FISCAL POLICY:
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CHANGE

FISCAL RULES AS ALTERNATIVES
FOR THE DESIGN OF FISCAL POLICY:
THE CASE FOR CENTRAL AMERICA AND
THE DOMINICAN REPUBLIC

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Fiscal Rules as Alternatives for the Design of Fiscal Policy: The Case for Central America and the Dominican Republic*

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Abstract

The presence of deficit bias of fiscal policy has generated a debate about the feasibility of adopting fiscal rules in order to mitigate it. Economies of Central America and the Dominican Republic (hereafter CARD economies) do not escape from this reality: since the last decade they are running fiscal deficits on the base of discretionary policies, jeopardizing fiscal sustainability and macroeconomic fundamentals. In this paper, we explore how fiscal rules can contribute to macroeconomic stability, and reduce volatility in macroeconomic variables when compared with discretionary behavior followed by the authorities. Using a small open economy RBC model calibrated for the above-mentioned economies, we ranked discretionary fiscal policy and fiscal rules using a welfare measure. Results point out that debt-goal rules based on adjustment of taxes, as well spending goals relative to output reduce macroeconomic volatility relative the discretionary case. This suggests that there is room for the improvement of the current framework of fiscal policy toward one that leads to less macroeconomic volatility. However, it is important to remark that the benefits from adopting a fiscal rule are conditional to a credible commitment from the authorities, with dynamic consistency of the fiscal regime.

JEL Codes: E32, E37, E62.

Keywords: Fiscal policy, Fiscal rules, Central America and the Dominican Republic, RBC model.

1   Introduction

Fiscal authorities build credibility from their record of consistent behavior and goal achievement across time (i.e., fiscal sustainability). Nevertheless, what the data on fiscal primary and general balances suggests is that what happens is the opposite: a consistent bias towards fiscal deficits and the consequent debt accumulation; a pattern that seems generalized across different groups of economies (see Figure A1 in the Appendix).

This "bias to deficit" exhibited by these economies could have a negative impact on the effectiveness of fiscal policy, mining the credibility of authorities, threatening fiscal sustainability and limiting the capacity to counteract adverse shocks. Given this "failure" of discretionary policy it is argued the necessity to implement legal and institutional mechanisms permitting a path for fiscal policy consistent with its goals.

Central America and the Dominican Republic economies are not divorced to the described scenario for fiscal deficits. In the last 20 years is notorious the deterioration of fiscal balances, mainly after the period of global financial crisis, despite periods of fiscal adjustment and consolidation.

In this paper we address the question if there is welfare gains of designing fiscal policy on the basis of fiscal rules instead of the currently discretionary set up in CARD economies. The evaluation is done using a small open economy RBC model that resembles the structure of these economies where the source of fluctuation are characterized by term of trade and productivity shocks. Equiped with this framework, we compare the welfare gains from adopting a fiscal rule instead of a discretionary behavior of government, in a set up where the inter-temporal budget constraint holds, that is debt is sustainable.

The rest of the paper is organized as follows. Section 2 summarizes the literature related to the determinants of deficit bias and the proposals to ameliorate this outcome. In Section 3 we present the analytical tool to evaluate alternatives for fiscal policy design based in several fiscal rules. Results are summarized in Section 4.

2   Literature Review

2.1   Fiscal Indiscipline: On the Source of 'Deficit Bias'

The sustained increase in the debt-to-GDP ratio's since the mid-1970s, both in advanced and emerging economies, has been called "bias towards deficit" of fiscal policy, see Cotarelli (2012).

The underlying causes of deficit bias have been studied by academics and policy makers in the area of public finance, who emphasize as possible explanations the role of impatience (for instance, Rogoff 1990, Alesina & Tabellini 1990, Debrun 2011) and the problem of common resources (for instance, Velasco 1999, Kontopoulos & Perotti 1999,

Wren-Lewis 2011, Gonzalez-Garcia & Grigoli 2013), since fiscal sustainability requires that the debt-to-GDP ratio be stationary in the long term (that is, it does not grow indefinitely).

In relation to impatience, Rogoff (1990) suggests that politicians exhibit myopia during election cycles, which prevents them from internalizing the cost of increasing indebtedness, since the benefits of reducing taxes and/or increasing expenses are perceived in the short term – e.g., an increase in the likelihood of re-election –, while the cost of increasing the debt service would occur in the long run. Similarly, Alesina & Tabellini (1990) indicate that governments with a low probability of re-election could borrow in order to restrict politicians from opposing parties.

Debrun (2011) states that in the presence of politicians who oversize their ability to influence economic growth, the pressure they exert so that their over-optimism is taken into account in the projection of collections, results in a constant overestimation of them, contributing the deficit bias.

In a different assessment, Velasco (1999) interprets the deficit bias as a manifestation of the classic problem of common resources (PCR), recognizing the externality that is generated when a general income fund, paid by all sectors of society through distorting taxes, finance public spending that benefits specific sectors. In this context, the deficit bias arises because the government yields to the influences of interest groups that wish to be favored.

Kontopoulos & Perotti (1999), appealing to the PCR's argument, point out that the fragmentation of the budget process partially explains the bias, that is, the number of rules governing that process and of individuals who decide on the budget, traditionally increasing with the amount of ministries. Under this approach, the centralization of the budget process appears as a potential solution to the coordination problem inherent in the preparation of the budget. Such fragmentation could also be caused by the political division of the territory, relevant in federal governments in which each federal sub-division has the power to prepare its own budget. Additionally, the promise of rescue at the federal level could encourage the permanence of state-owned companies that operate with systematic losses, contributing to deficit bias.

Wren-Lewis (2011) provides a reinterpretation of the PCR at the inter-temporal level, recognizing that through indebtedness current generations could take advantage of the resources available to future generations, as is the case with unsustainable social security systems.

Gonzalez-Garcia & Grigoli (2013) analyze the presence of state banks in the domestic financial system of 123 countries, finding a positive link between the size of the state bank relative to the total banking sector, credit to the government, the fiscal deficit and debt levels in proportion to GDP.

2.2   Fiscal Discipline: 'Discretion vs. Rules'

The deficit bias would not represent a risk to fiscal sustainability if the deficits were compensated with future surpluses, sufficient to prevent indefinite growth of the debt-to-GDP ratio. In this regard, a growing number of countries have adopted various mechanisms to eliminate the deficit bias in order to anchor expectations on the solvency of the government and reduce its risk premium, see IMF (2017).

Hallerberg & von Hagen (1999), interpreting the deficit bias as a manifestation of the problem of common resources, point to two approaches to correct it: delegation – associated with a discretionary scheme – and contracts – associated with a scheme of rules.

