.074)**
Number of treated observations	190	190	190	190	190	190
Number of control observations	180	180	180	180	180	180
Standardized difference in PS	$7{,}57.10^{-5}$	$6{,}12.10^{-5}$	0.0015	0.000	0.001	0.003
Standardized bias (p-value)	0.041	0.592	0.604	1	1	1

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Even if the distribution of Propensity Scores (are not to much distant, Matching is made in Common Support Region to make strong as possible Matching.

Table 6. Matching Results with BBR (Budget Balance Rules) as treatment variable. (HP filter is used to calculate cyclically adjusted primary balance CAPB)

	Nearest-neighbor Matching		Full Matching	Radius Matching		
	$N=1$	$N=2$		$c=0.01$	$c=0.025$	$c=0.05$
Dependant variable: $CAPB_{i,t}$ (Hp Filter Method)						
[1] ATT	**0.797***	**0.634***	**0.426***	**1.236*****	**0.875*****	**0.655*****
	(0.436)	**(0.373)**	**(0.244)**	**(0.299)**	**(0.190)**	**(0.219)**
Number of treated observations	116	116	116	116	116	116
Number of control observations	276	276	276	276	276	276
Dependant variable: $GFPI_{i,t}$						
[2] ATT	**0.283***	**0.118**	**0.273****	**0.304*****	**0.162****	**0.225****
	(0.154)	**(0.153)**	**(0.118)**	**(0.084)**	**(0.079)**	**(0.096)**
Number of treated observations	116	116	116	116	116	116
Number of control observations	276	276	276	276	276	276
Standardized difference in PS	$3{,}7.10^{-4}$	$6{,}12.10^{-5}$	0.0015	0.002	0.001	0.003
Standardized bias (p-value)	0.227	0.592	0.604	1	1	1

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Common Support Region is similar to all Sample (Appendix 2.2) so we can use all sample for Matching with BBR treatment.

Table 7. Matching Results with ER (Expenditure Rules) as treatment variable. (HP filter is used to calculate cyclically adjusted primary balance CAPB)

	Nearest-neighbor Matching		Full Matching	Radius Matching		
	$N=1$	$N=2$		$c=0.01$	$c=0.025$	$c=0.05$
Dependant variable: $CAPB_{i,t}$ (Hp Filter Method)						
[1] ATT	**1.095*****	**0.807****	**0.382**	**0.433*****	**0.766*****	**0.430*****
	(0.368)	**(0.329)**	**(0.240)**	**(0.104)**	**(0.175)**	**(0.142)**
Number of treated observations	115	115	115	115	115	115
Number of control observations	263	263	263	263	263	263
Dependant variable: $GFPI_{i,t}$						
[2] ATT	**0.478*****	**0.413*****	**0.286*****	**0.337*****	**0.329*****	**0.205*****
	(0.162)	**(0.150)**	**(0.121)**	**(0.080)**	**(0.073)**	**(0.075)**
Number of treated observations	115	115	115	115	115	115
Number of control observations	263	263	263	263	263	263
Standardized difference in PS	0.0014	0.0015	0.0056	0.001	0.000	0.001
Standardized bias (p-value)	0.694	0.120	0.00	1	1	1

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Matching is made in Common Support Region (see Appendix 2.3).

Table 8. Matching Results with DR (Debt Rules) as treatment variable. (HP filter is used to calculate cyclically adjusted primary balance CAPB)

	Nearest-neighbor Matching		Full Matching	Radius Matching		
	$N=1$	$N=2$		$c=0.01$	$c=0.025$	$c=0.05$
Dependant variable: $CAPB_{i,t}$ (Hp Filter Method)						
[1] ATT	**-0.149**	**-0.047**	**0.083**	**0.039**	**0.108**	**0.030**
	(0.263)	**(0.257)**	**(0.257)**	**(0.118)**	**(0.185)**	**(0.241)**
Number of treated observations	90	90	90	90	90	90
Number of control observations	225	225	225	225	225	225
Dependant variable: $GFPI_{i,t}$						
[2] ATT	**0.322***	**0.273***	**0.159**	**0.094*****	**0.208****	**0.246*****
	(0.180)	**(0.159)**	**(0.121)**	**(0.108)**	**(0.095)**	**(0.097)**
Number of treated observations	90	90	90	90	90	90
Number of control observations	225	225	225	225	225	225
Standardized difference in PS	0.0009	0.001	0.004	0.000	0.003	0.005
Standardized bias (p-value)	0.094	0.788	0.00	1	1	1

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively.Matching is made in Common Support Region (see Appendix 2.4).

Table 9. Heterogeneity of treatment effect of All Fiscal Rules (FR) on the CAPB.

