Effects of Fiscal Rules on the Fiscal Policy Reaction to Government Indebtedness

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Abstract

It is well known that fiscal policy is prone to react to public debt in order to ensure fiscal sustainability. This paper examines whether and how fiscal rules would exert an influence on this relationship. Our dataset consists of 28 OECD member countries over the period from 1985 to 2015. Our empirical evidence suggests that the reaction of fiscal policy to public debt is likely to become weak or even disappear when strong fiscal rules are in place. At the same time, fiscal rules exert significant disciplinary effects unless public debt exceeds a certain level. Governments need to lower public debt to a certain level in order to ensure the disciplinary effects of the fiscal rules and public debt itself.

1. Introduction

Since the outbreak of the COVID-19 pandemic, governments around the world have taken decisive actions to support their economies and people's lives. Most governments have been employing large fiscal support packages for households, workers, and businesses. The discretionary fiscal policies were unprecedented in size. With substantial falls in GDP, governments are running large fiscal deficits, and public debt ratios reached a record high in 2020. These are expected to climb further in some countries in 2021[1]. Despite the deterioration of fiscal positions and a severe collapse in the economies, financial markets have held up well thanks mainly to liquidity injections by major central banks around the world. The supportive financial conditions have enabled governments to concentrate on fighting against the pandemic. On the other hand, once the covid-19 pandemic fades, market pressure demanding fiscal sustainability might resurface in the future. Policymakers should be vigilant about fiscal risk and may need to start paying attention to medium-term strategies to restore fiscal soundness.

A government emphasizing disciplinary fiscal policy would be expected to secure sufficient

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[¶] The author is currently enrolled in the Ph.D. program at the Graduate School of Economics of Hosei University.
[1] The IMF projects the public debt of advanced countries to reach 122.5 percent of GDP at end-2021 (IMF, July 2021).

fiscal space either with measures to increase revenues or slush expenditures in the future to pay for current government liabilities. In such a fiscal regime, primary balances are likely to react to public debt and ensure long-term fiscal sustainability. The existing literature confirms the positive relationship between the primary balance and public debt (Me'litz, 1997; Favero, 2002; Afonso, 2008). On the other hand, the political economic theories argue that budgets are the result of a political process of budgeting that appears to be suffering from deficit bias[2]. A strand of literature reports the importance of budgetary institutions in mitigating deficit bias[3]. Indeed, to address deficit bias and pursue sustainable government finance, governments across the world have tried to invent or adopt frameworks to strengthen budgetary institutions, including fiscal rules. Fiscal rules are an institutional framework to impose a permanent quantitative constraint on fiscal policy. First adopted in advanced countries, they have also gained popularity among governments in emerging economies. Empirical literature generally confirms that institutionary strong fiscal rules tend to facilitate fiscal discipline and counter-cyclical fiscal policy (e.g., Debrun et al., 2008; Nerlich and Reute, 2013; Bergman et al., 2016).

Although disciplinary effects of fiscal rules and public debt are well established, the existing literature examines the response of fiscal policy to those two determinants independently. However, well-designed fiscal rules may allow governments to decide their fiscal policy independently from the level of public debt. In other words, the primary balance may not respond to public debt, but to the fiscal rules. As long as the fiscal rules work effectively, fiscal authorities could pursue a policy to reduce primary deficit. Therefore, lower responsiveness of primary balance to public debt would not undermine long-term fiscal sustainability. Furthermore, as high public debt is likely to cause fiscal policy to shift toward the pro-cyclical (Combes et al, 2017), reducing the influence of public debt in formulating budgets would be consistent with the argument that fiscal policy should be counter-cyclical.

With this consideration, in contrast to previous studies, we investigate how public debt and fiscal rules jointly influence fiscal policy measured by the cyclically adjusted primary balance. More precisely, we test the hypothesis that a stricter fiscal rule would abate the positive response of fiscal policy to public debt. For this evaluation, we employ a dynamic panel model for 28 member countries of the Organization of Economic Cooperation and Development (OECD) over the period from 1985 to 2015. The dataset covering pre- and post-Lehman periods allows us to incorporate the effect of fiscal governance reform in the EU into the analysis. Our source of underlying data on fiscal rules is the IMF Fiscal Rules Dataset 1985-2015. The dataset includes descriptions of the design of fiscal rules and information about the types and characteristics of rules.

Our empirical evidence suggests that a cyclically adjusted primary balance tends to respond to public debt positively, while cyclically adjusted primary expenditures do negatively. Those relationships would exist as long as fiscal rules are not in place or are not institutionally strong. With strong fiscal rules, the positive relationship between public debt and fiscal policy is likely to become weaker or even disappear. At the same time, fiscal rules exert significant disciplinary effects. On the other hand, fiscal rules do seem not to function effectively when the level of public debt is high, while higher public debt is less likely to contribute to improving fiscal positions even under stricter fiscal rules. Thus, adopting better budgetary institutions represented by fiscal rules is necessary but

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[2] A prevailing argument on the cause of deficit bias is the so-called common pool problem. Individual politicians or political parties have an incentive to increase specific spending to dispense favors to constituencies and win elections. As financing sources of this spending will be revenues raised through taxation, their constituencies bear only a fraction of the total costs. The mismatch between public service beneficiaries and bearers of the expense results in deficit bias (Velasco 2000, Weingast et al. 1981).

[3] Budgetary institutions are defined as the formal and informal rules governing the budgetary process (Hallerberg et al., 2009).

not sufficient for fiscal sustainability. Governments need to lower public debt to a certain level in order to ensure the disciplinary effects of the fiscal rules and public debt itself.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. In section 3, we present our empirical approach. Section 4 describes details of the data. Section 5 looks through and discusses the estimation results. In section 6, we conclude our findings with a possible direction for future work.

2. Literature review

Our study is related to research that focuses on the fiscal policy response to public debt. The pioneering research by Bohn (1998) confirms for the U.S. that the primary surplus is an increasing function of the public debt-to-GDP ratio in the U.S. This finding is also confirmed for France, Germany, Italy, and Spain by Favero (2002), who employs structural models to examine the effects of monetary and fiscal policies on macroeconomic variables. Additional supportive evidence is reported by Mulas-Grandos (2003) for the EU member countries and Tujula and Wolswijk (2007) for the OECD countries. Afonso (2008) also shows for the EU member countries that the positive response of the primary balance to public debt or the existence of Ricardian fiscal regimes hold for pre- and post-Maastricht, and pre- and post-Stabilty and Growth Pact period.

Our research is also related to studies that analyze the effects of fiscal rules on fiscal policy. A fiscal rule is defined as a permanent constraint on fiscal policy, typically setting a numerical target referring to an indicator of overall fiscal performance (Kopits & Symanski, 1998). The main aim is, in general, to control deficit bias existing in the decision-making process to formulate a government budget. According to Shaechter et al. (2012), there are four types of rules—budget balance rules, expenditure rules, debt rules, and revenue rules, and each type of rule has its strong and weak points.

