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« Fiscal rules' compliance and Social Welfare»

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Document de Travail n° 2021 – 50
Version révisée du WP 2021-38

Novembre 2021

Bureau d'Économie
Théorique et Appliquée
BETA

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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 social welfare. It considers national Budget Balance Rules' (BBR) compliance effects on macroeconomic indicators and social welfare proxy indicators in OECD 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 fiscal rules' performance on social welfare. The paper shows that governments seem to operate a reallocation of their spending to ensure both BBR's compliance and economic objectives. Nevertheless, governments choices regarding their public spending composition seem leading to an increase in social inequalities suggesting that governments finally face a trade-off between fiscal rules' compliance and social objectives. The analysis constitutes the first use of a causal Machine Mearning approach, namely the Double/Debiased Machine Learning recently developed by Chernozhukov et al. [2018], applied to fiscal rules' performance assessment issues. This method allows us to highlight the key determinants of national BBR's compliance as well as assessing the compliance's effect on different macroeconomic and social indicators. We take care of voter preferences by computing a new proxy variable through Latent Factor Analysis approach and show that voter preferences appear as a key determinant for BBR's compliance, giving an empirical proof that Wyplosz [2012]'s bias may matter when assessing fiscal rules' performance.

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

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

1 Introduction

The performance of fiscal rules is a broad concept which relies on a number of factors, including fiscal rules compliance. However, there is no guarantee that conducting enforcement of fiscal rules will influence only fiscal discipline. It may also affect the rest of the economy, with the potential to cause a decline in social conditions for citizens and workers. While a government is under a budget constraint, it could restrain public expenditure and thus affect its public spending composition. For example, complying with a fiscal rules' target may lead a government to reduce social or health expenditure, which could, in turn, have negative consequences for inequalities and quality of life. The potential re-allocation of public expenditure to achieve fiscal rules compliance thus implies severe effects, justifying a thorough investigation. Consequently, fiscal rules' performance may come with side-effects and this analysis looks to address the following question: is fiscal rules' compliance detrimental to the economy and, in particular, for social welfare? To tackle this issue, this work considers the Budget Balance Rules' (BBR) compliance effects on macroeconomic indicators and social welfare proxy indicators in 16 countries between 2004 and 2015.

Social welfare is a broad concept with a seminal definition that covers basic human needs and originates from Maslow's pyramid (Maslow [1970]). Since the 18^{th} century, utilitarians such as Jeremy Bentham and John Stuart Mill have developed the argument that societies and governments should promote "The Greatest Good for the Greatest Number". This "Greatest Good" broadly refers to happiness and acceptable levels of health, income, and social conditions. The World Health Organization (WHO) extended the definition in the Ottawa Charter (1986) by considering social welfare as "a state of complete physical, mental and social well-being". Consequently, social welfare refers to different economic and social concerns that we will try to capture through different channels identified in the literature.

To study how fiscal rules' performace affects social welfare, instead of fiscal rules strength or fiscal rules presence effectiveness, we focus on fiscal rules' compliance effect on the social area. The marked effect of fiscal rules (usually proxied by the Fiscal Rules Strength Index (hereafter FRSI) or fiscal rules adoption) on public finance has been well documented[1], with some evidence that fiscal rules may affect public spending. In this analysis, we want to assess whether compliance also plays a role. However, the pandemic crisis (2020-2021) hit people, businesses and the public finance, leading to new social challenges. Indeed, Blundell et al. [2020] provided evidence on the pandemic period, highlighting impacts on employment and ability to work, investments and health. Consequently, we need to consider with caution the effect of fiscal rules performance on the social field, because a decision-maker who wants to restore sustainable public finance and adopts fiscal rules for their disciplining effect may neglect potential side-effects on economic growth and social welfare.

This focus on the effects of fiscal rules compliance necessitates a rigorous definition of compliance. The study considers two definitions of fiscal rules compliance. The simplest definition of compliance is a binary reflection of whether the fiscal rules did or did not meet the limit (as in Reuter [2019]), but compliance may also be considered in a more sophisticated form[2].

[1] See e.g. Debrun et al. [2008], Bergman et al. [2016], Tapsoba [2012], Combes et al. [2018] and Barbier-Gauchard et al. [2021].

[2] 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.

Fiscal rules often include escape clauses or exceptions, making the task of defining fiscal rules compliance more complex. In the presence of such escape clauses, it does not appear reasonable to consider that a country is a non-compliant if it exceeded the limit, but the escape clause was activated. In that sense, it is possible to define compliance as a situation where a country either presents a targeted indicator under (or equal to) the limit, or where the indicator is above the limit, but an escape clause is activated. In the latter case, the country is exceptionally authorized to deviate and should not be sanctioned. Not considering the presence of escape clauses could distort the results by introducing an error in the definition of the effect, itself, that we are trying to estimate.

We follow a multi-step approach to the empirical analysis, with the identification of fiscal rules' compliance determinants being the first step. The analysis provides an investigation of fiscal rules' compliance determinants considering existing studies that addressed this identification issue (see Reuter [2019], Delgado-Téllez et al. [2017] or Baret et al. [2021]). In our analysis we focus on national fiscal rules, and more specifically on Budget Balance Rules (BBR) compliance. We follow a similar approach to that adopted in Baret et al. [2021] by identifying the main determinants of fiscal rules' compliance with Machine Learning methods that select the most prominent variables among many potential determinants. The second step is the Treatment Effect measurement. We expect that complied fiscal rules may have effects that non-complied fiscal rules could not have, in particular potential side-effects, on social welfare. This second step uses, as dependent variables, different channels through which fiscal rules compliance may affect social welfare between 2004 and 2015.

This work contributes to the literature in several ways.

Our approach first extends traditional assessment of fiscal rules performance by considering the fiscal rules compliance effect instead of fiscal rules effectiveness usually proxied by fiscal rules presence or strength. In 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 associated with approaches using composite indices, such as FRSI, that are time in- variant.[3]. That being said, variables relating to fiscal rules characteristics (including FRSI), are considered in the present approach by evaluating if they are key predictors for Budget Balance Rules' (BBR) 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 unprecedented and excludes biases that may arise in studies on fiscal rules performance, as discussed in Heinemann et al. [2018]. Indeed, Heinemann et al. [2018] noted that the majority of studies assessing the impact of fiscal rules on fiscal discipline is highly biased because endogeneity is not adequately controlled. The assessment of the fiscal rules performance effects employs numerous methodologies, including Instrumental Variable (IV), system-Generalized Method of Moments (sys-GMM) and propensity-score matching (PSM), as in Barbier-Gauchard et al. [2021]. IV and sys-GMM performance is highly dependent on the choice of instruments (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). On the other hand, propensity-scores are related to random assignment (meaning that conditional independence assumption must hold according to Rosenbaum and Rubin [1983]) which constitutes a strong constraint and assumption to ensure the robustness of the PSM approach. The algorithm we use is based on Norman

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

orthogonality and is supported by strong asymptotic properties, thus generating a useful estimator for causal inference. DML estimation avoids reverse causality bias (which often occurs with standard econometrics) and reduces the potential omission bias since we can test a vast number of predictors.