Dependant variable: CAPB

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Dummy variable FR	0.262***	0.832***	0.622***	0.117	0.378***	−0.167	−0.070	0.335**	0.217	0.241**	0.065	0.303**
	(0.150)	(0.255)	(0.160)	(0.173)	(0.129)	(0.374)	(0.310)	(0.161)	(0.149)	(0.128)	(0.210)	(0.137)
Propensity Score	−0.983***	−0.765***	−1.015***	−1.027***	−0.959***	−1.047***	−0.966***	−1.070***	−1.036***	−0.956***	−1.043***	−1.140***
	(0.254)	(0.273)	(0.252)	(0.246)	(0.252)	(0.152)	(0.272)	(0.261)	(0.253)	(0.239)	(0.251)	(0.258)
Macroeconomics Factors												
FR * Real Gdp per capita	−0.029											
	(0.030)											
FR * Debt ratio$_{t-1}$		−0.0089***										
		(0.004)										
FR * Bad Time			−0.623**									
			(0.247)									
Political factors												
FR * Government Stability				0.363**								
				(0.150)								
FR * Election mode					0.355							
					(0.416)							
FR * Electoral cycles						0.345*						
						(0.195)						
Factors linked with Rules												
FR * Number years covered by rules							0.092**					
							(0.039)					
FR * SGP								0.096				
								(0.237)				
Strenght Index$_{FRSI}$									0.321**			
									(0.153)			
FR * Strenght Index$_{FRSI}$									−0.264			
									(0.177)			
FR * monitoring institution										0.675***		
										(0.200)		
FR * number of rules											0.190*	
											(0.108)	
FR * Flexibility												0.261*
												(0.143)
Observations	392	392	392	392	392	392	392	392	392	392	392	392
Multiple R^2	0.011	0.021	0.011	0.020	0.012	0.017	0.017	0.010	0.013	0.017	0.013	0.013

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Intercepts as well as vector X variables in isolation (without interaction with FR) are included but not reported for space purpose. Because of the distributions of Propensity Scores in Appendix 2.1 Common Support Region is really near from all sample, so for this step we can use all the sample.

Table 10. Heterogeneity of treatment effect of All FIscal Rules (FR) on the Global Fiscal Performance Index (GFPI).

Dependant variable: GFPI

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Dummy variable FR	0.364***	0.646***	0.322**	0.038	0.324***	−0.598	−0.028	0.136	0.261*	0.288**	0.033	0.142
	(0.125)	(0.241)	(0.141)	(0.155)	(0.123)	(0.444)	(0.287)	(0.153)	(0.145)	(0.134)	(0.185)	(0.137)
Propensity Score	0.414*	0.623**	0.416*	0.323	0.430**	0.392*	0.385*	0.428**	0.385*	0.427**	0.337	0.285
	(0.234)	(0.244)	(0.223)	(0.225)	(0.220)	(0.217)	(0.231)	(0.224)	(0.225)	(0.220)	(0.225)	(0.225)
Macroeconomics Factors												
FR * Real Gdp per capita	−0.021											
	(0.016)											
FR * Debt ratio$_{t-1}$		−0.007*										
		(0.004)										
FR * Bad Time			0.050									
			(0.142)									
Political factors												
FR * Government Stability				0.334**								
				(0.152)								
FR * Election mode					0.399							
					(0.375)							
FR * Electoral cycles						0.536**						
						(0.229)						
Factors linked with Rules												
FR * Number years covered by rules							0.071**					
							(0.035)					
FR * SGP								0.417**				
								(0.215)				
Strenght Index$_{FRSI}$									0.075			
									(0.117)			
FR * Strenght Index$_{FRSI}$									−0.056			
									(0.142)			
FR * monitoring institution										0.114		
										(0.148)		
FR * number of rules											0.153*	
											(0.088)	
FR * flexibility												0.306***
												(0.187)
Observations	392	392	392	392	392	392	392	392	392	392	392	392
Multiple R^2	0.048	0.075	0.050	0.080	0.050	0.11	0.062	0.067	0.050	0.051	0.062	0.074

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Intercepts as well as vector X variables in isolation (without interaction with FR) are included but not reported for space purpose. Because of the distributions of Propensity Scores in Appendix 2.1 Common Support Region is really near from all sample, so for this step we can use all the sample.

mary structural balance deteriorates sharply it is possible to adopt Budget Balance Rules and Expenses Rules, especially because we have highlighted that they are complementary. Moreover, the effect of the rules must be considered with a set of related factors. In particular, the more "flexible" the rules are, the more important their effect is. This does not imply that they aren't strong but they aren't rigid. National numerical fiscal rules with a power of stabilization have greater effect. National numerical fiscal which exclude investment can also be more effective. For example, a golden rule can improve fiscal performance while maintaining a productive investment sufficient to generate growth. Moreover, in the control of heterogeneities, it appears that the SGP makes it possible to improve the GFPI.

The disciplining nature of national numerical fiscal rules must nevertheless be observed with the attendant consequences of this effect. The improvement in balance budgets has been accompanied by a drastic drop in public investment in the European Union (with its adverse effects on growth). Indeed, the decrease in public investment is concomitant to the rise in the number of national fiscal rules and the improvement of budget balances in the member countries of the European Union. This is accompanied by disappointing growth rates in the European Union and the Euro Zone. The public investments made in 2009 to counter the financial crisis have nevertheless demonstrated the importance of the impact of public interventions on growth. Guerguil and al (2017) highlighted that while the fiscal rules in general have experienced strong growth since the 2000s, the flexible rules have stopped increasing in number since 2002.