Budget balance rules, which typically specify a target on budget balance as a share of GDP, provide clear guidance and support fiscal authorities in ensuring debt sustainability. However, the rules defined as overall balance or not cyclically adjusted variables do not stabilize economies' cyclical movements but are likely to make fiscal policy pro-cyclical. Expenditure rules, which are typically set in absolute terms, a share of GDP, or growth rates, prove clear operational guidance for fiscal policy. They can also contribute to controlling fiscal balance or public debt when accompanied by budget balance or debt rules. Furthermore, expenditure rules foster counter-cyclical fiscal policy by excluding certain cyclical-sensitive expenditure items such as unemployment support. Debt rules, in general, set a ceiling for public debt as a share of GDP. While the rules have an advantage in being relatively easy to communicate and monitor, their weak point is that the response of debt-to-GDP ratio to fiscal policy is slow. Furthermore, when debt is well below its ceiling, the rule would not provide any binding guidance. Revenue rules, in general, aim at enhancing tax revenues or preventing an excessive tax burden. Unless rules restrict the use of windfall revenue for additional spending, they do not contribute to ensuring fiscal sustainability.

An early empirical study by Poterba (1994) indicates a positive correlation between restrictive fiscal rules and rapid adjustments to unexpected deficits for state governments in the United States. Also, for the United States, Inman (1996) points out that an effective balanced budget rule must be stipulated in the constitution, enforced by a politically independent council, and costly to amend. Among studies focusing on the Economic and Monetary Union (EMU), fiscal rules covering broader government sectors are likely to improve primary fiscal balance (Debrun et al., 2008). Afonso and Hauptmier (2009) is interesting in the context of our article. Like us, they interact public debt with a fiscal rule index to examine their effects on the primary balance, although they focus only on the effects of the public debt-to-GDP ratio on the relationships between fiscal rules and primary balance.

Moreover, their studies relate to EU member countries, not OECD member countries. Bergman et al. (2016) point out that the effectiveness of fiscal rules in reducing the pro-cyclicality of fiscal policy depends on government effectiveness.

Among fiscal rules, balanced budget rules and debt rules are the most effective. The independent fiscal councils and medium-term fiscal frameworks may help strengthen the function of fiscal rules (Nerlich and Reute, 2013). On the other hand, there is empirical evidence that expenditure rules can limit expenditure bias to some extent, especially when there are revenue shortfalls (Wierts, 2008). In the context of the business cycle and fiscal policy, fiscal rules tend to reduce fiscal pro-cyclicality in both advanced and emerging economies (Manasse, 2006; Ayuso-i-casals et al., 2009). Expenditure policy tends to be subject to a pro-cyclical bias, and strictly enforced expenditure rules may mitigate this tendency (Holm-Hadulla et al., 2012). On the other hand, the use of cyclically adjusted targets, well-defined escape clauses, and strict legal and enforcement arrangements may be essential to mitigate the pro-cyclicality of policy, especially in developing countries (Bova et al., 2014; Guergiul et al., 2017).

3.   Empirical Approach

To analyze whether and how fiscal rules affect the relationship between fiscal policy and public debt, we consider the following dynamic panel model:

$$Fiscal_{it} = \beta_0 + \beta_1 Fiscal_{it-1} + \beta_2 Public\ Debt_{it-1} + \beta_3 Fiscal\ rule_{it} + X'_{it}\theta + \alpha_i \quad (1)$$
$$+ \varepsilon_{it}$$

where F is our fiscal policy variable for country i and year t[4]. The cyclically adjusted fiscal variables capture the discretionary fiscal policy or the fiscal stance. α_i measures the unobserved country effects and ε_{it} is the error term[5]. The model includes a lagged dependent variable F_{it-1} to account for the possible autocorrelation of fiscal policy that results from a gradual adjustment to a fiscal target or just from the serial correlation in the exogenous shocks. $Public\ debt_{it-1}$ is the public debt-to-GDP ratio of the previous year. The coefficient β_2 indicates a discretionary fiscal policy response to the previous year's public debt. If β_2 is significantly positive, fiscal authorities try to reduce the primary deficit or increase the primary surplus in order to stabilize the public debt-to-GDP ratio. $Fiscal\ rule_{it}$ is the numerical fiscal rule index. X_{it} is a vector of control variables. We discuss details of dependent and independent variables in the next section.

To examine the interaction effect of fiscal rules, we estimate the following model, which includes the interaction term between public debt and fiscal rule index:

$$F_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 Public\ debt_{it-1} + \beta_3 Fical\ rule_{it} \quad (2)$$
$$+ \beta_4 (Public\ debt_{it-1} \times Fiscal\ rule_{it}) + X'_{it}\theta + \alpha_i + \varepsilon_{it}$$

$Public\ debt_{it-1} \times Fiscal\ rule_{it}$ is the interaction term. $\beta_2 + \beta_4 Fiscal\ rule_{it}$ is the marginal effect of public debt on fiscal policy for any given level of fiscal rule index.

The presence of a lagged dependent variable implies that the within estimator with fixed effect OLS creates biased and inconsistent estimates due to the correlation between the regressor and the

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[4] Holm-Hadulla et al. (2012) and Bergman et al. (2016), for example, estimate similar regression equations.

[5] In terms of model specification, a Hausman test suggests that regressors correlate with error terms. Therefore, the equation needs to be estimated with a fixed effect model instead of a random effect model.

centered lagged error term. Furthermore, as Celasun and Kang (2006) and Golineli and Momigliano (2009) suggest, we need to consider and instrument the likely endogeneity issue of some regressors such as the output gap. Following their arguments, we use Blundell and Bond (1998) system GMM. The system GMM estimator uses a subset of the internal instruments to handle the bias caused by dynamic panel specification. Assuming in our model that the lagged dependent variable and the cyclical variable are endogenous, and the lagged debt is weakly exogenous, we include these variables as a GMM-style instrument.

Another statistical issue related to performing the system GMM methods is that the number of instruments is quadratic in T. A large number of instruments may overfit endogenous variables and weaken the Hansen test of the instrument's joint validity (Roodman, 2009a). Roodman (2009b) recommends restricting the lag length used in generating these instrument sets or collapsing them by having different moments for each lag instead of each lag and time period. We use the Stata command xtabond2 written by Roodman (2009b) and apply both methods in estimating our equation.

4. Data

4.1. Dependent variables

We use a yearly unbalanced panel data set of 28 OECD countries covering a maximum period of 1985 to 2015[6]. The dependent variables are the cyclically adjusted primary balance, cyclically adjusted primary expenditures, and cyclically adjusted primary revenues (hereinafter, the primary balance, primary expenditures, and primary revenues, respectively). All three variables are measured as a percentage of GDP. The cyclically adjusted variables indicate the fiscal stance in a given year. All variables are taken from the OECD Public Finance Dataset, which provides a detailed breakdown of public expenditure and revenues for OECD member countries[7].

