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Research article

Dominance score in the fiscal-monetary interaction

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Abstract: The paper addresses a trade-off between the degree of fiscal dominance and fiscal and monetary sustainability conditions. The research aims at finding growth incentives in the complex fiscal-monetary environment. By testing the actual data, the study introduces the empirical specification of the non-linear relationship between the dynamics of broad money and public debt, which allows for interpolating the fiscal space. The study develops a Dynamic Stochastic General Equilibrium (DSGE) model for a small open developing economy that, in addition to several rigidities, such as deep habit formation, staggered pricing and wage stickiness, also incorporates the extended fiscal and monetary policy blocks, a composite lifetime utility-generating function, a low level of public investment efficiency and a negative relationship between the interest rate premium and foreign prices fluctuation. Employing the developed DSGE framework made it possible to outline a promising growth path in the policy trade-off between the degree of fiscal dominance and the persistence of sustainability conditions. The modeling results revealed that short-term growth outweighs the crowding-out effect and that excessive macroeconomic volatility, especially price and debt dynamics, is well-curbed. The calculation of elasticity functions allowed for calibrating the interrelationship between the maximum growth rate of output, the degree of fiscal dominance and the persistence of fiscal and monetary sustainability conditions. The study highlights two key messages. The public debt ratio is not the final indicator to determine fiscal sustainability conditions. The degree of dominance, not the ratio of public debt to output, matters most that fiscal and monetary authorities should consider in pursuing growth incentive policy.

Keywords: fiscal policy; monetary policy; fiscal dominance; fiscal-monetary interaction; public debt; fiscal space; DSGE modeling

JEL Codes: C31, D58, E63, H63

Abbreviations: DSGE—dynamic stochastic general equilibrium model; AF-PM—active fiscal-passive monetary policy; PF-AM—passive fiscal-active monetary policy; AF-AM—active fiscal-active monetary policy; FOC—first-order-condition; ZLB—zero lower bound; MMT—Modern Money Theory; FTPL—the Fiscal Theory of the Price Level.

1. Introduction

The frequency of crises has increased in recent decades. Most macroeconomic indicators have moved far from the targeted policy rules, which take longer to settle down. Sovereign debt obligations have risen aggressively, and inflation has accelerated dramatically since the fiscal expansion and subsequent monetary easing in line with the measures taken to address the Covid-19 crisis. The energy price dynamics resulting from the Russian invasion of Ukraine have further sped up the inflation movement, posing a challenge to sustainable growth. The trade-off between effective fiscal and monetary policies has been at the forefront of debates, pushing the issue of "policy space" as a practical solution to the fiscal-monetary interplay (Ferrer & Kireyev, 2022). The delegation scheme of active fiscal policy expects public debt to be one of the financial sources of expansion (fiscal policy dominant regime), and macroeconomic performance greatly depends on how and to what extent the monetary authority responds to the given measures. In this respect, monetary accommodation usually involves unconventional steps first (including negative interest rates), as a binding ZLB does not provide sufficient room for maneuvering. Faced with the threat of inflation, conventional monetary policy kicks in to pursue price stability, which only partially addresses the consequences of the prolonged fiscal dominance.

Nowadays, policy debates pay much attention to combating the risk of debt overhangs and inflating away the forthcoming price acceleration. The current dynamics of sovereign debt obligations are not optimistic. According to the Global Debt Monitor (IMF), public debt matched 96% of world GDP in 2021, which remains above pre-Covid-19 levels. The tendency is even less upbeat in the face of "elevated uncertainty" about the war in Ukraine, the spillover effects from sanctions on Russia, population aging and the first real signs of a coming global financial crisis. Therefore, public debt sustainability is prone to be a resolver issue for active fiscal targets but over an elastic time horizon. None of the preceding evidence detracts from one conclusion: if debt dynamics are not addressed at the outset, the monetary authority should soon deal with price acceleration, including excessive volatility in asset markets, which is more challenging to manage when undue macroeconomic fluctuations are underway. In light of the above, the current paper addresses the issues of public debt in the context of active fiscal and monetary policy, focusing on the degree of dominance that matters most.

