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Fiscal rules' compliance and Social Welfare

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Abstract

This paper studies the side-effects of fiscal rules' compliance on the economy and social welfare. It considers Budget Balance Rules' (BBR) compliance effects on maroeconomic indicators and social welfare proxy indicators in sixteen countries between 2004 and 2015. Instead of fiscal rules strength or fiscal rules presence effectiveness, we focus on fiscal rules' compliance to assess the impact of governments behavior on the social area. The paper shows that governments go beyond the expected trade-off between BBR's compliance and GDP Growth by operating a reallocation of their spending. Such choices in public expense lead to an increase in social inequalities highlighted that governments finally face a trade-off between fiscal rules' compliance and social objectives. The analysis constitutes the first use of double/debiased machine learning for treatment recently developed by Chernozhukov et al. [2018] applied to fiscal discipline issues. Through this method we are able to highlight key determinants for BBR's compliance and assess the compliance's effect on different macroeconomic and social indicators. We take care of Voter Preferences by computing a new proxy though Latent Factor Analysis Approach, and show that Voter prefenreces appear as a key variable for BBR's compliance, giving an empirical proof that Wyplosz [2012]'s bias matters.

Keywords: Fiscal rules' compliance; Social Welfare; Fiscal Surveillance; Machine learning.

JEL Codes: E61, H11, H50, H61, H62.

1 Introduction

During the last two decades countries experienced the world economic shocks (2008-2009 and 2010-2013) due the Global Financial Crisis. Recently the pandemic crisis due to the Covid-19 (2020-2021) increased the existing imbalances in public finance for many countries and raised the need for fiscal sustainability recovery after crises. Consequently, there is a growing discussion on fiscal discipline and its tool to restore sound public finance. Fiscal rules were implemented to achieve fiscal discipline and support fiscal sustainability since the common pool problem (Wyplosz [2012]) or governments temporal inconsistency (Kydland and Prescott [1977]) lead to important discretionary behaviors from public decision-makers [1]. Nowadays, fiscal rules are under debate since many of them suffer from a lack of compliance, leading economists such as Blanchard et al. [2021] to argue in favor of replacing them by "Fiscal Standards".

This paper feeds the debate by investigating the effect of fiscal rules' compliance on economic and social area. Indeed, identifying potential side-effects of fiscal rules' compliance will allow to argue in favor of maintaining or discarding fiscal rules. The rigorous effect of fiscal rules on public finance received a lot of attention in the literature[2]. If fiscal rules may affect public spending to ensure fiscal discipline, we want to study if compliance also achieves that task since many existing studies only focused on the effects of the presence and/or the rigor of fiscal rules but not on their compliance effects. Nevertheless, the pandemic crisis (2020-2021) hit economies from public finance to social field leading to new social challenges. Indeed, Blundell et al. [2020] provided evidences on the pandemic crisis impacts on inequalities in different fields such as employment and ability to work or investments and health. A naïve fiscal policy that may consist in considering fiscal rules only for their disciplining effect on public finance, will forget the potential side-effect on economic growth and social indicators that are linked under the concept of Social Welfare. Otherwise, the paper also raises the question of the definition of the compliance with fiscal rules. Since compliance may be considered in a simple definition where the fiscal rules met or not the limit (as in Reuter [2019]), compliance may also be considered in a more sophisticated form[3]. Indeed, we must pay attention to the design of fiscal rules' that may include escape clauses. Consequently, in presence of such escape clauses, the definition of compliance will be more complex: do we have to consider that a country is a non-complier when there is an escape clause activated? Starting from the expecting effects of fiscal rules' compliance (namely disciplining effect on public finance[4]) and then extending the study on economic and social indicators, we try to answer the following question: How fiscal rules' compliance may affect Social Welfare?

To address this problematic, we propose to study the effect of fiscal rules' compliance on several channels that make the link with Social Welfare. After the seminal work of Arrow [1951], the concept of Social Welfare was formalized in economics. We pay attention to the simple definition of Social Welfare which refers to the Welfare of a society. Social Welfare is thus relative to political economy and appears in the government objectives. Hediger [2000]

[1] Such considerations are even more important in monetary union as European Monetary Union where externalities are important (Dabrowski [2015]). Fiscal rules set the question of political constrain in monetary union (Grauwe [1975], Grauwe [2000]) and compliance is thus important to raise fiscal rules' credibility.

[2] See e.g. Debrun et al. [2008], Bergman et al. [2016],Tapsoba [2012] , Combes et al. [2018]

[3] See also for an alternative definition, Larch and Santacroce [2020] who explained the concepts to construct the European fiscal rules' compliance Tracker. In this database the European Deficit rule is complied with if the public balance is superior do 3% or if the limit is exceeded, the deviation should be smaller than 0.5% of GDP and over only one year.

[4] Reuter [2019] already showed that government implement a lot of efforts to comply with their rules to conduct sound fiscal policies.

discussed government trade-offs among social, ecological, and economic objectives. By studying the link between fiscal rules' compliance and Social Welfare, we here implement a testing analysis of the potential government trade-off between fiscal discipline (reflecting here by fiscal rules' compliance), social and economic objectives. Indeed, the list of Social Welfare determinants may concern a lot of candidates such as financial development Marini [2005], institutions Acemoglu [2003], international trade (Samuelson [1938]), fiscal policy (Gosh and Roy [2004]) and monetary policy (Lawler [2001]), geography (Smith [1974]), the level of development... Consequently, Social Welfare may be linked with economic growth and social indicators, and this paper tries to identify the ones on which fiscal rules' compliance may have an impact.

First of all, Social Welfare is related to the level of public debt (see e.g Flodén [2001] or Aiyagari and McGrattan [1998])[5]. The level of public debt is linked to the redistributive government function and could help people in smoothing their consumption (Burbidge [1983]). But growing public debt also leads to the common pool problem (Wyplosz [2012]) that may appear negative for future generations. We therefore are interesting in the link of fiscal rules' compliance and public debt. But, fiscal rules are numerical constraint that must be complied in a year, it thus appears difficult to assess a long-run effect on the stock of public debt. Indeed, fiscal rules' compliance may easier affect public deficit which is a short-term flow variable than the total stock of debt accumulated over many years. Our first link with public debt and fiscal rules' compliance will be made by the assessment of the relationship between fiscal rules' compliance and public deficit that feeds public debt. On the other hand, if fiscal rules' compliance may be able to decrease public deficit, it could send a positive signal to financial market leading to a decrease in the interest rate on public debt. It may consequently reduce the debt burden and gives governments more leeway. On that sense, we are interested on the effect of fiscal rules' compliance on both public balance and public debt interest rate.

Also, Social Welfare may be linked with GDP growth. First, Midgley [1999] explained that Social Welfare may be driven by the distribution of resources generated by GDP growth. GDP growth may thus affect Social Welfare itself but also through an undirect channel constituted by government performance. Indeed, government performance may increase during favorable economic periods which are supported by significant GDP growth rate, because governments may be less constrained. Nevertheless, the compliance effect is ambiguous regarding both economic growth and government performance. It could lead to an increase in government effectiveness[6] as suggested by Larch et al. [2021] but may also imply a trade-off between fiscal rules' compliance and GDP growth objectives (Bohn and Inman [1996]). We will thus look at the effect of fiscal rules' compliance on GDP growth per capita and government performance alternatively measured by government effectiveness and government efficiency indices. Second, distributional effect and government performance are also close to the nature of public spending that government implement. Indeed, Midgley [1999] explained that government may use positive return from GDP growth to implement social programs. This discussion is closed to the Musgravian functions[7] that government face. We thus should pay attention to the composition of public expenditure because they are a tool to conduct the redistribution function. It is also not clear how public expense affect economic growth. If public sector conducts inefficient spending, public spending may be damageable for economies. On the other hand, the government size may support economy and

[5]Flodén [2001] showed that variations in public debt may enhance Social Welfare. Aiyagari and McGrattan [1998] studied the question of the optimal amount of public debt for Social Welfare in the US.

[6]Larch et al. [2021]measured government effectiveness using the World Band index.

[7]Allocation ; Stabilization (Stabilization power of fiscal rules was already studied by Sacchi and Salotti [2015] or Guerguil et al. [2017] who highlight that fiscal rules are able to stabilize GDP variations and public expenditures); Redistribution.

public spending may be protected. On that sense, if fiscal rules' compliance may affect public spending to ensure fiscal discipline, the effect of fiscal rules' on economic growth is not clear. Castro [2011] investigated the link between fiscal rules and economic growth but there is no reference to effect of the compliance. We precise our main interest in the compliance effect, not the presence or the rigor of fiscal rules, and we study a potential higher social cost due to compliance.

Otherwise, we also should conduct further investigation in the final effect of government redistribution on inequalities. According to Kuznet [1955]'s work, the GDP growth is also linked with Inequalities in a non-linear relationship. Inequalities may thus introduce an additional channel with Social Welfare. Nevertheless, the link between fiscal rules and Inequalities is not obvious. Studying developing countries, Combes et al. [2019] found that Expenditure Rules increase inequalities while Budget Balance Rules and Debt Rules not; whereas Hartwig and Strum [2019] showed that fiscal rules increase inequality based on disposable income measures in the European Union. In line with these studies, we are interested in the side-effects of fiscal rules but we still focus on fiscal rules' compliance effects. We will propose to assess the compliance impact on inequalities measured by proxy indicators including the Gini Index computed by the World Bank.

To achieve the empirical analysis, the paper follows a several steps approach and the fiscal rules' compliance determinants identification constitute the first step. Determinants of fiscal rules' compliance were already studied in the literature (see Reuter [2019], Delgado-Téllez et al. [2017], Baret et al. [2021]). In our analysis we focus on national fiscal rules, and precisely on Budget Balance Rules (BBR). We follow Baret et al. [2021]'s approach by identifying the main determinants of fiscal rules' compliance using increasing popular Machine Learning methods that have proven their ability to select the most prominent variables among many potential determinants. The second step constitutes the Treatment Effect measurement. We expect that complied fiscal rules may have effects that non-complied fiscal rules couldn't have, and we will mostly focus on the potential side-effects of compliance. This second step uses, as dependent variables, the aforementioned channels to investigate the effect of budget balance rules compliance on Social Welfare in sixteen countries from 2004 to 2015.

Our approach first extends traditional assessment of fiscal rules effectiveness to fiscal rules' compliance performance. On that sense, we can measure the performance of fiscal rules with regards to the ultimate objective set out in the rules. Our study thus excludes problems due to approaches that use composite indices which are time invariant[8]. Nevertheless, variables related to composite indices as the strength of fiscal rule, are included in the present approach by testing if they are key predictors for budget balance rules' compliance in the first step of our methodology. Second, our use of Double/debiased Machine Learning (DML) treatment (Chernozhukov et al. [2017], Chernozhukov et al. [2018]) for fiscal discipline assessment is unprecedent and excludes biases that could happened in studies on fiscal rules as discussed in Heinemann et al. [2018][9]. The algorithm, based on Norman Orthogonality, is supported by strong asymptotic properties, and it

[8]This implies that they do not consider the current numerical target and do not consider for macroeconomic country situation.

[9]Heinemann et al. [2018], pointed out that the majority of studies assessing the impact of fiscal rules on fiscal discipline is highly biased because endogeneity is not controlled enough. Indeed, methods to assess the effects of the fiscal rules are numerous including Instrumental Variable (IV) method, system-Generalized Method (sys-GMM) of Moments or propensity-score Matching. IV and sys-GMM performance highly depends on instruments' choice and quality (see Fajeau [2021] for discussion on instruments used in GMM models for economics studies and Belloni et al. [2018] for a debiased GMM estimator that uses Machine Learning tools) and propensity-scores is related to random assignment (meaning that conditional independence assumption must hold according to Rosenbaum and Rubin [1983]).

generates a useful estimator for causal inference. DML estimator indeed avoids reverse causality bias (which often occurs with standard econometrics) and reduces the potential omission bias since we can test a huge number of predictors. Third, we include a proxy measure for Voter Preferences to increase the robustness of our analysis. This last point seems being a major added value among the existing literature on fiscal rules since previous studies based the robustness of their results on the assumption that Voter Preferences doesn't affect the results and proposed many statistics robustness checks. Nevertheless, there is no certainty that these studies can control for omission bias and, in particular, the importance of Voter Preferences discussed by Wyplosz [2012].