4.2 Fiscal rules

The primary explanatory variable in this study is the fiscal rule index. The fiscal rule data are collected from the Fiscal Rules Dataset 1985-2015 provided by the IMF Fiscal Affairs Department. The dataset covers four types of rules—budget balance rules, expenditure rules, debt rules, and revenue rules. It also provides details on characteristics of rules, including their legal basis, coverage of government sectors, and enforcement procedures, taking stock of key supporting features that are in place, such as multi-year expenditure ceilings, fiscal responsibility law, as well as independent bodies responsible for setting budget assumptions and monitoring budget implementation. Following the procedure proposed by Schaechter et al. (2012), we add up the scores of those characteristics and supporting features, normalizing the resulting fiscal rule index to have theoretical lower and upper limits of 0 and 5. The higher the index, the stronger the fiscal rule is. In order to examine the effects of each fiscal rule, we also construct the balanced budget rule index, the expenditure rule index, and the debt rule index using a similar methodology to that applied in constructing the fiscal rule index.

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[6] Countries in the sample are Australia, Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and the United States.
[7] The dataset is available at https://www.oecd.org/economy/public-finance/oecd-public-finance-dataset.htm. Bloch et al. (2016) elaborate technical details concerning the construction of the dataset.
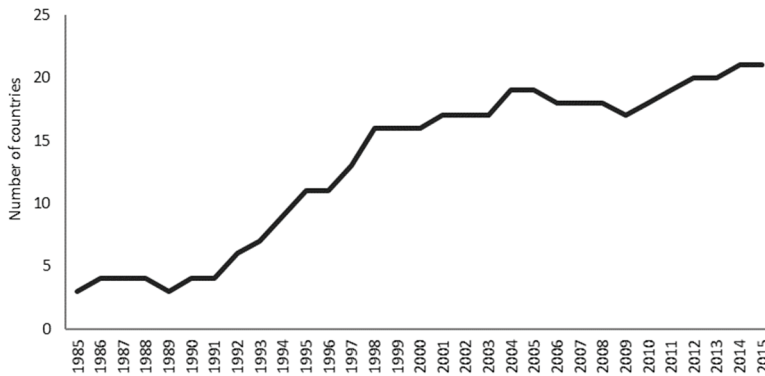
Figure 1   Number of countries adopting fiscal rules

Figure 1 shows the time series trends of the number of countries adopting the fiscal rule. While only three countries, Australia, Germany, and Japan, had some types of fiscal rules in 1985, the number reached 21 in 2015. Figure 2 presents a breakdown of the fiscal rule index for respective countries as of 2015. The index is zero for Canada, Hungary, and Iceland, as those countries did not implement fiscal rules in 2015. The value of the index reaches a maximum for the Netherlands, followed by Spain and Denmark. Most of the countries implement several types of fiscal rules. The type of rule most widely used in the sample countries is the balanced budget rule. As seen in section 2, budget balance rules are likely to lead to pro-cyclical fiscal policy when aiming at headline budget balance. To overcome this problem, some countries employ a cyclically adjusted budget balance or structural fiscal balance as a fiscal policy target[8].
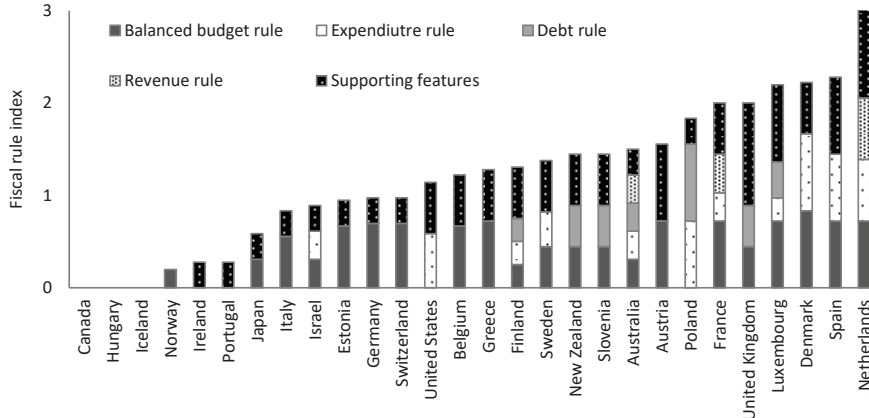

Figure 2   Types of fiscal rules adopted as of 2015

4.3 Public debts and other control variables

Following the literature on determinants of fiscal deficit, we employ control variables concerning i) fiscal and economic situations, ii) politics, and iii) others. Among the fiscal and economic variables, the first variable is the government indebtedness measured by public debt as a percentage of GDP

[8] Australia, Denmark, Finland, Germany, Norway, Spain, Sweden, Switzerland, and the U.K. adopted structural fiscal balance as a fiscal policy target in the 1990s or 2000s. In the EU, the treaty on Stability, Coordination and Governance in the Economic and Monetary Union (TSCG), which entered into force on 1 January 2013, provides the requirement that the euro area countries have a structural budget balance rule in domestic legal orders. The enforcement of the TSCG accelerated adoption of a structural balance target across the euro area countries.

(hereinafter, public debt). The variable is in the estimation to account for the considerations of fiscal authorities to ensure fiscal stability and sustainability. High public debt is expected to increase the primary balance. The lagged variable is in the estimation, as policymakers would refer to the public debt figure in the previous year to formulate a budget. The second variable is the output gap to capture the business cycle, measured as the difference between real GDP and potential GDP. The coefficient indicates the cyclical behavior of fiscal policy, which is found to be counter-cyclical if the coefficient is statistically significant and has a negative sign, pro-cyclical if it is positively significant, and a-cyclical otherwise. The third variable is the rate of consumer price inflation. The variable is in the model to capture its influence on fiscal balance via several channels. High inflation exerts upward pressure on government receipts and expenditures through nominal progression in tax rates and tax brackets and via price-indexation. Higher inflation can also affect government fiscal policy through possible impacts on economic growth via erosion of cost competitiveness (Tujula & Wolswijk, 2004). We also include the natural logarithm of the population as there might be economies of scale in public services. The old age dependency ratio, the percentage of population aged above 64 to the total population, is also in the model to capture the effects of aging on government expenditures or revenues. All economic and fiscal variables are collected from the OECD Economic Outlook 2020.

The political variables are in the model to control for impacts of political characteristics on fiscal policy and outcomes in each sample country. We use the fragmentation of government measured as the sum of the squared seat shares of all parties in the government. Various studies report evidence that political fragmentation within governments may lead to fiscal deficits. To account for election cycles in government expenditures, revenues, or budget deficits, we use the number of years remaining in the current term and an election year dummy variable equal to one for the year of the parliamentary election. These variables are taken from the World Bank Database of Political Institutions.

We also include two additional dummy variables. One is the euro dummy, which equals one if a country is a member of the EMU and zero if not. The countries in the EMU are strictly subject to the EU-wide fiscal governance framework, and thus their fiscal policy is less flexible than the non-member countries. Another dummy variable is the crisis dummy, which is equal to one if a country faces a financial crisis[9]. The descriptive statistics of all variables are presented in Table 1.