The contribution of the paper is threefold. First, by verifying actual data, the study introduces the empirically established specification of the relationship between the dynamics of broad money and public debt, which allows for interpolating the fiscal space. Second, employing the developed DSGE framework made it possible to outline a promising growth path in the policy trade-off between the degree of fiscal dominance and the persistence of sustainability conditions. Short-term growth outweighs the crowding-out effect, and the excessive macroeconomic volatility, especially price and debt dynamics, is well-curbed. Third, the calculation of elasticity functions allowed for calibrating the interrelationship between the maximum growth rate of output growth, the degree of fiscal

dominance and the persistence of fiscal and monetary sustainability conditions. Furthermore, two key messages are emphasized in the study. The public debt ratio is not the final indicator to determine fiscal sustainability conditions. The degree of dominance, not the ratio of public debt to output, matters most that fiscal and monetary authorities should consider in pursuing growth incentive policy.

The remainder of the paper is organized as follows. Section 2 summarizes the results of previous studies. Section 3 focuses on stylized facts. Section 4 presents the methodology. Section 5 demonstrates the modeling results. Section 6 presents the sensitivity analysis, and Section 7 concludes.

2. Literature review

Public debt plays an important role in promoting sustainable development. The debt instrument usually ensures fiscal solvency, but the debt burden can be problematic. As debt creators, governments can issue new securities by rolling over debt and shifting obligations to future generations. The case of price acceleration triggered by public debt growth was introduced in the seminal paper by Sargent and Wallace (1981), known as the Unpleasant Monetarist Arithmetic. This approach is not uniform, i.e., a high debt-to-GDP ratio increases the probability of price acceleration. Kwon et al. (2009) emphasize that the less developed the economy is, the higher the price acceleration associated with public debt growth. Regarding the complex issue of public debt, the literature on the relationship between public debt and output growth does not come to a single opinion (Panizza & Presbitero, 2013; Gómez-Puig et al., 2022; Augustine & Rafi, 2023). What is vital in this context, the public debt factor, by and large, is implicit in the fiscal-monetary interaction.

It has long been argued that individual policies cannot effectively internalize sustainability conditions into growth incentives. The best policy mix has to be pursued within a workable reach of fiscal-monetary interaction. Following the terminology proposed by Leeper (1991), two policy regimes are more often discussed in academic circles: the active-fiscal-passive-monetary (AF-PM) and the passive-fiscal-active-monetary (PF-AM). In this strand of policy discussion, the literature is not consolidated in deciding between money supply and debt-financed fiscal stimulus. Galí (2020) emphasizes an output-effective money channel against a debt-financed scenario under the conventional monetary policy. Giorgio & Traficante (2018) also advocate the money-financed channel but consider various fiscal adjustment schemes, such as budget transfers and a tax cut, which are less expansionary if an open economy is a case. Ma & Lv (2022) extend the presented results by considering a jointly financed fiscal incentive in the short and long time horizons. The general point highlighted by the cited papers is that in a high debt environment, policymakers face a trade-off between effectiveness and welfare losses, making it difficult to wrap up whether to use money-financed, debt-financed or jointly financed stimulus.

The success of the fiscal-monetary interaction has much to do with the degree of distress triggered by macroeconomic imbalances. The moderate and minor shocks associated with business cycles can be effectively smoothed by joint fiscal and monetary steps. The situation differs for more significant destabilizations, which are less frequent and hard to anticipate. In this case, the growth benefits over a limited time horizon tend to materialize in the policy regime tilted toward an active fiscal and monetary stance (Corsetti et al., 2019; Filiani, 2021). The active fiscal and monetary regime (AF-AM) promotes an unrealistic public debt trend (explosive debt path following Davig & Leeper, 2011), which requires valid constraints on the modus operandi of the mixed policy framework. Given the destabilizing factors of

complicated disturbances, these constraints still need to be sufficiently pronounced in magnitude and temporal consistency to find the policy steady states. The opening of the interaction focuses on debt sustainability on the fiscal side, while monetary policy follows price stability. The case of AF-AM policy concerning public debt issues is still rare in the literature. The study differs in response to the shock, which can be either fiscal or monetary, depending on the nature of the dominance. Cavalcanti et al. (2018) focus on the scenarios of the fiscal rule to ensure the sustainability of public debt in response to monetary shock. The researchers call attention to the effectiveness of the fiscal adjustment, which depends on aggressive (active) policy measures, in this context addressing the employment factors to be chosen. Philippopoulos et al. (2015) evaluate tax and spending instruments for debt consolidation in a closed economy, assuming that monetary policy actively relies on the nominal target rate for price stability. The results are robust but for the chosen parameter values, rigidity settings, and public debt ratio.