Third, we include a proxy measure for "voter preferences" to increase the robustness of our analysis. This provides a significant value added among the existing literature on fiscal rules since previous studies based the robustness of their results on the assumption that voter preferences do not affect the results, and proposed many econometric robustness tests. 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 highlight that voter preferences are one of the key determinants for BBR's compliance. Consequently, it suggests that studies dealing with fiscal rules performance issues should carefully account for Wyplosz [2012]'s bias. Second, we provided some evidence on BBR's compliance side-effects on social welfare. The negative consequences of strict compliance[4] operate through public spending composition, which mainly affect the redistribution function by reducing social expenditure. We also observe that BBR compliance increases inequalities. Governments seem to not 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. However, a compliance definition which incorporates the presence of escape clauses may affect the results since we find a positive effect of compliance on economic growth after accounting for escape clauses. This implies that introducing flexibility in fiscal rules' compliance definition matters for economic health. Nevertheless, the negative impact on inequalities is not solved by relaxing the compliance definition and demands new reflections on fiscal rules design to carefully preserve public social spending.

The rest of the paper is structured as follows. Section 2 develops the literature review on fiscal rules compliance effects and social welfare channelse, Section 3 describes the data by insisting on national budget balance rules' compliance measurement and exposes the stylized facts. Section 4 presents the methodology, Section 5 reports the benchmark results and policy recommendations, Section 6 concludes the analysis.

2 Literature review on fiscal rules compliance effects and social welfare channels

2.1 The identification of social welfare channels

The goal of the analysis is 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 and relies to political economy. That's being said, Hediger [2000] 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 performance (reflecting here by fiscal rules' compliance), social and economic objectives. Our main challenge is the identification of social welfare channels that may be concerned by the effects of fiscal rules compliance. Indeed, the list of social welfare determinants may refer to a lot of candidates such as the level of development, institutions (Acemoglu [2003]), fiscal policy (Gosh and Roy [2004])

[4]Strict compliance refers to the definition of compliance that only considers if a country met or not the limit of the BBR. It does not take account for flexibility by not considering the presence of escape clauses.

and monetary policy (Lawler [2001]), the international trade (Samuelson [1938]), the financial development (Marini [2005]), geography (Smith [1974])... Consequently, social welfare may be linked with economic indicators as well as social indicators, and this analysis tries to identify the ones on which fiscal rules' compliance may have an impact.

First of all, 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[5] 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[6] 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 public spending may be protected. In 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. Blundell et al. [2011] investigated the link between fiscal rules and economic growth but there is no reference to the 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.

Also, social welfare is related to the level of public debt (see e.g Flodén [2001] or Aiyagari and McGrattan [1998])[7]. The level of public debt could be linked to the redistributive government function and 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 interested in the link between 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 assessment of the relationship between public debt and fiscal rules' compliance will be studied through the effect of fiscal rules' compliance on public deficit that feeds public debt. On the other hand, if fiscal rules' compliance may be able to decrease public deficit, this may correspond to a positive effect on fiscal discipline. According to findings from Barbier-Gauchard et al. [2021], fiscal rules performance transit through financial market by sending a positive signal to financial markets leading to a decrease in the interest rate

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

[6] 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.

[7] 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.

on public debt. It may consequently reduce the debt burden and gives governments more leeway. In that sense, we are interested on the effect of fiscal rules' compliance on both public balance and public debt interest rate.

Otherwise, we also should conduct further investigation on inequalities that may be a direct and undirect channel of social welfare. Inequalities may introduce a direct channel with social welfare because they refer to the quality-of-life conditions. On the other hand, inequalities as they may be viewed as an undirect channel. Kuznet [1955]'s curve described a non-linear relationship between the GDP growth and inequalities. In the first steps of development of the economies, GDP growth comes with an increase of inequalities. After achieving a sufficient level of economic development, the countries could then reduce social inequalities by redistributing the accumulated wealth. As developed in the previous paragraph, GDP growth is a channel of social welfare which appears also linked with inequalities. Consequently, inequalities may be first be affected by GDP growth and then, inequalities may affect social welfare. Inequalities thus represent a key but complex link with social welfare and the relationship between fiscal rules performance 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 focus on fiscal rules' compliance effects rather than fiscal rules presence/or strength effect. We will propose to assess the compliance impact on inequalities measured by proxy indicators including the Gini index computed by the World Bank.

2.2 Assessment of fiscal rules compliance effects

The world economic crises of the last decades challenged the fiscal rules compliance, but they also increased the debt unsustainability risk, raising the discussion on the relevance of fiscal rules for sustainability recovery. Consequently, the debate put the design of fiscal rules at the center. The definition of an ideal fiscal rule proposed by Kopits and Symansky [1998] introduced the concept of enforceability[8]. 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)[9]) and independent fiscal councils should be in charge of monitoring[10]. Compliance thus appears being a major concept when assessing fiscal rules performance.

In the existing literature on fiscal rules compliance, a large part is devoted on the compliance determinants such as Delgado-Téllez et al. [2017] studying Spain regions through a first-difference General Method of Moments approach. Reuter [2019] focusing on the EU members and Nandelenga and Ellyne [2020] analyzing sub-Saharan African economies, both used a logistic model and highlighted that determinants of fiscal rules' compliance particularly concern fiscal rules' characteristics such as the registration in the law, the level of rigor, the degree of public finance coverage. Larch and Santacroce [2020] focused on the compliance with the supranational fiscal rules included in the SGP and its effect on various macroeconomic variables such as the market volatility index, the output gap, the nominal GDP growth or the quality of governance.

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

[9] 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 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.

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

Another part of this literature studies the government behavior face to the fiscal rules' compliance and its effect on the economic indicators. Reuter [2015], studying the dynamic of compliance showed that even if fiscal rules aren't comply, governments implement efforts to move close to the limit. This work was extended to emerging and developing 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, suggesting that compliance seems to be a goal for governments. On the other hand, paying attention to this compliance which may sometimes be forced -in the sense that it goes against economic and fiscal impulse needs- also constitutes a topic for economic studies. We set our study in this strand of literature which focuses on fiscal rules compliance effects. The effects of fiscal rules performance on some of the channels of social welfare we discussed in 2.1, were addressed by the literature. Nevertheless, the studies do not necessarily consider compliance as the indicator for fiscal rules performance. Also, they do not cover different channels focusing in only one social welfare indicator and a particular attention is dedicated to inequalities measures. Larch et al. [2021] showed that EU supranational fiscal rules compliance 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 national budget balance rules compliance on public finance indicators and public spending composition. Any change in the spending allocation and redistribution function of government implied by fiscal rules' compliance may lead to side-effect on social welfare. This also builds a bridge between fiscal rules' compliance effect and inequalities. The side-effects of fiscal rules simple presence on inequalities were already addressed by Combes et al. [2019] and Hartwig and Strum [2019]. Combes et al. [2019] found that BBR do not imply an increase in inequalities for developing countries while Hartwig and Strum [2019] found a positive 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 side-effect on inequalities which are related to social welfare.