Our main empirical findings first highlighted that Voter preferences is a key determinant for BBR's compliance. Consequently, it suggests that studies dealing with fiscal rules performance issues should carefully take into account for Wyplosz [2012]'s bias. Second, we provided some evidences on BBR's compliance side-effects on Social Welfare. The negative consequences of strict compliance operate through public spending composition which mainly affect redistribution function and thus Inequalities indicators. Government seem not to operate a trade-off between economic objectives and BBR's compliance since we do not find a significant effect of strict compliance on GDP growth rate. Nevertheless, a compliance definition which takes care of the presence of escape clauses changed the results since we found a positive effect of compliance on economic growth rate after taking into account for escape clauses presence. It may suggest that introducing flexibility in fiscal rules' definition matter for economic health. However, the negative impact on Inqualities is not solved by relaxing compliance definition and need new reflexions on fiscal rules design to carefully preserve public social spending.

The rest of the paper is organized as follow: Section 2 presents the literature review. Section 3 describes Data and exposes stylized facts on fiscal rules' compliance and Social Welfare channels. Section 4 develops the methodology and Section 5 presents the results and robustness checks. Section 6 concludes the analysis.

2 Literature review

The number of national fiscal rules increased in OECD countries since 1990's but the biggest world shocks (2008-2009 and 2010-2013) and the Covid-19 crisis (2020-2021) made fiscal rules impossible to comply. The non-compliance raised the fiscal rules design trilemma (Debrun et al. [2019]), explaining that it is impossible for a fiscal rule to be enforceable, simple and flexible at the same time. Nevertheless all these crises highly increased debt unsustainability risk, raising the discussion on the relevance of fiscal rules for sustainability recovery. Indeed, a large part of the literature focused on fiscal rules performance rules by studying their ability to strengthen fiscal discipline (Debrun et al. [2008], Marneffe et al. [2010], Bergman et al. [2016] or Barbier-Gauchard et al. [2021] pointed out that fiscal rules have positive effect on fiscal discipline in EU countries. Similar results were found by Tapsoba [2012] for developing countries or Combes et al. [2018] mixing countries.). Consequently the debate placed the design of fiscal rules as the major question to preserve fiscal rules credibility which may be reinforce by compliance achievement. The definiton of an ideal fiscal rules proposed by Kopits and Symansky [1998] introduced the concept of enforceability[10]. To make fiscal rules binding, sanctions can be included in the fiscal rules' design (as it is the case in the Stability and Growth Pact (SGP)[11]) and independant fiscal

[10]As defined by Kopits and Symansky [1998], the ideal fiscal rule should be simple regarding the target, clear, enforceable, consistent in the time, accompagnied by an adequate fiscal framework.

[11]The beginnings of European fiscal rules enforceability come from the Maastricht Treaty (1992) with the excessive deficit procedure. The supranational rule in the EMU has been formalized in the SGP. Indeed, in the

councils should be in charge of monitoring[12]. Compliance thus appears being a major concept when assessing fiscal rules performance.

However, all aforementionned works do not empirically assess fiscal rules' compliance effects. Our approach mainly focuses on the fiscal rules' compliance effects and tries to investigate the potential side-effects by identifying the mechanisms that make it possible to comply with the rules. As further developped in the introduction, we analyze the effect of national budget balance rules compliance on social welfare channels that may cover GDP growth (Midgley [1999]), government performance (see Sacks and Levi [2010] for a study at microeconomic level), Inequalities (see Sen [1977] for theorical development on welfare inequalities concept) or spending composition (Fan and Pestieau [2019]).

There is an existing literature on fiscal rules' compliance and the first part of this literature focused on fiscal rules' compliance determinants. Delgado-Téllez et al. [2017] used a First Difference General Method of Moments to identify fiscal rules non-compliance determinants in Spain's regions taking into account that bailing out could be due to voluntary government behaviors relfecting political motives during elections for example (see also L.Schuknecht [2004] for such consideration in EU context) or unvoluntary government behaviors due to cyclical events as economic shocks for example. Reuter [2019] used a logit model following a causal approach to identify the determinants of fiscal rules in European Union members between 1995 and 2015. Reuter [2019] found that the more strenght is the fiscal rule the more it is complied with. Such rules could be too strict and thus not enough flexible (as expected by Kopits and Symansky [1998]'s' definition) inducing social costs. A logit model is also used in Nandelenga and Ellyne [2020] that extend the study of fiscal rules' compliance in the conext of 20 sub-Saharian countries between 1997 and 2016. Due to our several steps approach, namely Double/Debiased Machine Learning methodology, we will identify the determinants that higly count for national budget balance rules compliance. This work is achieved in the first step and does not correspond to a simple correlation identification approach but allow to retrieve the determinants that are sufficient to explain variations in compliance.

A second part of the literature is interested in the government behavior face to the fiscal rules' compliance. In an other contribution, Reuter [2015] studied the dynamic of compliance showing that even if fiscal rules aren't comply, government implement efforts to move close to the limit. This work was extended to emerging and developping countries; including both national and supranational rules in Caselli et al. [2018]. Similarly, Eyraud et al. [2018] highlighted the "magnet-effect" describing the trend of government to move close to the limit of fiscal rules. Such studies point out the benchmark status that the fiscal rules seem to have. Larch et al. [2021] showed that EU supranational fiscal rules reduce public debt and promote counter-cyclical fiscal policies. Since we are interested in the potential side-effect of compliance on Social Welfare, we extend this part of the literature by investigating the effect of budget balance rules compliance on public finance indicators and public spending composition. Any change in the spending allocation and redistribution function of governement implied by fiscal rules' compliance may lead to side-effect on Social Welfare. This also builts a bridge with fiscal rules' compliance effect on Inequalities. The side-effects of fiscal rules simple presence on Inequalities was already adressed by Combes et al. [2019] and Hartwig and Strum [2019]. Combes et al. [2019] found that BBR do not imply an increase in equalities for developing countriles while Hartwig and Strum [2019] found a postitive effect of fiscal rules on inequalities in the EU. Despite the divergence between these results, they do not put a word on compliance effect. We thus extend these works by assessing if countries that comply with their national budget balance rules generate a

event of a recession of at least 2% of GDP, the European Commission then considers the economy in an exceptional situation, lifting the obligations to comply fiscal rules included in SGP.

[12]See Beetsma et al. [2018] for an assessment of fiscal councils effect on governments commitment.

side-effect on Inequalities which are related to Social Welfare.

Finally, the last part of the litterature focuses on fiscal rules' compliance forescating. Council [2013] paid attention to their Budget Balance Rule compliance. They provided projection on the General Government Deficit, Primary Deficit and Structural Deficit to study the *future* fiscal rules' compliance. Baret et al. [2021], focusing on supranational fiscal rules, forecasted the SGP compliance. Following a two-step methodology, their work highlighted the determinants that most accuratly forecast the SGP's Budget Balance Rule[13] compliance. Such finding sets a major difference from analyzes previously mentionned that studied the determinants of fiscal rules' compliance. Indeed, Baret et al. [2021] are not interested in all the elements that could influence fiscal rules' compliance but which weighs most strongly in the event of non-compliance. This suggests that some variables are more important than others in such assessment and the influence of a poorly correlated variable would not be enough to lead to a systematic rule violation. Despite we do not propose a forecasting study, our approach is interested in the identification of the key variables that design our treatment variable, namely BBR's compliance[14] which justifies our choice to follow their first step methodology in a causal inference study.

3 Data and Stylized facts

3.1 Data

3.1.1 Definition of Fiscal rules' compliance

All Budget Balance Rules and their target's definition come from IMF Fiscal Rules Database (Schaechter et al. [2016]) and targeted values' sources are developped in details in Appendix 1. Appendix 2 summarizes all BBR retained in this analysis and provides details on their definition. The construction of our dataset is driven by several constrains:

First, fiscal rules are defined as a numerical constrain set on public finance indicators (leading to Budget Balance Rules (BBR), Expenditure Rules (ER), Debt Rules (DR) and Revenue Rules (RR)). These different types of fiscal rules imply different effects[15]. On that sense we have to study the compliance by type of rule. The selected rules must be comparable to obtain a reasonnable average treatment effect and thus have to hold over the same period[16]. We finally indentified sixteen countries who had a Budget Balance Rules over the same period but we were not able to identify enough countries which would have applied the same rule over such a period for the other types of rules. The study includes the following sixteen countries[17] which had a BBR between 2004 and 2015: Chile, Costa Rica, Denmark, Estonia, Finland, Germany, Hungary, Indonesia, Japan, Malaysia, New Zealand, Peru, Spain, Sweden, Switherland, United Kingdom. Thirteen of these countries are OECD countries and the dataset was completed with countries that were also under a BBR on the period 2004-2015.

Second, we had to precisely define each BBR including the possible presence of exclusion clauses. Because we adopt a simple definition of compliance - i.e. a country complied with (resp.

[13] The well-known 3% of public deficit.

[14] Such a condition is necessary in order to offer efficient Machine Learning estimators and proposes a strong approach for specification identification. Nevertheless, the identification of fiscal rules' compliance is only the first step of our approach which is a causal approach (since we are interested in the treatment effect of BBR's compliance) and it is not a forecasting model as in Baret et al. [2021].

[15] See for heterogeneities of fiscal rules effect Debrun et al. [2008] or Barbier-Gauchard et al. [2021]).

[16] We could skew the distribution of the sample by taking countries that have had a fiscal rule for 5 years and compare them to countries that had a fiscal rule throughout our study period.

[17] Despite Israel also had a BBR all over this period, it is discarded due to the annual change in the targeted value of BBR which does not match with the definition of an annual numerical target.

did not comply with) the BBR wether it presents an indicator above or equal to (resp. below) the target -, we must take into account the presence of escape clauses that allow countries to meet the limit during "exceptional" economic circuntances [18]. The presence of escape clauses can disrupt the distribution of compliance as they are a part of the fiscal rules' design. The escape clauses also set a huge debate on the compliance definition that we try to consider by testing the influence of such escape clauses on our results. Our robustness check regarding escapes clauses are twice: i) we test wether the presence of an escape clause is a key determinant for national BBR's compliance in order to capture their influence on the treatment measurement; ii) we will conduct a robustness check of the treatment effect by removing all observations that did not complied with BBR but which had, simultaneously, an escape clause in the BBR's definition[19].

Third, some countries of our dataset need a special attention. (1) United Kingdom abandonned its golden rule in 2009 due to the Global Financial Crisis (GFC) that led to an excessive deficit making impossible the compliance with the Budget Balance Rule. They reintroduced a different Budget Balance Rules in 2010. Indeed, in 2010, United kingdom adopted a multi-annual Budget Balance Rule by targeting a balanced structural budget at the end of 5 years (2014). This new BBR is interpretated as an annual change targeted variables (Caselli et al. [2018], Reuter [2019]). Finally the UK just decided to abandon a BBR in 2009 because they expected not to comply with the Golden Rule as the impact of the GFC was huge on public deficit. We therefore consider that United Kingdom voluntarily didn't comply the golden rule in 2009. We then verify if this assumption does not affect our results by then conducting a robustness check which consists in removing this year-corresponding-observation from our sample. (2) Hungary had two fiscal rules between 2009 and 2011. Only the BBR that concerned General government is considered since all other countries are treated with only one BBR. Also, Hungary had no longer fiscal rules after 2011 in the IMF Database (Schaechter et al. [2016]). But Fiscal Compact (also known as "The Treaty on Stability, Coordination and Governance (TSCG)") was transposed in their national law, on that sense we could consider that Structural deficit should be above 0.5% (because debt is higher that 60%; as describes in TSCG). We also conduct the robustness check removing Hungary observations after 2011. (3) In Caselli et al. [2018] , Reuter [2019] Japan Golden rules isn't considered after 1993 since waiver looks as request. Since IMF Database includes it and Japan Government seems to still hold it, we follow IMF Database and include it.

3.1.2 The potential determinants for Budget Balance Rules' compliance and proxy variables for social welfare channels

Table 1 first reports the dependent variables of our interest. As discussed in the introduction, we identified several channels related to social welfare which are named "social welfare related indicators" in table 1. We consider them as reasonnable proxies for social welfare. Some of these channels are thus represented by macroeconomic variables as public balance, interest payments on public debt, general government gross fixed capital formation, general government final consumption[20], GDP per capita annual growth, GDP per capita expectations. To complete the dataset we indeed produced a measure for GDP growth expactation based on a moving-average

[18]For example, the European Commission defines exceptionnal circunstances in the SGP escape clauses as a recession of 2% of GDP.