Table 1   Descriptive statistics

	Mean	Obs.	Max	Min	Std. Div.
Cyclically adjusted primary balance	0.0	760	7.4	-27.7	3.2
Cyclically adjusted primary expenditures	41.9	759	63.8	26.6	6.7
Cyclically adjusted primary revenues	41.9	728	58.4	25.4	7.1
Public debt-to-GDP	69.9	736	217.9	6.7	36.5
Fiscal rule index	0.6	839	3.2	0.0	0.6
Output gap	-0.6	771	12.6	-16.5	3.3
Log population	16.3	839	19.6	12.4	1.6
Change of old age dependecy ratio	0.3	811	2.0	-0.7	0.3
Inflation	3.8	839	48.0	-4.5	5.2
Government fragmentation	0.7	839	1.0	0.2	0.3
Years left in current term	1.7	839	4.0	0.0	1.2
Election year	0.3	839	1.0	0.0	0.5
Crisis	0.1	839	1.0	0.0	0.3
Euro area	0.3	839	1.0	0.0	0.4

Source: Compiled by author from public sources.

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[9]   We follow crisis episode data compiled by Laeven and Valencia (2018).

4.4 Unit root tests

In this section, we present the unit root test results of our variables to examine whether the series is stationary or not. Given that the panel data is unbalanced, the ADF panel unit root test proposed by Im et al. (2003), namely the IPS, and Fisher-type test suggested by Maddala and Wu (1999) and Choi (2001) are applied. The test results are shown in Table 2. The results reveal that, except for the old age dependency ratio, the null unit root hypothesis can be rejected at the 10 percent level for all or most cases. Therefore, we consider those dependent and explanatory variables as stationary. Based on the test result, the old age dependency ratio is in the model with first differences.

Table 2   Unit root tests (p values)

Variable	IPS		Fisher, ADF		Fisher, PP	
	No trend	Trend	No trend	Trend	No trend	Trend
Cyclically adjusted primary balance	0.000	0.001	0.013	0.074	0.000	0.004
Cyclically adjusted primary expenditures	0.005	0.002	0.105	0.038	0.000	0.001
Cyclically adjusted primary revenues	0.016	0.001	0.009	0.078	0.004	0.001
Public debt	0.754	0.055	0.080	0.035	1.000	0.999
Output gap	0.000	0.000	0.000	0.000	0.091	0.969
Inflation	0.000	0.000	0.000	0.001	0.000	0.000
Log of population	0.016	0.000	0.010	0.000	0.001	0.000
Old age dependency ratio	0.960	0.623	0.034	0.208	0.710	1.000
Government fragmentation	0.000	0.116	0.036	0.454	0.000	0.011
Years left in current term	0.000	0.000	0.000	0.000	0.000	0.000
Fiscal rule index	Not tested					
Election dummy	Not tested					
Euro area dummy	Not tested					
Crisis dummy	Not tested					

Note: The null hypothesis is that all panels have unit roots. The test results were obtained by using the xtunitroot command of Stata. All the tests subtract the mean of the series across panels to mitigate the impact of cross-sectional dependence.
Source: Estimations by author.

5   Empirical results

5.1. Baseline

Table 3 reports fixed effects system GMM estimates for the primary balance. The consistency of the system GMM estimator depends on the validity of the instruments. We conduct two specification tests. The first is a Hansen J-test of over-identifying restrictions, which tests the joint validity of the instruments. The test results indicate that we cannot reject the null hypothesis that instrumental variables are exogenous for all estimate results. The second test examines the serial correlation in the error term. The Arellano-Bond test for AR(1) confirms the presence of the first-order autocorrelation in the differenced residuals. In contrast, the Arellano-Bond test for AR(2) indicates no second-order serial correlation in the differenced error terms. These test results confirm the appropriateness of the estimator.

Columns 1 of Table 3 are the regression results of Equation 1, suggesting that the primary balance positively responds to public debt and fiscal rule index. The coefficients are statistically significant at the 1 percent levels, respectively. The coefficient of public debt suggests that a 10-percentage point increase in government indebtedness drives up the primary balance by about 0.4 percentage points of GDP. A move from the lowest level debt burden to the highest level would

reduce the size of discretionary fiscal policy by about 8 percentage points of GDP. Furthermore, a one standard deviation increase in public debt leads to an additional 1 percentage point of GDP change on the primary balance. On the other hand, the positive coefficient of the fiscal rule index confirms that fiscal rules also have a disciplinary effect on fiscal policy. A one-point increase in the index drives up the balance by about 0.6 percentage points of GDP. The regression result predicts that a move from the lowest index level, which is zero, to the highest results in an additional improvement of the primary balance by about 2 percentage points of GDP. A one standard deviation change in the index predicts that the primary balance will increase by about 0.4 percentage points of GDP.

Regarding the control variables in column 1, all the economic variables have signs of coefficients, as we expected. The output gap is negatively related to the primary balance but insignificant. An increase in the output gap associated with a decline in the primary balance implies that fiscal policy tends to be pro-cyclical. A large population and a rise in dependency ratio are likely to worsen the primary balance. Higher inflation has a positive but insignificant effect on the primary balance. In the meantime, none of the political variables is statistically significant. The primary balance tends to improve with a larger number of years remaining in the current term. These results are consistent with a political business cycle theory that expects governments to carry out expansionary fiscal policy close to elections. Against our expectation from the common pool theory, the estimation results suggest that the more a government is fragmented, the more the primary balance tends to improve. The crisis dummy variable is negatively significant at the 1 percent level, implying that the primary surplus shrinks or the deficit widens during crisis periods. Finally, the negative coefficient of the euro area dummy indicates that a country in the EMU is likely to pursue an expansionary fiscal policy.

To capture the interaction effect between public debt and fiscal rule index, we estimate Equation 2, which includes an interaction term of those variables (column 2). The interaction term (lagged public debt $\times$ fiscal rule index) is statistically significant at the 1 percent level. A negative sign of the coefficient associated with the interaction term suggests that a strengthening of fiscal rules is likely to reduce the positive response of the primary balance to public debt. The marginal effect of public debt on the primary balance conditional on the fiscal rule index is represented by $0.060 - 0.035 \times$ Fiscal Rule Index. The coefficient of public debt, 0.060, shows the marginal effect when the value of the fiscal rule index is equal to zero. It is almost 1.5 times larger than that without the interaction term, indicating that the impact of public debt on fiscal policy is pronounced for governments with no fiscal rule.

This study is interested in interaction effects varying according to a range of condition variables, i.e., the fiscal rule index. Therefore, we try to identify this relationship by drawing marginal effects and confidence bounds of the estimation results following the procedure proposed by Brambor et al. (2006). Sub-figure (a) in Figure 3 reports the marginal effect corresponding to the minimum and maximum values of the fiscal rule index. The negative slope suggests that a more outstanding public debt-to-GDP improves the cyclically adjusted primary balance. At the same time, the effect tends to weaken as the fiscal index becomes stricter. The confidence bounds indicate that the marginal effect of public debt is statistically significant at the 5 percent level if the fiscal rule index is no higher than 1.5. Once the index is above this threshold, the marginal effect turns to be negative and statistically insignificant. Sub-figure (a) also presents a histogram describing the distribution of the fiscal rule index in our sample. It shows that there are fewer observations at higher levels of the fiscal rule index. Indeed, most countries fall somewhere between 0 and 2.0.