Our study thus extends existing literature by investigating the impact of fiscal rules compliance on different economic indicators to evaluate the presence of a potential government trade-off between economic objectives and fiscal rules compliance. Most importantly, we extend the assessment of fiscal rules performance effect to the effect of compliance on inequalities and other channels of social welfare that have not already been considered with their relationship to social welfare in the literature. All these channels are derived from the discussion proposed in in 2.1 and the data section 3.2 describes the measurement of these indicators. Moreover, our work comes with a causal Machine Learning estimator that discards reverse-causality such as overfitting bias, allowing for an interpretable treatment effect of fiscal rules compliance.

3 Data and stylized facts on national Budget Balance Rules' compliance and social welfare

This section presents the data, in particular the construction of the economies retained for the analysis, the compliance indicator as well as the list of potential determinants of national budget balance rules' compliance.

3.1 Measurement of Fiscal rules' compliance

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)). Different types of fiscal rules may mean *different effects* (See for heterogeneities of fiscal rules effect Debrun et al. [2008] or Baret et al. [2021]). In that sense we must study the compliance by type of rule. The selected rules must be comparable to obtain a reasonable average treatment effect and thus must hold over the same period[11]. We finally identified sixteen countries who had a Budget Balance Rules over the same period, but we could not identify enough countries who applied the other types of rules on a same period. The study includes the following sixteen countries[12] which had a BBR between 2004 and 2015: Chile, Costa Rica, Denmark, Estonia, Finland, Germany, Hungary, Indonesia, Japan, Malaysia, New Zealand, Peru, Spain, Sweden, Switzerland, United Kingdom. Fourteen of these countries are OECD economies and the dataset was increased by two countries that were also under a BBR on the period 2004-2015. The two non-OECD countries are Indonesia and Peru which could not be neglected to avoid any selection bias due to a possible voluntary selection of only OECD members. All Budget Balance Rules and their target's definition come from IMF Fiscal Rules Database (Schaechter et al. [2016]) and targeted values' sources are developed in Appendix 1. Appendix 2 summarizes all BBR retained in this analysis and provides details on their definition.

Second, we had to precisely define each BBR regarding the possible presence of exclusion clauses. Because we first adopt a simple definition of compliance - i.e. a country complied with (resp. did not comply with) the BBR whether 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 [13]. 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 tests regarding escapes clauses are two-fold: i) we test whether the presence of an escape clause is a key determinant for national BBR's compliance; ii) we conduct a robustness test of the treatment effect by removing all observations that did not complied with BBR that are designed with escape clauses[14].

Third, some countries of our dataset need special attention. (1) United Kingdom abandoned its Golden rule in 2009 due to the Global Financial Crisis (GFC) that led to an excessive deficit rendering the compliance with the Budget Balance Rule impossible. We assume that United Kingdom (UK) voluntarily did not comply the Golden rule in 2009 and treat the UK as a non-complier in 2009. The UK introduced a new Budget Balance Rule in 2010 which targets 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]). We then verify if this assumption does not affect our results by then conducting a robustness test 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

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

[12] 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.

[13] For example, the European Commission defines exceptional circumstances in the SGP escape clauses as a recession of 2% of GDP.

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

all other countries are treated with only one BBR. Also, Hungary seems to stop having fiscal rules after 2011 in the IMF Database (Schaechter et al. [2016]). But the Fiscal Compact (also known as "The Treaty on Stability, Coordination and Governance (TSCG)") was transposed in EU members' national law. In that sense we could not consider that there is no BBR applied at national level in Hungary. We thus assume that structural deficit should be above 0.5% (because debt is higher than 60%; as described in TSCG). We also conduct a robustness test that consists in removing Hungary observations after 2011 to give a proof that our results are not sensitive to this interpretation. (3) In Caselli et al. [2018] the Golden rule of Japan is considered only between 1990 and 1993 because waiver looks as requested since 1975. However, this rule is well considered in the IMF database and we assume that this is a voluntary attitude of Japan regarding its rule. Japan has never complied with its rule over the study period, but it is an assumed deviant behavior from Japan and we cannot neglect this aspect.

3.2 The potential determinants of national Budget Balance Rules' compliance and proxy variables for social welfare channels

Table 1 reports the dependent variables of our interest. According to the literature review (see section 2.1), we identified several channels related to social welfare which are named "social welfare related indicators" in table 1. We consider them as reasonable proxies for social welfare. Some of these channels are represented by macroeconomic variables as public balance, interest payments on public debt, general government gross fixed capital formation, general government final consumption[15], GDP per capita annual growth.

We expect that, when a government faces its BBR constraint, it will operate a change in its spending composition. This change may be based on their expected return-effect on economic growth. For example, according to the economic theory, public infrastructure expenditure may be positive for economic growth whereas consumption expenditure not (Everaert et al. [2015]). In that sense, a government that complied its BBR may choose to favor public GFCF while decreasing social expenditure and thus, expects GDP growth in return. We thus need to evaluate the impact of BBR compliance on government expectations. To do so, we produced a measure for the GDP growth expectation based on a 5 years moving-average of the GDP growth.

Government performance and its redistribution function may also be affected by fiscal rules because they may affect public finance indicators as well as other macroeconomic indicators. Thus, dependent variables also concern government performance by including the Government Effectiveness Index from the World Bank, and our own constructed index of Government Efficiency which summarized the government Musgravian functions. We aim at comparing the effect of BBR's compliance on government Effectiveness and government Efficiency that are two different concepts[16]. Following Afonso et al. [2006] and Afonso et al. [2019], we construct a measure for Government Efficiency index computed over-year. We choose 3-over-years computation (instead of 5 years as often found in the literature) to reduce the time-invariance of the indicator. We use mean-min function to aggregate 3 sub-indicators which correspond to the Musgravian functions (see Afonso et al. [2006] or Afonso et al. [2019] for similar proxies): - the proxy for the distribution function is the Gini index; - the proxy for the stabilization function is constructed by the sub-aggregation of the GDP per capita growth rate and inflation (3 years average); - the proxy for the economic performance function is the unemployment. Finally, due to the poten-

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

[16]See e.g. general introduction for discussion.

tial link between government performance and inequalities previously discussed in the literature review, we also introduced inequalities related measures among the dependent variables. These indicators are summarized by 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 summarized the list of potential predictors that may affect both the BBR's compliance and the dependent variables. In line with many results from studies analyzing the determinants of fiscal rules' compliance[17], 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 strength of fiscal rules) named "Fiscal Rule Related characteristics".