[19]Such observations may be interpretated as compliers if they are allow to exceptionnally deviate from their national rule. In that sense, we have to control if including them as non-compliers following a simple definition of compliance, doesn't affect the results.

[20]General Government final consumption is divided in Government individual consumption (P.31 in Eurostat classification) which includes social transfers and governement non-market production of individual goods ans services (D.631 and D.632), and Government collective final consumption (P.32 in Eurostat classification) which oncludes Government collective non-market output, other related to collective goods and services (P.132-5.631).

approach (over 5 years). because we expected that governement will make some choices in their spending by expecting GDP growth results. In other words, we expect that BBR's compliances may drive government expectations. As developped in introduction both finance public variables and economic growth variables are linked with government performance and its re distribution function. Thus, dependent variables also concern government performance by including the Government Effectiveness Index from the World Bank, and an computed index of Government Efficiency which summarized government Musgravian functions. We aim at comparing the effect of BBR's compliance on Governement Effectiveness and Governement Efficiency that are two different concepts. Following Afonso et al. [2006] and Afonso et al. [2019], we compute a measure for Government Efficiency. Since Government Efficiency index is computed over-year, we choose 3-over-years computation (instead of 5 as often found in the literature) to reduce the time-invariance of the indicator. In that sense we have three periods where the Governement Efficiency takes the same value: 2004-2007, 2008-2011, 2012-2015. We use mean-min function to aggregate 3 sub-indicators which correspond to Musgravian functions (see Afonso et al. [2006] or Afonso et al. [2019] for similar proxies): - the proxy for distribution function is Gini Index; - the proxy for stabilization function is the result of a sub-aggregation of the GDP per capita growth rate and inflation (3 years average); - the proxy for Economic performance function is the Unemployment. Finally , due to the link between government performance and Inequalities previously developped, among the dependent variables we also introduced Inequalities related measures such as the Gini Index from World Bank and the Poverty headcount ratio at 1.90$ a day which is defined as the percentage of the population living with less than 1.90$ per day.

Table 1 then summarized the list of potential predictors that may affect both BBR's compliance and dependent variablest. In line with many results from studies analyzing the determinants of fiscal rules' compliance[21], we expect that the compliance will be affected by many macroeconomic environment variables named "Macroeconomic Environment Variables" in Table 1 , but also by political variables (as the presence of election) named "Countries characteristic Variables" or variables related to fiscal rules' design (as the strenght of fiscal rules) named "Fiscal Rule Related characteristics". However, we are interested in those which are recurrent from one country to another and which contain the most useful information to explain the compliance with the budget balance rules.

To extend the list of potential determinant and improve the empirical literature on fiscal rules' compliance's determinants, we follow Debrun and Kumar [2007] and Wyplosz [2012] who suggested that fiscal rules effect could suffer from reverse causality bias. This argument is also supported by recent findings in Heinemann et al. [2018]. Such bias may still hold when assessing fiscal rules' compliance effect. Indeed, if compliance could imply differences in macroeconomic indicators, these latters could also influence the governments in their commitment (degraded public finance can strengthen the governments' willingness to comply with fiscal rules in order to restore sound public finance). We will thus be really carefull in the used of lagged macro variables in the tested dataset for potential predictors. Moreover, Wyplosz [2012] argued that Voters' Preferences may affect government behaviors, especially regarding the fiscal rules' compliance. Indeed, decision-makers may be tempted to break fiscal rules aiming at increase social spending to be re-elected. Conversely, if voters prefer disciplined governments, public authorities could force compliance with the rules. We thus follow Funk and Gathmann [2013] that used Latent Factor analysis to compute a measure of Voter Preferences for Swiss Canton. To do so, use five main variables that should reflect voter behavior namely Unemployment, Age dependency ratio (old in % of working-age poplation), the share of votes obtained by the largest government party,

[21] Reuter [2019], Delgado-Téllez et al. [2017], Larch et al. [2021] for example

the vote share obtained by the first opposition party, the vote share obtained by independent parties. The Chi-test revealed (for varimax and promax rotation) that 2 factors are sufficient. We will thus use these two factors as control variables since they constitute good proxies for Voter Preferences[22].

[22]If the feature selection step reveals that one or both of the factors are a key determinant for fiscal rules' compliance, it will give an empirical recommandation for studies on fiscal compliance to control for Voter Preferences.

Table 1: **Variables Overview**

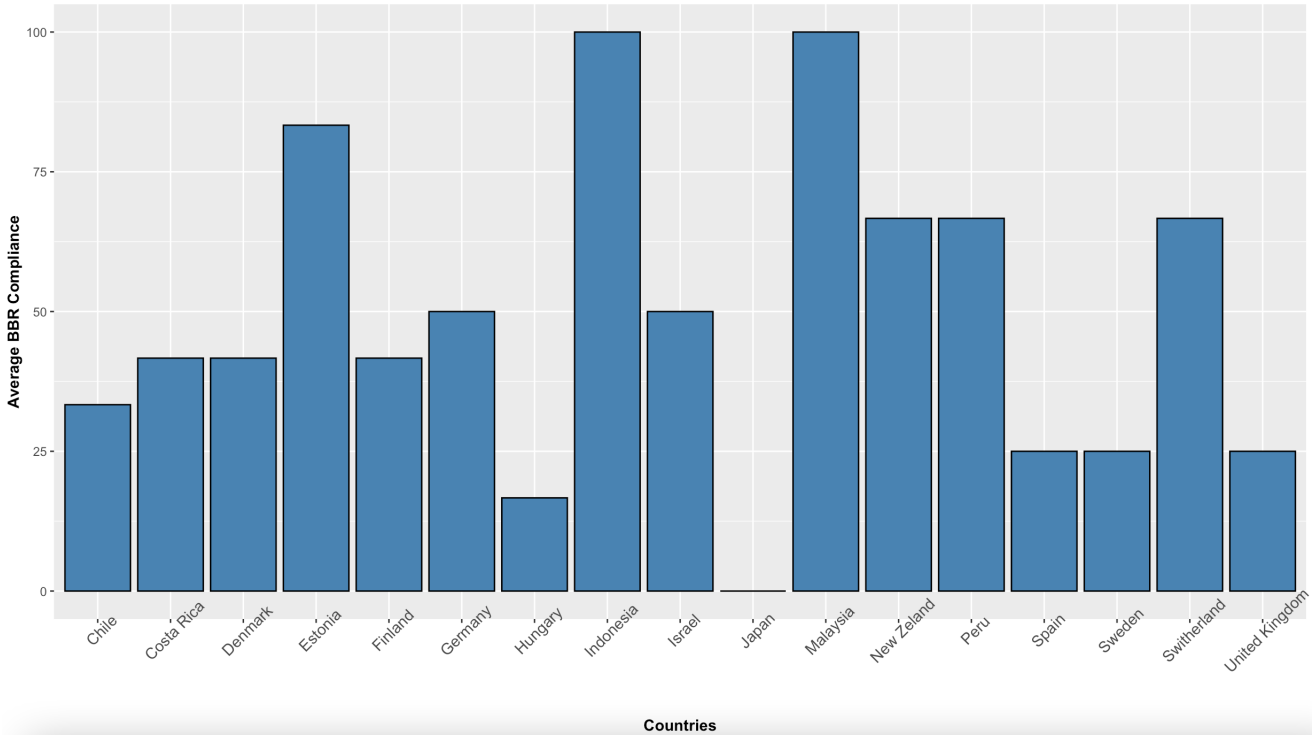
Variables	Correspondance Variables	Source/Database	
Dependant	Public Balance (in % of GDP)	World Bank	
Dependent	Interest payments (in % of expense)	World Bank	
Dependent	GG Gross Fixed Capital Formation (in % of GDP)	World Bank	
Dependent	GG Total Spending (in % of GDP)	World Bank	Social
Dependent	General Government Final Consumption (in % of GDP)	World Bank	Welfare
Dependent	GDP per capita expectations		Related
Dependent	GDP per capita (annual growth) in $t+1$		Indicators
Dependant	Government Effectiveness Index	World Bank	
Dependant	Government Efficiency Index	Author's calculation	
Dependent	Gini Index	World Bank	
Dependent	Poverty headcount ratio at $1,90$\$ a day (2011 PPP) (% of population)	World Bank	
Predictor	Control of corruption	WWGI	
Predictor	Political Stability	WWGI	
Predictor	Regulatory Quality	WWGI	
Predictor	Rule of law	WWGI	
Predictor	Voice and Accountability	WWGI	
Predictor	Dummy reflecting if the country is an Advanced country	IMF Fiscal rules' Database	
Predictor	Dummy reflecting if the country is a Ressource Rich country	IMF Fiscal rules' Database	
Predictor	Dummy reflecting if the country is an Emerging country	IMF Fiscal rules' Database	
Predictor	Dummy reflecting if the country is an Advanced country	IMF Fiscal rules' Database	Countries
Predictor	Dummy reflecting if the country is a EU member	IMF Fiscal rules' Database	Characteristic
Predictor	Dummy reflecting if the country is member of a currency union	IMF Fiscal rules' Database	indicators
Predictor	Political system	WWGI	
Predictor	Dummy reflecting if there was an legislative election in this year	WWGI	
Predictor	Dummy reflecting if there was an executive election in this year	WWGI	
Predictor	Executive Index of Electoral Competition	WWGI	
Predictor	The number of years the chief execute has been in place	WWGI	
Predictor	Time since formation of the largest government party	WWGI	
Predictor	Proxy 1 for Voter's preferences	Authors' calculations with LFA	
Predictor	Proxy 2 for Voter's preferences	Authors' calculations with LFA	
Predictor	Well specified escape clauses	IMF fiscal rules' Database	
Predictor	Monitoring of compliance outside government	IMF fiscal rules' Database	
Predictor	Formal enforcement procedure	IMF fiscal rules' Database	Fiscal
Predictor	Coverage level	IMF fiscal rules' Database	rule
Predictor	Dummy reflecting if an independent body sets budget assumptions	IMF fiscal rules' Database	Related
Predictor	Dummy reflecting of an independent body monitors implementation	IMF fiscal rules' Database	characteristics
Predictor	Dummy reflecting if the BBR is a golden rule	Authors' narrative approach and IMF fiscal rules Database	
Predictor	Dummy for economy conjoncture		
Predictor	Oils rents		
Predictor	Interest payments on debt in $t-1$		
Predictor	Gross Fixed Capital Formation (annual growth) in $t-1$		
Predictor	Gross Fixed Capital Formation (in % of GDP) in $t-1$		
Predictor	The Current account balance in $t-1$		
Predictor	The Unemployment rate in $t-1$		
Predictor	Trade (in % of GDP) in $t-1$		
Predictor	Inflation, consumer prices (annual %) in $t-1$		Macroeconomic
Predictor	Inflation, GDP deflator (annual %) in $t-1$		Environment
Predictor	Wage in $t-1$		Variables
Predictor	GDP per capita growth (annual %) in $t-1$		
Predictor	Labor Force in $t-1$		
Predictor	External Balance in $t-1$		
Predictor	General Government budget balance in $t-1$		
Predictor	General Government final consumption in $t-1$		
Predictor	Central government debt (in % of GDP) in $t-1$		
Predictor	Gross savings in $t-1$		
Predictor	Total expenses in $t-1$		

Note: GG = General Government; LFA = Latent Factor Analysis; GDP per capita expectation is computed using a 5 years moving-average approach based on GDP per capita data coming from the World Bank.

3.2 Fiscal rules' compliance Stylized facts

This part simply introduced graphical overviews that help to reinforce the intuitions developped in the introduction regarding the links we investigate between fiscal rules' compliance and Social Welfare channels.

Figure 1 first shows a high heterogeneity in government behaviors regarding national BBR's compliance. While some countries as Estonia, Indonesia, Malaysia or Switherland take care of the compliance, other as Japan, Hungary or Spain highlight a poor compliance record. These countries are historically, socialy and structurally different. On that sense, we expect that the identification of key common determinants for BRR's compliance would helpus to provide explanations about such differences.