In academic circles, the case of fiscal dominance is more commonly used because it is the fiscal authority that first calls for expansionary policy actions to prevent the negative consequences of economic distress. In the given scenario, the most common case of monetary response to fiscal dominance refers to unconventional policy through seigniorage and bond sales, as conventional steps are inappropriate in the binding ZLB condition (Woodford & Xie, 2022). The less common practice is to operate with the real interest rate and real GDP to bring the public debt back to its sustainable position. Leeper & Zhou (2021) call it "interest-rate twisting" when the real interest rate instrument is mobilized to reduce the debt burden. The case described is a well-known notion called the "Reinhart conjecture," which is studied in detail by Dufrénot et al. (2018). The researchers, among other things, implement the monetary rule consistent with public debt sustainability, i.e., the inflation target adjusts directly to changes in public debt. The results are quite acceptable, as the growth rate crosses a higher level and the long-term interest rate fixes a lower stage.

The logical step to ensure the dual objectives of public debt sustainability and inflation is to locate a functional link between the two. The literature is scarce on successful attempts to establish an analytical relationship between active fiscal and active monetary policies by exercising the debt-to-GDP ratio as an interactive key factor. Validating a negative correlation between debt-to-GDP ratio and fiscal multiplier, Iiboshi & Iwata (2023) find it more productive in multiplier terms to exploit a debt-stabilizing spending rule compared to the debt-to-GDP ratio. In other words, the fiscal adjustments aimed at public debt sustainability are the priority in determining the output multiplier effect, and the debt-to-GDP ratio is a secondary concern. Further preceding this point of view, Albonico et al. (2021) find a direct relationship between the steady-state debt-to-GDP ratio and the steady-state real interest rate. The researchers trace the nature of the link to periods of sovereign debt crises, when a risk premium pushes up the real interest rate, which shifts the debt-to-GDP ratio further up, and the motion repeats. The value of this is as follows: the higher interest rate allows conventional monetary policy to be applied until the ZLB is bound again.

Extending the thematic discussion of fiscal and monetary policy objectives, Bischi et al. (2022) focus on the involvement of monetary authority in ensuring debt sustainability. To this end, the paper allows the public debt ratio to be an integral part of the Taylor rule so that monetary policy actively monitors the critical factor of fiscal sustainability. The co-movement between debt-to-GDP ratio and real interest rate, which the non-linear relationship can theoretically bring both to stable or unstable states, is examined by cross-evaluating fiscal policy, monetary policy and the risk premium factor. It is worth noting that Bischi et al. (2022) are not the first who study the monetary contribution of fiscal solvency by modifying the Taylor rule and embedding a debt ratio as an anchor for policy decisions. Kumhof et al. (2010) do the same but for nominal interest rates and expect the monetary response to a lagged value of

the public debt ratio. The economic benefit of the fiscal dominance scenario over the Ricardian policy is ambiguous regarding excessive macroeconomic volatility, especially price dynamics, which is not welcome and contributes to a welfare loss. A negative value of the debt ratio parameter in the Taylor rule specification does not radically improve the situation, even sending a positive signal through the real interest rate. In any case, an aggressive monetary response to fiscal dominance in pursuit of sustainability measures is uncontroversial. However, it requires sound fiscal discipline—an indispensable prerequisite for a developing economy when considering a valid inflation target.

3. Stylized facts

The well-known government intertemporal budget constraint reflects, among other things, the linear relationship between the change in government debt and the change in the monetary base, which is related to seigniorage. In the case of broad money creation, the given relationship evolves nonlinearly because many financial intermediaries need more transmissions to reach equilibrium in the money market. "Brad" Crayne et al. (2021) studied the dynamics of M2, the Dow Jones index and the national debt and found them to be nonlinear for annual U.S. data starting in 1969. The methodology used in the paper confirms the exponential trajectories of the indicators studied and their interrelationship. In light of these results, the current paper introduces and tests its version of the nonlinear relationship between broad money and public debt based on the empirical specification below:

$$M_t = k_{fd} e^{\frac{B_t + s_t B_t^*}{P_t \bar{Y}} - \frac{\bar{B} + \bar{B}^*}{\bar{Y}}} (B_t + s_t B_t^*) \tag{1}$$

where M is the broad money M3; B and B^* are the public debt in domestic and foreign currency; Y is total output; P is the aggregate price level; k_{fd} is the degree of fiscal dominance; and the dash above the indicators refers to the steady-state value.