At this stage, the link between national numerical fiscal rules and public investment in the European Union should be examined.

In particular, it would be a matter of assessing if the investment is an important determinant when the rules are not respected, highlighting the arbitration of governments between respect for national rules and growth objectives. It sets (quantitatively) the question of the establishment of a golden rule or better still, the form that the optimal fiscal rule should take in the Economic and Monetary Union. A golden rule excludes public expenditures from Budget Balance Rules objectives. However, the evaluation of a golden rule remains unclear and often qualitative (see for example (Creel, 2003)) and the rules that exclude from their objective investment are few.

In addition, we also do not forget that our study does not embrace sub-national rules. Foremny (2014) assesses the influence of subnational fiscal rules and fiscal autonomy on the budget balances of sub-national sectors (regional and local governments) in the 'EU-15' (Belgium, France, Germany, Italy, Luxembourg, Netherlands, Denmark, Ireland, United Kingdom, Greece, Spain, Portugal, Austria, Finland and Sweden) between 1995 and 2008. It is important to take into account the link between the sub-national level and the higher level of power. Whether the country is a federation or a unitary state, the mechanism for linking the hands of lower-level governments will not be the same. The results of Foremny (2014) show that fiscal rules are effective to reduce deficits in unitary countries, while sub-national deficits in federations are reduced through fiscal autonomy. Thus, the effectiveness of fiscal rules also depends on decentralization of power and coordination between upper and lower levels of power. Thus, the European Commission ((2010, chap 5), (2015)) or Jacquet and Pisani-Ferry (1997) address the issue of a reform of fiscal governance including increased transparency between all national and sub-national governments but also in the supranational exchanges between member countries of the European Union (and more particularly of the Euro Zone).

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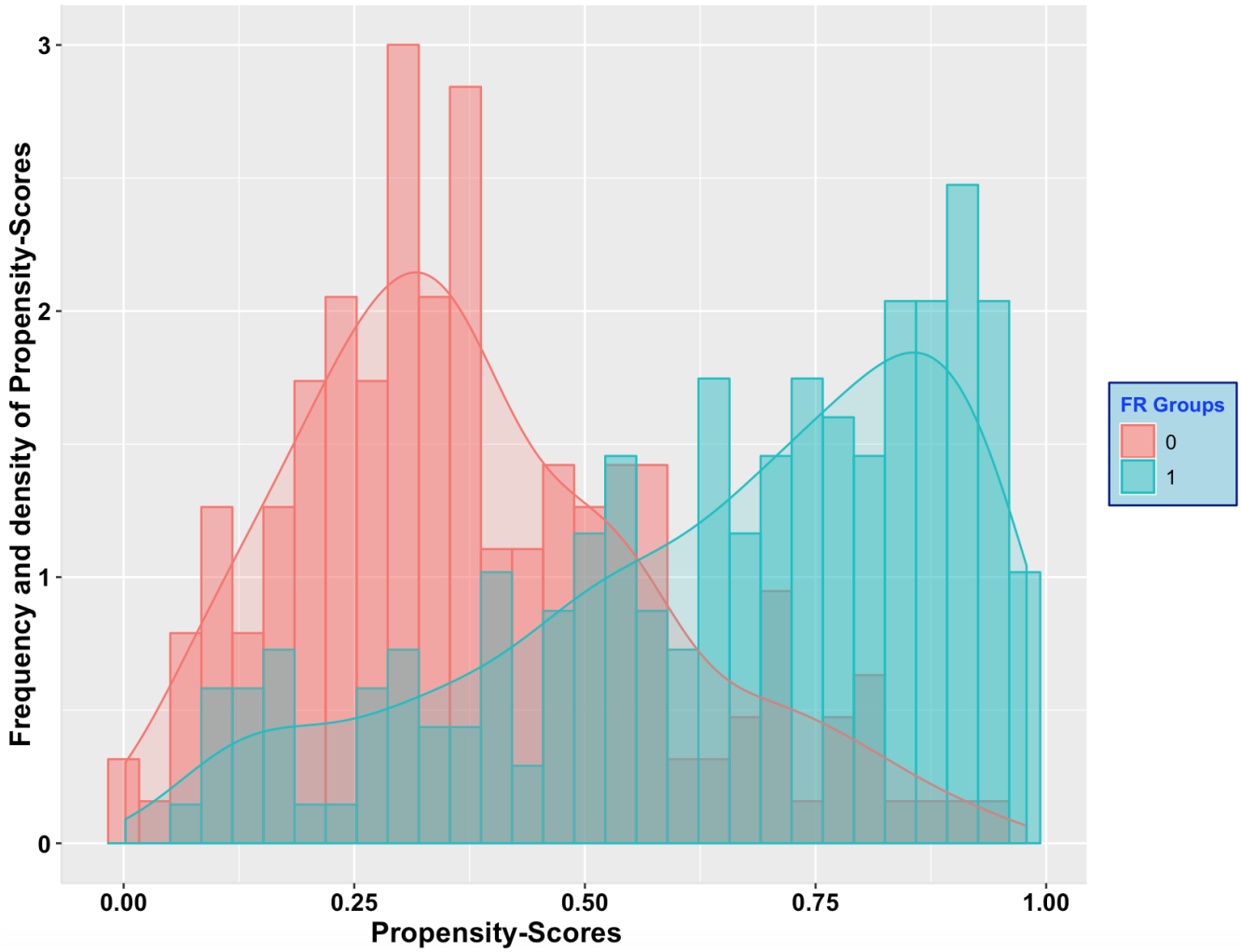
Appendices