Note: "0" means that the country never complied with its national BBR. "100" means that the country complied every year accross 2004-2015 period.
Source: Authors.

Figure 1: **Average Budget Balance Rules' (BBR) compliance between 2004 and 2015, in %**

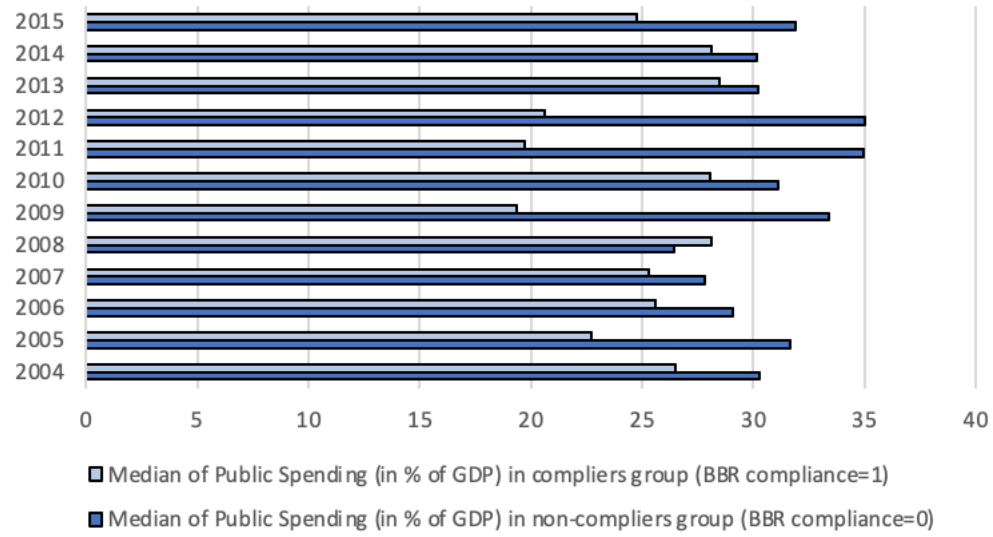
Face to this heterogeneity between countries regarding BBR's compliance, we are interesting on the potential effects of these differences. In other work, what we can suggest by graphically comparing compliers group (countries that complied with their BBR) and non-compliers group (countries that didn't comply with their BBR). We will focus on the Social Welfare channels previously discussed and try to provide simple graphical intuitions to support our empirical analysis. In order to keep this part simple and relate elementary intuitions, we focused on the differences between the medians of each group. Appendix 3 provides a comparison of public

spending and GINI index between each group by quantiles.

In Figure 2, the median of total public expenditure (in % of GDP) looks higher in countries that didn't comply with their BBR. It suggests that countries from compliers group operate a cut in public spending in order to comply with their BBR. This fact seems to reflect the disciplining effect of compliance since compliers implement more efforts by reducing total public spending to comply with their national BBR. Nevertheless, this simple overview does not provide information on which type of public spending are affected by the cut from compliers. The redistributionnal tools for borrowed money (that generate public deficit) or for economic growth ressources, may be into public spending composition. Among public spending we may find unproductive spending such as interest payment on public debt or productive investment such as public GFCF. Otherwise, social spending, such as transfers, are included in Government Final Consumption expenditure which are a part of total public expenditure. We thus need a deep empirical analysis of the effect of BBR's compliance on public spending composition.

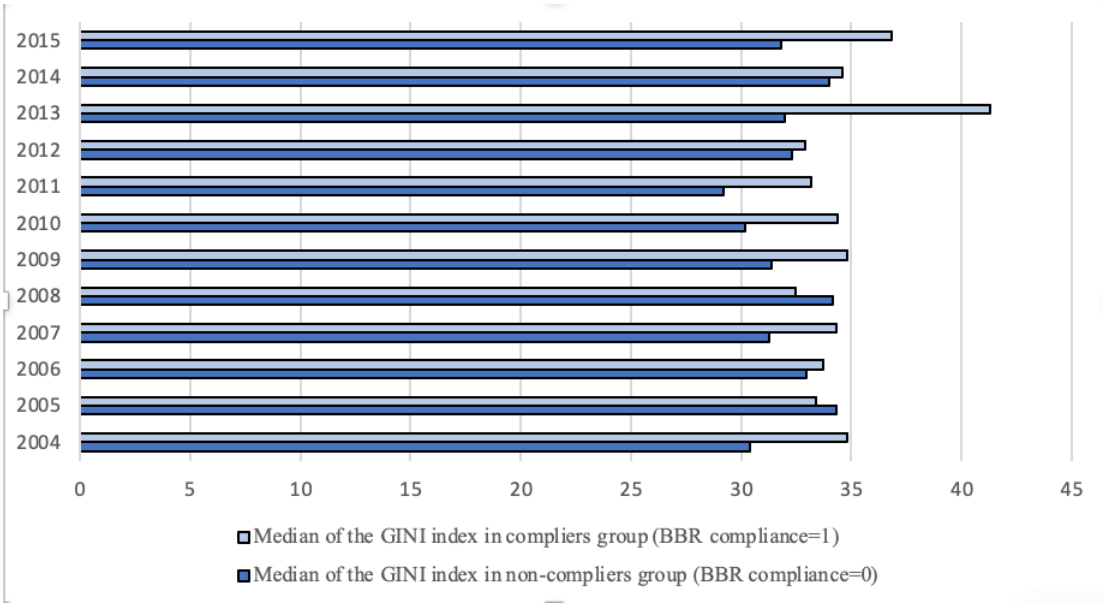
In parallel, figure 3 shows that the median of the Gini index seems to be higher for BBR-compliers which suggests that inequalities are higher for them. This highlight would mean that the cut in public spending seems to be done through public social spending and thus need a carefull attention. We also see that the differences in Gini Index highly increased after the Global Financial Crisis. Gini Index median became even more higher for compliers, suggesting that the GFC increased the social costs for compliance.

We have to notify that in the year of the Global Financial Crisis shock (2008) we observe a change in the previous findings: Gini index is lower for compliers and it is also the case for the total public expenditure. It may be due to the escape clauses application in this year which means that there was no BBR enforcement letting countries to implement their fiscal impulsion to help in economic recovery. The BBR's compliance groups do not present the same facts as those observed in "normal" time because the circumstances are exceptional and the governments do not therefore behave with the same rigor face to fiscal rules. Thus, during crises we observe less compliance, and countries which complied with BBR in normal times can observe important economic and social shocks. They must therefore increase their spending in order to counter the rise of social inequalities linked to the deterioration of their economies. In a few words, it is the exceptional circumstances that generate exceptional facts. When we move away from the crisis shock, we observee that countries which tend to comply with their BBR spend less and exhibit more inequalities. This point launches our motivation to empirically study the influence of the escape clauses on fiscal rules' compliance.



Source: Authors.

Figure 2: **Comparison of the median of the Public Spending between BBR compliers and BBR non compliers**



Source: Authors.

Figure 3: **Comparison of the median of the GINI index between BBR compliers and BBR non compliers**

4 Methodology

4.1 Treatment Effect Estimation

Recently, some studies focused on the usefulness of machine learning (ML) for the causal inference that belongs to the applied econometric field (Varian [2014], Mullainathan and Spiess [2017] or Athey and Imbens [2017]). Several techniques were developped to improve ML performance in the work of treatment effect methodology. Among these techniques we can find: i) sample splitting which uses different data partition to select the best models and parameters (see Athey et al. [2016] or Wager and Athey and Imbens [2017]) and ii) orthogonalization (e.g. Chernozhukov et al. [2017]). Such approaches imply properties as asymptotic normality for these ML estimators (see Athey et al. [2017] for the general semiparametric case or Chernozhukov et al. [2018] for the average treatment effect case).

The main goal of our procedure is to estimate confidence intervals for a low-dimensional parameter β_0 with high-dimensional nuisance parameter η_0. This η_0 should be estimated with recent nonparametric statistical methods namely Machine Learning. ML methods highlight high level forecasting power (see Härdle et al. [2009], Gogas et al. [2018] or Baret et al. [2021]). However, this performance in forecasting does not imply inference performance for "causal" parameters. To solve such problem, Chernozhukov et al. [2017] developped "double/debiased" Machine Learning (also called orthogonalized ML), introducing an approach inspired from Frisch-Waugh-Lovell (Frisch and Waugh [1933], Lovell [1963]) with a combination of feature selection and sample splitting aiming at proposing a strong estimator for causal parameters.

Our model is a partially linear model that could be written as:

$$Y = \beta_0 * D + \gamma_0(Z) + U, \qquad \mathbb{E}[U|Z, D] = 0, \tag{1}$$

with Y the outcome variable, D the treatment/policy variable, Z is a high-dimensial vector of controls/confounders, β_0 is our paramter of interest.
Z corresponds to control variables on the sense that the treatment $D = b_0 + \theta_0(Z) + V$ with $\theta_0 \neq 0$

If conditionnal exogeneity (view Rosenbaum and Rubin [1983]) is respected, β_0 corresponds to the average treatment effect of the treatment. The Double/Debiased Machine Learning (DML) works in several steps:

1) In a first step we will use two machine learning approaches[23] to predict Y and D on Z to obtain $\widehat{E[Y|Z]}$ and $\widehat{E[D|Z]}$. This step corresponds to the feature selection.

2) We then extract residuals $\widehat{W} = Y - \widehat{E[Y|Z]}$ and $\widehat{V} = D - \widehat{E[D|Z]}$. This step is an extraction of the residuals.

3) Following Frisch-Waugh-Lovell procedure (Frisch and Waugh [1933], Lovell [1963]) we regress $\widehat{W}$ on $\widehat{V}$ that allows us to obtain $\widehat{\beta_0}$. This step is the orthogonalization procedure.

All these steps are done with cross-validation procedure also named sample spliiting. More precisely, we use k-fold cross validation. We thus split our dataset in k subsets and $k-1$ subsets are used as training set while the k^{th} constitues the testing set. We will use 5-fold validation in all the paper. As discussed in Athey and Imbens [2019], each nuisance parameter could converge at rate close to $N^{-1/4}$ which corresponds to a magnitude's order slower than the Average Treatment

[23] Least Absolute Shrinkage and Selection Operator (LASSO) and the $l2$-boosting

Effect (ATE) estimate. The use of orthogalization precisely allows the well performance of the approach because errors in estimating nuisance parameters are orthogonal to the sample average errors in ATE (see Chernozhukov et al. [2018] for theorical details or Athey et al. [2017] for applications estimating heterogeneous effects with unconfoundedness).

4.2 Feature Selection Estimators

Following Chernozhukov et al. [2017] and Chernozhukov et al. [2018], we will use different feature selection procedures as robustness check that allows us to make our results generalisable. As techniques, we propose: the Least Absolute Shrinkage and Selection Operator (LASSO) that is increasingly applied in the literature, and the $l2$-boosting. In the context of our analysis, we should keep in mind that the dependent variables of interest are continous while the treatment effect (BBR's compliance) is a binary variable. On that sense, the following algorithms will be adapted of each case (continuous or binary). Because our main dependent variables (the overall public balance, the interest payments, the total public spending, the governement final consumption, the GDP per capita expectation, the GDP per capita in $t+1$, the Governement Effectiveness, the Musgravian Index, the Gini Index and the poverty headcount ratio) are continuous, we are able to report Root-Mean-Squared-Errors of each feature selection model in the tables of results. Appendices 4 and 5 provide an illustration of fitted values distribution (for one of our variable of interest[24]) resulting from both feature selection algorithm and highlight the normal properties that allow such procedures.

4.2.1 LEAST ABSOLUTE SHRINKAGE and SELECTION OPERATOR (LASSO)

Friedman et al. [2009] proposed LASSO as a regularization that operate a shrinkage procedure. It thus presents major advantage face to the ridge regression that couldn't reduce the number of features (Pereira et al. [2016]. The LASSO implements a feature selection that corresponds to the reduction of the feature set, by removing irrelevant ones for our model. It corresponds to a regularization process where the coefficients of redundant predictors are penalized and set to zero. Such approach also reduces the prevision error and the risk of overfitting.

As Baret et al. [2021], we retain LASSO rather than methodologies that implies transformation-based dimension as Principal Component Analysis (PCA) that provides factors that have no economic interpretability.

