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# On the Macroeconomic Effects of Fiscal Reforms : Fiscal Rules and Public Expenditure Efficiency

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## Abstract

We ask whether fiscal rules improve public expenditure efficiency. That is, after computing efficiency scores for a panel of 159 countries of all income levels over the period 1990-2017, we apply the entropy balancing method to assess the effect of fiscal rules on the scores obtained, thus mitigating selection bias. Evidence suggests that implementing a fiscal rule significantly increases expenditure efficiency, with economically significant effects. Robustness was checked using a range of economic and econometric tests. Moreover, we show that our findings are neither driven by a spurious trend, nor by confounding factors, nor are they confounded by the effects of other reforms such as inflation targeting, IMF programs or fiscal consolidation episodes. Finally, further analysis suggests that the effect of fiscal rules on public expenditure efficiency is subject to some heterogeneity, depending on the types of rules, their design, macroeconomic factors as well as time elapsed since the reform adoption.

**Keywords :** • Fiscal rules • Public expenditure efficiency • Entropy balancing

**JEL Classification :** E6, H6

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*“In many spheres of human endeavor, from science to business to education to economic policy, good decisions depend on good measurement.”*

Ben S. Bernanke, at the 32<sup>nd</sup> General Conference of the International Association for Research in Income and Wealth, Cambridge, Massachusetts (August 06, 2012).

## 1 Introduction

The emergence of legally binding fiscal frameworks — notably fiscal rules — has been one of the defining features of the first decades of the 21st century, in both advanced and developing countries. Since the 1990s, fiscal rules have been widely popularized around the world and today strongly condition budgetary choices. These constraints can relate to fiscal aggregates such as deficit, debt, expenditure or revenue, and aim to correct for policy biases that lead decision-makers to overspend and run up deficits. In other words, fiscal rules are designed to keep public finances on a sustainable path while preserving the counter-cyclical role of fiscal policy or promoting a less pro-cyclical fiscal policy. Numerous studies examining the effects of fiscal rules suggest that they promote fiscal discipline (Debrun et al., 2008), economic growth (Afonso and Jalles, 2013), mitigate the pro-cyclicality of fiscal policy (Combes et al., 2017), improve the credibility of countries in international markets (Thornton and Vasilakis, 2018 ; Sawadogo, 2020) or help constrain political budget cycles (Gootjes et al., 2021). While the literature has examined the effect of fiscal consolidation episodes on public sector efficiency, it seems quite legitimate to link fiscal rules to the latter. Fiscal rules differ from fiscal consolidation episodes in that they are permanent constraints on fiscal policy, and are often associated with structural reforms, with a strong influence on government behavior.

This study contributes to the literature by examining the effect of fiscal rules on public expenditure efficiency for a large set of 159 countries of all income levels, over the period 1990-2017. To sharpen identification, we mitigate the potential selection bias associated with policy adoption, using the entropy balancing method developed by Hainmueller (2012). Unlike concurrent evaluation approaches such as propensity score matching methods, entropy balancing combines both matching and linear regression, allowing to control for individual and time-fixed effects in the second stage. Evidence

suggests that implementing a fiscal rule leads to a significant increase in expenditure efficiency, with economically significant effects. Robustness was checked in several ways, notably by considering alternative samples, using alternative measures, additional controls and alternative estimation strategies, in particular propensity score matching methods, a fixed effect regression, the generalized methods of moments (GMM) and an instrumental variables (IV) approach. Additional placebo tests, re-estimating our main model from fictitious adoption dates or smaller sample windows, confirm that our results are not driven by unobservables or a spurious trend. Furthermore, we show that our results are not confounded by the potential effects of other reforms such as inflation targeting, IMF programs or fiscal consolidation episodes. Next, we deepen the analysis by exploring several potential heterogeneities in the effect of the reform, depending on a range of macroeconomic factors. First, although deficit, debt and expenditure rules all have a positive and significant effect on expenditure efficiency, the effect is more amplified for the first two types of rules. Second, we find that formal monitoring, enforcement arrangements, coverage, strong legal basis, the level of development as well as institutional quality (notably political stability) amplify the positive effect of fiscal rules on expenditure efficiency. Moreover, fiscal rules are more effective when adopted by countries with poor fiscal discipline. Finally, we find suggestive evidence that the positive effect of fiscal rules on expenditure efficiency tends to increase over time.

The remainder of the paper is organized as follows. The following section presents our theoretical predictions. Sections 3 and 4 describe the conceptual framework and the methodology for measuring efficiency scores, respectively. Section 5 reports some stylized facts. The empirical methodology and the data are discussed in Section 6. The main findings are presented in Section 8. Section 9 analyzes the sensitivity of our results. A final section concludes.

## **2 Fiscal rules and efficiency : theoretical predictions**

The literature on the effects of fiscal rules — permanent constraints on fiscal policy management — is quite extensive. Capitalizing on this literature, we believe that a rule-based fiscal framework may influence public expenditure efficiency for two main

reasons.

One major benefit shared by a large part of the literature is the discipline effect of fiscal rules on fiscal policy. Specifically, existing literature shows that fiscal rules are associated with lower deficit and debt levels. For example, [Combes et al. \(2018\)](#) show over the period 1990-2009, for 140 advanced and developing countries, that fiscal rules promote fiscal discipline by lowering the primary deficit and improving overall fiscal balance. For [Asatryan et al. \(2018\)](#), fiscal rules lower the debt-to-GDP ratio by eleven percentage points. Likewise, using fiscal deficit as a proxy for fiscal discipline, [Caselli and Reynaud \(2020\)](#) and [Caselli and Wingender \(2021\)](#) reach a similar conclusion.

Fiscal discipline through deficit or public debt reduction can stem from two main areas. As in the literature on monetary delegation, where the government loses seigniorage opportunities and, therefore, must make efforts to raise taxes or cut public expenditure ([Lucotte, 2012](#); [Minea et al., 2021](#)), fiscal rules, by limiting the government's ability to incur debt, may drive governments to either raise taxes or cut public expenditure. For governments that choose the tax option, accountability and willingness to pay taxes that is linked to quality of public goods provided to taxpayers may lead to better management of public resources to reach the highest achievable outcome. However, as shown by [Asatryan et al. \(2018\)](#), the favorable effect of fiscal rules on fiscal discipline is most likely to come from public expenditure cut — the taxation channel not being statistically significant. The cut in public expenditure may have a composition implication in two different ways : (i) a larger cut in current expenditure; (ii) a larger cut in public investment. However, the literature on the composition effect of rules suggests that they have a protective effect on productive expenditures or growth-friendly expenditures, particularly public investment ([Ardanaz et al., 2021](#)). In addition, [Castro \(2011\)](#) and [Afonso and Jalles \(2013\)](#) provide evidence that fiscal rules promote better output, suggesting that more outcome could be achieved with the same or less amount of public resources. Specifically, the decline in resources by limiting the opportunity for debt financing under fiscal rules leads governments to reallocate spending to productive sectors, i.e., better use of less public resources for achieving better results.<sup>1</sup>

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<sup>1</sup>A number of other authors share the conclusion that fiscal rules promote fiscal discipline (see [Kennedy et al., 2001](#); [Kopits, 2001](#); [Rose, 2006](#); [Debrun and Kumar, 2007](#); [Debrun et al., 2008](#); [Hatchondo et al., 2012](#); [Tapsoba, 2012](#); [Luechinger and Schaltegger, 2013](#); [Heinemann et al., 2014](#);

Second, beyond their impact on fiscal aggregates, fiscal rules can stabilize the macroeconomic environment by lowering inflation. Indeed, the reduction in debt or deficit following the adoption of fiscal rules limits the risk of monetization or inflation tax and thus potential inflationary pressures (Combes et al., 2018) — which may ultimately help improve tax performance. Although the effect of discipline is essentially achieved through public expenditure reduction rather than tax revenue increase, the potential impact on inflation may have a spillover effect on tax revenue. Indeed, by reducing inflation, fiscal rules limit the Oliveira-Keynes-Tanzi effect (Tanzi, 1992), thus stimulating tax revenue collection. Consequently, the accountability generated by taxation may induce the government to use public resources wisely, thus increasing the efficiency of public expenditure.

Putting these two arguments — fiscal discipline and tax performance — together, we can assume that fiscal rules may positively influence public expenditure efficiency.

## 3 Conceptual Framework

### 3.1 Public expenditure efficiency : conceptual framework

Conceptually, efficiency implies the achievement of an objective given the resources used to achieve that outcome. In other words, efficiency reflects the achievement of an outcome with an economy of means. This approach was first used in the literature to assess firm performance, before being progressively extended to the debate on the public sector, in order to judge to what extent public expenditure contributes to the objectives set, in the quest for better management of the public sector (for instance, see Eeckaut et al., 1993; Tanzi and Schuknecht, 1997; 2000; Gupta and Verhoeven, 2001; Worthington, 2000; Afonso et al., 2005, 2010; Afonso and Fernandes, 2008; or Hauner and Kyobe, 2010). From an empirical point of view, efficiency is captured by scores estimated from the relative distances of inefficient observations to an ideal frontier, made up of the best

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Tsai, 2014; Reuter, 2015; Grembi et al., 2016; Badinger and Reuter, 2017; Feld et al., 2017; Guerguil et al., 2017; Asatryan et al., 2018; Thornton and Vasilakis, 2018; Afonso and Jalles, 2019; Fatás et al., 2019; Gootjes et al., 2020; Thornton and Vasilakis, 2020; Barbier-Gauchard et al., 2021; Gootjes et al., 2021; Afonso et al., 2022b; Gomez-Gonzalez et al., 2022; Gootjes and de Haan, 2022a; Gootjes and de Haan, 2022b).

performing units in the sample (see [Farrell, 1957](#)). The literature distinguishes two approaches of efficiency : technical and allocative. The first refers to the capacity of a unit to produce a given set of outputs with a minimum of inputs, regardless of the price of the inputs.<sup>2</sup> The second measures the ability of a unit to use inputs in optimal proportions given their prices. This approach therefore requires information on the structure of input prices, which, in our context, would be difficult to obtain. Consequently, this leads us to choose the first approach, technical efficiency, which only requires quantity data ([Lovell, 2000](#); [Afonso and Fernandes, 2008](#)).

### **3.2 Efficiency analysis : non-parametric and parametric approaches**

Both parametric and non-parametric approaches are used in the literature to estimate efficiency scores. Non-parametric techniques include Free Disposal Hull (FDH) analysis and Data Envelopment Analysis (DEA). Unlike parametric methods, which rely on econometric estimation techniques, non-parametric methods have the advantage of imposing no restrictions on the distribution of inefficiency, nor any behavioral assumptions (profit maximization objective). However, non-parametric approaches, as deterministic methods, ignore measurement errors as well as any stochastic influence, considering any variation between units as inefficiency ([Kumbhakar and Lovell, 2000](#); [Kumbhakar and Lovell, 2003](#)). In other words, non-parametric approaches do not dissociate inefficiency resulting from public sector mismanagement from that resulting from exogenous factors (e.g. commodity price shocks, environmental shocks, etc.), which, by affecting the level of expenditure, also account for part of government inefficiency. Moreover, these methods are very sensitive to random data variations and measurement errors, sample variations, heterogeneity across units and the presence of outliers.<sup>3</sup> Given the limitations of non-parametric methods, parametric techniques are often used in the literature. These rely on a stochastic production function — a stochastic frontier analysis (SFA) — allowing the error term to have two components : a component that measures ineffi-

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<sup>2</sup>In other words, technical efficiency implicitly refers to the ability of a unit to avoid waste ([Borodak, 2007](#)).

<sup>3</sup>See [Bauer \(1990\)](#); [Seiford and Thrall \(1990\)](#); [Eckaut et al. \(1993\)](#) or [Gupta and Verhoeven \(2001\)](#) for a more in-depth discussion on non-parametric methods.



ciency and an idiosyncratic error that captures idiosyncratic shocks ([Aigner et al., 1977](#); [Meeusen and van Den Broeck, 1977](#)). However, these methods require strong assumptions on data distribution. The most commonly used distributions are the semi-normal, the exponential and the truncated normal ([Stevenson, 1980](#)).<sup>4</sup>

## 4 Measuring efficiency scores

Public sector efficiency (PSE) refers to the relationship between the socio-economic indicators targeted by the government, and the level of public resources used to achieve them. First, we describe the socio-economic indicators used in the study (public sector performance indices — PSP —). Then, we discuss the methodology for calculating public expenditure efficiency scores.