Table 3   Regression for the cyclically adjusted primary balance

Dependent variable	(1)	(2)
	Cyclically adjusted primary balance	
Public debt (t-1)	0.036***	0.060***
	(0.013)	(0.016)
Fiscal rule index	0.595***	3.119***
	(0.188)	(0.742)
Public debt (t-1) * Fiscal rule index		-0.035***
		(0.011)
Dependent variable (t-1)	0.629***	0.640***
	(0.063)	(0.064)
Output gap	-0.060	-0.089*
	(0.061)	(0.052)
Log population	-0.396***	-0.370***
	(0.121)	(0.102)
Change of old age dependecy ratio	-1.318**	-1.526***
	(0.578)	(0.497)
Inflation	0.107	0.138*
	(0.081)	(0.079)
Government fragmentation	0.192	0.053
	(0.591)	(0.668)
Years left in current term	0.011	-0.028
	(0.078)	(0.085)
Election year	-0.113	-0.231
	(0.200)	(0.213)
Crisis	-1.263***	-1.371***
	(0.366)	(0.386)
Euro area	-0.447	-0.486
	(0.328)	(0.342)
Constant	3.873**	1.850
	(1.563)	(1.524)
Observations	687	687
Number of countries	28	28
AR(1)	0.004	0.003
AR(2)	0.365	0.252
Number of instruments	22	23
Hansen's J	0.371	0.253

Note: The dependent variable is a cyclically adjusted primary balance. AR(1) and AR(2) are tests of autocorrelation of the first and second order. Hansen's J is a test for over-identifications. Tests for autocorrelation and over-identification report p-values. Figures in parentheses are robust standard errors. *** indicates $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: Estimations by author.

The interaction term in Equation (2) also allows us to evaluate the marginal effect of fiscal rules at different values of public debt-to-GDP. Sub-figure (b) confirms our expectations that the fiscal rule index exerts a significantly positive effect. However, the negative slope indicates that the effect declines along with an increase in public debt and becomes insignificant when public debt is above 75%, which is slightly higher than the sample mean. Fiscal rules positively impact the primary balance for more than half of the public debt values in our sample. The insignificant marginal effects of the fiscal rule index at high values of public debt align with the view that a combination of strong fiscal rules and lower debt ratios would be a good strategy for pursuing a sound fiscal policy, as suggested by Afonso and Hauptmeire (2009).
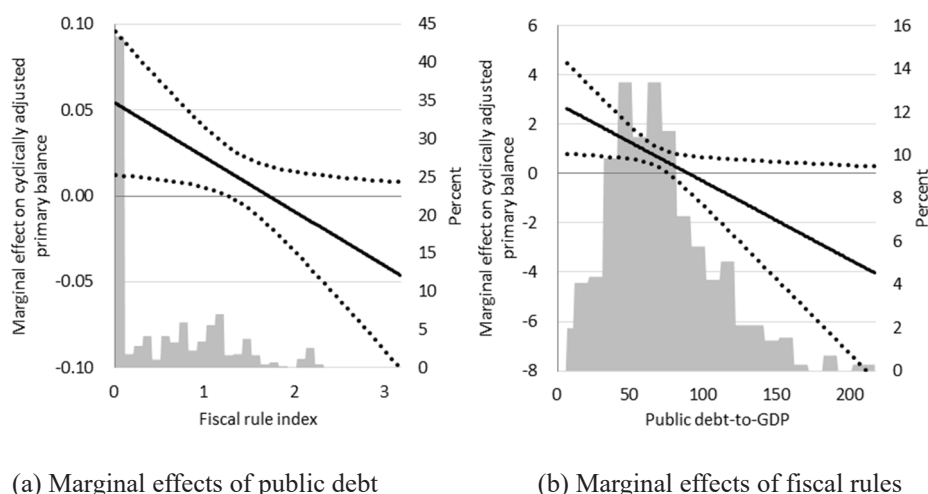
(a) Marginal effects of public debt   (b) Marginal effects of fiscal rules
Figure 3   Marginal effects on the cyclically adjusted primacy balance

5.2. Primary expenditures and revenues

This section uses alternative dependent variables—cyclically adjusted primary expenditures and cyclically adjusted primary revenues. Column 1 in Table 4 confirms that public debt and fiscal rule index negatively affect primary expenditures. The negative coefficients indicate that increasing public debt or strengthening fiscal rules tend to reduce the primary expenditures. However, they fail to reject the null hypothesis at the 10 percent level. The t-statistics of about 1.6 for public debt and 1.5 for the fiscal rule index imply milder effects on the primary expenditures. On the other hand, column 2, with the primary revenues, reveals that public debt and fiscal rule index also have negative coefficients, although neither are statistically significant.

The estimate with an interaction term for the primary expenditures (column 3) shows that public debt and fiscal rule index are now significant. The higher coefficient of public debt with rather than without the interaction term suggests that the effects of public debt in reducing primary expenditures are strong when governments have no fiscal rules to control fiscal policy. With the positively significant coefficient of the interaction term, the effects of public debt become small with strong fiscal rules. Sub-figure (a) of Figure 4 on the marginal effects confirms the above findings. The insignificance of public debt with a fiscal rule index higher than 0.55 implies that the government could control expenditure policy through fiscal rules when well-designed and strict fiscal rules are in place. The marginal effects of fiscal rules at different public debt values also confirm that the fiscal rules are effective as long as public debt is below a certain level, which, in our sample, is 66 percent of GDP. On the other hand, the estimation for the primary revenues does not show a meaningful result. Figure 5 also confirms these results.

Table 4   Regressions for the cyclically adjusted primary expenditures and cyclically adjusted primary revenues