Since sampling frequency is crucial in this particular case, quarterly data were deliberately chosen. The empirical specification (1) is tested using the IMF International Financial Statistics and the World Bank Quarterly Public Debt DataBank. The nonlinear component of the specification is an erratic movement of the public debt ratio relative to the steady state, simulating the turbulence an economy experiences during financial destabilization. The theoretical underpinnings of the introduced empirical specification come from the Modern Monetary Theory (MMT) and the Fiscal Theory of the Price Level (FTPL). There are many proponents and opponents of the government's legitimate power (see without valid constraints) to "print" money for fiscal solvency in times of crisis. This compulsive habit is not without undesirable consequences. As long as expectations are well-anchored, it is highly plausible that inflation will remain below target and that the real interest rate will be below the growth rate. This is not the case for developing countries, where the risk premium tends to push the interest rate higher than the growth rate, thus creating debt sustainability issues. In the light of successive crises and the most recent one associated with the aftermath of COVID-19 pandemic, which significantly accelerated the global debt trend, policies are being re-examined, going beyond the basic view of the fiscal-monetary interplay. The era of low-interest rates and inflation is coming to an end, and the challenge of sustainable growth (not to be confused with the secular stagnation of recent decades), which is primarily related to price stability, can be resolved by adjusting the inflation target and the neutral interest rate to their a bit higher levels.

These steps will change the bias in applying policy instruments between fiscal and monetary authorities in favor of the latter, giving monetary policy more room to maneuver and moving the zero lower bound further away (Corneo & Blanchard, 2023).

It is worth noting that fiscal dominance does not necessarily affect the sustainability of public debt. There is also no direct link between the volume of debt and its sustainability. However, in the longer term, the risk of debt overload is not far from reality, making it more difficult to meet the sustainability conditions in the given fiscal-monetary environment. Therefore, the coefficient degree of fiscal dominance introduced in the empirical specification (1) corresponds to the measure of debt burden, which is further translated into broad money multiplication. The specified coefficient depends on several factors, such as the consistency of fiscal and monetary policy, the conditions of internal and external shocks, and the consequences of the strategy adopted. In this respect, fiscal and monetary authorities play a crucial role in maintaining the sustainability conditions, including the instruments chosen to ensure an appropriate policy regime. A full illustrative report on the correlation between broad money and public debt for selected countries based on the empirical specification (1) is submitted in Appendix A.

Equation (1) corresponds to the direct measure of the broad money supply through the link between fiscal dominance and public debt sustainability: the higher the level of public debt and its gap ratio relative to the steady state, the more money is supplied to reinforce the given degree of fiscal dominance. Ranking the selected countries by their debt-to-GDP ratios reveals a dilemma between the level of public debt and the degree of fiscal dominance. Consequently, the higher the level of public debt, the less fiscal dominance the government can achieve. The decisive point of the level of public debt is around 50%, the lower value of which opens up a policy gap for manipulation, a fiscal space issue. In this respect, the technique of fiscal space assessment differs from existing methods (see, for example, Cheng & Pitterle, 2018; IMF, 2018a) but adheres to the same principles. The current working concept utilizes panel statistics. It takes the degree of fiscal dominance as a key factor and decides the fiscal space by operating with post-factum extrapolated data on output dynamics. The weak point of the proposed method of fiscal space assessment is that it is limited to the measurable scope of the data used, which corresponds to the biased size of the fiscal space dimension (Table 1, Figure 1).

Table 1. Factors driving M3 dynamics in the empirical specification (1).

Country	Fiscal dominance, degree	Steady-state ratio of public debt, % GDP	R-squared, actual vs. fitted
Hungary	0.7	89	0.7
Mauritius	1.9	79	0.9
South Africa	1.2	72	0.9
Poland	1.0	68	0.9
Costa Rica	0.9	68	0.9
Sweden	1.2	59	0.8
Colombia	1.0	59	0.9
Denmark	1.2	50	0.4
Norway	1.3	49	0.6
Czech Rep.	1.7	48	0.7

Continued on next page

Country	Fiscal dominance, degree	Steady-state ratio of public debt, % GDP	R-squared, actual vs. fitted
Ukraine	0.8	43	0.7
Indonesia	1.2	41	0.9
Chile	3.1	36	0.9
Bulgaria	2.6	35	0.9
Peru	1.9	34	0.9
Moldova	1.7	25	0.8
Average	1.5	53	0.8

Note: The results use Equation (1) and quarterly panel data. Steady-state values are linear trends of actual data. All data are market values in domestic currency. Source: IMF International Financial Statistics, World Bank Quarterly Public Debt DataBank.