Finally, the LASSO estimator is:

$$\hat{\beta}(\lambda) = \underset{\beta}{\operatorname{argmin}}(n^{-1}\sum_{i=1}^{n}\rho_{(\beta)}(X_i, Y_i) + \lambda||\beta||_1) \tag{2}$$

where λ is the shrinkage parameter provided through grid search and used the one-standard error rule (see Baret et al. [2021]).

4.2.2 $l2$-BOOSTING

The so-called Gradient Boosting is a machine learning application of Boosting which is based on sequential Ensemble. Ensemble learning method uses several learners to provide a final stronger learner. On that sense Boosting is an Ensemble technique that will produce several weak leaner used to construct a strong next learner that minimizes the total model prediction error. The weak learners (also named weak rules) are obtained by using ML algorithms on different distributions of our dataset.

[24] All fitted values distribution for all our variables of interest are available upon request to the authors.

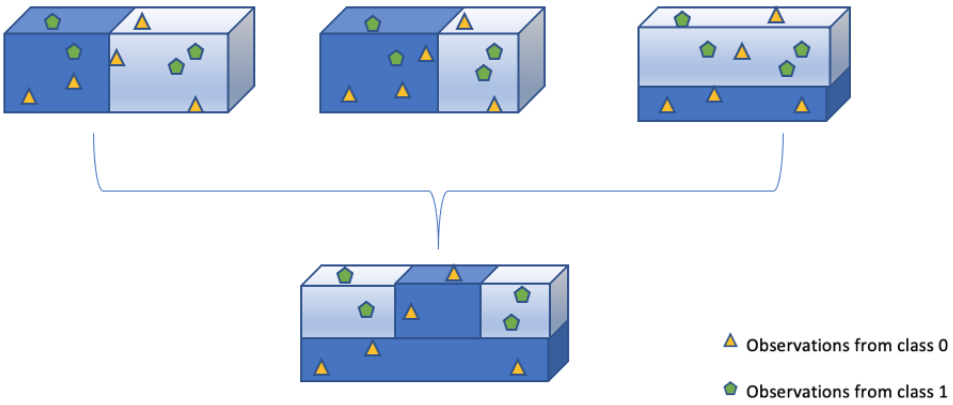


Figure 4: **Illustration of Boosting Algorithm**

The Figure 4 provides a simple illustration of how does the Boosting algorithm works. In the first step, the algorithm analyzes the Dataset and assigns equal weights to each sample. The false predicted observations provided by the "base" learner are identified in the second step. In the next iteration, these false predicted observations will be assigned to the next base learner with a higher weight. The third step repeats the second step until the algorithm accurate the prediction as best as possible.

By definition, Gradient Boosting is an Ensemble learning and thus also based on sequential Ensemble learning approach. It sequentially generates base learners that must be more effective than the previous one. Gradient Boosting makes the overall model improving sequentially with each iteration.

The specificity of Gradient Boosting is that the weights of misspredicted observations are not incremented. Gradient Boosting optimizes the loss function of the previous learner. To do so, Gradient boosting adds a new model that adds weak learners aming at reducing the loss function in order to overcome the errors in the previous learner's predictions.

The Boosting with $l2$-loss function follows the functionnal gradient descent procedure, including a $l2$-penalty term. Such procedures needs an initialization step, by seting target outcomes for the first next model (with the goal to the miniminze the error). This first step includes the regularization parameter. The second step consists in the projection of gradient descent to learner. It leads to the negative gradient which corresponds to the residual vector of boosting procedure. Third step is the line search using iteration to repeat the procedure until miniziming the overall error.

This algorithm is equivalent to functionnal gradient descent technique. The main goal is to estimate the function:

$F : \mathbb{R}^d \longmapsto \mathbb{R}$, minimizing an expected cost

$$\mathbb{E}[C(Y, F(X))], C(.,.) : \mathbb{R} \times \mathbb{R} \longmapsto \mathbb{R}^+ \qquad (1)$$

where Y_i is our dependant variable and X_i the potential predictors for observations $i = 1, ...n$. Alternatively, Y is continious and the problem is solved through regression, or Y is discrete and we are in a classication issue. Cost function C(.,.) verifies important properties to make sure that gradient approach well works: it is smooth and convex in the second argument.

L2-Boost cost function is: $C(y, f) = \frac{|y-f|^2}{2}$ with $y \in \mathbb{R}$ or $y \in \{0, 1\}$, $f \in \mathbb{R}$
Following Friedman et al. [2000], the population minimizers to Estimate (1) is:

$$F(x) = \mathbb{E}[Y|X = x]$$

The application of functional gradien descend to the dataset lead to minimize the empirical risk and estimate $F(.)$ given by:

$$n^{-1} \sum_{i=1}^{n} C(Y_i, F(X_i))$$

We thus apply this algorithm in a binary/classification issue when the dependent variable is the treatment (BBR (non-)compliance) and in a linear approach for our main variables of interests (GDP growth, Government Spending and social indicators) that are continuous. For further details on Generic functional gradient descend and L2 boosting with linear/classification learners, see Bühlmann and Yu [2003].

5 Results

This section develops the findings provided by our DML estimator. Results first report the finding from the feature selection step. We focus our attention to the identification of the determinants of BBR's compliance. We do not report the variables selected as determinants for the dependent variables but if any determinants of BBR affect one or several of our dependent variables, this information is considered by our methodology developped in Section 4.1. The second part of the result presents the Average Treatment Effect (ATE) of the BBR's compliance on the depedent variables defined in section 3.1.2 and which are the channels with Social Welfare we consider in our analysis.

5.1 Results from Feature Selection procedures

Table 2 reports the key common determinants for BBR's compliance retained by our two feature selection algorithms. The sign reported next to the identified determinants of BBR indicates wether the factor affects postively or negatively BBR's compliance.

Dummy for Crisis has a negative effect on BBR's compliance since it appears difficult for governments to comply with fiscal rules during worst economic periods. The presence of escape clauses makes governements tempted to not comply BBR. Despite escape clauses should operate during the worst economic circunstances, their presence seem to lead governements to count on them to relax. This is a first empirical proof that escape clauses drive government behavior and thus matter in the choice of compliance definition. On the contrary, the presence of formal enforcement procedure as sanctions for non-compliance, positively affects BBR's compliance. The Stability and Growth Pact includes such procedure which could explains the positive effect of being a member of a currency on the BBR's compliance since our dataset includes lot of eurozone members. The lagged value of interest payments on debt increases the compliance in the next year, suggesting that governments try to implement effort to comply to send a positive signal to financial market. Without surprise, the lagged value of public balance affects positively the BBR's compliance since it is easier to comply fiscal rule when public finance are in good health. Finally, the first latent factor we computed as proxy for voter preferences appears as significant. This suggests that we have to take into account for voter preferences when we assess fiscal rules effects. Indeed the voter preferences seem to increase the BBR's compliance, reflecting an average preference of the voters for disciplined governements. The number of years

of a chief executive has been in place is positively linked with BBR's compliance. If voters indeed prefer complier-government, a disciplined chief executive will stay longer and increase BBR's compliance.

Table 2: **Compliance determinants:**

LASSO and BOOSTING common determinants
Dummy crisis (-)
Dummy Well-specified escape clause (-)
Dummy Formal enforcement procedure (+)
Voice and Accountability (-)
Dummy for Federal country (+)
Dummy for member of a currency union (+)
Years chief executive (+)
The First proxy for Voter Preferences (+)
$lag-1$ interest payments (in % of expense) (+)
$lag-1$ of Public Balance (in % of GDP) (+)

Note : Years chief executive reflects the number of years the chief executive was in office . Election system takes value 2 for parliamentary system, 1 for Assembly-elected President and 0 for Presidential system (see Database of Political Institutions 2015 (2016) for further details). Only the ten common indicators are reported: l2-Boosting retained 10 key determinants and Lasso retained 15 (among these fifteen key determinants ten are the same as in l2-Boosting) . The signs (+) and (-) reflects the impact sign of the variable on BBR-compliance.

5.2 Average Treatment Effect on Social Welfare channels

Table 3 presents the ATE of BBR's compliance on our variables of interest. We decompose our results in a first part that summarizes the Average Treatment Effect (ATE) on the macroeconomic variables while the second part reveals the ATE on Social related indicators. All our results are stable accross feature selections approaches used in the first step of our DML algorithm. Nevertheless, the RMSE for the dependant variables provided by L2-Boosting is lowest in every cases, showing that it is the best model.

The Table 3 -part 1- highlights that, according to literature which links fiscal rules and fiscal discipline [25], the BBR's compliance increases *on average* the general government public balance by 0.5 percentage points (hereafter pp) (column 1). Nevertheless, BBR compliers seem to not benefit from lower interest rate on public debt since the corresponding ATE is not significant in column 2. This suggests that compliance does not send a postitive signal-effect to financial markets. However, Barbier-Gauchard et al. [2021] showed that fiscal rules presence reduces interest rate on debt. Finally, the simple presence of fiscal rules matters as a signal effect for financial markets but compliance does not imply difference. The total public spending decrease by 0.125 pp for BBR compliers while general government investment (Gross Fixed Capital Formation (GFCF)) increases by 0.263 pp *on average* as showed by, respectively, sinigificant and negative ATE (column 4) for total public spending and sinigicant and positive ATE (column 3) for general government GFCF. As explanation, governments operate a cut in government final

[25] See Section 1 and 2 for discussion

consumption to promote BBR's compliance as we can see a negative and significant ATE on GG final consumption in column 5. The final negative effect on public spending is the result of a cut in public consumption of fixed capital.

Through the increase in GFCF, compliers seem to expect economic growth benefits. They indeed present a GDP growth expectation 0.6 pp higher than for non-compliers, as suggested in colomun 6. However, in practice, their spending re-allocation do not provide higher GDP growth in the next year as suggested by column 7 where BBR's compliance has no impact on future GDP.

Table 3 -part 2- reports that BBR's compliance has no effect nor on Government Effectiveness nor on Government Efficiency. We first could expect that fiscal rules' compliance force governement to spend in a better way, taking care of each unit of money spent and thus increase government efficiency. Second, we could expect that government favor spending performance in order to insure favorable economic conditions and thus increase government effectiveness. Nevertheless, we observe that ATE asssociated with both government effectiveness and governement efficiency are not significant. Because governement reduce social spending but increase GFCF at the same time, both actions are going on the opposite side and finally lead to a zero-effect on the government performance. A major result is found in column 3 of Table 3 part 2: we observe a positive and significant ATE on Gini Index. Since Gini index is, by definition, an index between 0 and 1 without common units, it couldn't be interpretaded as variables expressed in percent of GDP. The BBR's compliance leads to an increase around 0.09 units in the Ginix index. By forcing compliance, but by simultaneously trying to increase public GFCF, government go beyond the trade-off between BBR's compliance and growth objectives and conduct to a side-effect on social spending. Some social spending are included in the goverment final consumption expenditure which are reduced by BBR's compliance. We thus observe an increase in Inequalities measured thourgh the Gini index. 0.09 unit of Gini index represents 9% of the index values' range. On that sense, compliance may explained aroung 9% of the differences in Gini Index between compliers and non-compliers. As suggested by the last column of Table 3 part 2, the poorest are affected by the spending re-allocation. Finally the side-effects observed in public expenditure impact both Inequalities and poverty, suggesting that governement may to face a trade-off between fiscal rules' compliance and social objectives.

Table 4 shows robustness check by removing observations for the UK and Hungary on which we set hypotheses in Section 3.1.1. Our results still hold with the two methods, and L2-boosting still being the best model regarding the RMSE measure.

Table 5 provides results removing observations-years where an escape clauses hold. We see that all results are still the same except for the GDP per capital growth in $t+1$. A more flexible definition of fiscal rules' compliance, allowing escape clause to matter, is favorable for economic growth. Consequently, escape clauses matter for compliance definition in two dimensions: i) escape clause affect compliance itself by increasing it (according to results in Section 5.1); ii) escape clause affect BBR's effect since if we allow flexility in compliance definition, GDP growth appears higher.

Finally, BBR's compliance seems not damageable for economic area but for social area. Such result reinforces our highlight suggesting that the side-effect on public spending composition is negative for Social Welfare and governments seem to not face a "Compliance vs GDP growth trade-off" but they deal with a "Compliance vs Social objectives trade-off".