Dependent variables	(1) Cyclically adjusted primary expenditures	(2) Cyclically adjusted primary expenditures	(3) Cyclically adjusted primary revenues	(4) Cyclically adjusted primary revenues
Public debt (t-1)	-0.046	-0.082**	-0.002	-0.007
	(0.028)	(0.032)	(0.017)	(0.021)
Fiscal rule index	-0.680	-5.328***	-0.111	-0.925
	(0.441)	(1.597)	(0.199)	(1.214)
Public debt (t-1) * Fiscal rule index		0.066***		0.012
		(0.023)		(0.017)
Dependent variable (t-1)	0.524***	0.548***	0.796***	0.798***
	(0.109)	(0.098)	(0.129)	(0.135)
Output gap	-0.234**	-0.156*	-0.144***	-0.129**
	(0.104)	(0.088)	(0.051)	(0.054)
Log population	0.090	-0.012	-0.242	-0.278
	(0.427)	(0.314)	(0.333)	(0.278)
Change of old age dependecy ratio	1.279	1.467	0.079	0.084
	(1.136)	(0.995)	(0.696)	(0.624)
Inflation	-0.097	-0.148	-0.006	-0.013
	(0.099)	(0.105)	(0.070)	(0.073)
Government fragmentation	-2.641	-2.177	-0.844	-0.750
	(1.795)	(1.741)	(0.877)	(0.846)
Years left in current term	0.005	0.072	0.064	0.078
	(0.091)	(0.098)	(0.087)	(0.084)
Election year	-0.148	0.068	-0.151	-0.107
	(0.296)	(0.290)	(0.228)	(0.217)
Crisis	1.526**	1.769***	0.678*	0.732*
	(0.593)	(0.555)	(0.367)	(0.398)
Euro area	1.867**	1.752*	0.468	0.430
	(0.899)	(0.910)	(0.444)	(0.519)
Constant	22.948***	25.942***	13.063	13.887
	(7.156)	(6.041)	(9.210)	(9.639)
Observations	687	687	670	670
Number of countries	28	28	27	27
AR(1)	0.002	0.003	0.000	0.000
AR(2)	0.193	0.143	0.013	0.013
Number of instruments	24	25	22	23
Hansen's J	0.154	0.148	0.215	0.195

Note: AR(1) and AR(2) are tests of autocorrelation of the first and second order. Hansen's J is a test for over-identifications. Tests for autocorrelation and over-identification report p-values. Figures in parentheses are robust standard errors. *** indicates $p<0.01$, ** $p<0.05$, * $p<0.1$.
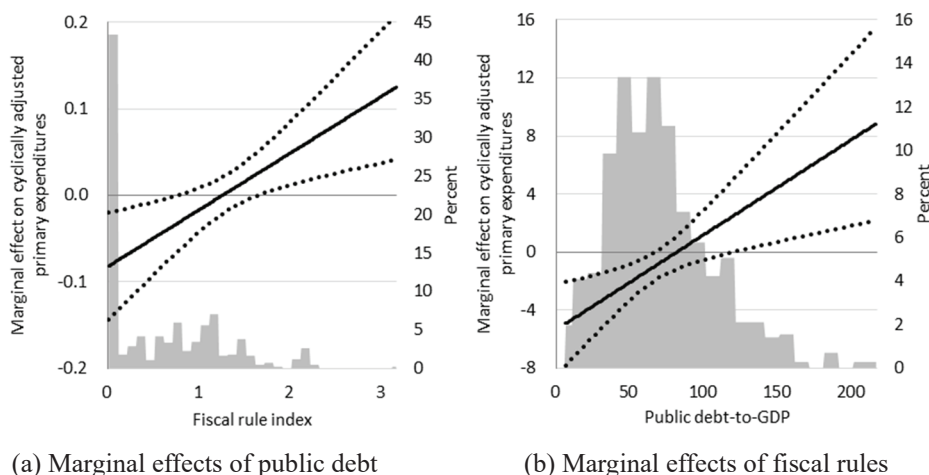Source: Estimations by author.

(a) Marginal effects of public debt (b) Marginal effects of fiscal rules

Figure 4 Marginal effects on the cyclically adjusted primary expenditures

(a) Marginal effects of public debt (b) Marginal effects of fiscal rules
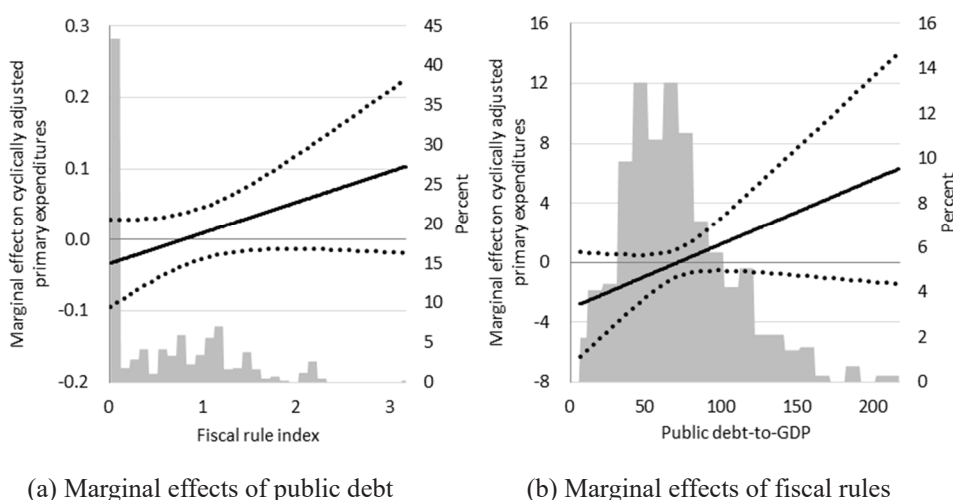
Figure 5 Marginal effects on the cyclically adjusted primary revenues

5.3. Extensions

5.3.1 Non-linear effects of public debt

The first set of extensions deals with a possible heterogeneous relationship between fiscal policy and public debt. The effect of public debt on the primary balance or primary expenditures and interaction effects of fiscal rules may not be linear. The effect may differ along with the level of public debt[10]. To examine these arguments, we introduce the squared public debt into the estimation model to capture possible non-linear effects of government indebtedness on fiscal policy. The estimation results are reported in Table 5. Column 1 confirms the non-linear effects for the primary balance. The negatively significant effects of the squared public debt imply that higher public debt

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[10] Our analysis in the following section focuses on the cyclically adjusted primary balance and primary expenditures, as the fiscal rules do not significantly affect the cyclically adjusted primary revenues.

tends to worsen the primary balance. The coefficient of the squared public debt means that the marginal effect of public debt turns negative only when the level exceeds 238 percent of GDP. A similar result is also confirmed for the primary expenditures (column 3). In both estimations, the response of the fiscal rule index is equivalent to the baseline.

Columns 2 and 4 show the estimation results when introducing the interaction term between public debt and fiscal rule and between the squared public debt and fiscal rule index. Both interaction terms are statistically significant and have opposite signs. The marginal effect of public debt depends on the fiscal rule index and public debt itself[11]. Therefore, we illustrate how the response of primary balance varies according to the fiscal rule index for three levels of public debt—the average of the quintile with low indebtedness (public debt=34% of GDP), the average of the quintile with medium indebtedness (public debt=65% of GDP), and the average of the quintile with high indebtedness (public debt=110% of GDP). Figure 6 shows the marginal effects on the primary balance. The graphs again indicate that increasing the strength of fiscal rules tends to reduce the response of the primary balance to public debt. However, for countries with higher government debt in Sub-figure (c), strict fiscal rules are likely to strengthen the positive marginal effects, although the confidence bands suggest the effects are mostly insignificant. Figure 7 shows that the marginal effect on the primary expenditures also has a similar function to the fiscal rules[12]. The estimation result in this section implies that even if the government adopts institutionally strong fiscal rules, disciplinary fiscal policy may not be warranted as long as public debt remains at a high level. Fiscal authorities need to keep public debt in check in order to ensure a disciplinary fiscal policy.