### 4.1 Public sector performance indices

Sectoral performance indices are calculated from a series of social indicators, for each country, in each area of government activity. An improvement in PSP therefore depends on an improvement in the values of the selected socio-economic indicators. The performance indicators chosen in this study are notably based on [Afonso et al. \(2005\)](#). We consider two categories of performance indicators. The first, described as opportunity performance, includes the following sectors : education, health, infrastructure and public administration. The second category, described as “Musgravian” performance, includes the traditional tasks for government : allocation, distribution and stabilization.<sup>5</sup>

We select a series of outcome indicators according to data availability and previous work (e.g. see [Afonso et al., 2005](#); [Herrera and Pang, 2005](#); [Hauner and Kyobe, 2010](#)). The education sector outcome index includes three sub-indicators : primary

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<sup>4</sup>See some studies that use parametric methods : [Evans et al. \(2000\)](#); [Jayasuriya and Wodon \(2003\)](#), [Grigoli and Kapsoli \(2018\)](#).

<sup>5</sup>For instance, see some of the literature that discusses the importance of these sectors in economic performance : [Aschauer \(1989\)](#); [Barro \(1990\)](#); [Ravallion \(1997\)](#) ; [Cornia and Reddy \(1999\)](#); [Wilhelm and Fiestas \(2005\)](#); [Afonso et al. \(2005\)](#).

school enrollment, secondary school enrollment and expected years of schooling.<sup>6</sup> The health sector outcome indicators are : life expectancy at birth and infant mortality rate (per 1000 live births). Following [Donaubauer et al. \(2016\)](#), we calculate an infrastructure sector outcome index using six infrastructure sub-indices classified into three main groups : transport, communication and energy. The outcome indicators in transport are : the total length of roads in kilometers, normalized by the area of the country, and the number of paved roads as a percentage of total roads. The outcome index for communication includes : fixed telephone subscriptions (per 100 people), fixed broadband subscriptions (per 100 people) and outages per 100 fixed telephone lines per year. Three sub-indicators are considered for the energy sector : the proportion of households with electricity, electricity consumption (in kWh per capita) and electricity transmission and distribution losses (as a percentage of production). Finally, following [Afonso et al. \(2005\)](#), we retain four sub-indicators for public administration : the independence of the judiciary, the quality of property rights, the quality of government and the level of the shadow economy. On the input side, we consider public expenditure on education (as a percentage of GDP) for the education sector, public expenditure on health (as a percentage of GDP) for the health sector, public capital stock (as a percentage of GDP) and public-private partnership stock (as a percentage of GDP) for infrastructure, and public final consumption expenditure (as a percentage of GDP) for administration.

As mentioned earlier, we also consider the Musgravian indicators, which include three sub-indicators : distribution, stability and economic performance. The outcome indicator for distribution is captured by the Gini index.<sup>7</sup> For the stability sub-indicators, we use the standard deviation of the three-year moving average of GDP growth and inflation. To measure economic performance, we consider GDP per capita, GDP growth (10-year average) and the unemployment rate (10-year average). We use total government expenditure (as a percentage of GDP) as an input for stability and economic performance, and social protection expenditure (as a percentage of GDP) for distribution.

To capture the common features of the performance sub-indicators used, we com-

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<sup>6</sup>Qualitative indicators such as PISA (Program for International Student Assessment) measures could have been taken into account, but these data are partly available only for OECD countries. Here we do not include them due to our sample size.

<sup>7</sup>Results remain robust when considering interquartile ratios as well.

pute a composite outcome index for each sector following [Anderson \(2008\)](#), to apply generalized least squares estimators. This procedure has two major advantages. First, it assigns less weight to highly correlated indicators, while uncorrelated indicators receive more weight, as they potentially provide new information. Second, the method also accounts for variables with missing data, giving them less weight, compared to complete cases.<sup>8</sup> Appendix A details the procedure for calculating the composite index.

## 4.2 Parametric analysis of efficiency

Given the limitations of the non-parametric methods discussed in subsection 3.2, in this study, we rely on a parametric approach to estimate the efficiency scores. Among the parametric methods, those of [Kumbhakar \(1991\)](#), [Lee and Schmidt \(1993\)](#) or [Battese and Coelli \(1992\)](#) have been widely used in the literature, notably on panel data. Here we adopt a more recent method, that of [Kumbhakar et al. \(2015\)](#), for two main reasons. First, the latter makes it possible to distinguish unobserved heterogeneity across units from inefficiency, unlike older methods (notably [Kumbhakar, 1991](#), [Lee and Schmidt, 1993](#); [Battese and Coelli, 1992](#)). This, therefore, allows capturing heterogeneous features among countries such as their level of development, structural or institutional characteristics, etc. Second, unlike [Greene \(2005b\)](#) and [Kumbhakar and Wang \(2005\)](#) who merely separate individual heterogeneity from stochastic noise, [Kumbhakar et al. \(2015\)](#) provide an additional decomposition of inefficiency by distinguishing persistent or long-run inefficiency from transient or variant inefficiency (short-run). This makes it possible to consider inefficiency resulting from structural characteristics that persist over time (predicted value of  $\eta_i$ , see Equation 1) and that resulting from short-term factors (predicted value of  $u_{it}$ , see Equation 1). The econometric model described in [Kumbhakar et al. \(2015\)](#) for estimating efficiency scores is specified as follows :

$$Y_{it} = \alpha_0^* + f(x_{it}; \beta) + v_{it} - u_{it}^* - \eta_i^* \quad (1)$$

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<sup>8</sup>We use the Stata procedure proposed by [Schwab et al. \(2020\)](#). For robustness purposes, we compare the composite indicators obtained following [Anderson \(2008\)](#) with those obtained using the principal component analysis (PCA) method. Overall, in our case, the two approaches lead to very similar results. For example, for the four sectors — education, health, infrastructure and administration — the Pearson correlations are 95%, 100%, 18% and 96%, respectively.

With :

$$\alpha_0^* = \alpha_0 - E(\eta_i) - E(u_{it}) \quad (1.a)$$

$$u_{it}^* = u_{it} - E(u_{it}) \quad (1.b)$$

$$\eta_i^* = \eta_i - E(\eta_i) \quad (1.c)$$

Where  $Y_{it}$  is a measure of government performance, proxied by the public sector performance index, in country  $i$  in year  $t$ .  $X_{it}$  is the vector of inputs. The model is estimated in three steps. First, we estimate Equation 1 using a standard random effect regression. We thus obtain consistent estimate of  $\beta$  and predicted values of  $\eta_i^*$  and  $u_{it}^*$ . Second, persistent technical efficiency is estimated using the predicted values of  $\eta_i^*$ . If we have reported them by  $\eta_i^*$ , then persistent technical inefficiency can be estimated from :

$$\eta_i = \text{Max}(\eta_i^*) - \eta_i^* \quad (2)$$

Finally, persistent technical efficiency (PTE) is obtained from  $\exp(-\eta_i)$ , then residual technical efficiency (RTE) is estimated in the last step. To do so, we go back to the first step and obtain the residues (i. e,  $Y_{it} - f(x_{it}; \beta) + \eta_i = \alpha_0 + v_{it} - u_{it}$  ). Assuming that  $v_{it}$  and  $u_{it}$  are iid, we can simply maximize the log likelihood function for the next standard normal stochastic frontier model for the grouped data :

$$r_{it} = \alpha_0 + v_{it} - u_{it} \quad (3)$$

Where  $r_{it} = y_{it} - f(x_{it}; \beta) + \eta_i$ . In practice, we use the estimated values of  $\beta$  and  $\eta_i$  to define  $r_{it}$ . In other words, the sampling variability associated with  $\beta$  and  $\eta_i$  is ignored. Using the standard boundary model on Equation 2, we obtain estimates of  $\alpha_0$ ,  $\sigma_v^2$  and  $\sigma^2$ . Following Jondrow et al. (1982), we estimate residual technical inefficiency,  $\hat{u}_{it}$ , based on the estimated residues,  $(v_{it} - u_{it})$ . Thus, we can use  $\hat{u}_{it}$  to calculate residual technical time-varying inefficiency defined as  $\text{RTE} = \exp(-\hat{u}_{it})$ , then find the overall technical efficiency (OTE) defined as the product of PTE and RTE ( $\text{OTE} = \text{PTE} * \text{RTE}$ ).

## 5 Stylized facts

First, we discuss some descriptive statistics of the scores calculated and fiscal rules (FR), over the period 1990-2017, for a large panel of 159 countries selected according to data availability. Next, we correlate the calculated scores with the treatment variable (FR).

### 5.1 Calculated efficiency scores

By construction, the calculated scores can range from 0 (worst performance) to 1 (best performance). We report 3,709 country-year observations with an average score of 0.66 over the sample and the period considered.<sup>9</sup> Figure 1 presents the average scores for 159 countries over the period 1990-2017, distinguishing between advanced and developing countries. On average, advanced countries are closest to the efficiency frontier, with a score of 0.71, while the average efficiency reported for developing countries is 0.65. The top 10 best performing countries show scores ranging from 0.73 to 0.79 and are all advanced economies, while the 10 worst performing countries display scores between 0.56 and 0.60, and seven are African economies (see Table C3).

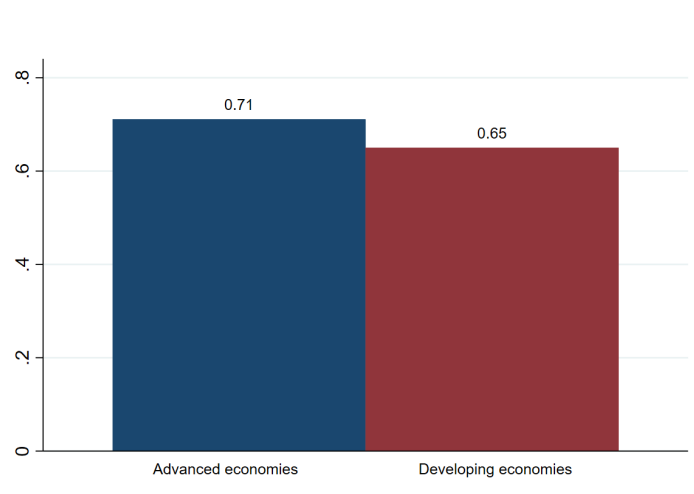


Figure 1: Average government efficiency scores (1990-2017)

**Notes :** The statistics cover 159 countries over 1990-2017, including : 35 advanced and 124 developing economies.

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<sup>9</sup>For illustrative purposes, a score of 0.66 for a given country means that the country could, on average, increase its efficiency by 34%, for the same level of resources used to achieve the targets set.

## 5.2 Fiscal rules

Over the study period, 80 countries have adopted at least one fiscal rule. Deficit or budget balanced rules are the most adopted (76 countries) followed by debt rules (63) and expenditure rules (44), while revenue rules do not seem to be in vogue as they are only adopted by 14 countries in the sample, over the study period. Figure 2 displays the evolution of the number of countries having adopted fiscal rules over the study period. There is an increasing number of countries around the world introducing fiscal rules, with a strong preference for deficit and debt rules, respectively, especially from the late 1990s onwards. The trend in expenditure rules adoption, although relatively weaker, seems to be increasing from the 2000s onwards, with a stronger push after the 2008-2009 Global Financial Crisis. Finally, revenue rules, despite a slight increase from the late 1990s onwards, appear to have stagnated since the 2000s until the end of the study period.