2.2.1   Discretion

The delegation approach implies giving to an non-elected agent – e.g., an independent fiscal agency – the power to decide on the formulation of fiscal policy and the coordination of the budget process. In theory, delegation could eliminate the deficit bias because it separates fiscal policy decisions from those participants in the budget process that could be captured by interest groups, thus eliminating the externality that is caused by the problem of common resources.

Some authors point out that the above bears certain similarities with the modern practice of monetary policy, in which the responsibility of maintaining price stability is delegated to an independent central bank. However, there are no precedents for countries that have adopted such an approach in the field of fiscal policy. Literature provides some reasons for this, emphasizing economic and political aspects.

On the economic side, Alesina & Tabellini (2007) point out that the success of the delegation of decisions requires a consensus on the objectives of economic policy and how to implement them. In an inflation targeting scheme the objective is clear and verifiable: price stability during the policy horizon. For this, the Central Bank has the freedom to choose the instrument to be used — e.g., the monetary policy rate – to generate macroeconomic projections that will serve as input in decision-making and, in case of deviations, it has the power to decide the speed of convergence of inflation towards the goal. In contrast, the objectives of fiscal policy are ambiguous given that it is used repeatedly for various purposes, traditionally the provision of public goods, inequality reduction, poverty reduction, business cycle stabilization, long-term growth and sustainability of public debt. Some of these objectives could conflict with each other, such as the case of the unsustainability of some social security systems, where the objective of combating inequality is incompatible with that of fiscal sustainability.

Wren-Lewis (2011) suggests that even if the ultimate objective of both policies is recognized as the maximization of social welfare, the social costs of public debt could be

ambiguous, while those of an increase in inflation are more direct – e.g., relative price dispersion, increase in poverty, increase in real transaction costs.

Regarding the political aspect, democratic systems require that fiscal policy decisions be approved by a congress or parliament, which could hinder their implementation and effectiveness, especially in cases where immediate actions are required. Wyplosz (2005) notes that this is justified because changes in taxes and public spending result in a redistribution of wealth between different sectors of society, which would only be legitimate if it arises as a result of a democratic process.

In contrast, the redistributive effects of monetary policy are reduced to transfers between creditors and debtors, as a result of variations in interest rates and the exchange rate, traditionally transitory, reversible and of lesser magnitude than those derived from fiscal policy. Therefore, central banks, other than finance ministries, have absolute control over their policy instruments.

In addition, some of the causes of the deficit bias mentioned in the previous section, such as the systematic overestimation of revenues, could be solved without resorting to a delegation of decisions, but by delegating to a panel of experts outside the political process, the task of projecting tax revenues.

Some of the reasons mentioned above provide elements of judgment that suggest that the delegation of fiscal policy to an independent agency is not feasible, so we next evaluate the alternative option: fiscal rules.

2.2.2 Rules

Fiscal rules imply explicit limits on budgetary aggregates – e.g., revenues, expenditures, fiscal balance –, sometimes accompanied by institutional arrangements aimed at improving the transparency and predictability of the budget process. In theory, the rules could contribute to eliminating deficit bias to the extent that the cost faced by governments to break it outweighs the benefit of doing so.

Fiscal rules have gained popularity in the last two decades; Schaercter & Tiadine (2012) point out that the number of countries operating under some kind of rule went from 5 in 1990, to 76 in 2012, and 96 in 2015, see IMF (2017). The design of rules responds to the fiscal policy objectives that are pursued, either (a) fiscal sustainability, (b) macroeconomic stability, (c) restricting the size of the public sector or some combination thereof.

2.2.3 Fiscal Sustainability

For fiscal sustainability we meant that government respect its inter-temporal budget constraint (IBC), which is equivalent to the debt-to-GDP ratio being stationary in the long run.

Formally, denoting the debt-to-GDP ratio of government as b, the primary balance in proportion to GDP as x, the real growth of GDP γ, the real interest rate of debt r and evaluating expressions in discrete time, we have:

$$b_t - b_{t-1} = \frac{1 + r_t}{1 + \gamma_t} b_{t-1} + x_t \tag{1}$$

The previous expression indicates that the debt-to-GDP ratio grows with the primary deficit and the interest rate, and it is reduced with economic growth. Iterating over an infinite horizon, the IBC is obtained, expressed in terms of GDP:

$$(1 + r_t)b_t = \sum_{n=0}^{\infty} \frac{x_{t+s}}{(1 + \phi_t)^n} + \lim_{N \to \infty} \frac{b_{t+N+1}}{(1 + \phi_t)^N} \tag{2}$$

where $\phi_t = (1 + r_t)/(1 + \gamma_t)$.

From the last equation, it is observed that the IBC links the current debt-to-GDP ratio, including the interest service, with the present value of the primary balance and the issuance of future debt. For the treasury to be solvent, the government cannot increase its indebtedness in proportion to the GDP in the long run, which will only be possible if it is met:

$$\lim_{N \to \infty} \frac{b_{t+N+1}}{(1 + \phi_t)^N} = 0 \tag{3}$$

The previous equality is called the transversality condition. If not met, it would imply that the government could systematically finance primary deficits with new debt. By imposing this condition we get:

$$(1 + r_t)b_t = \sum_{n=0}^{\infty} \frac{x_{t+s}}{(1 + \phi_t)^n} \tag{4}$$

The last two expressions are equivalent ways of writing the IBC. Both imply that if the government wishes to maintain solvency, it can only increase the debt-to-GDP ratio through increases in the present value of the primary surplus.

Some tax rules establish annual limits on public spending and/or floors for tax revenues. Others require that the treasury generate surpluses from the primary balance (i.e., $x_{t+s} > 0$) or the fiscal balance (i.e., $x_{t+s} + r_{t+s}b_t > 0$) year by year .

However, the IBC clearly states that fiscal sustainability is not an annual concept, but a long-term one, and the condition of transversality implies that the appropriate variable to restrict is the debt-to-GDP ratio. In this sense, the annual frequency requirement on the limits of the budget aggregates, as well as the limits themselves, are not necessary to ensure solvency, nor are they sufficient.

Controls over budgetary aggregates will only be consistent with sustainability insofar as they prevent a systematic increase in the debt-to-GDP ratio in the long term. If, to

ensure fiscal solvency, the variable to restrict is debt, it is worth asking: what is the optimal level of public debt? Unfortunately there is no consensus in the literature on the level of optimal debt, although some studies provide certain approximations (for instance, Leith et al. 2019, Schmitt-Grohe & Uribe 2004, Ostry et al. 2010, Bi & Leeper 2010).