Table 3: **ATE of Budget Balance Compliance with 5-fold cross-validation**

Part 1: ATE on Macroeconomic channels

DML Estimator \ Dependant Variable	GG Public Balance	Interest payments (% of expense)	GG GFCF (in % of GDP)	Total spending (in % of GDP)	GG final consumption (in % of GDP)	GDP per cap. expectation	GDP per cap. Growth in $t+1$
LASSO	0.534***	0.058	0.263***	-0.125***	-0.107***	0.601***	0.140
	(0.100)	(0.049)	(0.077)	(0.034)	(0.028)	(0.170)	(0.098)
RMSE y	0.532	0.338	0.370	0.172	0.202	0.402	0.557
BOOSTING	0.481***	0.108	0.266***	-0.095***	-0.141***	0.526***	0.077
	(0.087)	(0.030)	(0.068)	(0.023)	(0.029)	(0.151)	(0.109)
RMSE y	0.392	0.234	0.283	0.125	0.136	0.341	0.403

Note: GG = General Government, GFCF = Gross Fixed Capital Formation. The median standard error across the splits are reported in brackets.

Part 2: ATE on Government Performance and Inequalities channels

DML Estimator \ Dependant Variable	Government Effectiveness	Musgravian Index	Gini Index	Poverty headcount ratio at $1,90$\$ a day (2011 PPP) (% of population)
LASSO	-0.014	0.128	0.087*	0.079**
	(0.033)	(0.140)	(0.072)	(0.035)
RMSE y	0.147	0.635	0.344	0.216
BOOSTING	-0.019	0.099	0.032*	0.049**
	(0.031)	(0.133)	(0.065)	(0.036)
RMSE y	0.118	0.284	0.274	0.192

Table 4: **Robustness ATE of Budget Balance Compliance with 5-fold cross-validation: without observations related to hypotheses set by authors in 3.1.1**

Part 1: ATE on Macroeconomic channels

DML Estimator \ Dependant Variable	GG Public Balance	Interest payments (% of expense)	GG GFCF (in % of GDP)	Total spending (in % of GDP)	GG final consumption (in % of GDP)	GDP per cap. expectation	GDP per cap. Growth in $t+1$
LASSO	0.470***	0.020	0.231***	-0.107***	-0.172***	0.580***	0.120
	(0.096)	(0.052)	(0.068)	(0.029)	(0.037)	(0.160)	(0.127)
RMSE y	0.510	0.359	0.348	0.156	0.195	0.385	0.560
BOOSTING	0.452***	0.072	0.257***	-0.095***	-0.123***	0.581***	0.039
	(0.079)	(0.025)	(0.063)	(0.022)	(0.032)	(0.132)	(0.090)
RMSE y	0.387	0.248	0.281	0.125	0.150	0.329	0.400

Note: GG = General Government, GFCF = Gross Fixed Capital Formation. The median standard error across the splits are reported in brackets.

Part 2: ATE on Government Performance and Inequalities channels

DML Estimator \ Dependant Variable	Government Effectiveness	Musgravian Index	Gini Index	Poverty headcount ratio at $1,90$\$ a day (2011 PPP) (% of population)
LASSO	-0.0005	0.125	0.079*	0.087**
	(0.032)	(0.135)	(0.071)	(0.036)
RMSE y	0.153	0.661	0.359	0.200
BOOSTING	0.002	0.064	0.058*	0.031**
	(0.029)	(0.146)	(0.069)	(0.034)
RMSE y	0.121	0.329	0.298	0.197

Table 5: **Robustness ATE of Budget Balance Compliance with 5-fold cross-validation: without observations that didn't comply but escape clauses existed**

Part 1: ATE on Macroeconomic channels

DML Estimator \ Dependant Variable	GG Public Balance	Interest payments (% of expense)	GG GFCF (in % of GDP)	Total spending (in % of GDP)	GG final consumption (in % of GDP)	GDP per cap. expectation	GDP per cap. Growth in $t+1$
LASSO	0.431***	0.084	0.242***	-0.088***	-0.117***	0.551***	0.247***
	(0.091)	(0.040)	(0.067)	(0.025)	(0.032)	(0.152)	(0.084)
RMSE y	0.509	0.359	0.379	0.151	0.183	0.436	0.436
BOOSTING	0.514***	0.107	0.237***	-0.099***	-0.139***	0.527***	0.156***
	(0.084)	(0.041)	(0.071)	(0.023)	(0.037)	(0.151)	(0.094)
RMSE y	0.387	0.246	0.286	0.127	0.157	0.317	0.392

Note: GG = General Government, GFCF = Gross Fixed Capital Formation. The median standard error across the splits are reported in brackets.

Part 2: ATE on Government Performance and Inequalities channels

DML Estimator \ Dependant Variable	Government Effectiveness	Musgravian Index	Gini Index	Poverty headcount ratio at $1,90$\$ a day (2011 PPP) (% of population)
LASSO	-0.0005	0.125	0.079*	0.087**
	(0.032)	(0.135)	(0.071)	(0.036)
RMSE y	0.153	0.661	0.359	0.200
BOOSTING	-0.013	0.027	0.028*	0.064*
	(0.031)	(0.175)	(0.088)	(0.045)
RMSE y	0.120	0.557	0.312	0.177

6 Conclusion

The paper provides an assessment of Budget Balance Rules compliance side-effect on social welfare channels indicators. It uses Double/Debiased Machine Learning methodology including LASSO or Boosting feature selection algorithms as robustness check. All the results do not depend on the shrinking algorithm choice since results are consistent accross feature selection estimators. From the feature selection step, a set of key determinants for BBR's compliance is identified including voter preferences suggesting that voter preferences need to be taking into account in fiscal rules analyses. Such empirical results provide an empirical evidence that Wyplosz [2012]'s bias matters.

Finally, average treatment effect results, from the second step, showed that governements with national Budget Balance Rules seem to try to overcome the trade-off between BBR's compliance and Growth objectives by forcing public investment achieving BBR's compliance at the same time. Instead of an arbitration between compliance and economic growth, governments operate a re-allocation of spending. Governement favor Gross Fixed Capital Formation but decrease Governement Final Consumption that include social spending. Consequently, BBR's compliance seem to have an increasing effect on Inequalities and this effect seems to affect the poorest classes as suggested by the impact on the poverty head account ratio. Finally empirical findings provide evidences of side-effects of fiscal rules strict compliance. Nevertheless, by relaxing compliance definition, we finally found similar conclusion as in Castro [2011], that fiscal rules may support economic growth. The side-effects of fiscal rules' compliance operates through public spending composition by decreasing social spending. Consequently, we should not recommend to abandon fiscal rules and their rigorous application but to better design them. Flexible fiscal rules have been largely discussed in the literature (see Eyraud et al. [2018], Caselli et al. [2018]) and they may be a solution to limit fiscal rules' compliance side-effect. Indeed, the inclusion of escape clauses may have positive effects on economic growth but it does not appear sufficient to limit side-effect on Inequalities. But, Debrun and Jonung [2019] proposed a fiscal-Taylor rule following an over-cycle expenditure benchmark, while others as Creel et al. [2014] argue in favor of the Golden Rule. Both of them seem to work against the weakness regarding public social spending but the fiscal rules should be precisely defined, including a social area objective. Nevertheless, an expenditure benchmark or a golden rule requiere an harmonisation of governments accounting, especially for the members of a common currency union as the euro area. This leads to a higher debate on what should be considered as a productive expenditure and how to compute governement consumption of fixed capital (see Schreyer [2003] for discussion on productive capital and countries computional hypotheses).

Our results also launch the debate on the use on Machine learning in the econometric field (Athey [2018]). Indeed, our paper proposed a causal ML estimator robust against current econometrics biases such as reverse causality or ommission bias. Consequently, ML may be seriously considered as a useful tool in causal inference economic studies.

References

D. Acemoglu. Why not a political coase theorem? Social conflict, commitment and politics. Journal of Comparative Economic Studies, pages 620–652, 2003.

A. Afonso, L. Schuknecht, and V. Tanzi. Public Sector Efficiency: Evidence from new EU member states and Emerging market. ECB Working Paper No. 581, 2006.

A. Afonso, J. T. Jalles, and A. Venâncio. Taxation and Public Spending Efficiency: An International Comparison. Working Papers REM 2019/80, 2019.

S. R. Aiyagari and E. R. McGrattan. The optimum quantity of debt. Journal of Monetary Economics, 1998.

K. Arrow. Social Choice and Individual Values. Yale University Press, 1951.

S. Athey. The Impact of Machine Learning on Economics. Chapter in NBER book The Economics of Artificial Intelligence: An Agenda, pages 507–547, 2018.

S. Athey and G.W. Imbens. The state of applied econometrics: Causality and policy evaluation. The Journal of Economic Perspectives, 2017.

S. Athey and G.W. Imbens. Machine Learning Methods Economists Should Know About. arXiv:1903.10075v1, 2019.

S. Athey, G. Imbens, and S. Wager. Approximate residual balancing: De-biased inference of average treatment effects in high-dimensions. arXiv:1604.07125v3 . arXiv, 2016.

S. Athey, J. Tibshirani, and S. Wager. Generalized random forests. arXiv:1610.01271, 2017.

A. Barbier-Gauchard, K. Baret, and A. Minea. National Fiscal Rules Adoption and Fiscal Discipline in the European Union . Applied Economics, 2021.

K. Baret, A. Barbier-Gauchard, and T. Papadimitriou. Forecasting the Stability and Growth Pact compliance using Machine Learning. hal-03121966, 2021.

R. Beetsma, X. Debrun, X. Fang, Y. Kim, V. Lledó, S. Mbaye, and X. Zhang. Independent Fiscal Councils: Recent Trends and Performance. IMF Working Paper 18/68, 2018.

A. Belloni, V. Chernozhukov, D. Chetverikov, C. Hansen, and K. Kato. High-Dimensional Econometrics and Regularized GMM. Cornelle University, arXiv:1806.01888v2, 2018.

M. Bergman, M.M. Hutchison, and S.E. Hougaard Jensen. Promoting sustainable public finances in the European Union: The role of fiscal rules and government efficiency. European Journal of Political Economy, 44:1–19, 2016.

O. Blanchard, A. Leandro, and J. Zettelmeyer. Redesigning the EU Fiscal Rules: From Rules to Standards. Economic Policy, 2021.

R. Blundell, M. Costa Dias, R. Joyce, and X. Xu. COVID-19 and Inequalities. Fiscal Studies, pages 291–319, 2020.

H. Bohn and R.P. Inman. Balanced Budget Rules and Public Deficits: Evidence from the U.S. States. NBER Working Paper No. 5533, 1996.

J. B. Burbidge. Government Debt in an Overlapping-Generations Model with Bequests and Gifts. The American Economic Review, pages 222–227, 1983.

P. Bühlmann and B. Yu. Boosting With the L2 Loss: Regression and Classification. Journal of the American Statistical Association, 2003.

F. Caselli, L. Eyraud, A. Hodge, F. Diaz Kalan, Y. Kim, V. Lledó, S. Mbaye, A. Popescu, W. H. Reuter, J. Reynaud, E. Ture, and P. Wingender. Second-Generation Fiscal Rules : Balancing Simplicity, Flexibility, and Enforceability - Technical Background Papers . Staff Discussion Notes No. 18/04, 2018.

V. Castro. The impact of the European Union fiscal rules on economic growth. Journal of Macroeconomics, pages 313–326, 2011.

V. Chernozhukov, D. Chetverikov M. Demirer, E. Duflo, C. Hansen, and W. Newey. Double/Debiased/Neyman Machine Learning of Treatment Effects. American Economic Review, 2017.

V. Chernozhukov, D. Chetverikov, M. Demirer, E. Duflo, Ch. Hansen, W. Newey, and J. Robins. Double/debiased machine learning for treatment and structural parameters. The Econometrics Journal, 2018.

J-L. Combes, A. Minea., P.N. Sawadogo, and C. Vinturis. Can fiscal rules curb income inequality? Evidence from developing countries. CERDI Etudes et Documents No. 25, 2019.

J-L. Combes, X. Debrun, A. Minea, and R. Tapsoba. Inflation Targeting, Fiscal Rules and the Policy Mix: Cross-effects and Interactions. The Economic Journal, 128:2755–2784, 2018.

Irish Fiscal Advisory Council. Assessment of Compliance with Fiscal Rules. Irish Fiscal Advisory Council publications: Fiscal Assessment Report, 2013.