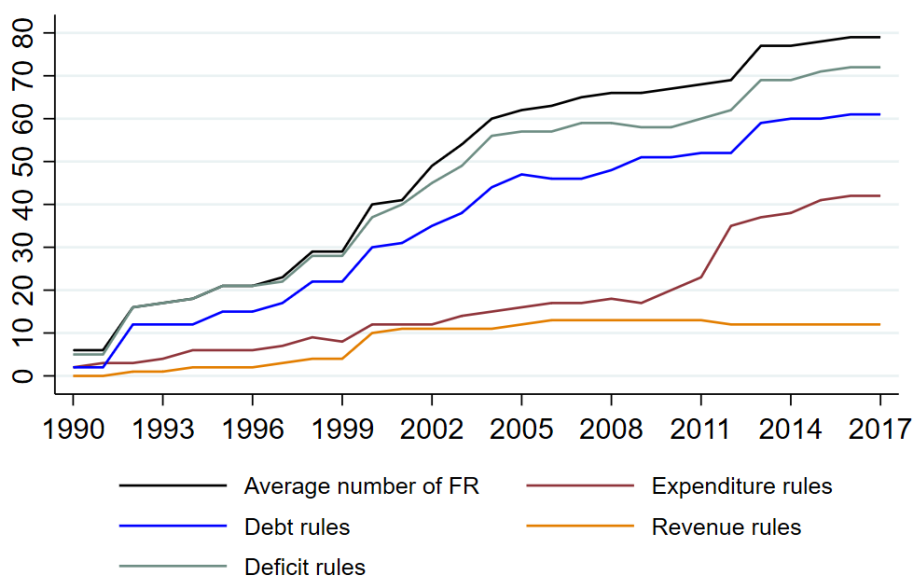


Figure 2: Evolution of the number of fiscal rules (1990-2017)

Source : Authors, from the IMF Fiscal Rules Dataset.

### 5.3 Correlational evidence

We then report correlational evidence linking the calculated scores and fiscal rules in our sample. Over the study period, we report 1,349 treated (with fiscal rules) and 2,486 untreated observations. Figure 3 shows, on average, a higher score for treated observations compared to untreated ones (0.69 vs. 0.65). This difference of 0.04 points may seem small, but it should be put in perspective with the efficiency index, which ranges from 0 to 1. Moreover, the efficiency gap between the two groups is statistically significant ( $t = -16.07$ ;  $p\text{-value} : 0.00$ ). Finally, this stylized fact correlates fiscal rules with efficiency scores, but does not provide any information about the causal effect of the reform.

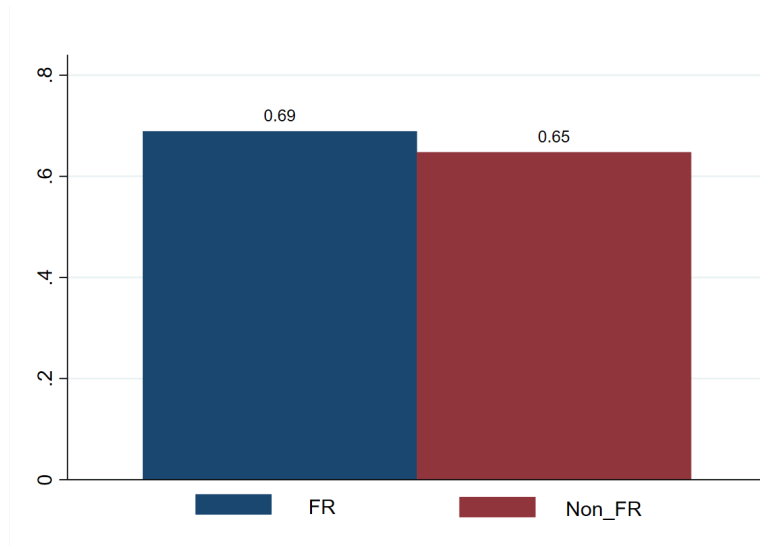


Figure 3: Average efficiency scores (1990-2017) with and without fiscal rules (FR)

**Notes :** This graph displays the average efficiency scores between treated (with fiscal rules) and untreated (without fiscal rules) observations for 159 countries over the period 1990-2017. We report 1,349 treated and 2,486 untreated observations.

## 6 Methodology

Our aim is to examine the impact of fiscal rules on public expenditure efficiency, proxied by the scores calculated earlier. Identifying and tracing down precisely any genuine effects induced by FR on the macro-variables of interest is challenging, given the potential selection problem that arises from the fact that implementing fiscal reforms may be cor-

related with factors that also affect the country’s fiscal orientation. If fiscal rules were exogenous, using a simple fixed-effects model would be quite sufficient to identify the effect of the reform. Thus, as stated by [Heinemann et al. \(2018\)](#), the potential endogeneity of fiscal rules — given the interdependencies between the latter and fiscal policies — must be seriously considered, otherwise it would lead to a bias in the estimates. Therefore, to address this problem, we follow the program evaluation methodology which consists in estimating the average treatment effect on the treated (ATT), defined as follows :

$$ATT = E[(Y_{i1}|T_i = 1)] - E[(Y_{i0}|T_i = 1)] \quad (4)$$

$T_i$  is a dummy variable equal to 1 if a country  $i$  has adopted a fiscal rule in year  $t$ , and zero otherwise.  $Y_{i0}$  represents the outcome for the untreated unit (without FR or  $T_i = 0$ ) and  $Y_{i1}$  is the outcome associated with  $T_i = 1$  (treated observation). The treatment effect is therefore the difference in expenditure efficiency between the situation due to the adoption of a fiscal rule and the situation without adoption. This approach would suffer from a counterfactual problem, since it is not possible to observe how the country would have evolved if it had not adopted the rule. Hence, we adopt a counterfactual framework consisting of untreated observations, but which otherwise represent a potential control group for the treated ones. Since the treatment assignment is not random, a simple difference in the outcome between the treated units and the control group would pollute the estimates, given the potential selection bias discussed above. Thus, the matching approach consists of reproducing a situation close to a context where units are randomly assigned to the treatment. The latter are therefore matched with those who were not exposed to the treatment, based on their pre-observables characteristics, which are as similar as possible. The ATT resulting from matching can be formalized as follows :

$$ATT(\chi) = E [Y_{i1}|T_i = 1, X = \chi] - E [Y_{i0}|T_i = 0, X = \chi] \quad (5)$$

Where  $\chi$  is a set of pre-treatment covariates described in [Section 7](#), correlated with the treatment and potentially with the outcome variable.  $E[Y_{i1}|T_i=1, X=\chi]$  is the expected outcome for the treated observations, and  $E[Y_{i0}|T_i=0, X=\chi]$  is the expected outcome for the best counterfactuals of the treated units.



In this study, we use the entropy balancing method developed by [Hainmueller \(2012\)](#) to match treated units with their untreated counterfactuals. For instance, this methodology was used by [Neuenkirch and Neumeier \(2016\)](#) to assess the impact of US sanctions on poverty, using macroeconomic data, [Sawadogo \(2020\)](#) to assess the impact of fiscal rules on financial market access for developing countries, or [Caselli and Wingender \(2021\)](#) to analyze the effect of fiscal rules on public deficits using the Maastricht treaty’s fiscal criterion as an example.<sup>10</sup> Entropy balancing is a two-step estimation method. The first step is to calculate and apply weights to untreated units so that the mean of the pre-treatment variables in the control group is not statistically different from their mean in the treated group (see [Neuenkirch and Neumeier, 2016](#)). This step creates a synthetic group, unexposed to treatment, but with observable pre-treatment characteristics close to the treated group. Then, in the second step, the weights resulting from the entropy balancing are used in a regression analysis with the treatment indicator as an explanatory variable. We briefly discuss some merits of the method used. First, unlike propensity score matching or difference-in-difference estimators, entropy balancing is a non-parametric approach, thus requiring no specification of the functional form of the empirical model or of the treatment assignment procedure, which may avoid specification errors. Second, the weight system orthogonalizes the covariates with respect to the treatment, which limits multicollinearity issues. Third, the method ensures a suitable balance of pre-treatment characteristics between the treatment and control groups, even in the presence of a small sample or a limited number of untreated units. This allows the construction of an appropriate control group, representing a near perfect counterfactual of the treated one. Finally, in the second step, the estimator exploits the panel structure of data by including individual and time effects to control for unobserved heterogeneity.

## 7 Data

Our dataset consists of 159 developed and developing countries over the 1990–2017 period. The dependent variable is proxied by the efficiency scores calculated earlier,

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<sup>10</sup>See other studies, among others, using the same approach : [Balima \(2017\)](#); [Ogrokhina and Rodriguez \(2019\)](#); [Balima et al. \(2021\)](#); [Bambe \(2022\)](#); [Apeti \(2023\)](#).

which can range from 0 to 1. The treatment is measured by a dummy equal to 1 when a country  $i$  has adopted a fiscal rule in year  $t$ , and zero otherwise.

Based on the literature on fiscal rules, we use a set of variables potentially correlated with FR adoption and potentially with the outcome variable, accounting for both macroeconomic and political factors. First, we consider past fiscal conditions, including the lagged public debt, as this variable is an important determinant of the government's ability to achieve the targets set for fiscal aggregates (Calderón and Schmidt-Hebbel, 2008; Tapsoba, 2012). In other words, past debt-to-GDP ratio would be negatively correlated with the probability of adopting FR. Second, in the same vein, since better economic performance (proxied by GDP per capita growth and inflation) would also affect the likelihood of FR adoption (Kumar et al., 2009; Budina et al., 2012), one would expect a positive (negative) influence of per capita growth (inflation) on FR. Third, we include capital account openness, following Tapsoba (2012), as in some countries fiscal rules have been adopted as part of more comprehensive economic reforms, including financial liberalization. Thus, financial openness could have a positive impact on the adoption of reforms such as FR. Fourth, we consider the exchange rate regime, since a substantial literature highlights a strong correlation between the exchange rate regime and fiscal discipline, embodied in fiscal rules (e.g. see Masson et al., 1991; Giavazzi and Pagano, 1988; Elbadawi et al., 2015). Fifth, we control for a series of institutional variables, namely : the level of democracy, corruption control and government fragmentation. A better institutional framework encourages governments to justify their control of the state apparatus, promotes greater transparency in the budget approval process and budget regulation, and provides an overview of public sector activity. Moreover, institutional factors such as the control of corruption can be an important determinant of government budget management, as corruption leads to the misuse of public funds. Therefore, a better democratic framework and better control of corruption, by promoting better fiscal discipline, should be positively associated with the likelihood of adopting FR. Finally, a large literature has examined the effect of government fragmentation on fiscal outcomes. For example, Kontopoulos and Perotti (1999) find that fragmentation tends to be associated with higher spending in OECD countries, since the most important representatives of individual spending interests in European governments are

spending ministers. Other studies have found similar results (see for example: [Edin and Ohlsson, 1991](#); [Borrelli and Royed, 1995](#); [Franzese, 2000](#); [Volkerink and De Haan, 2001](#); [Balassone and Giordano, 2001](#); [Artés and Jurado, 2018](#)). Given the potentially negative influence of this variable on public finances, it can be argued that, on the one hand, fiscal laxity may reflect the unwillingness of the state to adopt sound but binding reforms. On the other hand, in a fragmented government, voters may support the adoption of reforms such as fiscal rules in the quest for greater fiscal discipline. The effect of government fragmentation on the likelihood of FR adoption could therefore be ambiguous.

Most of our variables are taken from the World Bank’s WDI (World Development Indicators) database. Data related to fiscal rules adoption are extracted from the IMF Fiscal Rules Dataset. Public debt is measured as a percentage of GDP and comes from [Abbas et al. \(2011\)](#). Financial openness is approximated by an index between approximately -2 and 2 and comes from [Chinn and Ito \(2006\)](#). The exchange rate regime is constructed from [Ilzetzi et al. \(2017\)](#)’s classification and is captured by a dummy equal to 1 if a country  $i$  is classified as having a fixed exchange rate regime in year  $t$ , and zero otherwise. Corruption control ranges from 0 to 100, where higher values are better, and is from the Worldwide Governance Indicators database ([Kaufmann et al., 2011](#)). The level of democracy is captured by the Polity V democracy score, ranging from -10 (absolute autocratic regime) to 10 (absolute democratic regime). Finally, government fragmentation measures the probability that two deputies picked at random from the government parties will be of different parties, and is from the Database of Political Institutions (DPI).