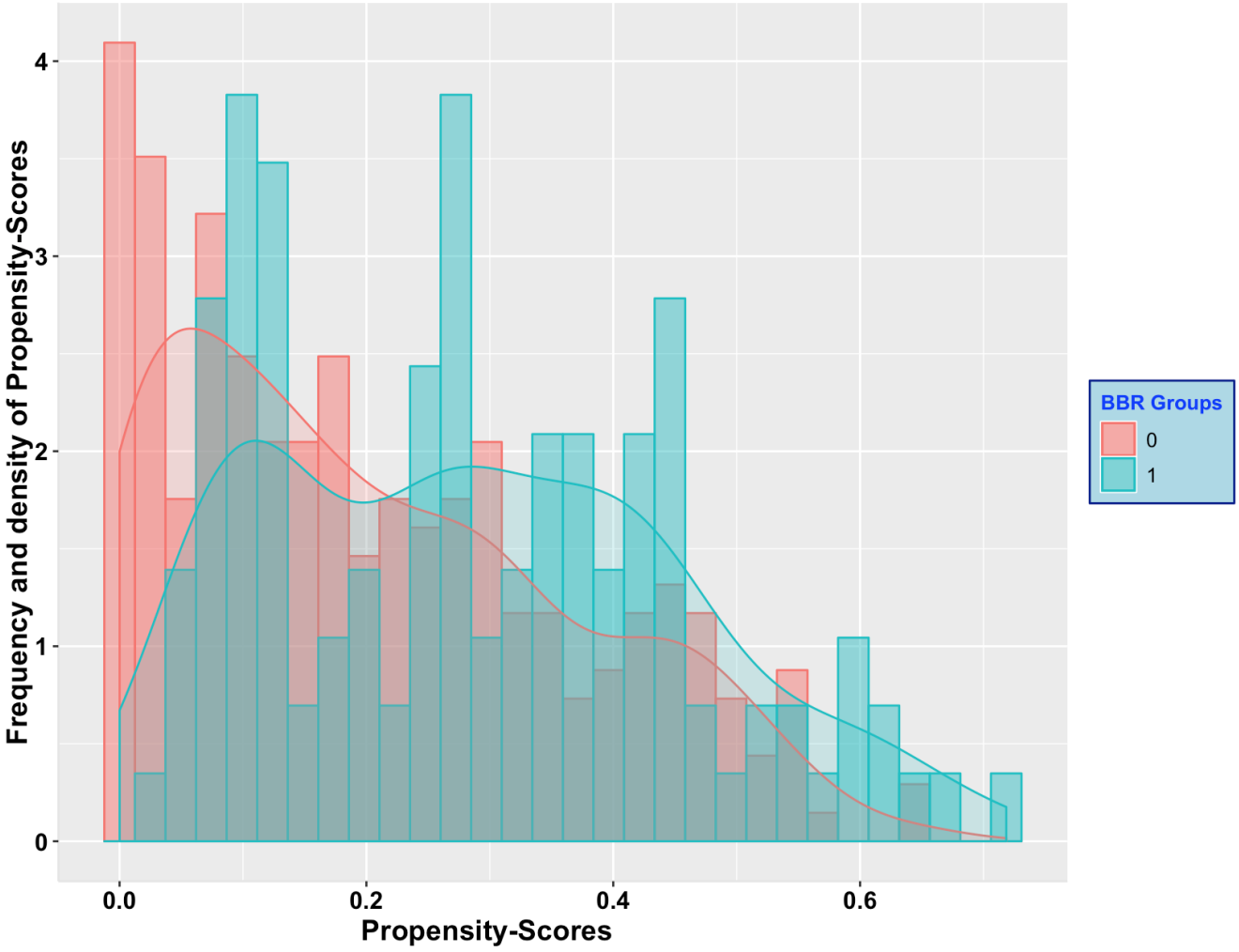
Appendix 1: Fiscal Rules excluded by definition