Regardless of the level of target debt that is pursued, it is important to note that by definition, a rule on the debt-to-GDP ratio is pro-cyclical, since it requires tax savings in the lower part of the cycle to keep the debt stable, which could threaten macroeconomic stability.

2.2.4 Macroeconomic Stability

Wyplosz (2012) points out that in the absence of deficit bias, the fiscal balance should fluctuate with the economic cycle, alternating between surpluses and deficits according to the policy response of the authorities, historically counter-cyclical in advanced economies and pro-cyclical in emerging economies.

To eliminate the propensity to generate deficits some countries have introduced rules on the fiscal balance, either through numerical goals or requiring surpluses from the global or primary balance. A particular case, the "golden rule", excludes capital expenditure from the balance to be restricted, under the premise that it contributes to the long-term growth of the economy. However, like debt goals, balance sheet rules are pro-cyclical by construction and, as previously discussed, they are not necessarily linked to fiscal sustainability.

In an analysis for the Latin American region, Perry (2003) points out that the pro-cyclical bias of fiscal policy increases macroeconomic volatility and the social cost of demand and supply shocks facing these economies. In this sense, some countries have designed their fiscal rules in order to eliminate the pro-cyclicality of fiscal policy.

Burnside (2005) suggests that a well-designed rule should convey credibility, sufficient to anchor long-run fiscal sustainability expectations, and at the same time, provide flexibility, necessary to stabilize the cycle in the short term. This presents a dilemma: credibility requires rigidity, which could be counterproductive in recession or slowdown periods, while systematic flexibility is reduced to a discretionary policy, the opposite of a rule.

Fiscal rules that impose goals on the structural balance, that is, the fiscal balance adjusted for short-term factors such as the economic cycle, provide an automatic stabilization mechanism in the short run. In this type of rules, public spending is calculated based on structural income instead of actual income, which leads to reductions in the fiscal balance during recessions and increases in boom periods, thus eliminating pro-cyclical fiscal policy bias. The proper functioning of this rule requires precision in the calculation of the structural balance. Given that the level of expenditure is determined based on

Table 1: Properties of different types of rules by objectives

Type of Rule	Objectives		
	Debt Sustainability	Economic Stabilization	Size of the Government
General balance	++	-	0
Primary balance	+	-	0
Cyclical-adjusted balance	++	++	0
Balanced budged during the cycle	++	+++	0
Public debt (% GDP)	+++	-	-
Expenditure	+	++	++
Revenues			
Revenue ceiling	-	-	++
Revenue floor	+	+	-
Limits to revenue windfalls	+	++	0

Notes: Positive signs (+) indicate stronger property, negative signs (-) indicate weaker property, zeros (0) indicate neutral property with regard the objective. Source: IMF (2009).

structural revenues, a systematic overestimation of these could introduce a deficit bias in the effective balance, threatening fiscal sustainability in the long term. The evidence suggests that independent agencies provide more accurate projections than government entities, which would suggest delegating responsibility for these estimates to reduce such bias.

2.2.5   Limits on Government Size

An alternative to fiscal balance rules and debt targets are the rules on public spending and tax revenues. These types of rules are intended to limit the size of the government. The former establish limits in absolute terms, as a proportion of GDP or in terms of growth over primary, current or total expenditure. The latter establish floors over income. As previously mentioned, these rules are not directly linked to fiscal sustainability, but could contribute to reducing the deficit bias in the presence of overstatements of fiscal revenues that lead to systematically high public spending programming. On the other hand, if the income rule is accompanied by limits on the use of extra-budgetary income, they could play a stabilizing role containing public spending in the presence of transient increases in tax revenues, preventing a pro-cyclical fiscal stance. If this clause is not included, these types of rules tend to contribute to the pro-cyclical position since automatic income stabilizers tend to exceed those of public spending. Table (1) summarizes the types of rules, classified according to their link to government objectives.

Fiscal rules are not synonymous of fiscal discipline. Evidence of the effect of fiscal rules

on reducing deficit bias is ambiguous and could suggest a reverse causality, that is, those countries that went through fiscal consolidations introduced fiscal rules to strengthen the credibility signal.

Rules suffer from dynamic inconsistency; they will be violated as long as the political cost of evading them exceeds the benefit of allowing debt increases. If a rule with politically unfeasible adjustments is adopted, it could weaken the credibility of the government. If there is a credible commitment to comply with it, the fiscal adjustment does not usually consider the design of the tax system, nor the composition and quality of public expenditure, which suggests a role for institutional arrangements leading to the transparency of the budget process.

3 Alternatives for Fiscal Policy Design in CA and the DR. Is There Chance for Improvement?

Given the discussion in the previous section that fiscal rules constitute a potential approach to resolve the problem of deficit bias, a valid question is whether, beyond fiscal sustainability, the rules provide any gains in terms of macroeconomic volatility and welfare relative to the discretionary case.

In this section we address this question. We calibrate an open economy RBC model, for the purpose of evaluating the different types of fiscal rules in terms of the welfare implications of the adoption of each of these alternatives for fiscal policy management, in a context of business cycle stabilization.

In this model, the equilibrium implies that government is subject to its intertemporal budget restriction, without recurring to default, meaning that public finances are sustainable. For this reason, conditions of debt sustainability keep outside of the scope of this exercise.

The election of a fiscal rule that promotes macroeconomic stability, conditional on the establishment of the institutional mechanisms that support its operation, requires evaluating its performance in terms of the macroeconomic volatility that it would generate: a rule leading to reducing it will be preferred over that which increases it. Since there are no precedents of fiscal rules in these economies, it is difficult to carry out a contrafactual exercise that allows comparing between alternative rules. Therefore, it is convenient to simplify some of the main characteristics of the economies of interest in a model that allows to evaluate the behavior of a selection of macroeconomic variables, for different fiscal rules, while the economy is subject to domestic and external shocks. In this sense, the model replicates certain real aspects of economies of interest, linked to fiscal policy: (a) they are small and open economies, (b) producers of tradable and non-tradable goods, (c) subject to real domestic shocks (i.e., productivity and fiscal) and external (i.e., terms

of trade). In addition, the model is divided into three blocks, according to the agents that interact: (1) public sector, (2) households and (3) firms. Each sector is detailed below along with the model calibration.

3.1 Government and Fiscal Policy

The government collects income taxes (labor and capital) τ_t^i and consumption taxes τ_t^c, while financing the fiscal deficit by issuing external debt b_t^*. On the other hand, the government transfers z_t to households and consumes tradable (g_t^T) and non-tradable (g_t^N) goods, so that public consumption g_t is represented by a basket with constant elasticity of substitution (CES) between both goods.