Political variables can interfere with the governments behavior, especially with regard to their compliance with fiscal rules. As illustration, the government stability or the rule of law index (that assesses the extent which economies adhere to the rule of law in practice) reflect political credibility which may play a role in governments commitment and their ability to fulfill their objectives. On the other hand, characteristics of fiscal rules (such as the coverage level or the presence of enforcement procedure in case of non-compliance) could also affect the credibility of the rule itself, and thus should be considered when assessing fiscal rules' performance.

Among these list of potential determinants, we are interested in finding those which are recurrent from one country to another and contain useful information to explain the compliance with the budget balance rules.

To extend the list of potential determinants 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 ones 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 careful in the use 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 variables that reflect the voter behavior namely Unemployment, Age dependency ratio (old in % of working-age population), the share of votes obtained by the largest government party, 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[18].

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

[18] If the feature selection step reveals that one or both factors are a key determinant for fiscal rules' compliance, it will give an empirical recommendation for studies on fiscal compliance to control for voter preferences.

Table 1: **Variables Overview**

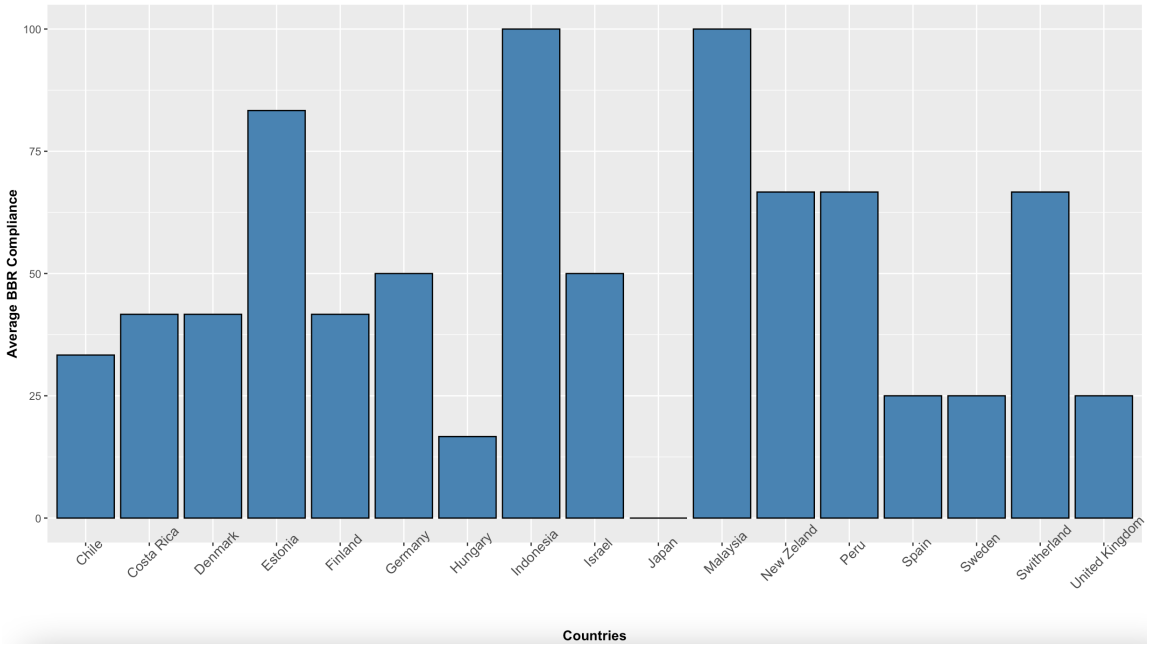
Variables	Correspondence Variables	Source/Database	
dependent	Public Balance (in % of GDP)	World Bank	
Dependent	Interest payments (in % of expense)	World Bank	
Dependent	GG Gross Fixed Capital Formation (in % of GDP)	World Bank	
Dependent	GG Total Spending (in % of GDP)	World Bank	Social
Dependent	General 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
dependent	Government Effectiveness Index	World Bank	
dependent	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 variable reflecting if the country is an Advanced country	IMF Fiscal rules' Database	
Predictor	Dummy variable reflecting if the country is a Resource Rich country	IMF Fiscal rules' Database	
Predictor	Dummy variable reflecting if the country is an Emerging country	IMF Fiscal rules' Database	
Predictor	Dummy variable reflecting if the country is an Advanced country	IMF Fiscal rules' Database	Countries
Predictor	Dummy variable reflecting if the country is a EU member	IMF Fiscal rules' Database	Characteristic
Predictor	Dummy variable reflecting if the country is member of a currency union	IMF Fiscal rules' Database	indicators
Predictor	Political system	WWGI	
Predictor	Dummy variable 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	Author's calculations with LFA	
Predictor	Proxy 2 for Voter's preferences	Author's 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	
Predictor	Coverage level	IMF fiscal rules' Database	Fiscal rule
Predictor	Dummy variable reflecting if an independent body sets budget assumptions	IMF fiscal rules' Database	Related
Predictor	Dummy variable reflecting of an independent body monitors implementation	IMF fiscal rules' Database	characteristics
Predictor	Dummy variable reflecting if the BBR is a Golden rule	Author's narrative approach and IMF fiscal rules Database	
Predictor	Dummy variable for economy conjuncture		
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.

3.3 National BBR compliance and social welfare stylized facts

This part aims at illustrating the intuitions regarding the potential links 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 Switzerland take care of the compliance, other as Japan, Hungary or Spain exhibit a poor compliance record. These countries are historically, socially, and structurally different. In that sense, we expect that the identification of the key common determinants for the BRR's compliance to help us to provide explanations about such differences across countries' compliance record.



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

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

Face to this heterogeneity between countries regarding the BBR's compliance, we are interested on the potential effects of these differences on the economy and social welfare. We thus propose a graphic comparison of the compliers group (countries that complied with their BBR) over the non-compliers group (countries that did not comply with their BBR). We are interested in the analysis of the social welfare related indicators of these two groups by comparing the median 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 did not comply with their BBR. It suggests that countries from the compliers group use part of their public spending in order to comply with their BBR. This fact seems to reflect the disciplining effect of compliance since the 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 the compliers. The redistribution tools for borrowed money (that generate public deficit) or for economic growth resources, 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 the 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 the BBR-compliers which suggests that inequalities are higher for them. A possible way to link