Countries/Fiscal Rules Excluded	Budget Balance Rule BBR	Debt Rule DR	Expenses Rules ER	Revenue Rule RR
Austria	2000-2013 : MTBF (FMI Fiscal rules Database and Reuter (2015))			
Belgium	Note: Belgium adopted a BBR in 2014 (according to FMI and European Comission databases), so Belgium doesn't have a fiscal rules on our study period.	-	-	-
France	2013 : The rule is written in the public finance programming law that can be revised, so it is not comparable to a numerical rule in the sense of Kopits and Sysmanky We classify it as a MTBF			2006-2013 : MTBF
Unitd-Kingdom	2009 : Rule abandoned during the year 2009 (FMI fiscal rules database and Reuter (2015))	2009: Rule abandoned during the year 2009 (IMF fiscal rules database) 2010: rule also abandoned in 2010. Mathieu and Sterdyniak (2012) mention that the debt of the United Kingdom even reached 60.5% in 2011 which reinforces us in the decision to exclude this rule in 2010. On the other hand we remain in agreement with the European Commission and the IMF on the return to the budget balance rule as early as 2010.	-	-

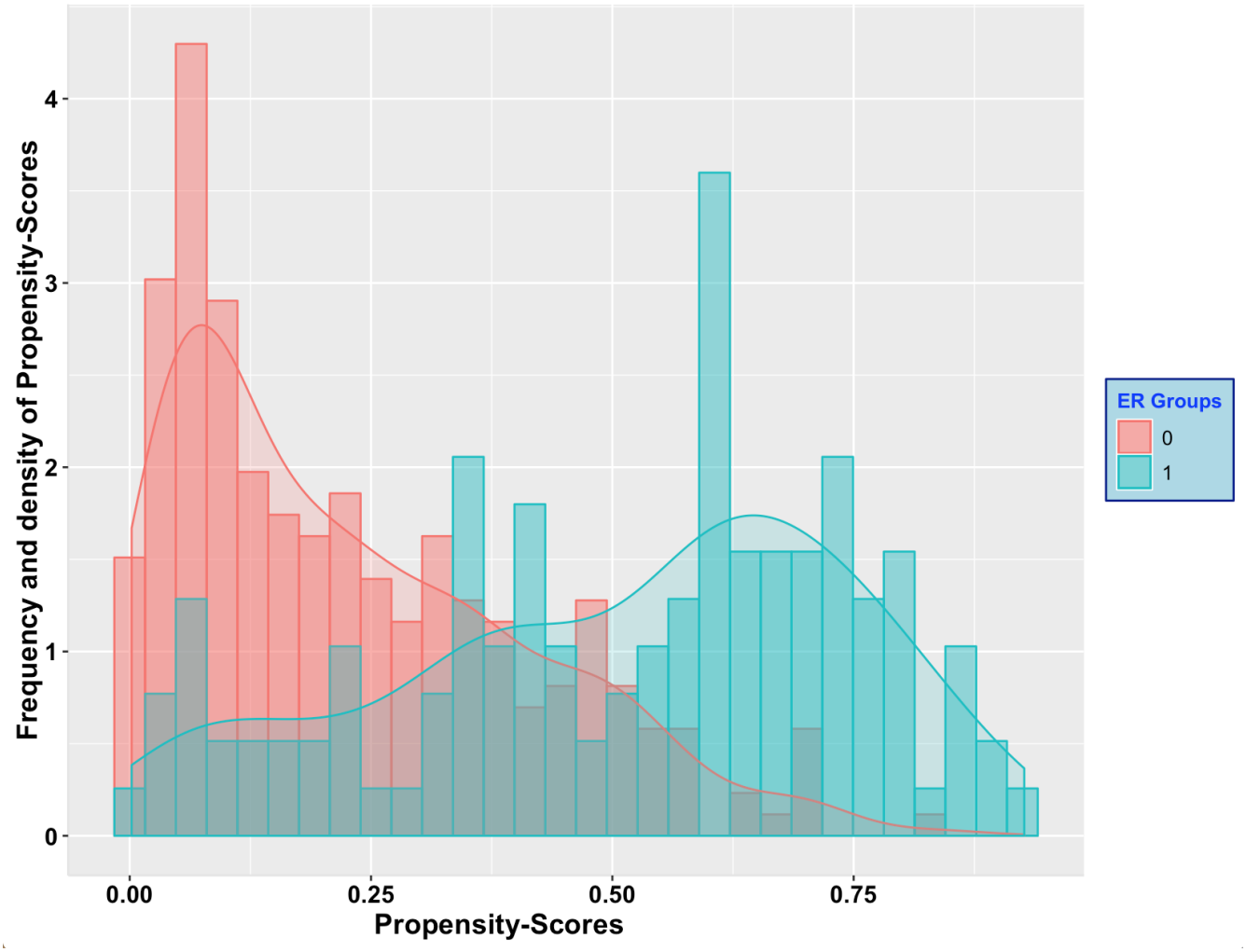
Appendix 2.1: Common Support Region for FR