## 8 Results

### 8.1 Descriptive statistics

Table 1 displays descriptive statistics relating to the first stage equation. Panel A shows a simple comparison of pre-weighting sample means of all matching covariates between treated (Column [2]) and control (Column [1]) units, which represent the potential synthetic group. On average, treated observations report lower inflation and growth, greater

Table 1: Descriptive statistics and covariate balancing

	[1]	[2]	[3] = [1] - [2]	[4]	[5]
<b>Panel A : Descriptive statistics</b>	<b>Non_FR</b>	<b>FR</b>	<b>Difference</b>	<b>t-Test</b>	<b>p-Val.</b>
Lag Debt	52.9	55.19	-2.29	-1.26	0.21
Lag GDP per capita growth	3.16	2.33	0.83	3.23	0.00
Lag Inflation	10.09	3.67	6.42	4.91	0.00
Lag Capital openness	0.03	1.20	-1.17	-16.99	0.00
Fixed exchange rate dummy	0.32	0.51	-0.19	-8.01	0.00
Democracy	3.22	7.4	-4.18	-16.93	0.00
Corruption control	41.12	64.89	-23.77	-19.43	0.00
Government fragmentation	0.19	0.31	-0.12	-9.41	0.00
<b>Observations</b>	<b>859</b>	<b>903</b>			
	[1]	[2]	[3] = [1] - [2]	[4]	[5]
<b>Panel B : Covariate balancing</b>	<b>Non-treated</b>	<b>Treated</b>	<b>Difference</b>	<b>t-Test</b>	<b>p-Val.</b>
Lag Debt	55.23	55.19	0.04	-0.02	0.99
Lag GDP per capita growth	2.33	2.33	0.00	-0.01	1.00
Lag Inflation	3.89	3.67	0.22	-0.70	0.48
Lag Capital openness	1.19	1.2	-0.01	0.09	0.93
Fixed exchange rate dummy	0.51	0.51	0.00	0.05	0.96
Democracy	7.39	7.40	-0.01	0.05	0.96
Corruption control	64.78	64.89	-0.11	0.05	0.96
Government fragmentation	0.31	0.31	0.00	-0.00	1.00
<b>Observations</b>	<b>859</b>	<b>903</b>			
<b>Total of weights</b>	<b>903</b>	<b>903</b>			

**Notes :** We lag all covariates by one year, except the exchange rate regime and institutional variables, to circumvent problems of reverse causality.

debt and financial openness, better institutional quality (notably a higher level of democracy and greater control of corruption), and tend to be more oriented towards a fixed exchange rate regime. Since the differences between the two groups are significant (Column [5]), except for public debt, estimating the treatment effect from traditional econometric methods such OLS estimators could bias the effect of the measure due to a potential selection problem. Therefore, in Panel B (Column [1]), we construct a synthetic control group by reweighting the control units using the pre-treatment covariates of the baseline specification. This approach allows making the pre-treatment covariates of the synthetic group on average as comparable as possible to those of the treated units. Column [5] of Panel B shows that the weighting eliminated any significant pre-treatment differences between the means of the treated and synthetic covariates, as all p-values after weighting are above the 10% threshold. Therefore, we can consider the synthetic group as a “near perfect” counterfactual of the treated one.

## 8.2 Treatment effects

Second, we assess the effect of fiscal rules on expenditure efficiency by estimating the following econometric model :

$$Y_{i,t} = \alpha + \beta FR_{i,t} + \eta X_{i,t} + \mu_i + \psi_t + \epsilon_{i,t} \quad (6)$$

Where  $Y_{i,t}$  is a measure of expenditure efficiency of country  $i$  in year  $t$ .  $FR$  is a dummy variable equal to 1 for a country  $i$  having adopted a fiscal rule in year  $t$ , and zero otherwise.  $X_{it}$  is the set of the covariates described above.  $\mu_k$  and  $\psi_j$  represent country and time fixed effects, respectively, capturing unobserved heterogeneity. Finally,  $\epsilon_{i,t}$  is the idiosyncratic error term.

**Entropy balancing estimates.** Using the weights computed in Panel B of Table 1, we estimate Equation 6 from weighted least squares regressions, in which the dependent variable is approximated by public expenditure efficiency scores and FR is the treatment. Panel A of Table 2 presents the main results, using different sets of estimates. First, Column [1] displays the baseline results of the FR effect on expenditure efficiency. Next, Columns [2]-[4] include country, time and country-time fixed effects. Finally, in Columns [5]-[8], we include all control variables. Column [8] reports the main model results. Estimates suggest that adopting a fiscal rule significantly increases expenditure efficiency, by approximately 3.8 percentage points, with a statistically significant effect at the 1% threshold.

**Magnitude of the effects.** Results from Panel A suggest that adopting a fiscal rule improves public expenditure efficiency of about 3.8 percentage points. this indicates that implementing a fiscal rule would on average allow non-treated countries to increase the efficiency of their spending by about 6%, enabling them to move from an average efficiency of 0.065 to 0.068, which would significantly reduce their gap with treated countries. Moreover, since the estimated effect is about 42% of the standard deviation of the efficiency score variable (equal to 0.076, see Table C2), we can reasonably conclude that the economic gain from FR adoption is economically significant.

Table 2: The effect of FR on Public Sector Efficiency (PSE)

<b>Panel A : Entropy balancing</b>									
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	Baseline	Adding Country/FE	Adding Time/FE	Adding Country/Time/FE	Adding controls	Adding Country/FE	Adding Time/FE	Adding Country/Time/FE	Adding Country/Time/FE/Trend
FR dummy	0.025*** (0.0048)	0.041*** (0.0050)	0.025*** (0.0051)	0.039*** (0.0054)	0.025*** (0.0043)	0.040*** (0.0056)	0.018*** (0.0039)	0.038*** (0.0056)	0.038*** (0.0056)
Observations	1745	1745	1745	1745	1745	1745	1745	1745	1745
R-squared	0.0331	0.427	0.1135	0.5345	0.2938	0.464	0.3908	0.5597	0.5597
<b>Panel B : Alternative samples</b>									
FR dummy				[1]	[2]	[3]	[4]	[5]	
				0.038*** (0.0056)	0.039*** (0.0059)	0.038*** (0.0056)	0.038*** (0.0057)	0.034*** (0.0074)	
Observations				1727	1546	1745	1599	1204	
R-squared				0.5604	0.5453	0.5597	0.5412	0.6096	
Country, Time FE & Controls				Yes	Yes	Yes	Yes	Yes	
<b>Panel C : Propensity score matching</b>									
				N-nearest-Neighbors Matching			Radius Matching		
				N=1	N=2	N=3	r=0.005	r=0.01	r=0.05
				0.027*** (0.0058)	0.024*** (0.0055)	0.025*** (0.0056)	0.023*** (0.0052)	0.023*** (0.0049)	0.024*** (0.0043)
Observations				1745	1745	1745	1745	1745	1745
Controls				Yes	Yes	Yes	Yes	Yes	Yes
Bootstrap replications				500	500	500	500	500	500
Pseudo R <sup>2</sup>				0.023	0.014	0.015	0.009	0.010	0.023
Rosenbaum bounds sensitivity tests				2.00	1.90	2.10	1.90	2.00	2.30

**Notes :** This table reports estimates of the impact of FR on expenditure efficiency. Panel A uses weighted least squares regressions. Panel B estimates the main equation using alternative samples. That is, the first column of Panel B excludes from the sample any episode of hyperinflation. Columns [2] and [3] ignore the 2008-2009 financial crisis and the post-Cold War years (1990-1995), respectively. In Column [4], we exclude fragile states. In the last column, we exclude years in which countries with a fiscal rule in place also joined an IMF program, adopted monetary reforms such as inflation targeting, or have implemented fiscal consolidations. Finally, Panels C re-estimates the main model using the propensity score matching methods. All specifications include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. All regressions include the constant, not reported in the table. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## 9 Sensitivity

### 9.1 Robustness

#### 9.1.1 Combined entropy balancing and trend.

Fiscal rules have shown an upward trend over our period, reflecting their popularity worldwide. Similarly, one can assume an improvement in public expenditure management over time, resulting in an upward trend in expenditure efficiency, without this being fully explained by fiscal rules. To account for the improvement in efficiency over time and the growing trend in the number of countries adopting fiscal rules over our study period, we augment our baseline model by introducing a trend in the last column of Panel A (Table 2). New estimates remain similar to those of the baseline model (Panel A, Column [8]).

#### 9.1.2 Alternative samples

In Panel B of Table 2, we conduct some additional tests by re-estimating our main model from alternative samples. First, we exclude from the sample any episode of hyperinflation, i.e. years when the inflation rate was 40% or more. Second, we drop the 2008-2009 financial crisis, during which many countries have experienced major economic deficits and imbalances. Third, we exclude the post-Cold War years (1990-1995) when many countries experienced particular dynamics in their economies. Fourth, we exclude fragile states, i.e. countries classified by the IMF as having characteristics that significantly undermine their economic and social performance, with weak governance, limited administrative capacity, chronic humanitarian crises, persistent social tensions and, often, violence or the legacy of armed conflict and civil war. Finally, we exclude years in which countries with a fiscal rule in place also joined an IMF program, adopted monetary reforms such as inflation targeting, or have implemented fiscal consolidations.<sup>11</sup> New results, reported in Columns [1]-[5], respectively, remain positive and significant, with a

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<sup>11</sup>Following Afonso et al. (2022a), we define fiscal consolidation episodes as those that show at least a positive annual change in the Cyclically Adjusted Primary Balance (CAPB) of 0.5% of GDP for two consecutive years. A dummy variable is created that takes a value of 1 if there is a consolidation in year  $t$ , and 0 otherwise.

magnitude comparable to our benchmark estimates. Moreover, excluding other reforms yields a coefficient that is almost similar to that of the main model. That said, these tests suggest that our results are not confounded by the effects of other reforms, notably IMF programs, the inflation targeting regime or fiscal consolidations, reinforcing our findings.

### 9.1.3 Alternative estimation methods

On the econometric side, we further extend our tests by using four alternative estimation methods : Propensity Score Matching (PSM), panel fixed-effects, Generalized Moment Method (GMM) and Instrumental Variable (IV) estimation.

**PSM estimates.** The propensity score matching estimation consists of two steps. First, we calculate the likelihood for a country adopting FR, conditional on the covariates used in the baseline model. In a second step, the propensity scores obtained are used to match treated and untreated observations, then the ATTs are computed to estimate the effect of the treatment. In line with the existing literature, we draw upon four propensity score matching methods to pair up treated with comparable untreated observations : the N-nearest-Neighbors method (with  $N$  ranging from 1 to 3 nearest neighbors); the radius method (with  $R = 0.005; 0.01; \text{ and } 0.05$ , respectively); the Kernel Method and the Local Linear Regression. Moreover, we impose the common support, which allows matching each treated observation with at least one untreated counterfactual that is as similar as possible. New ATTs are reported in Panel C (Table 2), with the tests relating to the quality of the matching. First, results are stable. Second, all the Pseudo- $R^2$  in our estimates are less than 10%, suggesting that the matching provided balanced scores. That is, our findings are robust regarding the hypothesis of common support. Finally, our findings are also robust regarding the Conditional Independence Assumption (CIA), since the cutting points from Rosenbaum sensitivity tests at 10% significance hover between 1.9 and 2.3, comparable with existing studies (see e.g. [Aakvik, 2001](#) or [Rosenbaum, 2002](#), page 188). Therefore, new findings strengthen our main results.

**OLS estimates.** Second, we test the robustness of our results using the Ordinary Least Squares (OLS) or a panel fixed-effects regression. Results reported in Column



[1] of Table D1 suggest a positive and significant effect of fiscal rules on expenditure efficiency, with a magnitude of about 2 percentage points, qualitatively comparable to that of the main model (3.8 percentage points).