Table 5   Regressions with the squared public debt

Dependent variables	(1) Cyclically adjusted primary balance	(2) Cyclically adjusted primary balance	(3) Cyclically adjusted primary expenditures	(4) Cyclically adjusted primary expenditures
Public debt (t-1)	0.108***	0.164**	-0.125**	-0.334**
	(0.037)	(0.073)	(0.054)	(0.131)
Public debt^2 (t-1)	-0.000**	-0.001*	0.000**	0.002**
	(0.000)	(0.000)	(0.000)	(0.001)
Fiscal rule index	0.591**	5.580**	-0.768	-15.307***
	(0.223)	(2.382)	(0.517)	(5.382)
Public debt (t-1) * Fiscal rule index		-0.135*		0.352**
		(0.066)		(0.141)
Public debt^2 (t-1) * Fiscal rule index		0.001*		-0.002**
		(0.000)		(0.001)
Observations	687	687	687	687
Number of countries	28	28	28	28
AR(1)	0.004	0.005	0.003	0.009
AR(2)	0.401	0.271	0.214	0.149
Number of instruments	26	28	28	30
Hansen's J	0.412	0.149	0.0843	0.101

Note: All explanatory variables and a constant term are included but not shown here for brevity. AR(1) and AR(2) are tests of autocorrelation of the first and second order. Hansen's J is a test for over-identifications. Tests for autocorrelation and over-identification report p-values. Figures in parentheses are robust standard errors. *** indicates p<0.01, ** p<0.05, * p<0.1.
Source: Estimations by author.

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[11] The marginal effect is represented by $\beta_1 + \beta_3 Pulcib\ deb_{it-1} + \beta_4 Fiscal\ rules_{it} + \beta_5 Pulcib\ deb_{it-1} \times Fiscal\ rules_{it}$.

[12] Although we do not present graphs of the marginal effects of fiscal rules conditional upon public debt, these also support our findings in the baseline estimation.
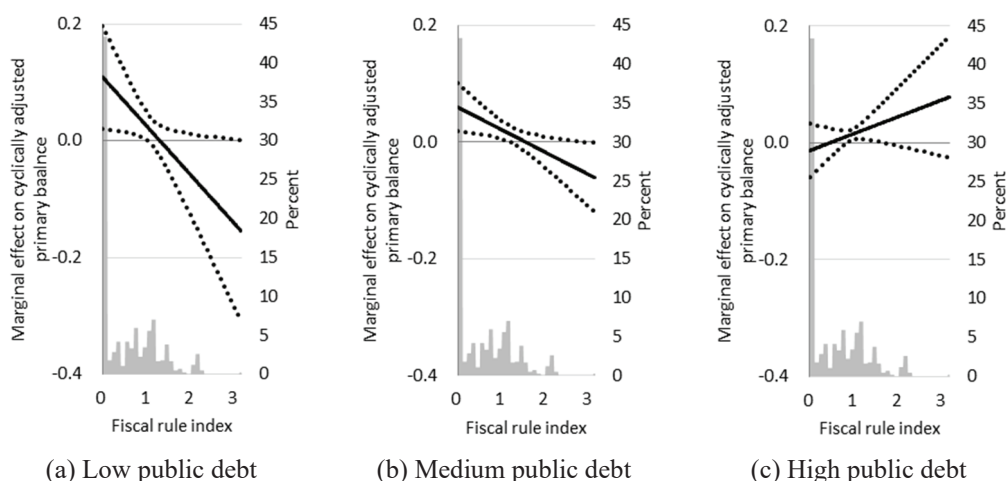
(a) Low public debt   (b) Medium public debt   (c) High public debt

Figure 6 Marginal effects on the cyclically adjusted primary balance for different levels of public debt

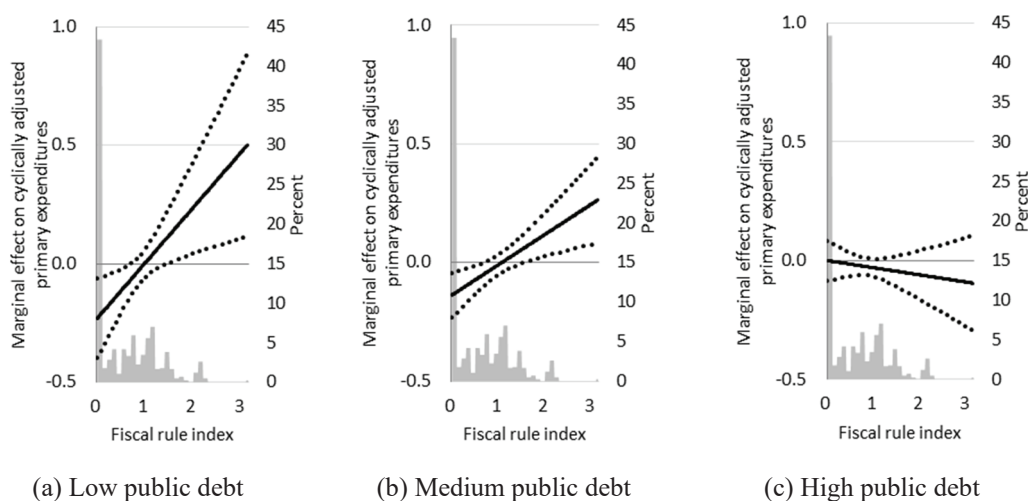(a) Low public debt   (b) Medium public debt   (c) High public debt

Figure 7 Marginal effects on the cyclically adjusted primary expenditures for different levels of public debt

5.3.2 Breakdown of the fiscal rule index

The second set of extensions is to break down the fiscal rule index into each type of rule. To understand what type of rules influences the link between the fiscal policy variables and public debt, we replace the fiscal rule index, which is an aggregate index, with three types of rule indices—the balanced budget rule index, expenditure rule index, debt rule index[13].

Table 6 indicates the regression results of Equation 2 with the three indices, respectively. While the signs of public debt, each type of fiscal rules, and their interaction terms are the same as those

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[13] We do not estimate using the revenue rule index as the revenue rules are not always designed to contribute to maintaining fiscal sustainability.

in the baseline estimation, the effects of each rule type differ. Balanced budget rules are the most effective tool in improving the primary balance, the coefficients being significantly positive at the 5 percent level for the primary balance and at the 1 percent level for the primary expenditures (columns 1 and 4). Debt rules are also significant at the 10 percent level for both dependent variables (columns 3 and 6), while the coefficient of expenditure rules does not show a statistically significant effect (columns 2 and 5). The interaction terms of the balanced budget rule index and debt rule index are significant for the primary balance and primary expenditures[14]. Debrun et al. (2008) points out that the balanced budget rules and debt rule exert effective impacts on fiscal policy, while expenditure rules are marginal. Their arguments are supported by other studies (e.g. Nerlich et al., 2013; Bergman et al. 2016). Our results are mostly in line with those suggested by the related literature.