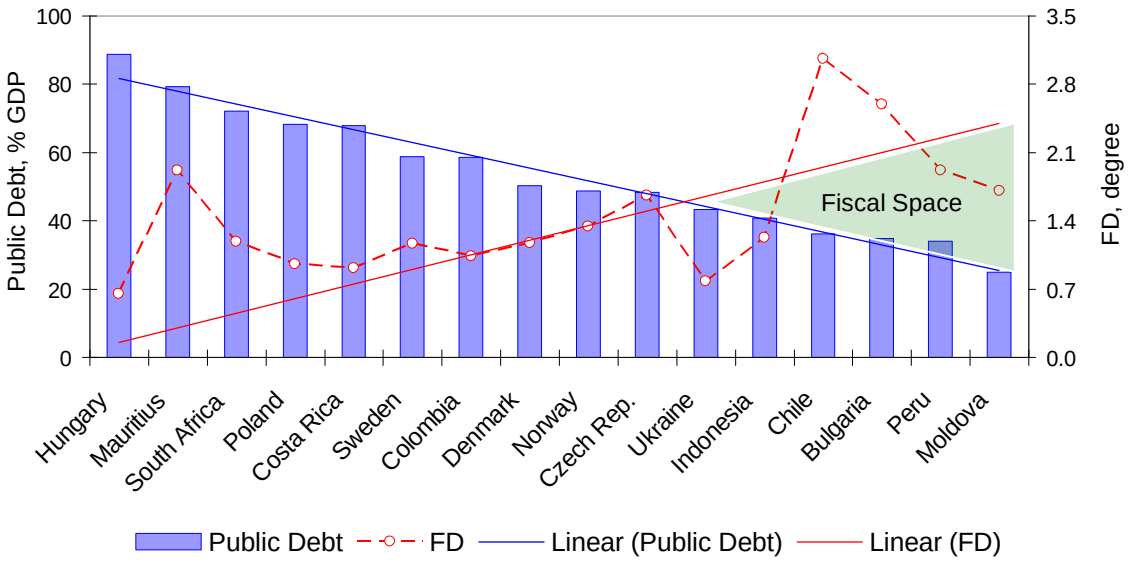

Figure 1. Selected countries ranked by empirically established degree of fiscal dominance according to Equation (1). Source: Author's calculation.

4. Methodology

Given the value of the introduced empirical specification (1) for establishing a measure of broad money depending on the degree of fiscal dominance, the equation is further examined in the complex DSGE framework to find a balance between public debt sustainability and price stability. The elaborated DSGE framework represents a canonical New Keynesian model developed for a small open developing economy. Developing countries are characterized as highly indebted economies, so the public debt problems are authentic and inspired by fiscal-monetary interplay. The description of the model structure accounts for complex fiscal and monetary blocks by incorporating Equation (1) but in a more appropriate specification. The model structure also incorporates a composite lifetime utility-generating function for Ricardian and non-Ricardian households with separability in preferences between private and government consumption and real money holdings. The other details of the model structure are a low level of public investment efficiency, absorptive capacity constraints, and a well-positioned set of rigidities. These rigidities include deep habit formation,

staggered pricing á la Calvo, and wage stickiness in monopolistically competitive firms, violating the neutrality principle of money holdings. The framework allows for a direct endogenous effect of public investment on output by including public capital in the production function. In addition, the model embeds a negative relationship between interest rate premium and foreign price fluctuations, which affects the economy's external competitiveness and borrowing conditions.

4.1. Policy framework

The policy block includes fiscal and monetary components committed to achieving sustainability goals.