**GMM estimates.** Third, we re-estimate the main model using the [Blundell and Bond \(1998\)](#) two-step system-GMM dynamic panel estimator.<sup>12</sup> This method allows controlling for the persistence of fiscal outcomes, notably public expenditure efficiency, to control for the Nickell bias ([Nickell, 1981](#)) that arises in a dynamic panel model — a model with the lagged endogenous in the control variables — with fixed effects, to limit the influence of time-varying unobservable factors that may influence both the outcome and treatment variables, and to mitigate the challenge of finding an exogenous instrument for estimating the effect of the fiscal rules. New results presented in Column [2] of Table D1 lead to qualitatively similar conclusions to the baseline results. Furthermore, regarding the instrument selection criteria, the Hansen test does not reject the hypothesis of instrument validity. Finally, the AR (1) test for the absence of autocorrelation of the first-order error term and the AR (2) test for the absence of autocorrelation of the second-order error term do not raise concerns about the validity of our estimates.<sup>13</sup>

**IV estimates.** To deal with the potential endogeneity of fiscal rules, other studies in the literature rely on instrumental variables (IV). For instance, [Caselli and Reynaud \(2020\)](#) estimate the causal effect of fiscal rules on fiscal balances in a panel of 142 countries over the period 1985-2015 by exploiting the geographical diffusion of fiscal rules across countries as an instrumental variable. The intuition is that reforms in neighboring countries can influence the adoption of domestic reforms, for example through peer pressure or through an imitation effect to send a credibility signal on international markets, as [Balvir \(2022\)](#) shows. This instrument is also used by [Ardanaz et al. \(2021\)](#) to evaluate the effect of fiscal rules. Along these lines, following [Caselli and Reynaud \(2020\)](#),

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<sup>12</sup>This approach combines equations in levels and first differences in a system and estimated them with an extended system-GMM estimator that allows the use of lagged differences and levels of explanatory variables as instruments. Compared to the difference GMM estimator, system-GMM allows introducing more instruments by adding a second equation, which should improve estimation efficiency. To tackle the problem of instrument proliferation raised by the above method ([Roodman, 2009](#)), the instrument matrix is collapsed. Moreover, to avoid that the standard errors are downward-biased, we use the [Windmeijer \(2005\)](#) finite-sample correction to reduce the possibility of spurious precision.

<sup>13</sup>The stationarity tests conducted lead us to reject the null hypothesis of non-stationarity for all our variables. Results can be reported upon request.

we use as an instrument the number of fiscal rules in place in countries with common borders with respect to the national economy.<sup>14</sup> Column [1] of Table D2 presents the first stage equation, where the treatment (fiscal rule dummy) is regressed on the instrument and on all other explanatory variables of the baseline model. We observe that the instrument (“Contiguity”) positively and significantly explains the treatment, suggesting the instrument used appears to be relevant. Specifically, having neighboring countries with a fiscal rule increases the probability of adoption in the domestic economy by about 13%. This effect is comparable to that obtained by Caselli and Reynaud (2020) who find a probability of 10%. Column [1] reports the results of the causal impact of fiscal rules on expenditure efficiency, after instrumentation. Results suggest that adopting a fiscal rule significantly improves expenditure efficiency, at the 5% threshold. Moreover, the estimated effect (4.7 percentage points) remains comparable to that of the baseline model (3.8 percentage points).

#### 9.1.4 Alternative measures of efficiency scores

We then examine the robustness of our results, considering a series of alternative measures of the dependent variable. Results are provided in Table 3, where the baseline model result is reported in Column [1].

**Considering Greene (2005b)’s approach.** Our main model estimates public expenditure efficiency scores from Kumbhakar et al. (2015). Besides accounting for unobserved heterogeneity across countries, this approach has the advantage of decomposing inefficiency into persistent (long-run) and transitory (short-run) inefficiency, thus requiring a two-stage estimation procedure. Greene (2005b)’s approach, although not allowing for this inefficiency decomposition, does take into account unobserved het-

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<sup>14</sup>The instrument is defined as follows :

$$contiguity_{i;t} = \sum_{j \neq i}^{n-i} FR_{j,t} * X_{j,i,t} \quad (7)$$

Where  $j$  is the neighboring country of the domestic country  $i$ .  $FR_{j,t}$  is a dummy equal to 1 when the country  $j$  has a fiscal rule at the time  $t$ , and zero otherwise.  $X_{j,i,t}$  is equal to zero when countries have no common borders, and sums the number of countries with common borders. Finally,  $contiguity_{i;t}$  is our instrument and captures the number of fiscal rules in place in countries with common borders with respect to the national economy.

erogeneity across countries and offers a one-step specification model, which allows for greater flexibility in the econometric procedure. In Column [2] of Table 3, we regress the outcome variable on the treatment, using Greene (2005b)'s approach to estimate our efficiency scores. Results are stable.

**Including a subjective indicator of well-being.** Second, we further exploit a “subjective” approach of well-being for robustness purposes. That said, among the outcome indicators for economic performance, we replace GDP per capita with a happiness measure. Economic performance therefore includes : happiness, GDP growth (10-year average) and unemployment rate (10-year average). The happiness index is based on how respondents feel about their well-being, the best possible life for them being a score of 10 and the worst, 0.<sup>15</sup> New estimates are reported in Column [3] of Table 3. Again, results remain consistent.

**Excluding public administration.** Referring to Afonso et al. (2005), we consider public administration among the sectors studied, since a good quality of public administration, characterized by a good judicial system, efficient property rights and well-functioning markets, can be seen as preconditions for a level playing field in the organization of a society (Afonso et al., 2005), and helps to build conditions for strong and sustained economic growth. The outcome indicators for public administration include the following variables : the independence of the judiciary, the quality of property rights, the quality of government and the level of the shadow economy (Afonso et al., 2005). One could be skeptical about the selected indicators, as they may also be strongly affected by other factors. Indeed, while it seems quite intuitive that variables such as the quality of property rights partly depend on public expenditure allocated to the judiciary, other factors of the economy such as the independence of the judiciary, the quality of the government or the size of the shadow economy are strongly correlated to long-term institutional factors or to the overall performance of the economy (this is notably the case for the shadow economy, which may be strongly associated with the level of taxation or financial development). For robustness purposes, we remove public administration from the sectors studied and consider only education, infrastructure, and health. New

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<sup>15</sup>Data publisher's source : Gallup World Poll surveys (life evaluation question) : <https://ourworldindata.org/happiness-and-life-satisfaction>.

results reported in Column [4] of Table 3 hold.

### 9.1.5 Additional controls

We further augment our main specification by including additional covariates. In Column [5] of Table 3, we include annual GDP growth instead of per capita growth, as is the case in the baseline specification. In Columns [6]-[12], we augment our main specification with the following variables : trade openness, GDP per capita (used as a proxy for economic development), credit rating, a monetary union dummy, an inflation targeting regime dummy, presidential system and political checks and balances, respectively.<sup>16</sup> Results remain robust.

### 9.1.6 Placebo tests

Our results suggest that implementing a fiscal rule has a positive and significant effect on expenditure efficiency. The robustness tests conducted so far support our conclusions. In Panel A of Table 5, we further conduct some falsification tests. Specifically, we perform a random assignment to the treatment within the treated countries, considering false adoption dates. Our intuition is that, if the effects obtained are due to fiscal rules, using

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<sup>16</sup>The argument used for financial openness also prevails for trade openness : since fiscal rules have been adopted as part of broader economic reforms, including liberalization, trade openness should encourage FR adoption. As economic development is positively correlated with the quality of institutions, governments of better developed countries are more likely to adopt rules-based fiscal frameworks. The effect of debt ratings on the probability of adopting a fiscal rule is not trivial. On the one hand, since a better sovereign debt rating reflects a good reputation for fiscal policy, it is conceivable that the most disciplined governments are the most likely to adopt a credible fiscal rule. On the other hand, given the positive effect of fiscal rules on access to financial markets (Thornton and Vasilakis, 2018; Afonso and Jalles, 2019; Sawadogo, 2020), one might imagine that low-rated countries would also have an incentive to adopt rules-based fiscal frameworks in order to benefit from better access conditions to financial markets. As argued in Guerguil et al. (2017) and Debrun et al. (2008), the implementation of supranational fiscal rules aimed at preventing free-riding behavior between member states of a monetary union can in turn catalyze the implementation of national rules. Likewise, given the disciplining effect of inflation targeting and the complementarity between this regime and fiscal rules (Minea and Tapsoba, 2014; Combes et al., 2018), one would naturally expect a positive influence of this variable on the probability of adopting FR. Since there is a strong rigidity between the political parties in the decision-making process in a presidential regime (Tsebelis, 2000; Gerring et al., 2005), this factor would be negatively correlated with FR adoption. Finally, sharing policies among a larger number of decision-makers can lead to problems of negotiation, agency, coordination and collective action (Franzese Jr, 2002), which can complicate the adoption of reforms such as fiscal rules. On the other hand, power-sharing might also constrain some of the government's budgetary choices, avoiding for example certain lax or purely ideological expenditures.

Table 3: The effect of FR on Public Sector Efficiency (PSE) : Robustness

Dependent : PSE	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
FR dummy	0.038*** (0.0056)	0.043*** (0.0076)	0.035*** (0.0054)	0.016*** (0.0047)	0.038*** (0.0056)	0.039*** (0.0055)	0.033*** (0.0054)	0.033*** (0.0054)	0.039*** (0.0057)	0.039*** (0.0055)	0.038*** (0.0055)	0.040*** (0.0055)
Annual GDP growth					0.003*** (0.0007)							
Trade openness (Log.)						0.008 (0.0111)						
GDP per capita (Log.)							0.083*** (0.0221)					
Credit rating								0.006*** (0.0012)				
Currency union									0.020* (0.0120)			
Full inflation targeting										-0.009 (0.0094)		
Presidential system											-0.028** (0.0138)	
Checks and balances												0.004*** (0.0015)
Observations	1745	1762	1745	1621	1745	1707	1745	1408	1745	1745	1745	1731
R-squared	0.5597	0.4006	0.5592	0.8015	0.5615	0.5815	0.5687	0.5939	0.5607	0.56	0.561	0.5625
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Notes :** This table reports the results of various robustness tests of the effect of RF on efficiency, using the entropy balancing method. Column [1] displays the baseline model results. In Column [2], the expenditure efficiency scores are re-estimated following Greene (2005a). In Column [3], among the outcome indicators for economic performance, we replace GDP per capita with a happiness measure. In Column [4], we re-estimate the efficiency scores considering only the three sectors: education, health and infrastructure. In Column [5], we include annual GDP growth instead of per capita growth, as is the case in the benchmark model. Columns [6]-[12] include the following variables : trade openness, GDP per capita, credit rating, a monetary union dummy, an inflation targeting regime dummy, presidential rule and political checks and balances, respectively. All specifications of the baseline model include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. All regressions include the constant, not reported in the table. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

placebo dates will lead to statistically non-significant effects. Indeed, random assignment to treatment leads to no significant effect, suggesting that our results are not driven by confounding factors, reinforcing the robustness of our findings.

### 9.1.7 Constraining the treatment period

The effects obtained so far from the implementation of a fiscal rule are a comparison of conditional efficiency averages in periods when the rules are in place versus periods when they are not. The effect captured in this paper may suffer from some problems. Indeed, adopting fiscal rules can trigger a change in the economic, political, institutional, and social environment of countries. In this sense, it can be argued that the effect captured may not be due to the fiscal rules but to changes in institutional, political, social, or economic conditions after its adoption. Similarly, any other characteristic that may determine the adoption of fiscal rules, but not included in the econometric specification, may be a source of endogeneity. To circumvent these problems, it would be interesting to compare the results obtained from the full sample period with those around a smaller period. A narrower sample window should provide a more robust estimate of the effects of the rule, since confounding factors such as the implementation of other reforms or change in political regime are more likely to play out over time (Neuenkirch and Neumeier, 2015). That is, we deepen the robustness of our results with four modifications of our initial sample, considering a window of two, three, four and five years, respectively. Results are presented in Panel B of Table 5, Columns [1]-[4]. Overall, the coefficients obtained from a smaller window are around those obtained from the full sample. Therefore, it seems unlikely that the estimated effect of fiscal rules is due to a fortuitous change in the policy or institutional environment of the treated country.