The price index of government goods is given by:

$$p_t^g = [\varphi^g (p_t^N)^{1-\chi} + (1 - \varphi^g) s_t^{1-\chi}]^{\frac{1}{1-\chi}} \tag{3.1}$$

where φ^g is the government consumption of domestic goods, χ is the intra-temporal substitution rate, s_t is the real exchange rate and p_t^N is the relative price of non-tradable goods.

The government restriction is given by:

$$\tau_t^c c_t + \tau_t^i (w_t l_t + r_t^N k_{t-1}^N + r_t^T k_{t-1}^T) - (s_t b_{t-1}^* - p_t^g g_t - z_t) = q_t s_t b_t^* \tag{3.2}$$

where q_t is the price of external bonds and $q_t s_t b_t^*$ is the number of local goods that can be acquired by selling b_t^*. It is assumed that government bondholders are risk neutral, that is, that the demand for local bonds is inelastic (i.e., $q_t = \beta$, where β is the economy's discount factor).

The evolution of the fiscal variables will depend on the rules adopted, detailed below.

3.1.1 Debt Target Rules

This type of rule establishes a goal (b/y) on the debt-to-GDP ratio that will be achieved through adjustments to taxes, public spending or both through the primary balance. In that sense,

- Debt - Revenue Rule:

$$\tau_t = \alpha_0 \tau_{t-1} + \alpha_1 \Big(\frac{b_t^*}{y_t} - \frac{b^*}{y} \Big) \tag{3.3}$$

and $\alpha_0 > 0$, $\alpha_1 > 0$

- Debt - Expenditure Rule:

$$g_t = \alpha_0 g_{t-1} + \alpha_1\Big(\frac{b_t^*}{y_t} - \frac{b^*}{y}\Big) \tag{3.4}$$

and $\alpha_0 > 0$, $\alpha_1 < 0$

- Debt - Balance Rule:

$$bp_t = \alpha_0 bp_{t-1} + \alpha_1\Big(\frac{b_t^*}{y_t} - \frac{b^*}{y}\Big) \tag{3.5}$$

and $\alpha_0 > 0$, $\alpha_1 > 0$

Where α_0 corresponds to the inertia of the adjustment instrument and α_1 the degree of adjustment to the rule. In the limit, while α_1 approaches infinity the debt would stabilize at b^*/y.

3.1.2 Revenue Rule

The income rules establish a minimum (or maximum) of collection, without restricting the level of debt, or the behavior of public spending. In this case, the relationship between collections and GDP, τ^*, is set at the desired level.

$$\tau_t = \tau \tag{3.6}$$

3.1.3 Expenditure Rule

The spending rules specify an expenditure limit, independent of the trajectory of the debt and income. For this exercise a maximum will be set in proportion to GDP:

$$\frac{g_t}{y_t} = \frac{g^*}{y} \tag{3.7}$$

3.1.4 Primary Balance Rules

Finally, the primary balance rules set a goal with respect to GDP, leaving the trajectories of fiscal revenues and expenses free. Balance rules may consider a balance adjustment partially.

$$\frac{bp_t}{y_t} = \Big(\frac{bp}{y}\Big)^* \tag{3.8}$$

3.2 Rest of the model

3.2.1 Households

Households derive utility by consuming a basket of goods $\tilde{c}_t$, which incorporates public and private goods, and leisure consumption $(1 - l_t)$. Where the total time available in

the day is normalized to 1. The total consumption of goods is a CES index:

$$\tilde{c}_t = \left[\omega(c_t)^{\frac{\nu-1}{\nu}} + (1-\omega)(g_t)^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}]} \tag{3.9}$$

where ω is the participation of private consumption in the basket and ν reflects the degree of substitution between public and private goods. Preferences are characterized by the following utility function:

$$U_t = \left(\log\left(\tilde{c}_t\right) + \phi \frac{(1-l_t)^{1-\sigma}}{1-\sigma} \right) \tag{3.10}$$

where σ is the inverse of Frisch's elasticity of the job offer, and ϕ is the weight of leisure in the utility function. Households maximize $E_t \sum_{t=0}^{\infty} \beta^t U_t$; $\beta \in (0,1)$ over an infinite horizon, where β is the discount factor, choosing optimal paths for the good of consumption, labor, investment and capital, both in the tradable and non-tradable sector, subject to the following budget constraint :

$$(1+\tau_t^c)c_t+i_t^N+i_t^T+\frac{\kappa}{2}\Big(\frac{i_t^N}{k_{t-1}^N}-\delta\Big)^2 k_{t-1}^N+\frac{\kappa}{2}\Big(\frac{i_t^T}{k_{t-1}^T}-\delta\Big)^2 k_{t-1}^T = (1-\tau_t^i)(w_t l_t+r_t^N k_{t-1}^N+r_t^T k_{t-1}^T)+z_t \tag{3.11}$$

where i_t^T, i_t^N, k_t^T, k_t^N represent investment spending and capital in the tradable and non-tradable sectors, respectively.

Following Schmitt-Grohe & Uribe (2003), it is assumed that spending on investment assets is subject to adjustment costs (quantified by the κ parameter) as a device to close the model. Finally, it is assumed that the depreciation rate of capital δ is the same in both sectors.

The laws of movement of capital are:

$$k_t^N = (1-\delta)k_{t-1}^N + i_t^N \tag{3.12}$$

$$k_t^T = (1-\delta)k_{t-1}^T + i_t^T \tag{3.13}$$

and the aggregate investment expense is:

$$i_t = i_t^N + i_t^T \tag{3.14}$$

The first-order conditions of this optimization problem result in the following intertemporal equilibrium relationships for households:

$$\phi(1-l_t)^{-\sigma} = (1+\tau_t^c)(1-\tau_t)w_t\omega c_t^{\frac{-1}{\nu}}\tilde{c}_t^{(\frac{1}{\nu}-1)} \tag{3.15}$$

$$1 + \kappa\Big(\frac{i_t^N}{k_{t-1}^N} - \delta\Big) = \beta E_t \Big(\frac{c_{t+1}}{c_t}\Big)^{\frac{-1}{\nu}} \Big(\frac{\tilde{c}_{t+1}}{\tilde{c}_t}\Big)^{(\frac{1}{\nu}-1)} \Big(\frac{1+\tau_{t+1}^c}{1+\tau_t^c}\Big) \big[(1-\tau_{t+1})r_{t+1}^N \tag{3.16}$$

$$-\kappa\Big(\frac{i_t^N}{k_{t-1}^N} - \delta\Big)^2 + \kappa\Big(\frac{i_t^N}{k_{t-1}^N} - \delta\Big)\Big(\frac{i_{t+1}^N}{k_t^N}\Big) + (1-\delta)\Big(1 + \kappa\Big(\frac{i_t^N}{k_{t-1}^N} - \delta\Big)\Big)\big]$$