4.1.1. Fiscal policy block

Two bonds circulate in the asset market: one is denominated in domestic currency, $\frac{B_t - B_{t-1}}{P_t}$ and the other is denominated in foreign currency, $\frac{B_t^* - B_{t-1}^*}{P_t}$. For simplicity, the bonds are issued to mature at the end of the period. Besides the issued bonds, the government collects lump-sum taxes, T_t, and takes economic gain of seigniorage, $\frac{M_t - M_{t-1}}{P_t}$. Government expenditures include public spending, G_t, and the repayment of bond interests, i_{t-1} and i_{t-1}^*, issued correspondingly in domestic, $\frac{B_{t-1}}{P_t}$, and foreign, $\frac{B_{t-1}^*}{P_t}$, currency. That is, the government budget constraint conforms to the following:

$$\frac{B_t - B_{t-1}}{P_t} + s_t \frac{B_t^* - B_{t-1}^*}{P_t} + \frac{M_t - M_{t-1}}{P_t} + T_t = G_t + i_{t-1}\frac{B_{t-1}}{P_t} + s_t i_{t-1}^* \frac{B_{t-1}^*}{P_t} \tag{2}$$

Mind the goal of the public debt sustainability and acting in the broad part of the feasible time horizon, the fiscal authority follows a simple rule proposed by Gali et al. (2004):

$$T_t - \bar{T} = \sigma_g (G_t - \bar{G}) + \sigma_b \left(\frac{B_{t-1}}{P_t} - \frac{\bar{B}}{\bar{P}} + \frac{s_{t-1} B_{t-1}^*}{P_t} - \frac{\bar{s}\bar{B}^*}{\bar{P}} \right) \tag{3}$$

where σ_g is the elasticity of lump-sum taxes to public spending; σ_b is the elasticity of lump-sum taxes to public debt.

Given the issue of fiscal dominance and taking into account empirical specification (1), the fiscal policy rule takes the corresponding form:

$$T_t - \bar{T} = \sigma_g (G_t - \bar{G}) + \sigma_b \bar{Y} \left(log \frac{M_{t-1}}{\bar{M}} - log \frac{B_{t-1} + s_{t-1} B_{t-1}^*}{\bar{B} + \bar{s}\bar{B}^*} \right) \tag{4}$$

The factor of the public debt gap is refreshed to the gap between money supply and public debt, each in its initial change and all inversely normalized to the steady-state output. The new key factor of fiscal sustainability corresponds to the gap dynamics between money supply and public debt in favor of the former. In this case, money creation should exceed the need for fiscal adjustment to be consistent with sustainability goals. It is important to emphasize that the purely monetary indicator, the money supply, is present in the reconstructed rule for the sustainability of public finances. In this setup, money has an effective role in making objective decisions and adjusting fiscal accounts. The

comparatively rapid increase in the money supply can alleviate the burden of public debt growth, the feature that approximates the theoretical model to the real data record of economic policy implementation. Thus, the fiscal-monetary nexus is at the forefront of the fiscal sustainability rule.

The general assumption is that public spending, *G*, is divided into public consumption, C^g, and public investment, I^g: $C_t^g + I_t^g$. It is well-known that the efficiency of public investment is not perfect, especially in the case of a developing economy. In this context, one currency unit of investment expenditure can deliver less than one currency unit of public capital. Another problem is related to the absorptive capacity constraints. As public investment increases relative to the capital stock, absorptive constraints also increase, which tends to slow the rate of public capital accumulation and discourage the benefits of higher investment. According to Agenor (2016), the law of motion for public capital captures the low efficiency and absorptive capacity constraints inherent to the typical developing economy:

$$K_t^g = (1-\delta)K_{t-1}^g + \varepsilon^0 \left(\frac{I_{t-1}^g}{K_{t-1}^g}\right)^{-\varepsilon^1} I_t^g \tag{5}$$

where $\varepsilon^0 \in (0,1)$ is the marginal efficiency; and $\varepsilon^1 > 0$ is the exceeding adjustment costs.

4.1.2. Monetary policy block

The monetary authority pursues price stability and is committed to an active policy stance. The nominal interest rate target is subject to an alternative Taylor rule. The modification specifies that the monetary authority monitors the path of the public debt-to-output ratio in the same way as it reacts to deviations of inflation and output from steady states, as suggested by Kumhof et al. (2010):

$$\begin{aligned} i_t^n = \bar{\imath}^n + \rho_i(i_{t-1}^n - \bar{\imath}^n) + \rho_\pi(\pi_{t-1} - \bar{\pi}) + \rho_y(Y_{t-1} - \bar{Y}) + \rho_s(s_{t-1} - \bar{s}) \\ +\rho_b\left(\frac{B_{t-1} + s_{t-1}B_{t-1}^*}{P_t\bar{Y}} - \frac{\bar{B} + \bar{s}\bar{B}^*}{\bar{P}\bar{Y}}\right) \end{aligned} \tag{6}$$

where i_t^n is the nominal interest rate, ρ_i, ρ_π, ρ_y, and ρ_b are positive parameters that respectively measure the degree of reaction to deviations from the steady-state of the nominal interest rate, inflation, output, exchange rate, and the public debt-to-GDP ratio (apart from the others, which are in the range of (0, 1), the parameter $\rho_\pi > 1$ is intended to satisfy the Taylor principle and be consistent with an active monetary policy).