J. Creel, P. Veroni, and F. Saraceno. Has the Golden Rule of Public Finance Made a difference in the UK. hal-00972843, 2014.

M. Dabrowski. Monetary Union and Fiscal and Macroeconomic Governance. European Commission Discussion Paper 013, 2015.

X. Debrun and L. Jonung. Under threat: Rules-based fiscal policy and how to preserve it. European Journal of Political Economy, 57:142–157, 2019.

X. Debrun and M.S. Kumar. The Discipline-Enhancing Role of Fiscal Institutions: Theory and Empirical Evidence. IMF Working Paper No. 07/171, 2007.

X. Debrun, L. Moulin, A. Turrini, J. Ayuso i casals, and M. Kumar. Tied to the Mast? National Fiscal Rules in the European Union. Economic Policy, 23:297–362, 2008.

X. Debrun, M. Gerard, and J. Harris. Fiscal Watchdogs and Sound Fiscal Policy: Is the Barking Loud Enough to Tame Politicians? MPRA Paper No. 96683, 2019.

M. Delgado-Téllez, V. D. Lledó, and J. J. Pérez. On the Determinants of Fiscal Non-Compliance: An Empirical Analysis of Spain's Regions. IMF Working Paper 17/5, 2017.

L. Eyraud, X. Debrun, A. Hodge, V. Lledó, and C. A Pattillo. Second-Generation Fiscal Rules : Balancing Simplicity, Flexibility, and Enforceability. Staff Discussion Notes No. 18/04, 2018.

M. Fajeau. Too much finance or too many weak instruments? International Economics, 2021.

S. Fan and P. Pestieau. A model of the optimal allocation of government expenditures. Journal of public economic theory, pages 845–876, 2019.

M. Flodén. The effectiveness of government debt and transfers as insurance. Journal of Monetary Economics, 2001.

J. Friedman, T. Hastie, and R. Tibshirani. Regularization for Generalized Linear Models via Coordinate Descent. Department of Statistics Stanford University, 2009.

J.H. Friedman, T. Hastie, and R. Tibshirani. Additive Logistic Re- gression: A Statistical View of Boosting. The Annals of Statistics, 2000.

R. Frisch and F.V. Waugh. Partial time regression as compared with individual trends. Econometrica, pages 387–401, 1933.

P. Funk and C. Gathmann. Voter preferences, direct democracy and government spending. European Journal of Political Economy, 2013.

P. Gogas, T. Papadimitriou, and A. Agrapetidou. Forecasting bank failures and stress testing: A machine learning approach. International Journal of Forecasting, 34:440–455, 2018.

S. Gosh and U. Roy. Fiscal policy, long-run growth, and welfare in a stock-flow model of public goods. Canadian Journal of Economics/Revue canadienne d'économique, pages 742–756, 2004.

P. De Grauwe. The interaction of monetary policies in a group of European countries. Journal of International Economics, 5:207–228, 1975.

P. De Grauwe. Monetary Policies in the presence of asymmetries. CEPR discussion paper No. 2393, 2000.

M. Guerguil, P. Mandon, and R. Tapsoba. Flexible fiscal rules and countercyclical fiscal policy. Journal of Macroeconomics, 52:189–220, 2017.

J. Hartwig and J.E. Strum. Do fiscal rules breed inequality? First evidence for the EU. Economic Bulletin, 2019.

W. Hediger. Sustainable development and Social Welfare. Ecological Economics, pages 481–492, 2000.

F. Heinemann, M-D. Moessinger, and M. Yeter. Do fiscal rules constrain fiscal policy? A meta-regression-analysis. European Journal of Political Economy, 51:69–92, 2018.

W. Härdle, Y-J. Lee, D. Schäfer, and Y-R. Yeh. Variable Selection and Oversampling in the use of Smooth Support Vector Machines for Predicting the Default Risk of Companies. Journal of Forecasting, 28:512–534, 2009.

G. Kopits and S.A. Symansky. Fiscal Policy Rules . Occasional Paper No. 162, 1998.

S. Kuznet. Economic Growth and Income Inequality. The American Economic Review, pages 1–28, 1955.

F.E. Kydland and E.C. Prescott. Rules Rather than Discretion: The Inconsistency of Optimal Plans. Journal of Political Economy, 85:473–492, 1977.

M. Larch and S. Santacroce. Numerical compliance with EU fiscal rules: The compliance database of the Secretariat of the European Fiscal Board (Database). 2020.

M. Larch, E. Orseau, and W. van der Wielen. Do EU Fiscal Rules Support or Hinder Counter-Cyclical Fiscal Policy?). Journal of International Money and Finance, 2021.

P. Lawler. Monetary policy, central bank objectives, and social welfare with strategic wage setting. Oxford Economic Papers, page 94–113, 2001.

M.C. Lovell. Seasonal adjustment of economic time series and multiple regression analysis. Journal of the American Statistical Association, pages 933–1010, 1963.

L.Schuknecht. EU FISCAL RULES: ISSUES AND LESSONS FROM POLITICAL ECONOMY. ECB Working Paper N.421, 2004.

F. Marini. Banks, financial markets, and Social Welfare. Journal of Banking and finance, pages 2557–2575, 2005.

W. Marneffe, B. Van Aarle, W. Van Der Wielen, and L. Vereeck. The Impact of Fiscal Rules on Public Finances: Theory and Empirical Evidence for the Euro Area. CESifo WORKING PAPER No. 3303, 2010.

J. Midgley. Growth, Redistribution, and Welfare: Toward Social Investment. University of Chicago Press, 1999.

S. Mullainathan and J. Spiess. Machine learning: an applied econometric approach. The Journal of Economic Perspectives, 2017.

M. Wafula Nandelenga and M. J. Ellyne. Fiscal Rules and the Compliance debate: Why do Countries adopt Rules and fail to comply. ERSA Working Paper No 815, 2020.

J.M. Pereira, M. Basto, and A. Ferreira da Silva. The Logistic Lasso and Ridge Regression in Predicting Corporate Failure. Procedia Economics and Finance, 39:634–641, 2016.

W.H. Reuter. National numerical fiscal rules: not complied but still effective? European Journal of Economy, 39:67–81, 2015.

W.H. Reuter. When and why do countries break their national fiscal rules? European Journal of Political Economy, 57:125–141, 2019.

P.R. Rosenbaum and D. Rubin. The central role of the propensity score in observational studies for causal effects. Biometrika, 1983.

A. Sacchi and S. Salotti. The impact of national fiscal rules on the stabilisation function of fiscal policy. European Journal of Political Economy, 37:1–20, 2015.

A. Sacks and M. Levi. Measuring Government Effectiveness and Its Consequences for Social Welfare in Sub-Saharan African Countries. Social Forces, page 2325–2351, 2010.

P. Samuelson. Welfare Economics and International Trade. The American Economic Review, pages 261–266, 1938.

A. Schaechter, T. Kinda, and N. Budinaand A. Weber. Fiscal Rules in Response to the Crisis—Towards the 'Next-Generation' Rules. A New Dataset). IMF Fiscal Affairs Department, 2016.

P. Schreyer. CAPITAL STOCKS, CAPITAL SERVICES AND MULTI-FACTOR PRODUCTIVITY MEASURES. OECD Economic Studies, No. 37, 2003/2, 2003.

A. Sen. Welfare Inequalities and Rawlsian Axiomatics. In: Butts R.E., Hintikka J. (eds) Foundational Problems in the Special Sciences. The University of Western Ontario Series in Philosophy of Science, vol 10. Springer, 1977.

D. M. Smith. Who gets what Where, and How: A welfare focus for human geography. Geography, pages 289–297, 1974.

R. Tapsoba. Do National Numerical Fiscal Rules really shape fiscal behaviours in developing countries? A treatment effect evaluation. Economic Modelling, 29:1356–1369, 2012.

H.R. Varian. Big data: New tricks for econometrics. The Journal of Economic Perpectives, 2014.

C. Wyplosz. Fiscal Rules: Theorical issues and historical experience. NBER Working Paper No. 17884, 2012.

Appendices—For *online publication only*

Appendix 1: Origin of Budget Balance Rules' targeted values

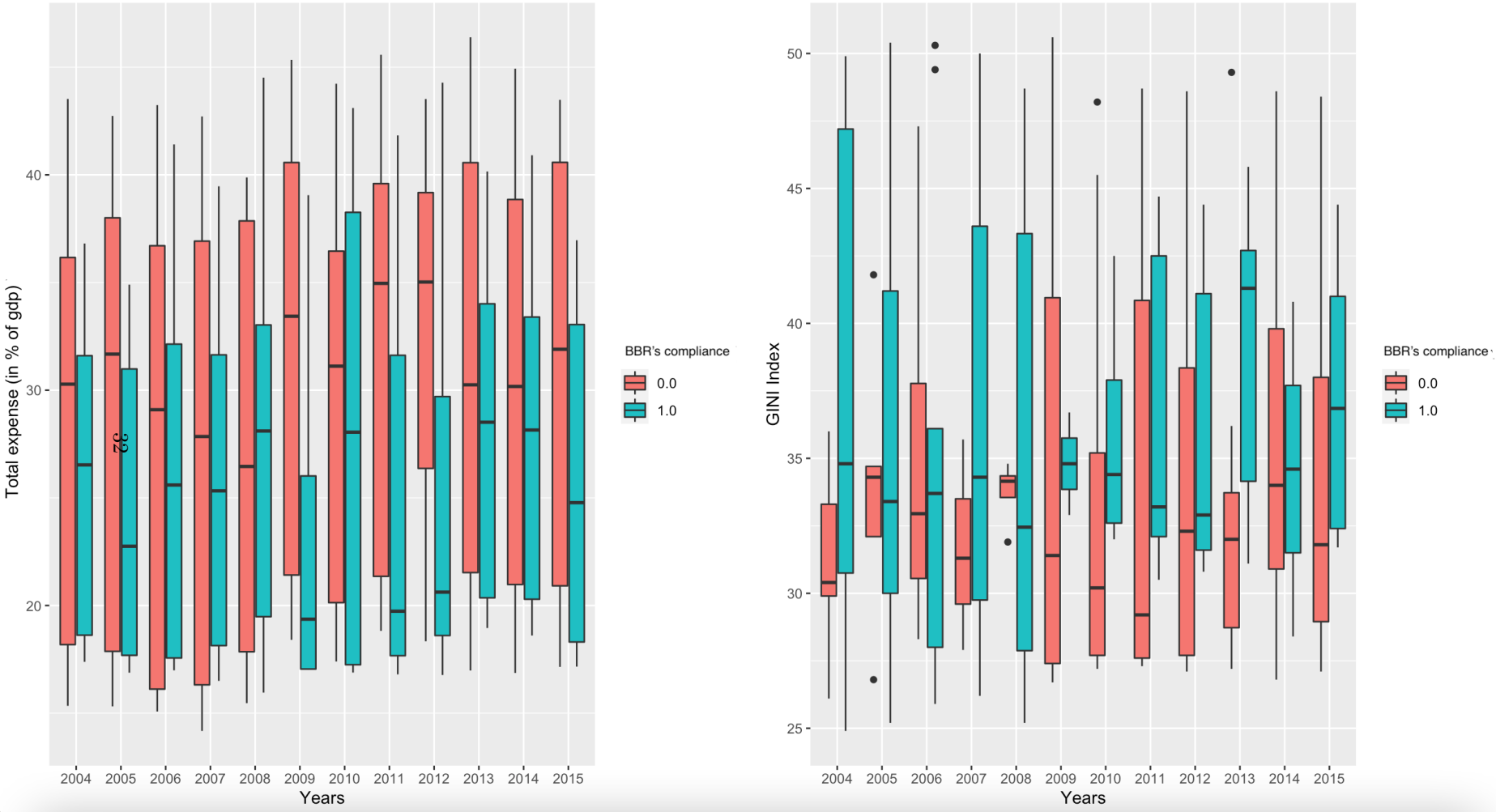
Country	Years	Database origin for Budget Balance Rule's Target
Chile	2004-2015	IMF World Economic Outlook Database 2018
Costa-Rica	2004-2015	Fiscal balance comes from World Bank*(except in 2015, Fiscal Balance comes from Banco Central de Costa Rica(BCCR) and Gross Fixed Capital Formation comes from IMF Investment and Capital Stock dataset 1960-2015
Denmark	2004-2015	IMF World Economic Outlook Database 2018
Estonia	2004-2015	IMF World Economic Outlook Database 2018
Finland	2004-2015	Eurostat
Germany	2004-2010	Eurostat
Germany	2011-2015	IMF World Economic Outlook Database 2018
Hungary	2004-2015	IMF World Economic Outlook Database 2018
Indonesia	2004-2015	IMF World Economic Outlook Database 2018
Israel	2004-2015	IMF World Economic Outlook Database 2018
Japan	2004-2015	IMF World Economic Outlook Database 2018
Malaysia	2004-2015	IMF World Economic Outlook Database 2018 and Gross Fixed Capital Formation comes from IMF Investment and Capital Stock dataset 1960-2015
New Zealand	2004-2015	New Zeland Treasury "Fiscal Time Series Historical Indicators 1972 - 2018"
Peru	2004-2015	IMF (Peru: Selected Issues Paper, IMF, 2012, number 12-27) and Banco Central de Reserva del Perú (BCRP)
Spain	2004-2015	IMF World Economic Outlook Database 2018
Sweden	2004-2015	IMF World Economic Outlook Database 2018
Switherland	2004-2015	IMF World Economic Outlook Database 2018
United Kingdom	2004-2009	Eurostat
United Kingdom	2010-2015	IMF World Economic Outlook Database 2018

Source: Authors.