$$1 + \kappa\Big(\frac{i_t^T}{k_{t-1}^T} - \delta\Big) = \beta E_t \Big(\frac{c_{t+1}}{c_t}\Big)^{\frac{-1}{\nu}} \Big(\frac{\tilde{c}_{t+1}}{\tilde{c}_t}\Big)^{(\frac{1}{\nu}-1)} \Big(\frac{1+\tau_{t+1}^c}{1+\tau_t^c}\Big) \big[(1-\tau_{t+1})r_{t+1}^T \tag{3.17}$$

$$-\kappa\Big(\frac{i_t^T}{k_{t-1}^T} - \delta\Big)^2 + \kappa\Big(\frac{i_t^T}{k_{t-1}^T} - \delta\Big)\Big(\frac{i_{t+1}^T}{k_t^T}\Big) + (1-\delta)\Big(1 + \kappa\Big(\frac{i_t^T}{k_{t-1}^T} - \delta\Big)\Big)\big]$$

The consumption and aggregate investment of private goods, tradable and non-tradable, is divided by imperfect substitution, through a CES function with inter-temporal elasticity of substitution χ and degree of domestic bias ϕ.

$$c_t = \Big[\varphi^{\frac{1}{\chi}}(c_t^N)^{\frac{\chi-1}{\chi}} + (1-\varphi)^{\frac{1}{\chi}}(c_t^T)^{\frac{\chi-1}{\chi}}\Big]^{\frac{\chi}{\chi-1}} \tag{3.18}$$

$$i_t = \Big[\varphi^{\frac{1}{\chi}}(i_t^N)^{\frac{\chi-1}{\chi}} + (1-\varphi)^{\frac{1}{\chi}}(i_t^T)^{\frac{\chi-1}{\chi}}\Big]^{\frac{\chi}{\chi-1}} \tag{3.19}$$

In terms of the distribution of intersectoral work and denoting φ^l as the steady-state participation of the non-tradable sector in total employment, and χ^l the elasticity of substitution between sectors, the CES aggregator results in:

$$l_t = \Big[\varphi^{l-\frac{1}{\chi^l}}(l_t^N)^{\frac{1+\chi^l}{\chi^l}} + (1-\varphi^l)^{-\frac{1}{\chi^l}}(l_t^T)^{\frac{1+\chi^l}{\chi^l}}\Big]^{\frac{\chi^l}{1+\chi^l}} \tag{3.20}$$

The representative household chooses the amount of labor that will be assigned to each sector solving the following optimization problem subject to (4.20):

$$\min w_t^N l_t^N + w_t^T l_t^T \tag{3.21}$$

The labor supply of each sector arise from the first order conditions:

$$l_t^N = \varphi^l \Big(\frac{w_t^N}{w_t}\Big)^{\chi^l} l_t \tag{3.22}$$

$$l_t^T = (1-\varphi^l)\Big(\frac{w_t^T}{w_t}\Big)^{\chi^l} l_t \tag{3.23}$$

The aggregate salary arises from the problem of cost minimization (3.21):

$$w_t = \Big[\varphi^l(w_t^N)^{1+\chi^l} + (1-\varphi^l)(w_t^T)^{1+\chi^l}\Big]^{\frac{1}{1+\chi^l}} \tag{3.24}$$

In this model, prices are presented as relative prices with respect to the price of the private compound good, which is normalized to 1. Defining the relative price of nontradables as p_t^N, and the real exchange rate s_t (assuming that the law of one price holds), the price index of private goods:

$$1 = [\varphi(p^N)^{1-\chi} + (1-\varphi)(s_t)^{1-\chi}]^{\frac{1}{\chi-1}} \tag{3.25}$$

3.2.2 Firms

Firms produce tradable and nontradable goods in perfectly competitive markets, through a Cobb-Douglas function:

$$y_t^N = a_t(k_t^N)^{1-\alpha^N}(l_t^N)^{\alpha^N} \tag{3.26}$$

$$y_t^T = a_t(k_t^T)^{1-\alpha^T}(l_t^T)^{\alpha^T} \tag{3.27}$$

$$\ln\frac{a_t}{a} = \rho_a \ln\frac{a_{t-1}}{a} + \varepsilon_t^a \tag{3.28}$$

$$\varepsilon_t^a \sim N(0, \sigma_a^2) \tag{3.29}$$

where y_t^N and y_t^T are the production levels, a_t is the total factor productivity that follows a first-order autoregressive process and ε_t^a the productivity shock, common to both sectors.

Each firm takes the prices of the factors as given and obtains the labor and capital demands of each sector maximizing benefits, subject to their respective production functions:

$$\max \Pi_t^N = p_t^N y_t^N - w_t^N l_t^N - r_t^N k_{t-1}^N \tag{3.30}$$

$$\max \Pi_t^T = p_t^T y_t^T - w_t^T l_t^T - r_t^T k_{t-1}^N \tag{3.31}$$

The demand for labor and capital of each sector is derived from the first order conditions:

$$l_t^N = \alpha^N \left(\frac{p_t^N}{w_t^N}\right) y_t^N \tag{3.32}$$

$$l_t^T = \alpha^T \left(\frac{p_t^T}{w_t^T}\right) y_t^T \tag{3.33}$$

$$k_{t-1}^N = (1-\alpha^N)\left(\frac{p_t^N}{r_t^N}\right) y_t^N \tag{3.34}$$

$$k_{t-1}^T = (1-\alpha^T)\left(\frac{\xi_t s_t}{r_t^T}\right) y_t^T \tag{3.35}$$

where $\xi_t = p_t^x/s_t$ are the terms of trade, which follow an exogenous process:

$$\ln \frac{\xi_t}{\xi} = \rho_\xi \ln \frac{\xi_{t-1}}{\xi} + \varepsilon_t^\xi \tag{3.36}$$

$$\varepsilon_t^\xi \sim N(0, \sigma_\xi^2) \tag{3.37}$$

3.2.3 General equilibrium

In the aggregate the supply of labor and capital must match their respective demands:

$$k_t = k_t^N + k_t^T \tag{3.38}$$

$$l_t = l_t^N + l_t^T \tag{3.39}$$

In addition, the output in units of local currency results in:

$$y_t = p_t^N y_t^N + \xi_t s_t y_t^T \tag{3.40}$$

The equilibrium condition in the non-tradable goods market is:

$$y_t^N = (p_t^N)^{-\chi} \left\{ \varphi \left[c_t + i_t + \frac{\kappa}{2} \left(\frac{i_t^N}{k_{t-1}^N} - \delta \right)^2 k_{t-1}^N + \frac{\kappa}{2} \left(\frac{i_t^T}{k_{t-1}^T} - \delta \right)^2 k_{t-1}^T \right] + \varphi^g (p_t^g)^\chi g_t \right\} \tag{3.41}$$