### 9.1.8 Entropy Balancing for continuous treatments

So far, we have considered as treatment variable a dummy equal to 1 if a country  $i$  at time  $t$  has adopted a fiscal rule, and zero otherwise. Other studies in the literature use an alternative measure of fiscal rules, considering continuous indicators (see, among other examples, Gootjes et al., 2021). Such an approach, while having the advantage

of capturing the “strength” of the fiscal regime, encounters a major issue regarding the endogeneity of the treatment variable. In other words, using continuous indicators involves finding external instruments (to go beyond GMM methods), which is naturally complicated. Hence, reform measures — as is the case in this study — allow using impact evaluation methods to better correct for endogeneity issues. Indeed, the prevailing literature on treatment effects analysis generally uses reform variables, i.e. binary measures. However, recent studies have focused on the application of these methods to continuous treatments. Against this background, [Tübbicke \(2022\)](#) extends the entropy balancing method of [Hainmueller \(2012\)](#) to continuous treatments.<sup>17</sup> Thus, relying on [Tübbicke \(2022\)](#), we test the robustness of our results using a continuous treatment, i.e. a measure of the strength of the rule. Following [Gootjes et al. \(2020\)](#), we construct a fiscal rule index, considering national and supranational fiscal rules for four categories : balanced budget rules, debt rules, expenditure rules and revenue rules. The indicator is constructed as follows :

$$FRI = Coverage + Legal\ basis + Supporting\ procedures + Enforcement + Flexibility \quad (8)$$

Where *FRI* (Fiscal Rules Index) represents the strength of the rule. Coverage identifies the level of government (central or general) covered by the rule. Legal basis considers the legal basis of the rule, ranging from political agreements to legislative statutes to constitutional rules. Supporting procedures are the sum of the existence (or absence) of multi-annual expenditure ceilings, a law on fiscal responsibility and an independent fiscal body that sets budgetary assumptions and monitors their implementation. Enforcement is measured as the sum of having a formal enforcement procedure in place. Flexibility determines whether there is a well-defined exemption clause, whether the balanced budget target is cyclically adjusted and whether public infrastructure spending is excluded from the expenditure ceiling. We normalize each of the five components to unity so that the index ranges from 0 to 5. In line with [Fig.2](#), [Fig. A1](#) shows a gradual evolution of fiscal rules from the 1990s onwards, with a more pronounced rise for advanced economies. [Table 4](#) reports the effects of fiscal rules on expenditure efficiency, using a continuous index of the rule, applying entropy balancing and a fixed effects model in Columns [1] and [2], respectively. Once again, new estimates show a positive and significant treatment effect.

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<sup>17</sup>See [Tübbicke \(2022\)](#) for technical details.

Table 4: Robustness : Fiscal rules index and public expenditure efficiency (PSE)

<b>Dependent : PSE</b>	[1]	[2]
	Entropy balancing	Fixed-effects
Fiscal rules index	0.027*** (0.0053)	0.020*** (0.0034)
Observations	1745	1745
R-squared	0.6032	0.5158
Controls	Yes	Yes
Country & Time/FE	Yes	Yes

**Notes :** This table displays the results of the impact of fiscal rules on public expenditure efficiency. We use as a variable of interest a fiscal rule strength index described as follows : Fiscal Rules Index = Coverage + Legal basis + Supporting procedures + Enforcement + Flexibility (see Equation 8). Column [1] reports the results based on entropy balancing for continuous treatments. Column [2] reports the results using the OLS estimator. The specifications include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Moreover, the magnitude of the new coefficients (about 2 percentage points) remains comparable to those obtained previously, strongly supporting our findings.



Table 5: Fiscal rules and expenditure efficiency : falsification tests

<b>Panel A : Placebo tests</b>	[1]			
Random treatment	-3.24E-10 (0.0034)			
<b>Panel B : Constraining the treatment period</b>	[1]	[2]	[3]	[4]
FR dummy [-2, 2]	0.019*** (0.0056)			
FR dummy [-3, 3]		0.029*** (0.0058)		
FR dummy [-4, 4]			0.037*** (0.0060)	
FR dummy [-5, 5]				0.040*** (0.0059)

**Notes:** This table reports the results of the causal impact of fiscal rules on public expenditure efficiency, using entropy balancing. Panel A performs a random assignment to the treatment within the treated countries, considering false adoption dates. Columns [1]-[4] constrain the period of adoption, considering a window of two, three, four and five years, respectively. The specifications include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## 9.2 Heterogeneity

### 9.2.1 Does the length of the reform matter ?

As argued earlier, a key difference between fiscal rules and other measures, such as fiscal consolidation episodes, is that fiscal rules are permanent and are often associated with structural reforms in the conduct of fiscal policy, which can enhance their credibility over time. In Table 6, we assess the effect of the reform according to the time elapsed since its adoption. Specifically, in Columns [1]-[10], we estimate the effect of fiscal rules on expenditure efficiency, up to 10 years after adoption, respectively. On the one hand, estimates suggest that fiscal rules improve expenditure efficiency one year after their implementation. This result is not surprising since, if fiscal rules are adopted at the end of the year, the effects are likely to be felt the following year. On the other hand, there is a gradual increase in the estimated effects, suggesting that the positive impact of fiscal rules on expenditure efficiency tends to be higher over time.

### 9.2.2 The types of fiscal rule

The previous sections have shown that adopting a fiscal rule has a positive, significant and robust effect on expenditure efficiency. This subsection explores some heterogeneities

Table 6: Heterogeneity (1/3): Does the length of the reform matter ?

<b>Dependent : PSE</b>	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10
FR dummy	0.011 (0.0067)									
FR dummy		0.016** (0.0065)								
FR dummy			0.023*** (0.0065)							
FR dummy				0.027*** (0.0065)						
FR dummy					0.030*** (0.0064)					
FR dummy						0.033*** (0.0064)				
FR dummy							0.035*** (0.0063)			
FR dummy								0.038*** (0.0065)		
FR dummy									0.041*** (0.0066)	
FR dummy										0.044*** (0.0065)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Notes :** This table presents the results of the causal impact of fiscal rules on expenditure efficiency according to the time elapsed since reform adoption. The equation is estimated from the baseline model, using entropy balancing. In Columns [1]-[10], we estimate the effect of fiscal rules on expenditure efficiency, up to 10 years after adoption, respectively. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 7: Heterogeneity (2/3): types of rules

Dependent : PSE	[1]	[2]	[3]	[4]
	BBR	DR	ER	RR
ATT	0.038*** (0.0057)	0.043*** (0.0069)	0.012*** (0.0039)	0.005 (0.0139)
Observations	1745	1745	1745	1745
R-squared	0.5484	0.5591	0.605	0.623
Country, Time FE & Controls	Yes	Yes	Yes	Yes

**Notes :** This table presents the results of the causal impact of fiscal rules on expenditure efficiency, by type of rule and using the baseline model. The equation is estimated from the baseline model, using entropy balancing. We consider budget balanced rules (BBR), debt rules (DR), expenditures rules (ER) and revenue rules (RR), respectively. All specifications include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

in the effect of the reform, depending on the different types of rules. As observed earlier, over our study period, budget balanced rules (BBR) are the most widespread, followed by debt rules (DR) and expenditures rules — ER — (Fig. 2). BBR, by setting a ceiling or numerical target for the government’s budget balance, aim to promote greater fiscal discipline. DR set an explicit limit on the stock of government debt to ensure convergence to a debt target. ER, by limiting total, primary or current expenditure, directly target the size of government (Schaechter et al., 2012). Finally, revenue rules (RR) consist in constraining, often numerically, public revenues. Columns [1]-[4] of Table 7 suggest that DR and BBR have a greater effect on expenditure efficiency compared to ER. Finally, over our sample and study period, only 14 countries have adopted RR.<sup>18</sup> Although the coefficient for RR is positive, it is not significant.

### 9.2.3 Design of the rules

Second, we explore other sources of heterogeneity by examining conditional effects. We consider our main specification, augmented as follows :

$$Y_{i,t} = \alpha + \beta FR_{i,t} + \phi FR_{i,t} * V_{i,t} + \eta X_{i,t} + \mu_i + \psi_t + \epsilon_{i,t} \quad (9)$$

<sup>18</sup>Australia (1998), Belgium (1992), Benin (2000), Burkina Faso (2000), Denmark (2001), France (2006), Guinea-Bissau (2000), Kenya (1997), Mali (2000), Netherlands (1994), Niger (2000), Senegal (2000), Timor-Leste (2005) and Togo (2000).

Where  $V$  represents the vector of variables that may be a source of heterogeneity. A positive (negative) and significant sign of  $(\phi)$  suggests that the benefit of the reform is amplified (reduced) in the presence of the variable considered. First, we check for possible heterogeneity due to the design of fiscal rules. We consider the following factors : monitoring, enforcement, coverage, legal basis, supporting procedures, independent fiscal institutions (fiscal councils) and flexibility.<sup>19</sup> Evidence reported in Table 8 (Columns [1]-[7]) suggests that formal monitoring, enforcement arrangements and coverage, as well as a strong legal basis for the rule amplify the positive effect of FR on expenditure efficiency.

#### 9.2.4 Macroeconomic and institutional factors

Next, we consider other sources of heterogeneity, examining the role of macroeconomic and institutional factors. Column [8] of Table 8 reveals that the positive effect of fiscal rules is amplified for countries with high per capita income, potentially due to the beneficial effect of income level on efficiency. In Column [10], we examine whether the effect of the reform is conditioned by institutional quality, proxied by political stability. There is suggestive evidence that fiscal rules are most effective when adopted by countries with good institutions, especially those with good political stability. This result is in line with that of Columns [8], since poorer countries have been found to have poorer government performance and weak institutions (La Porta et al., 1999; Acemoglu et al., 2002; Acemoglu et al., 2008). In Column [11], we cross the treatment with a fiscal transparency variable, extracted from Wang et al. (2015). The coefficient for the interaction is not significant, albeit positive. Finally, the last column explores a heterogeneity according to fiscal discipline. The term “Poor fiscal discipline” is a dummy equal to 1 when a country

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<sup>19</sup>The design variables of the rules were constructed following Gootjes et al. (2021). Monitoring captures to what extent national compliance monitoring outside of government is implemented. Enforcement is measured as the sum of having a formal enforcement procedure in place. Coverage identifies the level of government (central or general) covered by the rule. Legal basis considers the legal basis of the rule, ranging from political agreements to legislative statutes to constitutional rules. Supporting procedures are the sum of the existence (or absence) of multiannual expenditure ceilings, a law on fiscal responsibility and an independent fiscal body that sets budgetary assumptions and monitors their implementation. Fiscal councils provide information on whether independent public institutions that aim to strengthen commitments to sustainable public finances are in place. Finally, flexibility determines whether there is a well-defined exemption clause, whether the balanced budget target is cyclically adjusted and whether public infrastructure spending is excluded from the expenditure ceiling.

$i$ , at time  $t$ , has a sovereign debt rating below its long-term average (over 1990-2017), and zero otherwise. Results suggest that fiscal rules are more effective when adopted by countries with poor fiscal discipline. In other words, sound reform, notably fiscal rules, aimed at promoting greater discipline, tends to be more conducive to expenditure efficiency for countries with lax and weak fiscal policies.

Table 8: Heterogeneity (3/3) : Design of the rule and macroeconomic factors

Dependent : PSE	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
FR dummy	0.025*** (0.0057)	0.031*** (0.0055)	0.019*** (0.0061)	0.022*** (0.0072)	0.037*** (0.0057)	0.038*** (0.0055)	0.033*** (0.0067)	0.028*** (0.0065)	0.038*** (0.0063)	0.033*** (0.0065)	0.034*** (0.0102)	0.034*** (0.0060)
<b>Design of the rule</b>												
FR * Monitoring	0.083*** (0.0129)											
FR * Enforcement		0.072*** (0.0184)										
FR * Coverage			0.079*** (0.0168)									
FR * Legal basis				0.020** (0.0081)								
FR * Supporting procedures					0.009 (0.0105)							
FR * Fiscal councils						0.015* (0.0087)						
FR * Flexibility							0.008 (0.0069)					
<b>Macroeconomic factors</b>												
FR * GDP per capita								0.003*** (0.0011)				
FR * Natural resources									-3.05E-4 (0.0013)			
FR * Political stability										0.013*** (0.0047)		
FR * Fiscal transparency											1.74E-4 (0.0003)	
FR * Poor fiscal discipline												0.012* (0.0075)
Observations	1745	1745	1745	1745	1745	1745	1745	1745	1741	1622	1088	1745
R-squared	0.5749	0.5667	0.5685	0.561	0.5599	0.5608	0.5601	0.566	0.5838	0.5603	0.6488	0.5637
Country, Time FE & Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Notes :** This table reports the results of the heterogeneity effects of fiscal rules. The equation is estimated by considering the main model augmented by the interactive term. Vector X variables in isolation (without interaction with FR) and controls are included but not reported for space purpose. All specifications include the variables of the baseline model : lag public debt, lag GDP per capita growth, lag inflation, lag capital openness, fixed exchange rate dummy, democracy, corruption control and government fragmentation. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## 10 Conclusion

Fiscal rules are now widespread in both industrialized and developing countries. These reforms have often been successful, at least so far, given their ability to promote strong fiscal discipline. Against this background, in line with previous work, this paper assesses the effect of fiscal rules on public expenditure efficiency. First, using a parametric approach, we calculate efficiency scores for 159 developed and developing countries over the period 1990-2017. Next, from the obtained scores, we rely on the entropy balancing method to assess the effect of reform adoption on public expenditure efficiency, thus mitigating selection bias issues. Evidence suggests that implementing a rule positively and significantly improves expenditure efficiency, with economically significant effects. Robustness is checked through a set of economic and econometric tests. Furthermore, we show that our results are not driven by a spurious trend and are not confounded by the effects of other reforms such as inflation targeting, IMF programs or fiscal consolidation episodes. Finally, we deepen the analysis by examining some sources of heterogeneity in the effectiveness of the reform, depending on the types of rules, their design, and macroeconomic factors. On the one hand, although deficit, debt, and expenditure rules all have a positive and significant effect on expenditure efficiency, the effect is more amplified for the first two types of rules. On the other hand, formal monitoring, enforcement arrangements, coverage, strong legal basis, the level of per capita income as well as institutional quality (notably political stability) amplify the positive effect of the rule on expenditure efficiency. Moreover, there is suggestive evidence that fiscal rules are more effective when adopted by countries with poor fiscal discipline. Finally, we also find that the positive effect of fiscal rules on expenditure efficiency tends to increase over time.