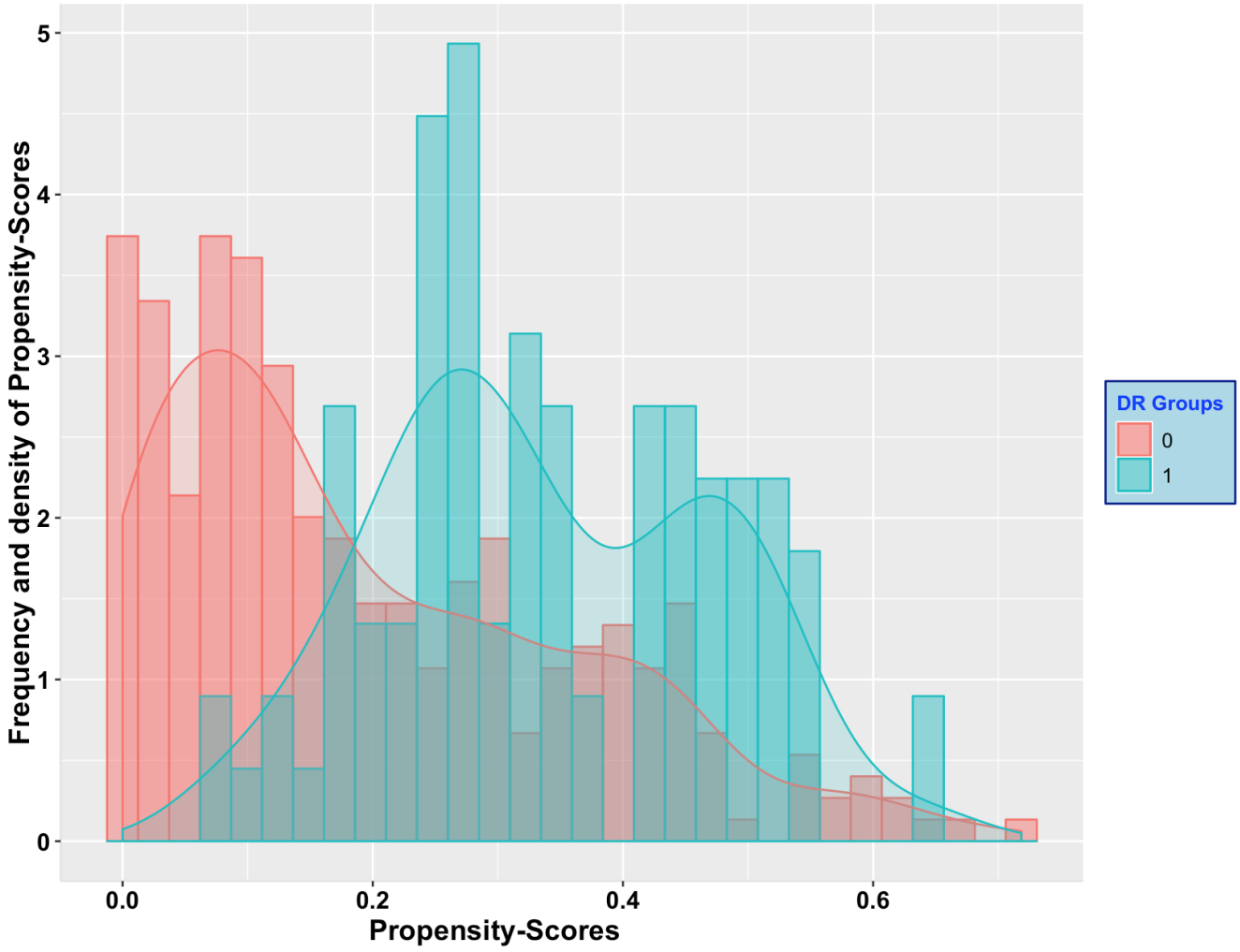
Appendix 2.2: Common Support Region for BBR



Appendix 2.3: Common Support Region for ER



Appendix 2.4: Common Support Region for DR



ANNEXE 3: Correlations between Indicators to construct the Global Fiscal Performance Index.

	(Total) Budget Balance	External Deficit	Decrease in Revenues of Public Administrations	Sustainability Debt Index
(Total) Budget Balance	1.000	-0.338	-0.010	-0.099
External Deficit	-0.338	1.000	-0.002	0.052
Decrease in Revenues of Public Administrations	-0.010	-0.002	1.000	0.017
Sustainability Debt Index	-0.099	0.052	0.017	1.000

Appendix 4. Propensity Scores Results (Trigonometric filter is used to calculate cyclically adjusted primary balance CAPB)

Dependent variable	[1] FR	[2] BBR	[3] ER	[4] DR
Intercept	-5.734***	-7.454***	-8.964***	-0.208
	(1.019)	(1.157)	(1.207)	(1.039)
$CAPB_{t-1}$	0.104**	0.085**	0.065	0.025
	(0.043)	(0.046)	(0.044)	(0.048)
Debt $ratio_{t-1}$	-0.024***	-0.017***	-0.013***	-0.022***
	(0.003)	(0.003)	(0.003)	(0.003)
Real GDP growth	-0.041*	-0.033*	-0.083***	0.004
	(0.022)	(0.020)	(0.021)	(0.020)
Dependency ratio	0.163***	0.174***	0.183***	0.013
	(0.022)	(0.024)	(0.025)	(0.021)
Inflation rate	-0.083***	-0.057*	-0.013	-0.062**
	(0.029)	(0.030)	(0.027)	(0.032)
Government stability	-0.338**	0.214	0.419**	0.200
	(0.168)	(0.180)	(0.181)	(0.196)
SGP	-0.223	-0.519***	0.223	-0.447***
	(0.171)	(0.176)	(0.177)	(0.178)
Dummy EU membership	0.266	0.224	0.257	0.256
	(0.397)	(0.415)	(0.479)	(0.398)
Adjusted R^2	0.359	0.321	0.358	0.235
Number Observations	392	392	392	392
Cramer-von Mises test (p-value)	0.402	0.329	0.155	0.114