Finally, the model closes with the definition of the balance of payments,

$$y_t - c_t + i_t + \frac{\kappa}{2} \left(\frac{i_t^N}{k_{t-1}^N} - \delta \right)^2 k_{t-1}^N + \frac{\kappa}{2} \left(\frac{i_t^T}{k_{t-1}^T} - \delta \right)^2 k_{t-1}^T + p_t^g = s_t[q_t b_t^* - b_{t-1}^*] \tag{3.43}$$

3.3 Calibration

The model is calibrated for an "average" economy representing the economies of Central America and the Dominican Republic, in order to study the performance of each of the fiscal rules presented in the previous section. There are two types of parameters: "deep" parameters, which are taken from the literature (due to the absence of previous studies for CADR) or using regional aggregate data, and parameters associated with fiscal policy. Table (2) summarizes the model's parameters.

The proportion of non-tradable items in the consumer basket (φ) is calibrated at 0.5, extracted from the percentage of goods classified as non-tradable in the definition of the Non-tradable Consumer Price Index of CADR central banks and statistics agencies.

Frisch's elasticity of the labor supply is calibrated to 0.5, implying a value of $\sigma = 2$, a common assumption in the literature. In terms of elasticity of substitution between private and public goods of the consumer basket (ν), it is calibrated at 0.49, consistent with the value of the fiscal multipliers of emerging economies found in Greenwood &

Table 2: Models' structural parameters

φ	Share of non tradables in consumption basket	0.5
σ	Inverse of Frisch labor supply elasticity	2
ν	Elasticity of substitution between c_t and g_t	0.49
ω	Share of c_t in effective consumption basket	0.8
χ	Elasticity of Subst. between tradables and non tradable in c_t and g_t	0.44
χ^l	Elasticity of substitution between l_t^N and l_t^T in l	1
φ^l	Share of non tradable income in steady state	0.5
κ	Adjustment cost of investment	1.7
α^N	Share of labor income in the non tradable sector	0.5
α^T	Share of labor income in tradable sector	0.5
ϕ	Share of leisure in steady state	0.25
δ	Depreciation rate	0.1

Huffman (2013). For the calibration of effective consumption, $\tilde{c}_t$, follow Bouakez & Rebei (2007), who set the weight of private goods consumption on cash at $\omega = 0.8$.

The elasticity of substitution between tradable and non-tradable goods, χ, for both the public and private basket is set at 0.44, using the estimates provided in Stockman & Tesar (1995). Likewise, the sector elasticity that governs labor mobility (χ^l) is calibrated at 1, while the investment adjustment costs parameter is set at 1.7, following Gourio (2012).

According to Obstfeld & Rogoff (1996), the non-tradable sector tends to be as labor-intensive as the tradable sector. In that sense $\alpha = 0.66$ and $\alpha^T = 0.55$. Finally, the weight of leisure in the utility function (φ) is calibrated in such a way that the representative agent dedicates 25% of his time in labor market activities.

As for the calibration of the parameters associated with fiscal policy, these require special attention. The initial calibration of the model corresponds to what we call the base case or "discretionary policy", which approximates the trajectory of revenues and public spending implicit in the discretionary behavior of the authorities. In particular, deviations from indebtedness over the implicit government goal have not been adjusted via reductions in public spending, but through recurrent changes in government tax rates, which has coincided with an a-cyclical behavior of public spending (see Figure 1).
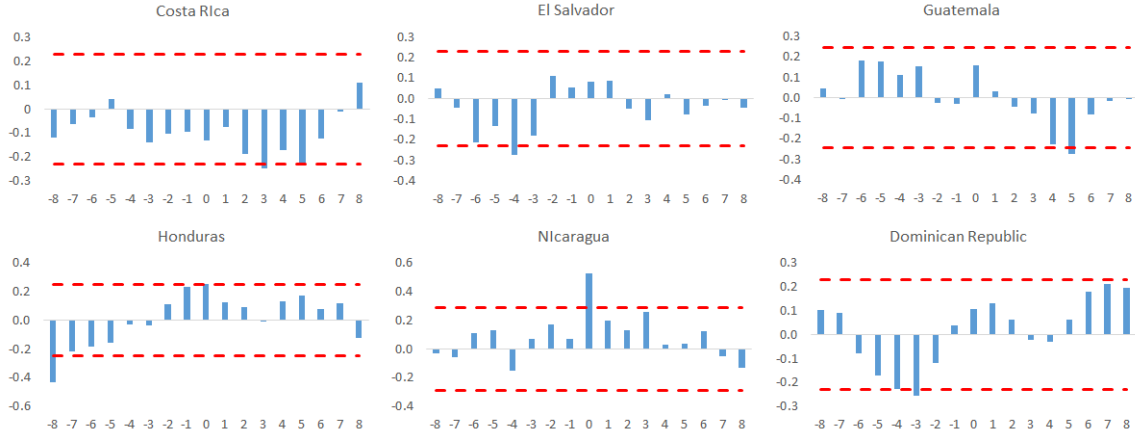
In that sense, fiscal policy is represented by:

$$\tau_t = \phi\Big(\frac{b_t}{y_t} - \frac{b^*}{y}\Big)$$

where

$$\phi = 0.25$$

That is, given that the model is in annual frequency, it is assumed that the adjustments in the deviations of the debt-to-GDP ratio with respect to the goal implied by the authorities

Figure 1: Cross correlation between GDP growth versus lead and lags of real public expenditures

Notes: Dashed lines indicate the 95% confidence level. Source: Author's calculations.

are corrected via tax revenue in 4-year cycles.

In terms of expenditure, as mentioned, this has an a-cyclic behavior with respect to the economy and has not been considered within the policy maker's plans as a relevant adjustment variable, so in the discretionary case it is represented as an stochastic AR (1) process.

$$g_t = \delta g_{t-1} + \varepsilon_t^g$$

where $\varepsilon_t^g \sim N(0, \sigma_g^2)$.

In terms of calibration of the debt-to-GDP ratio, this is chosen outside the model, using the "fiscal limit" methodology presented by Bi & Leeper (2010), and implemented by Ramírez & Wright (2017) for the CADR case. The calculations establish that the long-run debt-to-GDP ratio is approximately 55%, this being the number to perform the simulations.

From this calibration and the assumptions about the behavior of the "discretionary" fiscal policy, the comparison of the moments of the economy with those generated by the specified model is presented in Table (3).