Gross inflation is expressed as $\pi_t = \frac{P_t}{P_{t-1}}$, and the nominal exchange rate is $s_t = \frac{P_t}{P_t^*}$. Applying the adjusted form of the alternative Taylor rule specification by Equation (1), and referring to the issue of fiscal dominance, Equation (6) takes the new record:

$$\begin{aligned} i_t^n = \bar{\imath}^n + \rho_i(i_{t-1}^n - \bar{\imath}^n) + \rho_\pi(\pi_{t-1} - \bar{\pi}) + \rho_y(Y_{t-1} - \bar{Y}) + \rho_s(s_{t-1} - \bar{s}) \\ +\rho_b\left(log\frac{M_{t-1}}{\bar{M}} - log\frac{B_{t-1} + s_{t-1}B_{t-1}^*}{\bar{B} + \bar{s}\bar{B}^*}\right) \end{aligned} \tag{7}$$

In the newly specified monetary sustainability rule, the monetary authority monitors the gap between the velocity of money creation and the degree of fiscal adjustment with the contribution of public debt, each in its initial change. The velocity of broad money creation should not exceed the growth of public debt. In other words, as long as money creation remains within the bounds of public debt escalation, the potential threat of extensive price dynamics is minimal. Otherwise, the nominal interest rate should react positively, eliminating potential inflationary pressure.

4.2. Non-policy blocks

There are four agents present in the model: households, firms, government authority and the rest of the world.

4.2.1. Households

The lifetime utility function includes aggregate private consumption, which is current consumption, C_t^P, habit formation, C_{t-1}^P, and utility-generating public consumption, C_t^G, real money holdings, $\frac{M_t}{P_t}$, and labor supply, L_t. The representative household maximizes the expected discounted value of the utility function:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \left[log(C_t^P - \hbar C_{t-1}^P + \varphi C_t^G) + \chi_M \, log \frac{M_t}{P_t} - \chi_L \frac{{L_t}^{1+\phi}}{1+\phi} \right] \quad (8)$$

where $\beta \in [0,1]$ is the subjective discount factor, h is the degree of habit formation, ϕ is the elasticity of substitution between private and public consumption, $\varphi>0$ is the inverse of the Frisch elasticity of labor supply, and χ_M and χ_L are positive numbers fixing the steady-state utility of real money holdings and labor supply, respectively.

The chosen additive separability format in the utility Equation (8) is the widely used specification of constant elasticity of substitution between private and government consumption if the elasticity equals unity (Leeper et al., 2017). The complex specification of aggregate private consumption is consistent with robust evidence that a deep habit formation allows for a more flexible representation of consumption preferences. In addition, the government purchases of goods and services can shift the marginal utility of private consumption. In turn, the substitution format dampens a combined response of private consumption and labor supply to public spending shock, a more severe case streamlined to the actual benchmark conditions. A crucial notation in this specification is a bypassing discount factor shock that is mandatory in bringing the economy to a zero lower bound and not actual for developing countries (Christiano et al., 2011).

There are two types of households: Ricardian and non-Ricardian consumers. While Ricardian households are intertemporal consumers who accumulate and rent capital to firms and hold government bonds, non-Ricardian households consume all their disposable income each period. According to the budget constraint of the Ricardian households, they consume private goods, C_t^P, gain welfare from holding real money balances in the current and previous periods, $\frac{M_t - M_{t-1}}{P_t}$, invest in the production of goods, I_t^P, access domestic and foreign financial markets by buying riskless government bonds in real terms under the no-Ponzi condition denominated in the domestic, $\frac{B_t}{P_t}$, and