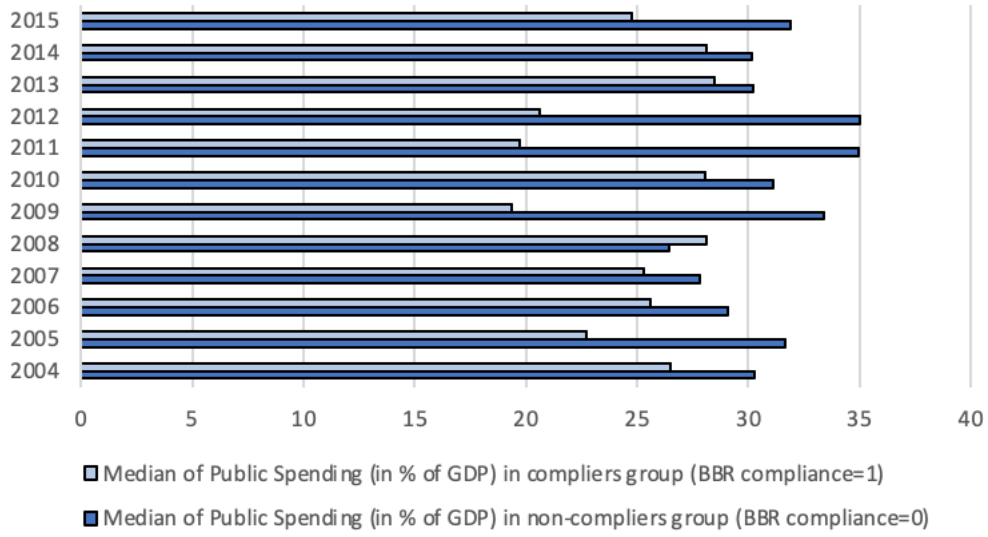
these graphical findings is that the cut in public spending seems to be done through public social spending and thus need a careful attention. We also see that the differences in Gini index highly increased after the GFC. Gini index median became even more higher for compliers, suggesting that the GFC increased the social costs for compliance.

We must note that in the year of the GFC shock (2008) we observe the opposite to what we described above for the rest of the study period. Indeed, the Gini index is lower for compliers, while the total public expenditure is higher than non-compliers. We see two possible explanations:

i) the exceptional circumstances that generate exceptional facts. 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. In such conditions, the distinction between "compliers" and "non-complier" is no longer so clear. Finally, in times of crisis, few countries comply with their rule (in the strict sense/without taking into account the escape clauses) and, in general, public spending increases to support activity. On the other hand, the deterioration of economic conditions, in particular employment, also increases social inequalities. When we move away from the crisis shock, we observe that countries which tend to comply with their BBR seem to spend less and exhibit more inequalities;

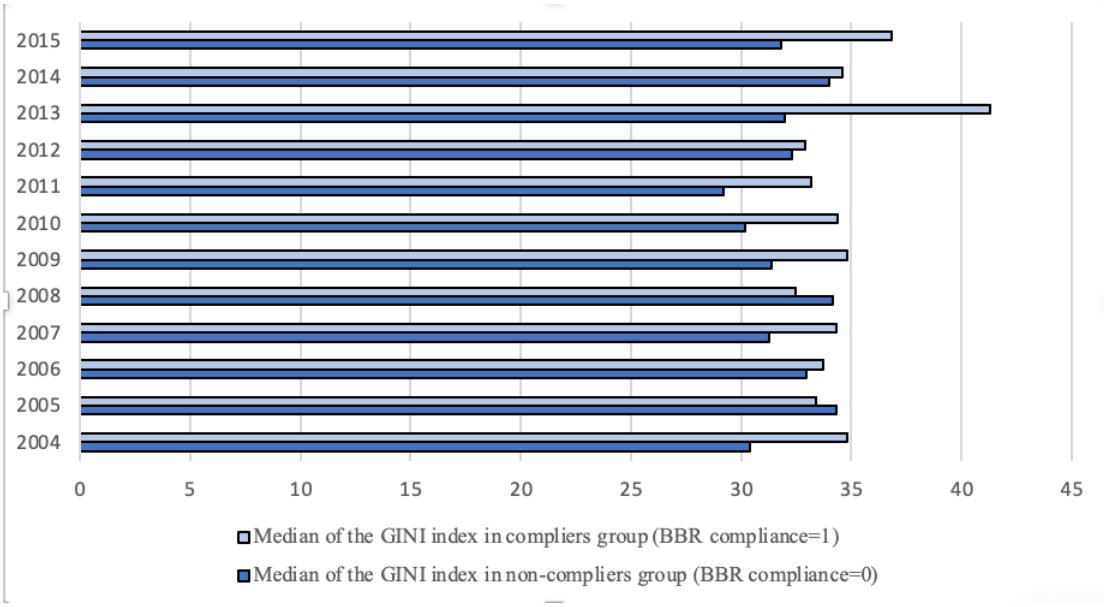
ii) it is also possible that countries that are used to respecting their rules will be in better shape when the crisis arrives. This would give them more scope to limit the crisis (less inequality and more public spending). But when conditions return to normal, more than half of the countries that respect their rules have higher inequality and lower spending again.

This point launches the importance of analyzing the definition of compliance, in particular a flexible definition that incorporates escape clauses.



Source: Author.
Note: *BBR compliance* is a Dummy variable taking the value 1 if the country complied with it BBR and value 0 if it did not comply with. The compliance definition considered here is the simplest one that does not consider flexibility and escape clauses in fiscal rules' design. The sample covers our sixteen studied countries.

Figure 2: **Comparison of the median of the Public Spending between BBR compliers and BBR non compliers between 2004 and 2015**



Source: Author.
Note: *BBR compliance* is a Dummy variable taking the value 1 if the country complied with it BBR and value 0 if it did not comply with. The compliance definition considered here is the simplest one that does not consider flexibility and escape clauses in fiscal rules' design. The sample covers our sixteen studied countries.

Figure 3: **Comparison of the median of the Gini index between BBR compliers and BBR non compliers between 2004 and 2015**

4 Methodology: Feature selection and Double/Debiased Machine Learning estimator

4.1 Treatment Effect Estimation

Recently, some studies focused on the usefulness of Machine Learning (ML) on the causal inference that belongs to the applied econometric field (Varian [2014], Mullainathan and Spiess [2017] or Athey and Imbens [2017]). Several techniques were developed to improve ML performance in the work of the 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 in 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 work is to estimate confidence intervals for a low-dimensional parameter β_0 with high-dimensional nuisance parameter η_0. The η_0 parameter should be estimated with the recent nonparametric statistical methods belonging to the Machine Learning (ML) field. ML methods highlight high level forecasting power (see e.g. Baret et al. [2021] or Härdle et al. [2009] and Gogas et al. [2018]). However, this performance in forecasting does not imply inference performance for "causal" parameters. To solve such problem, Chernozhukov et al. [2017] developed Double/Debiased Machine Learning methodology (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-dimensional vector of controls/confounders, β_0 is our parameter of interest.
Z corresponds to control variables on the sense that the treatment D is defined as

$D = b_0 + \theta_0(Z) + V$ with $\theta_0 \neq 0$

If conditional 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[19] 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 $\widehat{V} = D - \widehat{E[D|Z]}$.

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.

4.2 Feature Selection Estimators

Following Chernozhukov et al. [2017] and Chernozhukov et al. [2018], we will use different feature selection procedures as robustness tests that allow us to make our results generalizable. As techniques, we propose the Least Absolute Shrinkage and Selection Operator (LASSO) and the $l2 - boosting$.