Table 3: Standard deviation of observed variables and model variables

(*relative to GDP*)

Variables	Data	Model
GDP	1.0	1.0
Consumption	1.6	1.5
Investment	4.0	3.9

4   Results

As previously discussed, the goal of the analysis is to order the type of rule according to the volatility introduced to the economy, and compare it with the discretionary case, and between rules.

It is important to note that the results are conditional on the previously discussed structure of the model, also on the type of shock. In particular, the terms of trade shocks exhibit a variance three times higher than that of domestic shocks (productivity shock), typical of small and open economies, such as the countries under analysis.

We use two metrics to discuss the reliability of each fiscal arrangement: (1) volatility of macroeconomic variables, such as output, consumption, investment and employment; and (2) a welfare measure that capture the cost/benefit of the transition from the discretional regime to one regime based on a fiscal rule.

Related to the welfare variation measure, we follow Schmitt-Grohe & Uribe (2004) who compares the value function of models with different policy regimes or shocks, to estimate the cost in terms of consumption willing to give up in exchange for maintaining the same level of utility before the policy change or the occurrence of shocks. We define the welfare function as:

$$V = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, (1 - l_t))$$

under discretionary fiscal policy, the value of the welfare function is:

$$V^D = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t^D, (1 - l_t^D))$$

similarly, the welfare function associated with the fiscal rule R is:

$$V^R = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t^R, (1 - l_t^R))$$

Denoting λ as the cost of adopting regime D instead of regimen R, in terms of the fraction of consumption that household would be willing to give up to be as well off under regime D as under regime R. Formally:
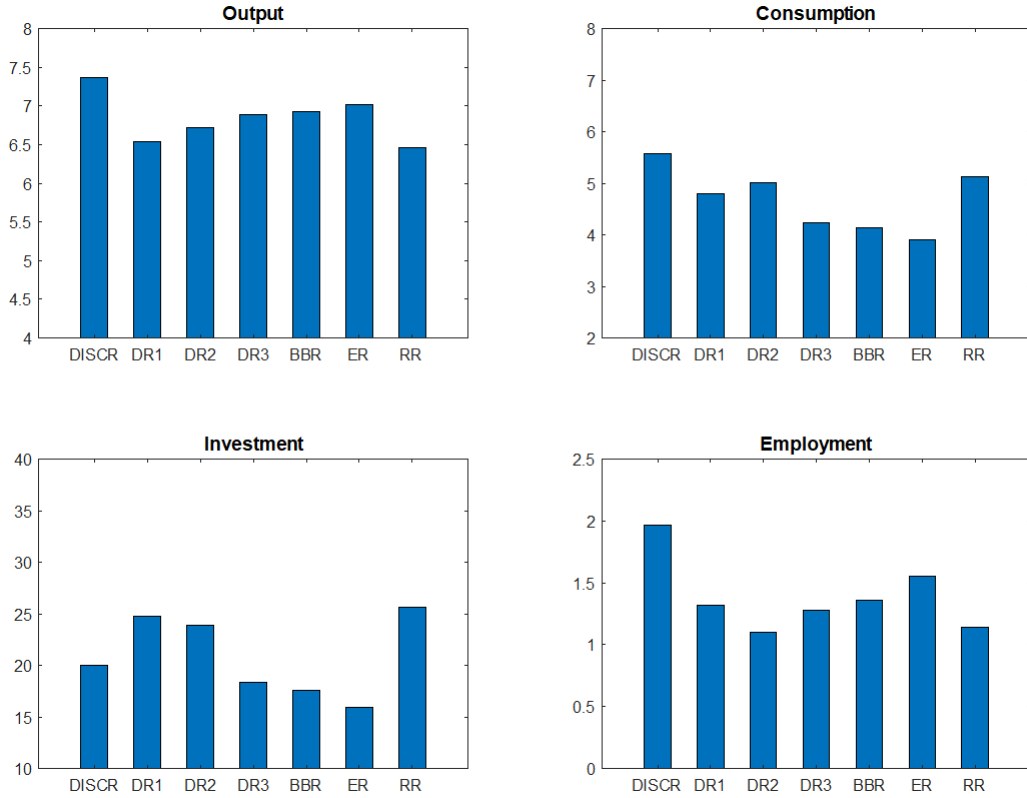
$$V_t^D = E_0 \sum_{t=0}^{\infty} \beta^t U((1 - \lambda)c_t^R, (1 - l_t^R))$$

If $\lambda > 0$ then a fiscal rule is preferred, in terms of welfare, related to the discretionary case. Using the functional form for the utility function (U), then:

$$\lambda = 1 - \exp[(1 - \beta)(V^R - V^D)]$$

Figure (2) shows the standard deviations of the output, consumption, investment and

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Figure 2: Volatility of macroeconomic variables under different rules

Notes: DISCR: Discretionary fiscal policy; DR1: Debt rule based on the adjustment of revenues against deviation of debt-to-GDP from target. DR2: Debt rule based on the adjustment of expenditures against deviation of debt-to-GDP from target. DR3: Debt rule based on the adjustment of fiscal balance against deviation of debt-to-GDP from target. BBR: Balance rule. ER: Expenditure rule. RR: Revenues as a percentage of GDP rule. Source: Author's calculations.

employment under the proposed rules, including the discretionary case.

Results indicate that in an open economy where the business cycle is driven by domestic (productivity) and external (term of trade) shocks, at least a fiscal rule dominates over the discretionary fiscal policy regime, regardless either looking at macroeconomic volatility or the welfare gains of changing from a regime based on discretionary policy towards a fiscal rule-based scheme.

From the point of view of welfare variation indicator (see Figure 3), revenue rules based on the size of the government (as percentage of GDP) deliver lager positive welfare variations. This is regardless its evident procyclical behavior. Debt rules based either on expenditure or revenues adjustments to stabilize public debt around a steady state value, follows in terms of welfare gains. The negative note is for the case of debt rules based on adjustment of fiscal balance and balance rules, which do not produce any significant welfare gains.

Nevertheless, volatility analysis highlights that procyclical profile of revenue rules limiting the size of government trigger more volatility to consumption and investment.