Country	Constrained variable	Target Value	Period	Comments	Level of Government constrained
Chile	Structural Balance	1	2001-2007		Central
	Structural Balance	[0.5; -2]	2008-2015	Rule defined in a range	Central
Costa Rica	Budget Balance excluding gross investment	0	2001-2015	Golden Rule	Central
Denmark	Structural Balance	0.5	2001-2011		General
	Structural Balance	-0.5	2014 2015		General
Estonia	Structural Balance	0	1993 2011		General
	Structural Balance	0	2012		General
Finland	Structural Balance	[0;1]	1999-2013	1% between 2007 and 2011	Central
	Budget Balance (Total)	[-2.75; -2.5]	1999-2008	-2.75% between 1999 and 2002	Central
	Budget Balance (Total)	-1	2011		Central
Germany	Budget Balance excluding net investment	0	1969-2010		Central
	Structural Balance	-0.35	2011		Central
Hungary	Primary Balance	0	2004 2009		General
	Annual changes of Primary Balance	0	2010 and 2011		General
	Primary Balance	0	2009 2011	Not included in our analysis	Central
	Structural deficit above 0.5% (because debt is higher that 60% as described in TSCG)	-0.5	2012-2015	Transpose in national law from TSCG, interpreted as national BBR by hypothesis here	General
Indonesia	Budget Balance (Total)	-3	1967-2015		General
Israel				Not included due to annual change in the targeted value. Not a numerical rule.	
Japan	Budget Balance excluding net investment	0	1990--2015	Golden Rule	Central
Malaysia	Budget Balance excluding net investment	0	1959-2015	Golden Rule	Central
New Zealand	Budget Balance excluding net investment	0	1994-2015	Golden Rule	General
Peru	Budget Balance	[-1; 2]	2000 2013		Central
	Structural Balance	-1	2014		General
Spain	Budget Balance (Total)	[-2;0]	2003 2011	Limit related to GDP growth	General
Sweden	Budget Balance	[1;2]	2000	Only 1% since 2007	General
Switzerland	Structural Balance	0	2003		Central
United Kingdom	Budget Balance excluding net investment	0	1997 2008	Golden Rule	General
	Annual changes in Budget Balance (Total)	0	2010		General

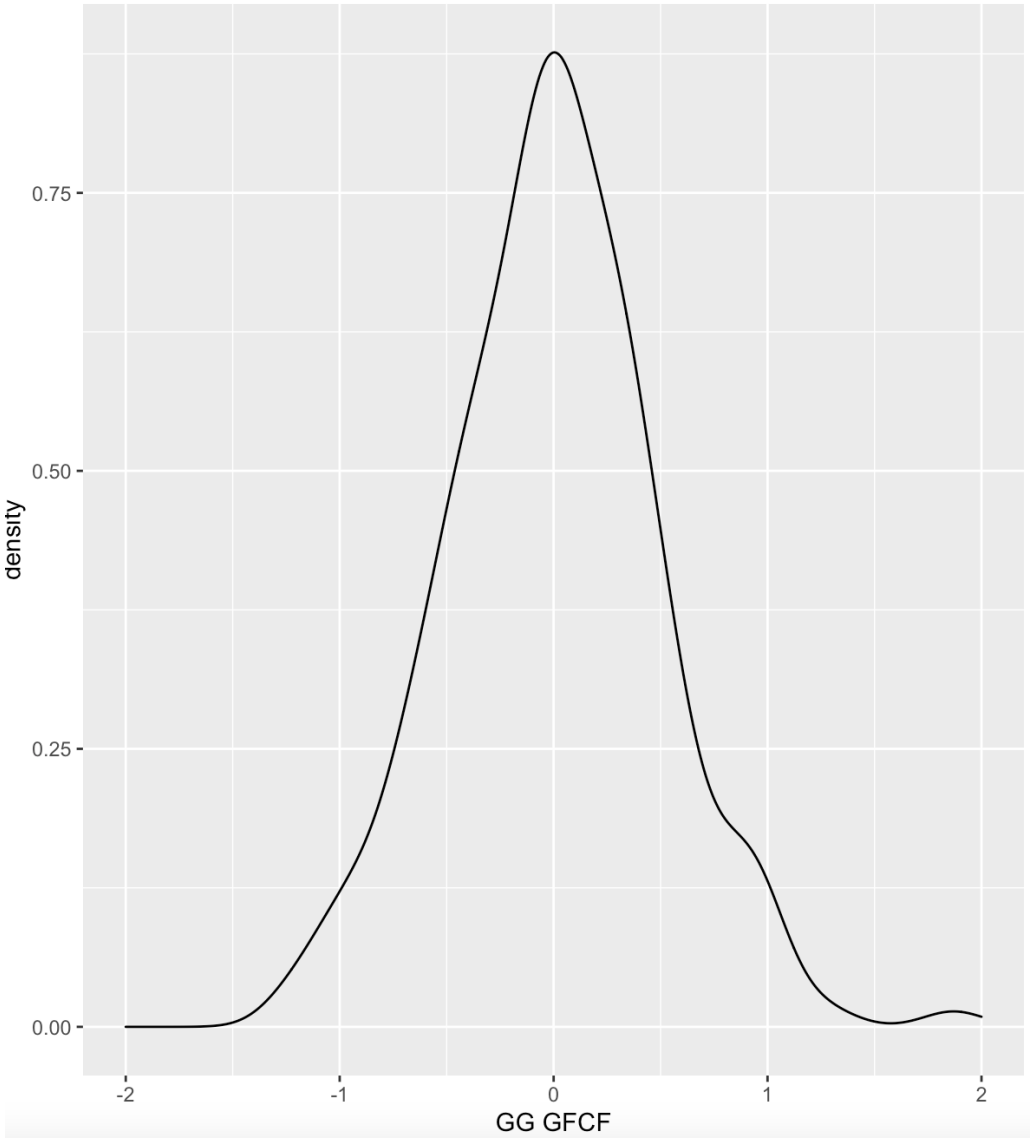
Note: BBR = Budget Balance Rule. We stop all reported periods in 2015 because IMF Fiscal Rules Database only reports fiscal rules until 2015. It does not mean that fiscal rules are no more in force after 2015. Source: Caselli et al. [2018], Reuter [2019], Eyraud et al. [2018], but authors assume some differences for Hungary, Japan and United Kingdom developed in section 3.1 and robustness checks are implemented in section 5.

Appendix 2. Fiscal rules included in our analysis -Only 2004-2015 period is considered for this paper-



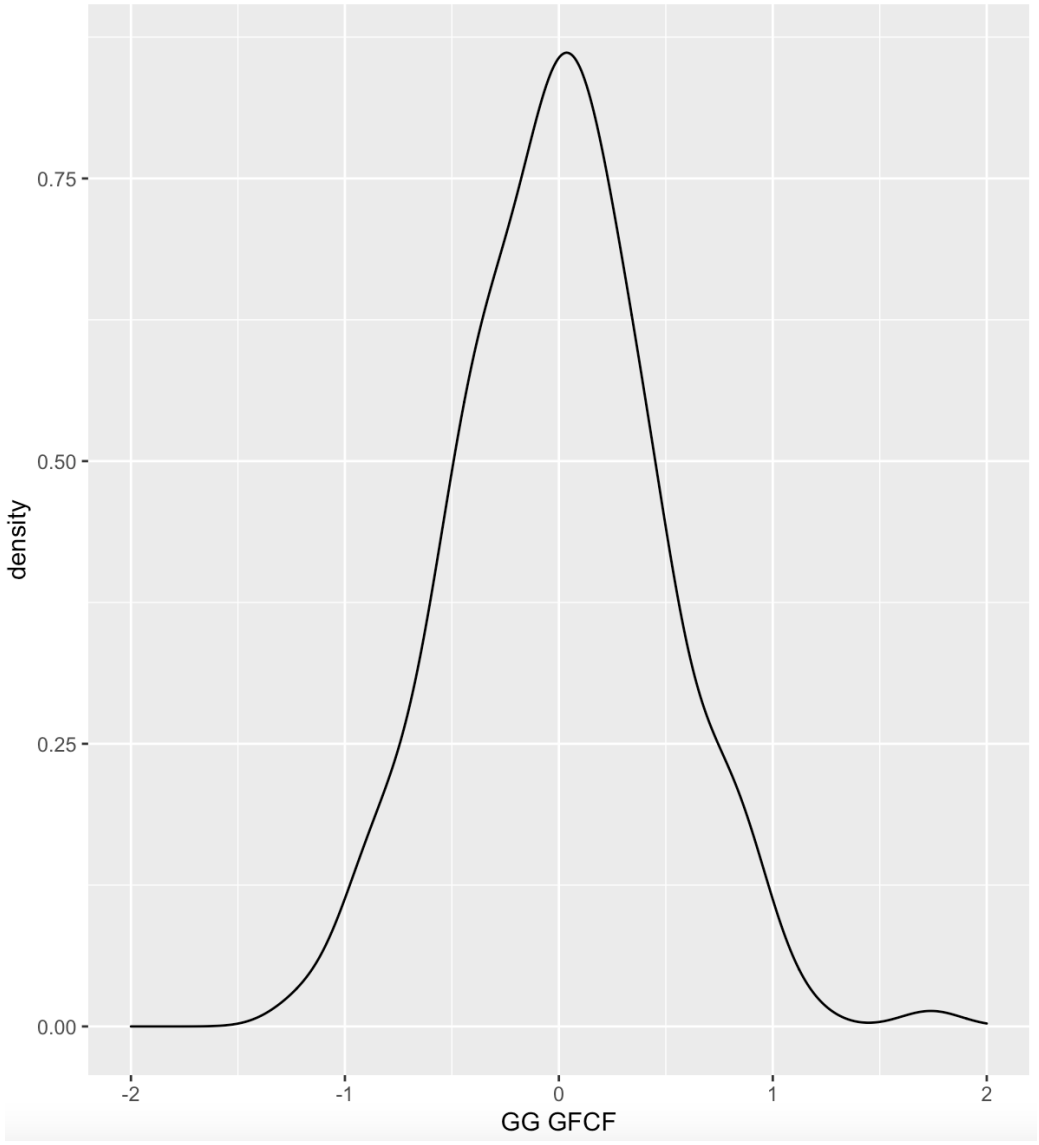
Note: BBR = Budget Balance Rule. "0" means BBR non-compliance and "1" means BBR's compliance. Source: Authors.

Figure 5: **Appendix 3. Comparison of Public Spending and Gini Index between BBR compliers and BBR non-compliers by quantiles**



Note: GFCF stands for Gross Fixed Capital Formation. All data are standardized before applying ML algorithm. Source: Authors.

Appendix 4. Distribution of General Government GFCF fitted values resulting from LASSO feature selection



Note: GFCF stands for Gross Fixed Capital Formation. All data are standardized before applying ML algorithm. Source: Authors.

Appendix 5. Distribution of General Government GFCF fitted values resulting from Boosting feature selection