In the context of our analysis, we should keep in mind that the dependent variables of interest are continuous while the treatment effect (BBR's compliance) is a binary variable. In that sense, the following algorithms will be adapted of each case (continuous or binary). Since our main dependent variables (the overall public balance, the interest payments, the total public spending, the government final consumption, the GDP per capita expectation, the GDP per capita in $t+1$, the government Effectiveness, the Musgravian Index, the Gini index and the poverty headcount ratio) are continuous, we are able to report the efficiency using the 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 variables of interest[20]) resulting from both feature selection algorithm and highlight the normal properties that allow such procedures.

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.

[19] Least Absolute Shrinkage and Selection Operator (LASSO) and the $l2$-boosting.
[20] All fitted values distribution for all our variables of interest are available upon request to the author.

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]).

Presentation of the $l2$-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. In that sense Boosting is an Ensemble technique that will produce several weak leaners 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.

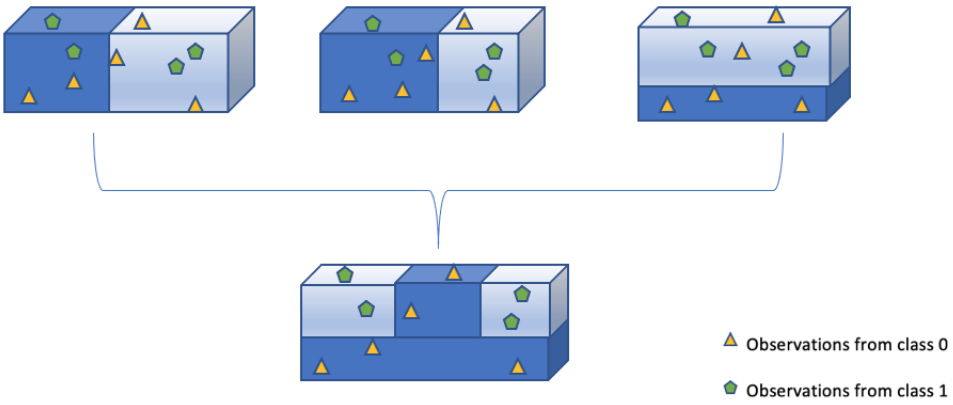


Figure 4: **Illustration of Boosting Algorithm**

The Figure 4 provides a simple illustration of how 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, the false predicted observations will be assigned to the next base learner with a higher weight. The algorithm continues with the repeats the weights update and forecasting until the ending criteria is met.

By definition, Gradient Boosting sequentially generates base learners that are more effective than the previous one. Gradient Boosting makes the overall model improving sequentially with each iteration.

Gradient Boosting optimizes the loss function of the previous learner. To do so, Gradient boosting adds a new model that adds weak learners aiming 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 functional gradient descent procedure, including a $l2$-penalty term. Such procedures need an initialization step, by setting target outcomes

for the first model. This algorithm is equivalent to the functional 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 dependent variable and X_i the potential predictors for observations $i = 1, ...n$. When Y is continuous, the problem is solved through regression; when Y is discrete, we are in a classification issue. Cost function C(.,.) verifies important properties to make sure that gradient approach works well: 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 gradient descent to the dataset lead to the minimization of the empirical risk and the estimation of $F(.)$ 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) which corresponds to the compliance determinants identification step. Then, we apply this algorithm 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 descent and $L2$-boosting with linear/classification learners, see Bühlmann and Yu [2003].

5 Results and policy recommendations

This section develops the findings provided by our Double/Debiased Machine Learning (DML) estimator. Results first report the findings from the feature selection step. This step is crucial because it extracts information from both dependent variables and treatment (namely BBR compliance) before assessing the treatment effect. We focus our attention to the identification of the determinants of national BBR's compliance because it is the selected indicator of fiscal performance of interest. We do not report the variables selected as determinants for the dependent variables. If any determinant of the BBR affects one or several of our dependent variables, this information is considered by our methodology developed in Section 4.1. The second part of the result presents the Average Treatment Effect (ATE) of the BBR's compliance on the dependent variables defined in section 3.2. There variables correspond to the social welfare channels.

5.1 Results from Feature Selection procedures

Table 2 reports the ten key common determinants for BBR's compliance retained by our two feature selection algorithms: the Dummy variable for economic crisis, the Dummy variable reflecting the presence (or not) of escape clauses, the Dummy variable reflecting the presence (or not) of a formal enforcement procedure in the BBR's design, the voice and accountability measure, the Dummy variable reflecting if a country is a federal country, the dummy reflecting if a country is member of a currency union, the number of years the chief executive hold, a proxy for voter preferences, the first lag of the interest payments on debt (expressed in percent of total public

expense), the first lag of public balance (expressed in percent of GDP). The sign reported next to the identified determinants of BBR indicates whether the factor affects positively or negatively BBR's compliance.

Dummy variable for Crisis has a negative effect on BBR's compliance. It suggests that it is difficult for governments to comply with fiscal rules during worst economic periods. The presence of escape clauses makes governments tempted to not comply BBR. Governments seem tempted to relax because of the presence of these escape clauses. It constitutes an empirical evidence that escape clauses drive government behavior and thus matter in the choice of compliance definition. On the contrary, the presence of sanctions for non-compliance positively affects BBR's compliance. It means that governments seem to consider with caution the potential application of financial sanctions if they deviate from their objective. 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 positively affects the BBR's compliance because it is easier to comply fiscal rule when public finance is in good health. Finally, one of our two proxies for voter preferences appears significant. We tested two proxies of voter preferences coming from our latent factor computation. The significance of one these two factors reflecting voter preferences, suggests that we must take into account 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 governments. 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 variable for crisis (-)
Dummy variable for Well-specified escape clause (-)
Dummy variable for Formal enforcement procedure (+)
Voice and Accountability (-)
Dummy variable for Federal country (+)
Dummy variable 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 Average Treatment Effect (ATE) of BBR's compliance on our variables of interest. We decompose our results in a first part that summarizes the ATE on the macroeconomic variables while the second part reveals the ATE on Social related indicators. All our results are stable across feature selections approaches used in the first step of our DML algorithm. Nevertheless, the RMSE for the dependaet variables provided by $L2$-Boosting is lowest in every case, showing that it is the best model.

The Table 3 -part 1- highlights that, according to literature which links fiscal rules and fiscal discipline [21], 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 positive signal-effect to financial markets. However, Barbier-Gauchard et al. [2021] showed that the fiscal rules presence reduces the interest rate on debt. Finally, the simple presence of fiscal rules matters as a signal effect for financial markets, but fiscal rule compliance does not imply any difference. This finding highlights that the definition of fiscal rules performance retained may drive the conclusions.