Figure 3: Welfare gains by fiscal rule, relative to discretionary regime
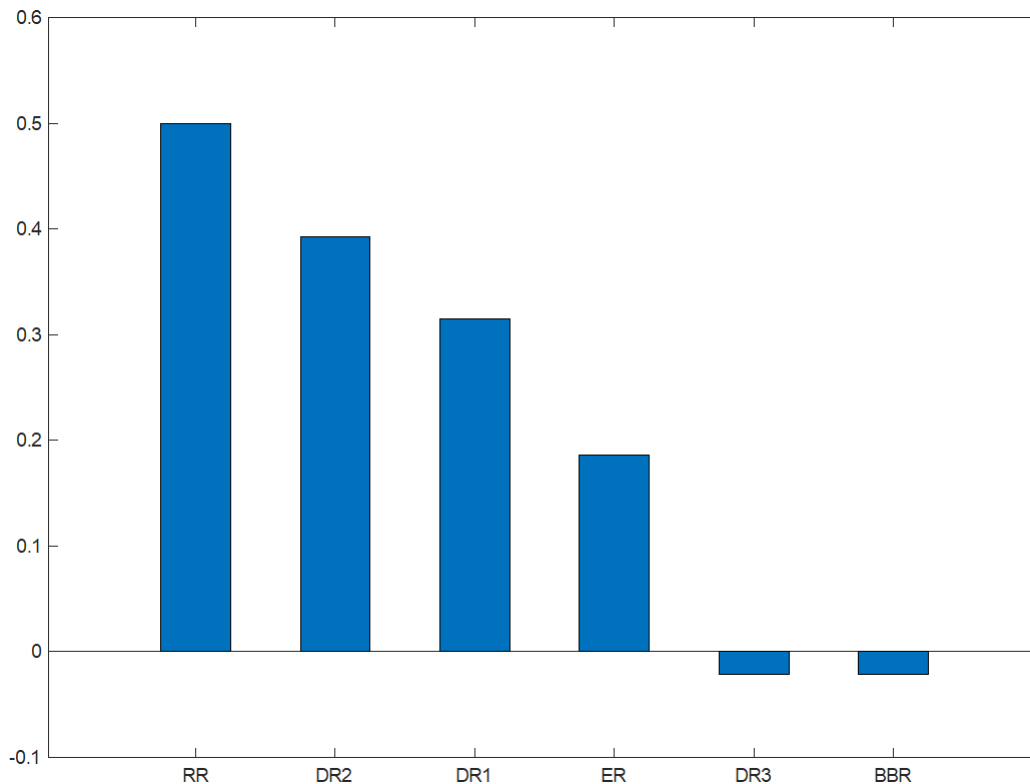
Notes:DR1: Debt rule based on the adjustment of revenues against deviation of debt-to-GDP from target. DR2: Debt rule based on the adjustment of expenditures against deviation of debt-to-GDP from target. DR3: Debt rule based on the adjustment of fiscal balance against deviation of debt-to-GDP from target. BBR: Balance rule. ER: Expenditure rule. RR: Revenues as a percentage of GDP rule. Source: Author's calculations.

However, despite their procyclicality, revenue rules tend to maintain tax structure relative stable preventing the negative impact of distortions on welfare from adjusting the tax rates. This is a property absent in fiscal rules where its implementation requires at least implicit adjustment in taxes in order to achieve their goals.

Similarly, the implementation of a fiscal balance goal should be based on the duration of the business cycle, in order to reduce the volatility involved in doing so based on the fiscal year. If an annual balance goal is established, it should pursue a structural balance target.

Regarding the rules based on the adjustment of public expenditure, whether through a debt goal or the setting of a level of public expenditure relative to GDP, the reduction in volatility caused by this type of arrangement relative to the discretionary case (in the case of output, consumption and employment), reveals that there is space to modify the current design of fiscal policy towards one that leads to less macroeconomic uncertainty. It is important to remember that the gains of adopting such a rule require a credible commitment from the authority, beyond the numerical objectives.

5 Concluding Remarks

Deficit bias is a negative trait of fiscal policy that could weaken the credibility of the government and threaten its solvency. Together with the pro-cyclical behavior of fiscal variables, the persistence of the deficit bias introduces volatility and uncertainty to the macroeconomy, reducing welfare. Fiscal rules appear as a reliable alternative to discretionary policies to resolve the aforementioned phenomenon. However, rules are not synonymous with fiscal discipline, especially if they lack a credible commitment when implementing them.

In this paper we evaluated the impact of different types of fiscal rules on CARD's macroeconomic stability, comparing them with the discretionary behavior followed by the authorities. We rely in a RBC model as a framework to do this exercise.

Results indicate that at least exist a fiscal rule dominating over the discretionary fiscal policy regime. This observation is regardless we look at volatility of macroeconomic variables or the welfare variation indicator.

Among fiscal rules, fiscal balance goals increase macroeconomic volatility, while rules based on debt-goals rules based on adjustment of taxes and public spending to output reduce it. Despite pro-cyclical behavior, revenue rules are preferable over the rest of rules based on welfare deviations from discretionary policy.

These results suggest that the transit from a discretionary scheme to a rules approach could translate into significant welfare gains, provided with an appropriate design of those rules. As for the former, adjustments that mitigate the effects of the economic cycle should be considered, as occurs when a structural balance goal is established.

However, aware that the model represents only one dimension of reality and assumes that in the formulation horizon there is no risk of default, these results should be considered with cautiousness when choosing between the discretionary approach and the one of rules. That is, a discussion of the institutional framework is required to eliminate the problem of inter-temporal inconsistency that would inherit a rule if it lacks a credible commitment and an institutional framework that includes accountability.

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Appendix

Figure A1: Primary balance by group of economies
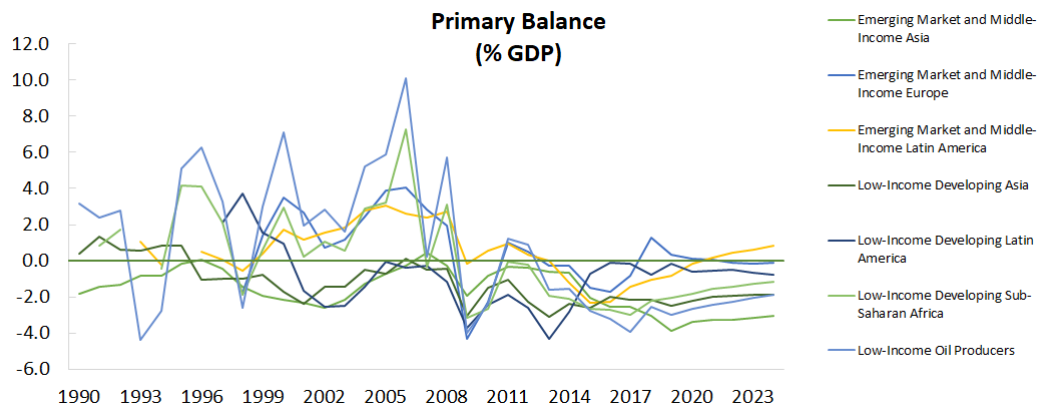
Notes: IMF Databases are used for this classification.