Note: Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. FR = All Fiscal Rules, BBR = Budget Balance Rules, ER = Expenditure Rules, DR = Debt Rules.

Appendix 5. Propensity Scores Results (IMF serie using production-function to calculate cyclically adjusted primary balance CAPB)

Dependent variable	[1] FR	[2] BBR	[3] ER	[4] DR
Intercept	-5.818***	-7.446***	-9.462***	-0.985
	(1.101)	(1.304)	()	(1.188)
$CAPB_{t-1}$	0.061**	0.087**	0.007	-0.025
	(0.030)	(0.033)	(0.031)	(0.036)
Debt $ratio_{t-1}$	-0.024***	-0.017***	-0.012***	-0.020***
	(0.003)	(0.003)	(0.003)	(0.004)
Real GDP growth	-0.037	-0.015	-0.067***	0.014
	(0.025)	(0.024)	(0.025)	(0.024)
Dependency ratio	0.166***	0.181***	0.192***	0.020
	(0.023)	(0.026)	(0.025)	(0.023)
Inflation rate	-0.059	-0.071	-0.033	-0.072***
	(0.045)	(0.045)	(0.051)	(0.046)
Government stability	-0.367**	-0.370*	0.504**	0.536**
	(0.184)	(0.200)	(0.205)	(0.236)
SGP	-0.317**	-0.713***	0.167	-0.430***
	(0.180)	(0.190)	(0.185)	(0.187)
Dummy EU membership	0.242	0.261	-0.134	0.211
	(0.447)	(0.480)	(0.639)	(0.448)
Adjusted R^2	0.356	0.372	0.377	0.212
Number Observations	356	356	356	356

Note: Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. FR = All Fiscal Rules, BBR = Budget Balance Rules, ER = Expenditure Rules, DR = Debt Rules.

Appendix 6. Heterogeneity of treatment effect of All Fiscal Rules (FR) on the CAPB. Logit is used for Propensity Score.

Dependant variable: CAPB

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Dummy variable FR	0.463***	0.826***	0.624***	0.121	0.382***	−0.170	−0.064	0.334**	0.223	0.246*	0.070	0.259*
	(0.155)	(0.255)	(0.160)	(0.173)	(0.1130)	(0.373)	(0.309)	(0.161)	(0.149)	(0.128)	(0.210)	(0.143)
Propensity Score	−0.978***	−0.756***	−1.006***	−1.019***	−0.954***	−1.042***	−0.955***	−1.055***	−1.025***	−0.950***	−1.034***	−1.077***
	(0.251)	(0.271)	(0.250)	(0.243)	(0.249)	(0.152)	(0.269)	(0.258)	(0.250)	(0.237)	(0.248)	(0.251)
Macroeconomics Factors												
FR * Real Gdp per capita	−0.029											
	(0.030)											
FR * Debt ratio$_{t-1}$		−0.009***										
		(0.004)										
FR * Bad Time			−0.619**									
			(0.247)									
Political factors												
FR * Government Stability				0.362**								
				(0.150)								
FR * Election mode					0.354							
					(0.415)							
FR * Electoral cycles						0.351*						
						(0.195)						
Factors linked with Rules												
FR * Number years covered by rules							0.091**					
							(0.039)					
FR * SGP								0.109				
								(0.237)				
Strenght Index$_{FRSI}$									0.316**			
									(0.153)			
FR * Strenght Index$_{FRSI}$									−0.260			
									(0.195)			
FR * monitoring institution										0.675***		
										(0.200)		
FR * number of rules											0.190*	
											(0.108)	
FR * Flexibility												0.260*
												(0.143)
Observations	392	392	392	392	392	392	392	392	392	392	392	392
Multiple R^2	0.011	0.022	0.011	0.020	0.012	0.017	0.017	0.010	0.013	0.017	0.013	0.013

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Intercepts as well as vector X variables in isolation (without interaction with FR) are included but not reported for space purpose. Because of the distributions of Propensity Scores in Appendix 2.1 Common Support Region is really near from all sample, so for this step we can use all the sample.