Our results have some policy implications. First, sound economic reforms — notably fiscal rules — aimed at correcting the policy biases that lead policymakers to overspend and run deficits, not only promote greater fiscal discipline while preserving the countercyclical stabilizing role of fiscal policy, but also improve government expenditure efficiency. This is especially true for countries with poor fiscal discipline, as our findings suggest. Second, mechanisms such as formal monitoring, enforcement arrangements, coverage, strong legal basis and institutional quality are important to promote

greater effectiveness of the reform.

Another issue relates to the challenges of fiscal policy regarding socio-economic issues. As is well known, the prevailing tax rates in industrialized countries today leave little room for increased taxation, notably in countries facing strong aging pressures. On the other hand, developing countries — generally characterized by high poverty and income inequality, as well as high population dependency — face a huge development challenge, moving fiscal choices to the top of the political agenda for achieving the Sustainable Development Goals. That said, while governments in both industrialized and developing countries should adopt a much more ambitious fiscal policy — given their room for maneuver — to better align public policies with their objectives, sound economic reforms, notably fiscal rules, are a tool that can promote greater efficiency gains. Finally, the experience of the Covid-19 pandemic shows that countries that had good fiscal discipline before the crisis were able to deploy larger fiscal stimuli (Apeti et al., 2021). This suggests that sound economic reforms, notably fiscal rules, which promote greater fiscal discipline and expenditure efficiency, may also condition the effectiveness of fiscal policy during shocks.

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## Appendix A Constructing the summary index

This section details the procedure for calculating the composite index following the method of [Anderson \(2008\)](#) and using the Stata procedure proposed by [Schwab et al. \(2020\)](#). The synthetic index is a weighted average of several normalized outcomes. The weights are calculated to maximize the amount of information captured in the index. The method consists of standardizing the indicator variables before constructing the inverse covariance matrix used in the Generalized Least Squares (GLS) weighting procedure. The GLS weighting procedure is efficient as it allocates less weight to highly correlated indicators, while uncorrelated indicators receive more weight as they potentially provide new information. By default, the program normalizes to the mean and standard deviation of the full sample, which is equivalent to obtaining the weights by inverting the correlation matrix. The procedure allows the index to be constructed even when data on the indicators are missing, by setting the values of the missing indicators to zero, which corresponds to the mean of the reference group after normalization. The standardized weighted index  $\bar{s}$  for each observation  $i$  is calculated in the following six steps (see [Schwab et al., 2020](#)) :

- 1- Select  $k$  indicators relevant for outcome  $j$ .
- 2- Adjust sign : For all  $k$  indicators, ensure the positive direction always indicates a “better

outcome”.

3- Normalize indicators : Demean all  $k$  indicators by subtracting the mean of the indicator in the reference group (the full sample is the default reference group). Then, convert them to effect sizes,  $\tilde{y}_k$ , by dividing each indicator by its reference group standard deviation.<sup>20</sup>

4- Construct weights : Create weights using  $\Sigma^{-1}$ , the inverse of the covariance matrix of the normalized indicators.<sup>21</sup> Specifically, set the weight  $\tilde{w}_k$  on each indicator equal to the sum of its row entries in  $\Sigma^{-1}$ . With this rule, highly correlated indicators are assigned small or offsetting weights, while less correlated outcomes receive larger weights.

5- Construct index : Calculate the weighted average of  $\tilde{y}_k$  for observation  $i$ . Formally, the weighted average  $\tilde{s}_i$  is calculated using  $\tilde{s}_i = (\mathbf{1}' \widehat{\Sigma}^{-1} \mathbf{1})^{-1} (\mathbf{1}' \widehat{\Sigma}^{-1} \tilde{\mathbf{y}}_i)$ , where  $\mathbf{1}$  is a column vector of 1s and  $\tilde{\mathbf{y}}_i$  is a column vector of all outcomes for observation  $i$ . This is an efficient GLS estimator.

6- Normalize index : Demean index  $\tilde{s}_i$  by subtracting the mean of the index in the reference group, and convert it to effect sizes by dividing it by its reference group standard deviation.<sup>22</sup> This normalization results in an index distributed with mean zero and standard deviation one in the reference group.

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<sup>20</sup>In some cases, particularly when all sub-indicators are of comparable scales, the normalization may not be necessary. The `swindex` command accommodates this special case using the `nostd` option.

<sup>21</sup>This is equivalent to using the correlation matrix in the special case that the normalization procedure described in step 3 standardizes against the full sample using the default option.

<sup>22</sup>This step is implicitly done by [Anderson \(2008\)](#), although it is not formally discussed. This step is optional using the `swindex` command with the `norescale` option. The default uses the reference group from step 3, but the full sample mean and standard deviation can alternatively be used to normalize the index with the `fullrescale` option.

# Appendix C Data and sample

Table C1: List of Fiscal Rules (FR) and Non-FR countries

FR	Dates	FR	Dates	FR	Dates	FR	Dates
Argentina	2000	Germany	1990	Italy	1992	Netherlands	1992
Armenia	2002	Dominica	1998	Jamaica	2010	Norway	2001
Australia	1998	Denmark	1992	Japan	1990	New Zealand	1994
Austria	1995	Ecuador	2003	Kazakhstan	2013	Pakistan	2005
Burundi	2013	Spain	1992	Kenya	1997	Panama	2002
Belgium	1992	Estonia	1993	Liberia	2009	Peru	2000
Benin	2000	Finland	1995	Sri Lanka	2003	Poland	1997
Burkina Faso	2000	France	1992	Lithuania	2004	Portugal	1992
Bulgaria	2003	Georgia	2013	Luxembourg	1990	Paraguay	2015
Brazil	1998	Guinea-Bissau	2000	Latvia	2004	Russian Federation	2007
Botswana	2003	Equatorial Guinea	2002	Maldives	2013	Rwanda	2013
Central African Republic	2002	Greece	1992	Mexico	2006	Senegal	2000
Canada	1998	Grenada	1998	Mali	2000	Singapore	1990
Switzerland	2003	Croatia	2009	Malta	2004	Serbia	2011
Chile	2001	Hungary	2004	Mongolia	2013	Slovenia	2000
Cameroon	2002	Indonesia	1990	Mauritius	2008	Sweden	1995
Colombia	2000	India	2004	Malaysia	1990	Togo	2000
Cabo Verde	1998	Ireland	1992	Namibia	2001	Timor-Leste	2005
Costa Rica	2001	Iceland	2004	Niger	2000	Uganda	2013
Cyprus	2004	Israel	1992	Nigeria	2007	Uruguay	2006
<b>Non FR</b>							
Afghanistan	Jordan	Sierra Leone	Congo, Rep				
Angola	Cambodia	El Salvador	Congo, Dem Rep				
Albania	Kiribati	Suriname	Iran, Islamic Rep.				
Azerbaijan	Kuwait	Seychelles	Yemen, Rep.				
Bangladesh	Lebanon	Thailand	Bolivia				
Bahrain	Lesotho	Tajikistan	Kyrgyz Republic				
Bosnia and Herzegovina	Morocco	Tonga	Slovak Republic				
Belarus	Madagascar	Trinidad and Tobago	St Vincent and the Grenadines				
Belize	Myanmar	Tunisia	United States				
Barbados	Mozambique	Turkey	Laos				
Bhutan	Malawi	Ukraine	Hong Kong				
China	Nicaragua	Uzbekistan	United Kingdom				
Dominican Republic	Nepal	Vanuatu	Tanzania				
Algeria	Oman	Samoa	Korea, Rep.				
Ethiopia	Philippines	South Africa	Egypt, Arab Rep.				
Fiji	Papua New Guinea	Zambia	Bahamas, The				
Ghana	Qatar	Zimbabwe	Swaziland				
Guatemala	Saudi Arabia	Czech Republic	Venezuela, RB				
Honduras	Sudan	Moldova	Vietnam				
Iraq	Solomon Islands	Cote d'Ivoire					

## Appendix B Graphs

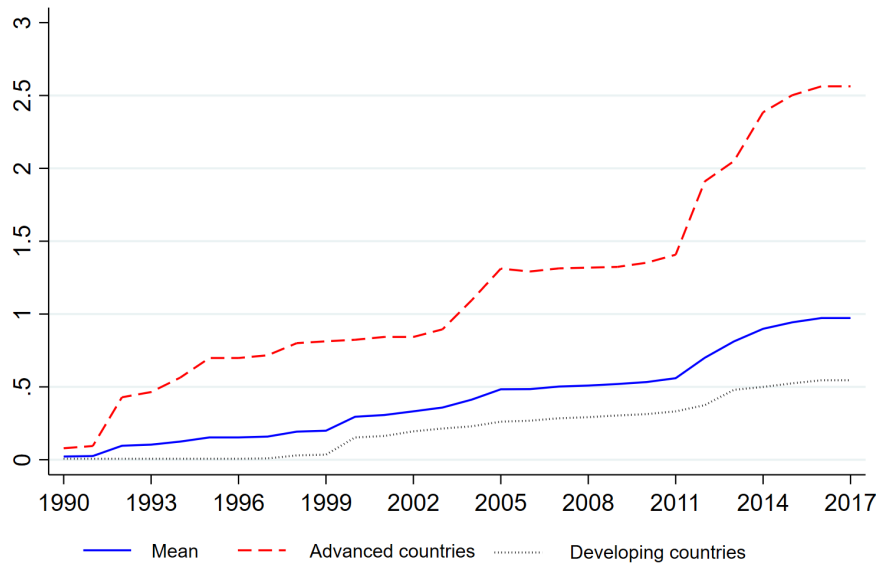


Figure B 1: Fiscal rules index for advanced and developing countries (1990-2017)

**Notes :** This figure shows the evolution of fiscal rule strength. The index ranges from 0 to 5 and is constructed as follows : Fiscal Rules Index = Coverage+ Legal basis+ Supporting procedures+ Enforcement + Flexibility (see Equation 8). **Source :** Authors, from the IMF Fiscal Rules Dataset.