Table 6   Regressions for different types of fiscal rules

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	Cyclically adjusted primary balance			Cyclically adjusted primary expenditures		
Type of fiscal rules	Balanced budget rule	Expenditure rule	Debt rule	Balanced budget rule	Expenditure rule	Debt rule
Public debt (t-1)	0.054**	0.034**	0.035**	-0.073***	-0.052*	-0.039
	(0.022)	(0.015)	(0.016)	(0.026)	(0.030)	(0.024)
Fiscal rule index	1.958**	0.762	1.136*	-2.922***	-1.664	-2.032*
	(0.840)	(0.479)	(0.562)	(0.892)	(1.218)	(1.087)
Public debt (t-1)	-0.022*	-0.008	-0.013*	0.034**	0.021	0.023*
* Fiscal rule index	(0.012)	(0.006)	(0.007)	(0.014)	(0.014)	(0.013)
Observations	687	687	687	687	687	687
Number of countries	28	28	28	28	28	28
AR(1)	0.004	0.003	0.004	0.00274	0.00165	0.000537
AR(2)	0.458	0.480	0.442	0.154	0.198	0.408
Number of instruments	23	23	23	25	25	25
Hansen's J	0.135	0.497	0.505	0.172	0.107	0.265

Note: All explanatory variables and a constant term are included but not shown here for brevity. AR(1) and AR(2) are tests of autocorrelation of the first and second order. Hansen's J is a test for over-identifications. Tests for autocorrelation and over-identification report p-values. Figures in parentheses are robust standard errors. *** indicates $p<0.01$, ** $p<0.05$, * $p<0.1$.
Source: Estimations by author.

5.4. Robustness analysis

This study estimates the baseline model using the system GMM estimator that is widely used in previous literature in similar fields and is well suited to dynamic panels with small T and large N. However, it may be worth examining alternative estimation methodologies to verify the robustness of our results. The first and second methodologies applied are the pooled OLS and the fixed effect estimations. The third is the feasible generalized least squares (FGLS), which is most efficient for panels with large T and small N as well as cross-sectional correlation and group-wise heteroscedasticity in the error term. The final technique is the bias-corrected least-squares dummy variable (LSDV) proposed by Bruno (2005), which is suitable for the autoregressive panel mode.

Table 7 presents robustness test results. All estimations except the pooled OLS include country fixed effects. Although the pooled OLS, fixed effect, and FGLS estimation cannot deal with the bias caused by a lagged dependent variable, we include it for comparison purposes. All estimations mostly support our arguments. Although the interaction terms are insignificant in some estimations, the signs of the coefficients are the same as the baseline model.

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[14] Although we do not present the graphs of marginal effects, they also support the estimation results.

Table 7 Robustness tests

Depedent variable	(1) Cyclically adjusted primary balance	(2) Cyclically adjusted primary expenditures	(3) Cyclically adjusted primary balance	(4) Cyclically adjusted primary expenditures	(5) Cyclically adjusted primary balance	(6) Cyclically adjusted primary expenditures	(7) Cyclically adjusted primary balance	(8) Cyclically adjusted primary expenditures
Estimators	Pooled	Pooled	Fixed effect	Fixed effect	FGLS	FGLS	LSDV	LSDV
Public debt (t-1)	0.016***	-0.013***	0.022*	-0.026	0.020***	-0.040***	0.019***	-0.031***
	(0.004)	(0.004)	(0.012)	(0.016)	(0.005)	(0.005)	(0.007)	(0.007)
Fiscal rule index	0.953***	-0.713**	1.073**	-1.554**	0.628**	-1.644***	0.966**	-1.557***
	(0.280)	(0.307)	(0.393)	(0.574)	(0.305)	(0.267)	(0.398)	(0.428)
Public debt (t-1) * Fiscal rule index	-0.008**	0.005	-0.008	0.014**	-0.003	0.015***	-0.007	0.015***
	(0.004)	(0.004)	(0.005)	(0.006)	(0.003)	(0.003)	(0.005)	(0.005)
Dependent variable (t-1)	0.710***	0.936***	0.651***	0.684***	0.645***	0.645***	0.726***	0.779***
	(0.068)	(0.017)	(0.041)	(0.039)	(0.028)	(0.023)	(0.032)	(0.027)
Observations	687	687	687	687	687	687	687	687
Number of countries	28	28	28	28	28	28	28	28
R-squared	0.632	0.899	0.539	0.655				

Note: All explanatory variables and a constant term are included but not shown here for brevity. AR(1) and AR(2) are tests of autocorrelation of the first and second order. Hansen's J is a test for over-identifications. Tests for autocorrelation and over-identification report p-values. Figures in parentheses are robust standard errors. *** indicates $p<0.01$, ** $p<0.05$, * $p<0.1$.

Source: Estimations by author.

6. Conclusions

The current health crisis has led to public debt rising to unprecedented levels across the world. Expansionary fiscal policies are critical to protect people and support firms under the Covid-19 pandemic. While it is still too early to wind down sizable spending and revenue measures, governments may need to start preparing to shift from crisis-mode policy to fiscal restoration in the medium-term with mounting debt burdens. With this consideration, this paper has examined the interaction effect of fiscal rules on the relationship between public debt and fiscal policy—the cyclically adjusted primary balance, cyclically adjusted primary expenditures, and cyclically adjusted primary revenues.

The empirical evidence suggests that, as previous studies reported, the cyclically adjusted primary balance tends to respond to public debt positively, while the cyclically adjusted primary expenditures react negatively. The cyclically adjusted primary revenues do not show a significant response. However, our empirical study finds that those relationships are likely to weaken or disappear when stricter fiscal rules are in place. At the same time, fiscal rules exert significant disciplinary effects. These results indicate that well-designed fiscal rules will be dominant in the budgeting process and will reduce the influence of public debt requiring the government to adjust fiscal policy to ensure fiscal sustainability. However, fiscal rules do seem not to function effectively when the level of public debt is high. With the result that higher public debt makes it less likely that fiscal positions can be improved even under stricter fiscal rules, we may conclude that adopting better budgetary institutions represented by fiscal rules is a necessary but not sufficient condition for fiscal sustainability. Governments need to lower public debt to a certain level in order to ensure the disciplinary effects of the fiscal rules and public debt itself. Finally, balanced budget rules show the most significant influence, followed by the debt rule. Our estimation fails to show significance with regard to the expenditure rule.

There remains work to be conducted to understand the nature of the relationship among public debt, fiscal rules, and fiscal policy. The fiscal rule index we employ is based on the IMF Fiscal Rules Dataset 1985-2015. While containing details of institutional characteristics, the dataset does not provide information on whether each rule works effectively or not. We need to incorporate a track record of whether and how much fiscal policy has complied with rules. Furthermore, we did not perform a profound examination of why the fiscal rules do not show an effective influence under a high public debt. High public debt may result from fiscal policy that has less emphasis on long-term fiscal stability or ineffectiveness of the government to contain deficit bias. Answering this question might also contribute to the literature focusing on debt sustainability issues.

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