Appendix 7. Propensity Scores Robustness check (HP filter is used to calculate cyclically adjusted primary balance CAPB)

Dependent variable	[1] FR	[2] FR	[3] FR	[4] FR	[5] FR	[6] FR	[7] FR
Intercept	-5.736***	-6.066***	-5.781**	-5.544*	-5.762***	-5.753***	-5.413***
	(1.020)	(1.107)	(1.021)	(1.089)	(1.054)	(1.025)	(1.068)
$CAPB_{t-1}$	0.109***	0.109***	0.112***	0.111***	0.110***	0.112***	0.088*
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.049)
Debt $ratio_{t-1}$	-0.024***	-0.025***	-0.025***	-0.025***	-0.024***	-0.025***	-0.022***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.008)	(0.003)	(0.004)
Real GDP growth	-0.037*	-0.036*	-0.035	-0.037*	0.037-*	-0.037*	-0.039*
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Dependency ratio	0.163***	0.168***	0.164***	0.161***	0.163***	0.165***	0.157***
	(0.022)	(0.023)	(0.022)	(0.022)	(0.022)	(0.022)	(0.023)
Inflation rate	-0.085***	-0.085***	-0.084***	-0.084**	-0.085***	-0.085***	-0.087***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.030)
Government stability	-0.343**	-0.295*	-0.341**	-0.306*	-0.350**	-0.326**	-0.383**
	(0.168)	(0.181)	(0.184)	(0.184)	(0.175)	(0.172)	(0.174)
SGP	-0.221	-0.209	-0.212	-0.214	-0.220	-0.220	-0.273
	(0.171)	(0.172)	(0.172)	(0.172)	(0.172)	0.171)	(0.179)
Dummy EU membership	0.272	0.287	0.247	0.275	0.272	0.280	0.285
	(0.396)	(0.400)	(0.400)	(0.397)	(0.396)	(0.397)	(0.398)
Adding External deficit		0.001					
		(0.002)					
Adding Decrease in Revenues			-0.023				
			(0.024)				
Adding Trade Openess				-0.002			
				(0.003)			
Adding Squared Debt $Ratio_{t-1}$					-0.000007		
					(0.00007)		
Adding Government fragmentation						-0.152	
						(0.303)	
Adding Total Budget $Balance_{t-1}$							0.029
							(0.028)
Adjusted R^2	0.360	0.361	0.362	0.361	0.360	0.361	0.363
Number Observations	392	392	392	392	392	392	392

Appendix 8. Matching Results with FR (All Fiscal Rules) as treatment variable. (Trigonometric filter is used to calculate cyclically adjusted primary balance CAPB. Logit is used for Propensity Score.)

	Nearest-neighbor Matching		Full Matching	Radius Matching		
	$N=1$	$N=2$		$c=0.01$	$c=0.025$	$c=0.05$
Dependant variable: $CAPB_{i,t}$ (Hp Filter Method)						
[1] ATT	**0.676***	**0.368***	**0.491****	**0.726*****	**0.460*****	**0.409*****
	(0.363)	**(0.226)**	**(0.223)**	**(0.096)**	**(0.140)**	**(0.096)**
Number of treated observations	180	180	180	180	180	180
Number of control observations	188	188	188	188	188	188
Dependant variable: $GFPI_{i,t}$						
[2] ATT	**0.353****	**0.305****	**0.273****	**0.130**	**0.250*****	**0.279*****
	(0.165)	**(0.146)**	**(0.111)**	**(0.096)**	**(0.083)**	**(0.058)**
Number of treated observations	180	180	180	180	180	180
Number of control observations	188	188	188	188	188	188
Standardized difference in PS	0.0005	0.00046	0.0008	0.002	0.001	0.000
Standardized bias (p-value)	0.030	0.7586	0.6772	1	1	1

Note: PS = Propensity Score. Bootstrapped standard errors (with 500 replications) in brackets. *, **, *** indicate the significance level of 10%, 5%, and 1%, respectively. Matching is made in Common Support Region to make strong as possible Matching.

Appendix 9. Source of all variables used in the study

Variable	Source
Debt/PIB ratio	IMF Historical Database
Term of trade (index)	IMF
Primary Balance	AMECO Database
Revenues of public administrations	Eurostat
Inflation	IMF
Commodity Price Index	Federal Reserve Bank of St Louis
Real PIB	World Bank
Population	World Bank
Governmnent Stability	World Bank (Worldwide Governance Indicators)
Dependency ratio	World Bank (Worldwide Governance Indicators)
Government fragmentation	Wolrd Bank (DPI 2015)
Election mode	Wolrd Bank (DPI 2015)
Electoral Cycles	Wolrd Bank (DPI 2015)
External Deficit	EUrostat
Fiscal Rules	IMF Fiscal Rules Database
Number of rules	IMF Fiscal Rules Database
Number of years covered by rules	Autor's calculations
Flexibility of rules	IMF Fiscal Rules Database
(cyclically-adjuted or rules which exclue public investment)	IMF Fiscal Rules Database
Total Budget Balance	IMF
Structural budget balance (Hodrick Precott filter)	Autor's calculations
Structural budget balance (Trigonometric filter)	Autor's calculations
Structural budget balance (function of production approach)	IMF
Interest of debt	World Bank (World Development Indicators)
Output Gap (Hodrick Prescott filter)	Autor's calculations
Output Gap (Trigonometric filter)	Autor's calculations