Table C2: Descriptive statistics of the main variables

Variable	Obs.	Mean	Sd	Min	Max
Expenditure efficiency scores	3,709	0.665	0.076	0.245	0.882
Public debt	3,319	61.704	61.042	0.474	2092.920
GDP per capita growth	3,733	2.274	6.185	-64.992	140.371
Inflation	3,390	21.333	194.216	-18.109	7481.664
Financial openness	3,554	0.293	1.566	-1.917	2.347
Fixed exchange rate dummy	3,455	0.39	0.49	0	1
Government fragmentation	3,381	0.250	0.286	0	1
Corruption control	2,980	49.844	29.013	0	100
Democratic system	3,341	4.196	6.276	-10	10

Table C3: Country rankings by average efficiency scores : 1990-2017

Country	Score	Rank	Country	Score	Rank	Country	Score	Rank	Country	Score	Rank
United Kingdom	0.7897	1	Mauritius	0.6887	41	Dominican Republic	0.6627	81	Cambodia	0.6364	121
United States	0.7561	2	Sri Lanka	0.6884	42	Kuwait	0.6611	82	Sudan	0.6351	122
Japan	0.7475	3	Czech Republic	0.6866	43	Colombia	0.6608	83	Pakistan	0.6349	123
New Zealand	0.7422	4	Kiribati	0.6859	44	Paraguay	0.6605	84	Honduras	0.6348	124
Korea, Rep0.	0.7412	5	Greece	0.6821	45	Mozambique	0.6597	85	Bangladesh	0.634	125
Australia	0.7377	6	Kazakhstan	0.6821	46	El Salvador	0.6593	86	Central African Republic	0.6338	126
Netherlands	0.7313	7	Grenada	0.6818	47	Croatia	0.6592	87	Benin	0.6302	127
Norway	0.7287	8	Tonga	0.6816	48	Serbia	0.6591	88	Sierra Leone	0.6277	128
Italy	0.7277	9	Belarus	0.6813	49	Luxembourg	0.6588	89	Mongolia	0.6262	129
Malta	0.7275	10	Argentina	0.6811	50	Bosnia and Herzegovina	0.6584	90	Congo, Rep	0.6259	130
Bolivia	0.7268	11	Finland	0.6811	51	Russian Federation	0.6571	91	Malawi	0.6258	131
Belgium	0.7263	12	Tunisia	0.681	52	Morocco	0.657	92	Nepal	0.6257	132
Vietnam	0.7256	13	Bahrain	0.6808	53	Trinidad and Tobago	0.6568	93	Namibia	0.6251	133
Denmark	0.7222	14	Barbados	0.6808	54	Sweden	0.656	94	Albania	0.625	134
Egypt, Arab Rep0.	0.7216	15	Mexico	0.6804	55	Burkina Faso	0.6558	95	Bhutan	0.6224	135
Iceland	0.7203	16	Turkey	0.6779	56	Slovak Republic	0.6557	96	Congo, Dem Rep	0.6218	136
Canada	0.7202	17	Uzbekistan	0.6779	57	Bulgaria	0.6554	97	Zimbabwe	0.6211	137
Germany	0.7191	18	Uruguay	0.6769	58	Ukraine	0.6529	98	Cameroon	0.6205	138
St Vincent and the Grenadines	0.7147	19	Dominica	0.6768	59	Timor-Leste	0.6514	99	Madagascar	0.6199	139
Austria	0.7142	20	Seychelles	0.676	60	Oman	0.6488	100	Mali	0.6159	140
Ireland	0.7135	21	Panama	0.6756	61	Botswana	0.6477	101	Kenya	0.6143	141
Israel	0.7133	22	Latvia	0.6747	62	Guatemala	0.6471	102	Yemen, Rep.	0.6125	142
Slovenia	0.7125	23	Malaysia	0.6716	63	Venezuela, RB	0.6468	103	Afghanistan	0.6082	143
Spain	0.7123	24	Thailand	0.6712	64	Laos	0.6454	104	Burundi	0.6053	144
France	0.7086	25	Indonesia	0.6687	65	Solomon Islands	0.6447	105	Liberia	0.6047	145
Hong Kong	0.7081	26	Hungary	0.6679	66	Armenia	0.6443	106	Zambia	0.6041	146
Portugal	0.7062	27	Senegal	0.6672	67	Cote d'Ivoire	0.6435	107	Equatorial Guinea	0.6039	147
Singapore	0.7058	28	Qatar	0.6663	68	Suriname	0.6434	108	Lesotho	0.6032	148
Samoa	0.7057	29	Estonia	0.6654	69	Niger	0.6426	109	Bahamas, The	0.6022	149
Costa Rica	0.7056	30	Iran, Islamic Rep0.	0.6652	70	Guinea-Bissau	0.6424	110	Myanmar	0.599	150
Poland	0.7037	31	Belize	0.6652	71	Philippines	0.6421	111	Nicaragua	0.5979	151
Switzerland	0.6995	32	Saudi Arabia	0.6648	72	Rwanda	0.6418	112	Swaziland	0.5976	152
Cyprus	0.6979	33	Algeria	0.6642	73	Tajikistan	0.6412	113	Uganda	0.5954	153
Lithuania	0.6956	34	Jamaica	0.664	74	Ghana	0.6398	114	Angola	0.5947	154
China	0.6945	35	Jordan	0.664	75	Iraq	0.6387	115	Papua New Guinea	0.5909	155
Chile	0.6937	36	Georgia	0.6637	76	Maldives	0.638	116	Ethiopia	0.5784	156
Lebanon	0.6932	37	Fiji	0.6632	77	Kyrgyz Republic	0.6379	117	Togo	0.5679	157
Peru	0.6931	38	Ecuador	0.6631	78	Azerbaijan	0.6375	118	Nigeria	0.5646	158
Brazil	0.6912	39	Vanuatu	0.6628	79	India	0.6373	119	Tanzania	0.5629	159
Cabo Verde	0.6908	40	Moldova	0.6628	80	South Africa	0.6365	120			

Table C4: Sources of variables for the calculation of efficiency scores

	Variables	Nature	Sources
	<b>1. Public expenditure (inputs)</b>		
Education	— Education expenditure (%GDP)	Continuous	Public Expenditures for Economic Development (SPEED)
Infrastructure	— Infrastructure expenditure (%GDP)	Continuous	SPEED
Health	— Health expenditure (%GDP)	Continuous	SPEED
Government	— Government final consumption (%GDP)	Continuous	World Economic Outlook (WEO)
	<b>2. Sectoral performance indices (outcomes)</b>		
Education	— Primary enrollment	Continuous	World Development Indicators (WDI)
	— Secondary enrollment	Continuous	WDI
	— Expected years of schooling	Continuous	WDI
Health	— Life expectancy at birth	Continuous	World Development Indicators (WDI)
	— Infant mortality rate (per 1000 live births)	Continuous	WDI
Infrastructure :	— Total length of roads in kilometers	Continuous	World Telecommunication/ICT Indicators Database
	— Number of paved roads (% total roads)	Continuous	World Telecommunication/ICT Indicators Database
	— Fixed telephone subscriptions (per 100 people)	Continuous	World Telecommunication/ICT Indicators Database
	— Fixed broadband subscriptions (per 100 people)	Continuous	World Telecommunication/ICT Indicators Database
	— Faults for 100 fixed telephone lines per year	Continuous	World Telecommunication/ICT Indicators Database
	— Proportion of households with electricity	Continuous	World Telecommunication/ICT Indicators Database
	— Electric power consumption (in kWh per capita)	Continuous	World Telecommunication/ICT Indicators Database
	— Electric power transmission and distribution losses (%production)	Continuous	World Telecommunication/ICT Indicators Database
Administration	— Independence of the judiciary	Continuous	Teorell et al. (2021)
	— Quality of property rights	Continuous	Teorell et al. (2021)
	— Quality of government	Continuous	Teorell et al. (2021)
	— Level of the shadow economy	Continuous	Teorell et al. (2021)
Stability	— Standard deviation of the three-year moving average of GDP growth	Continuous	Authors, from WDI
	— Standard deviation of the three-year moving of inflation	Continuous	Authors, from WDI
Distribution	— Gini index	Continuous	Standardized World Income Inequality Database (SWIID)
Economic performance	— GDP per capita	Continuous	WDI
	— GDP growth (10-year average)	Continuous	WDI
	— Unemployment rate (10-year average)	Continuous	WDI

Table C5: Fiscal rules and expenditure efficiency : sources of variables

Variables		Sources
1. Main model variables		
	Nature	
Public expenditure efficiency	Scores ranging from 0 to 1	Authors, from data in Table C4
Fiscal rules	Dummy	IMF Fiscal Rules Dataset
Public debt (%GDP)	Continuous	<a href="#">Abbas et al. (2011)</a>
Inflation	Continuous	WDI
GDP per capita growth	Continuous	WDI
Financial openness	Index ranging approximately from -2 to 2	<a href="#">Chinn and Ito (2006)</a>
Fixed exchange rate regime	Dummy	Authors, from <a href="#">Ilzetzki et al. (2017)</a>
Corruption control	Index ranging from 0 to 100	Worldwide Governance Indicators database ( <a href="#">Kaufmann et al., 2011</a> )
Democratic regime	Index ranging from -10 to 10	Polity
Government fragmentation	Index ranging from 0 to 1	Database of Political Institutions (DPI)
<b>2. Additional variables</b>		
Annual GDP growth	Continuous	WDI
Trade openness	Continuous	WDI
GDP per capita	Continuous	WDI
Credit rating	Index ranging from 1 to 21	<a href="#">Kose et al. (2017)</a>
Inflation targeting	Dummy	<a href="#">Rose (2007)</a> ; <a href="#">Roger (2009)</a> ; <a href="#">Jahan and Sarwat (2012)</a> and <a href="#">Cizkowicz-Pekala et al. (2019)</a>
Presidential system	Dummy	Database of Political Institutions
Political checks and balances	Continuous	Database of Political Institutions
Natural resources	Continuous	WDI
Fiscal transparency	Index ranging from 0 to 100	<a href="#">Wang and Alvi (2011)</a>
Political stability	Index ranging from -2 to 2	Worldwide Governance Indicators database ( <a href="#">Kaufmann et al., 2011</a> )

## Appendix D Robustness

Table D1: Results from OLS and GMM estimators

Dependent : PSE	[1] OLS	[2] GMM
FR dummy	0.019*** (0.0057)	0.070* (0.0415)
Lagged Public debt	4.09E-5 (0.0001)	-1.76E-5 (0.0001)
Lagged GDP per capita growth	0.002*** (0.0006)	0.001** (0.0004)
Lagged Inflation	-6.45E-6 (0.0000)	2.17E-4 (0.0004)
Lagged Capital openness	0.002 (0.0027)	-0.010 (0.0102)
Fixed exchange rate regime	0.024*** (0.0077)	3.70E-4 (0.0702)
Democratic system	0.003*** (0.0008)	-0.004 (0.0069)
Corruption control	0.001*** (0.0003)	0.001 (0.0009)
Government fragmentation	0.012 (0.0092)	0.011 (0.0315)
Lagged Expenditure efficiency (PSE)		0.621*** (0.2224)
Observations	1745	1737
R-squared	0.5077	
Country FE & Time FE	Yes	Yes
Number of observations	1745	1737
Number of countries		108
Number of instruments		64
AR(1) p-value		0.003
AR(2) p-value		0.103
Hansen p-value		0.716

**Notes :** This table reports estimates of the impact of fiscal rules on expenditure efficiency. Column [1] reports the results obtained with the OLS estimator. Column [2] reports the results obtained using a two-step system-GMM and relying on internal instruments. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01



Table D2: Results from instrumental variables (IV)

VARIABLES	Panel A : First stage	Panel B : IV estimates
	[1] FR dummy	[2] PSE
Lagged Public debt	-0.001** (0.0002)	5.71E-5 (0.0001)
Lagged GDP per capita growth	-0.002** (0.0012)	0.002*** (0.0003)
Lagged Inflation	-4.651E-4** (0.0002)	6.39E-6 (0.0001)
Lagged Capital openness	0.053*** (0.0105)	2.325E-4 (0.0028)
Fixed exchange rate regime	0.008 (0.0318)	0.024*** (0.0074)
Democratic system	0.004 (0.0038)	0.002*** (0.0009)
Corruption control	0.001 (0.0009)	0.001*** (0.0002)
Government fragmentation	0.004 (0.0339)	0.012 (0.0079)
Contiguity (Instrument)	0.130*** (0.0122)	
FR dummy		0.047** (0.0220)
IV	Contiguity	Contiguity
Stock-Yogo Stats test.		16.38
Stock-Wright p-value		0.0323
Observations	1745	1745
R-squared	0.8135	0.5006
Country FE & Time FE	Yes	Yes

**Notes :** This table presents the results of the effect of fiscal rules on expenditure efficiency, using as an instrumentation strategy the geographical diffusion of rule adoption. The instrument (contiguity) captures the number of fiscal rules in place in countries with common borders with respect to the national economy. Panel A reports the first stage equation, where the endogenous variable (fiscal rule dummy) is regressed on the instrument and on the set of controls in the baseline model. Panel B reports the results of the causal effect of fiscal rules after instrumentation. Robust standard errors in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01