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, significant and negative ATE (column 4) for total public spending and significant and positive ATE (column 3) for general government GFCF. As explanation, governments operate a cut in government final 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 column 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 the BBR's compliance has no effect on Government Effectiveness and Government Efficiency. We expected that fiscal rules' compliance forces government to spend in a better way, taking care of each unit of money spent and thus increase government efficiency. We also expected that government favor spending performance in order to insure favorable economic conditions and thus increase government effectiveness. Nevertheless, we observe that ATE associated with both government effectiveness and government efficiency are not significant. Governments reduce social spending but increase GFCF at the same time; two actions going on the opposite side that 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 interpreted as variables expressed in percent of GDP. The BBR's compliance leads to an increase around 0.09 units in the Gini 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 is included in the government final consumption expenditure which is reduced by the BBR's compliance. We thus observe an increase in inequalities measured through the Gini index. 0.09 unit of Gini index represents 9% of the index values' range. In that sense, compliance may explain around 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

[21] See Section 1 and 2 for discussion

re-allocation. Finally, the side-effects observed in public expenditure impact both inequalities and poverty, suggesting that government may to face a trade-off between fiscal rules' compliance and social objectives.

Table 4 shows the robustness test by removing observations for the UK and Hungary on which we set hypotheses in Section 3.1. Our results still hold with the two methods, and $L2$-boosting is still being the best model regarding the RMSE measure.

Table 5 provides results removing observations-years where an escape clause holds. 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 flexibility in compliance definition, GDP growth appears higher.

Finally, BBR's compliance seems not damageable for the economic area but for the social area. Such result reinforces our highlight suggesting that the side-effect on public spending composition is negative for social welfare and governments seem not to 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 \ Dependent 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 is reported in brackets.

Part 2: ATE on government performance and inequalities channels

DML Estimator \ Dependent 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 the author in 3.1**

Part 1: ATE on Macroeconomic channels

DML Estimator \ Dependent 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 is reported in brackets.

Part 2: ATE on government performance and inequalities channels

DML Estimator \ Dependent 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 did not comply with their BBR but escape clauses existed**

Part 1: ATE on Macroeconomic channels

DML Estimator \ Dependent 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 is reported in brackets.

Part 2: ATE on government performance and inequalities channels

DML Estimator \ Dependent 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

5.3 Technical and policy recommendations

Following our main results, the first implication for future research is technical. Indeed, the significance of voter preferences proxy suggests that taking care of voter preferences when assessing fiscal rules performance highly matter. Neglecting this variable could lead to an omission bias, which appears important for all models estimating average treatment effects. The accurate specification of the treatment itself is key to achieve the conditional independence assumption described by Rosenbaum and Rubin [1983]. Statistical robustness tests may be insufficient to cover such omission bias when assessing fiscal rules performance, as discussed in Wyplosz [2012] and Heinemann et al. [2018]. Political database such as the Database on Political Institution (DPI, Cruz et al. [2020]) should be seriously considered and used to construct variables to proxy and control voter preferences.

The other technical recommendation is to extend the use of models that account for reverse causality and omission bias at the same time. The use of causal Machine Learning to estimate inference parameter may offer opportunities for future research. Even tough, Machine Learning is mostly famous for forecasting and classification, it should also be considered as an alternative for econometrics in causal estimation. The Double/Debiased Machine Learning model developed by Chernozhukov et al. [2018] that we used in this study presents several advantages such as testing for a larger number of predictors than standard econometrics approach, and it thus reduces the potential omission bias. The orthogonalization procedure and the use of lagged macroeconomic variables in our model discard reverse causality bias. The risk of overfitting is avoided by cross-validation procedure. Consequently, the use of the combination of these techniques proposes a Machine Learning tool as a solution with strong asymptotic properties for causal estimation. We thus support the use of such approaches for future studies in fiscal issues as well as in other macroeconomic topics.

On the other hand, we must put some words on policy recommendations. Due to the importance of voter preferences and the number of years that a chief executive stays on office, as fiscal rules compliance determinants, governments should consider with caution the importance that fiscal discipline represents for elective purposes. We first expected that governments may be tempted to run deficit to increase public spending to carry favor from electors in order to be re-elected. Nevertheless, when electors prefer disciplined governments such behavior no longer holds. This appears even more relevant because modern societies are increasingly informed and not easily fooled by government elective strategies.

Our findings regarding the side-effects of fiscal rules compliance should serve as a warning as well as a guide for the future design of fiscal rules. The flexibility of fiscal rules compliance definition (by considering escape clauses) seems to limit the negative effects we found by improving the GDP growth. However, it is not sufficient to limit the negative impact on social expenditure (in particular on social transfers). The coming years will not be able to ignore the amount of public debt accumulated that followed covid-19 crisis. Fiscal rules will therefore have an important role to play in restoring fiscal discipline. But, this cannot be done without serious considerations of social spending and inequalities, as the pandemic crisis has also increased inequalities by affecting more some sectors than others[22]. Thus, the future of fiscal rules must be achieved through thoughtful and discussed reforms, favoring fiscal discipline while preserving productive spending (investment) without damaging social spending. There is no miracle solution, but improvements are possible. In particular, the multiplicity and complexity of fiscal rules, as in the Stability and Growth Pact in the EU, may make fiscal rules inefficient but also not credible. A simplification

[22]For example, restaurants and shops have been on partial unemployment for a very long time, while other jobs have been able to telework without loss of pay.

of fiscal framework using more flexible rules regarding the definition of their target indicators could be considered. We are thinking, in particular, of over-the-cycle rules or a Golden rule. Such fiscal rules that are more flexible by definition, could include sanctions in case of deviation from the rule. Indeed, a country that does not comply with a flexible rule could turn out to be far too lax in relation to the margins already authorized by the rule.

6 Conclusion

The study provides an assessment of national Budget Balance Rules compliance side-effect on social welfare channels indicators. It uses the Double/Debiased Machine Learning methodology including LASSO or Boosting feature selection algorithms as robustness test. All the results do not depend on the shrinking algorithm choice since results are consistent across 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 suggest that Wyplosz [2012]'s bias matters.

Finally, average treatment effect results, from the second step, showed that governments with national Budget Balance Rules seem to try to overcome the trade-off between BBR's compliance and Growth objectives. Governments conduct public investment and achieve BBR's compliance at the same time. Instead of an arbitration between compliance and economic growth, governments operate a re-allocation of spending. Governments seem to favor Gross Fixed Capital Formation but decrease government Final Consumption that includes social spending. Consequently, BBR's compliance seem to have an increasing effect on inequalities and this effect affect more the poorest classes as suggested by the impact on the poverty head account ratio. Finally, empirical findings provide of side-effects of fiscal rules strict compliance. Nevertheless, by relaxing the compliance definition, we finally found similar conclusion as in Blundell et al. [2011], that fiscal rules may support economic growth. The side-effects of fiscal rules' compliance operate through public spending composition by decreasing social spending. Consequently, we should not recommend abandoning 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 seem to work against the weakness regarding public social spending but the fiscal rules should be precisely defined, including a social related objective. However, an expenditure benchmark or a Golden rule require a harmonization 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 government consumption of fixed capital (see Schreyer [2003] for discussion on productive capital and countries computational hypotheses).

Baret et al. [2021] already supported the use of Machine Learning but for forecasting purposes. The results of the study also launch the discussion on the use of Machine Learning in the econometric field (Athey [2018]). Indeed, this work proposed a robusr causal Machine Learning estimator against standard econometrics biases such as reverse causality or omission bias. Consequently, Machine Learning may be seriously considered as a useful tool in causal inference economic studies.

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Appendices

Appendix 1: Source of Budget Balance Rules' targeted values

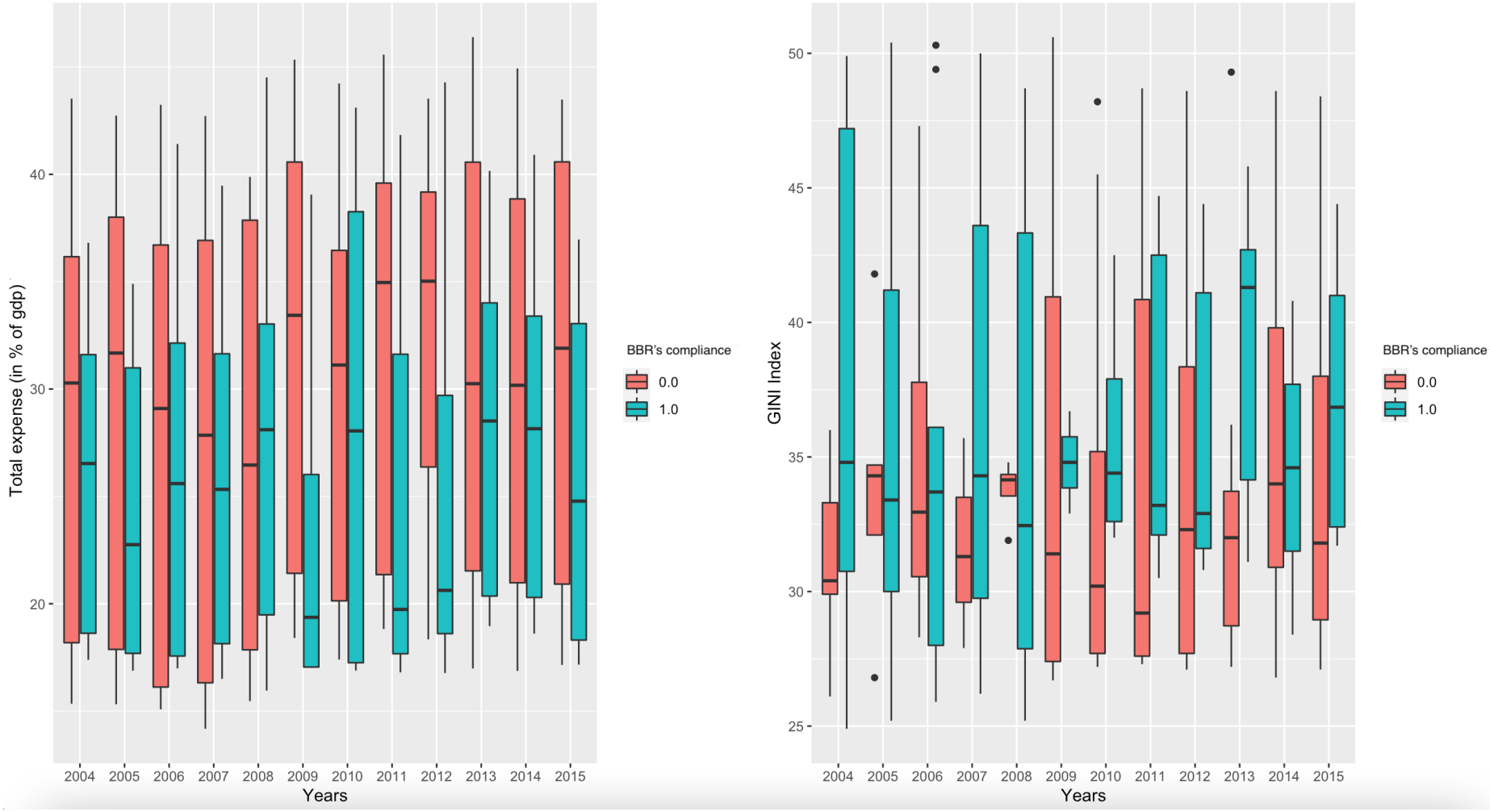
Country	Years	Source for Budget Balance Rule's Target
Chile	2004-2015	IMF World Economic Outlook Database 2018
Costa-Rica	2004-2015	Fiscal balance comes from World Bank except in 2015 where Fiscal Balance comes from Banco Central de Costa Rica (BCCR) and Gross Fixed Capital Formation comes from IMF Investment 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 Peru (BCRP)
Spain	2004-2015	IMF World Economic Outlook Database 2018
Sweden	2004-2015	IMF World Economic Outlook Database 2018
Switzerland	2004-2015	IMF World Economic Outlook Database 2018
United Kingdom	2004-2009	Eurostat
United Kingdom	2010-2015	IMF World Economic Outlook Database 2018

Source: Author.

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

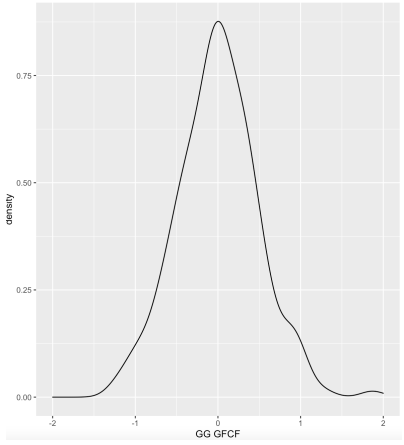
Note: BBR = Budget Balance Rule. We stop all reported periods in 2015 because IMF Fiscal Rules Database only reports fiscal rules until 2015. It does not mean that fiscal rules are no more in force after 2015. Source: Caselli et al. [2018], Reuter [2019], Eyraud et al. [2018], but we assume some differences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

Appendix 2. Fiscal rules included in our analysis between 2004 and 2015



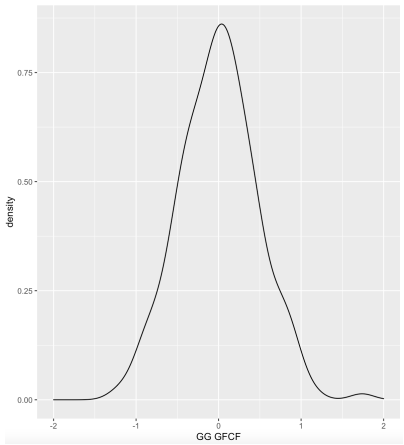
Note: BBR = Budget Balance Rule. "0" means BBR non-compliance and "1" means BBR's compliance.
Source: Author.

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: Author.

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: Author.

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