foreign currencies, $\frac{B_t^*}{P_t}$, receive benefits in the form of past-term real domestic and foreign interests, i_{t-1}, and i_{t-1}^*, charge real interest, r_t, on past-period capital accumulation, K_{t-1}^P, find compensation in the form of wages, $\frac{W_t}{P_t}$, and pay lump-sum taxes, T_t:

$$\begin{aligned} C_t^R + I_t^P + \frac{M_t - M_{t-1}}{P_t} + \frac{B_t - B_{t-1}}{P_t} + s_t \frac{B_t^* - B_{t-1}^*}{P_t} \\ = \frac{W_t}{P_t} L_t^R + r_t K_{t-1}^P + i_{t-1} \frac{B_{t-1}}{P_t} + i_{t-1}^* s_t \frac{B_{t-1}^*}{P_t} - T_t \end{aligned} \tag{9}$$

Assuming the depreciation rate δ ∈[0,1], the law of motion for private capital follows the rule:

$$K_t^P = (1-\delta) K_{t-1}^P + I_t^P \tag{10}$$

The budget constraint of non-Ricardian households takes the form:

$$C_t^{NR} = \frac{W_t}{P_t} L_t^{NR} \tag{11}$$

4.2.2. Labor market and wage setting

The labor market is competitive, and both households, Ricardian and non-Ricardian, work the same hours. Households are given a market power as price-setters, so the wages are staggered à la Calvo. According to this assumption, the wages can be changed after receiving some random signal. Households supply differentiated labor services to intermediate firms, which operate as monopolistically competitive market units. Independently and randomly chosen, one fraction of households $(1-\theta^w)$ sets the optimal nominal wages, while the other fraction (θ^w) maintains the same wage level as in the previous period. The optimal wage index and one that follows the stickiness rule define the aggregate wage (the information on the optimal wage level, W°, and its calculation are disclosed in Appendix B):

$$W_t = \left[\theta^w {W_{t-1}}^{1-\omega^w} + (1-\theta^w) {W_t^\circ}^{1-\omega^w}\right]^{\frac{1}{1-\omega^w}} \tag{12}$$

where ω^w is the elasticity of substitution between differentiated labor.

Based on the above assumptions, the gross wage inflation rate is $\pi^W{}_t = W_t/W_{t-1}$.

4.2.3. Firms

The firms operate in the wholesale and retail markets. They are subject to sector-specific Calvo pricing rigidities. The retailers, which are entirely identical, sell their products in the market, which is a perfectly competitive one. The wholesale firms decide the price and the number of factor endowments using the Cobb-Douglas production function. The production function exhibits constant returns to scale to the production inputs of private capital in the previous period, K_{t-1}, and labor force, L_t, which is a qualified requirement for an endogenous setting. By incorporating the public capital in the previous period, K_{t-1}^g, the production function indicates increasing returns to scale. For all components, the output elasticities are positive numbers, and, to ensure a balanced

growth path, the condition must be met $\alpha_k + \alpha_g < 1$ (Turnovsky, 2004). Thus, the production function has the form:

$$Y_t = {K_{t-1}^p}^{\alpha_k} {L_t}^{1-\alpha_k} {K_{t-1}^g}^{\alpha_g} \tag{13}$$

where the parameters α_k and α_g correspondingly denote the output elasticity with respect to private and public capital.

The wholesale firms have the market power of price-setters by following the Calvo rule. In each period *t*, a randomly selected fraction of firms $(1-\theta)$ adjusts its prices to obtain the highest discounted value of the current and future profits. The remaining firms of fraction (θ) follow a stickiness rule by maintaining the prices of the previous period. The aggregate price levels for the firms are (the information on the optimal price level, $P°$, for the wholesale firms and its calculation are disclosed in Appendix B):

$$P_t = \left[\theta {P_{t-1}}^{1-\omega} + (1-\theta){P_t^\circ}^{1-\omega}\right]^{\frac{1}{1-\omega}} \tag{14}$$

4.2.4. Rest of the world

A continuum of small open economies represents the world economy. Each economy is so small that it does not impinge on the rest of the world. Under this assumption, the world output approaches its steady-state level, $Y_t^* = \bar{Y}^*$ and also the world interest rate, $i_t^w = \bar{\imath}^*$. The domestic economy takes the prices in foreign currency, P_t^*, as given. Financial markets are incomplete, with an endogenous risk premium on foreign borrowing. The interest rate on foreign borrowing becomes closer to the world interest rate, as proposed by Drechsel & Tenreyro (2018) and confirmed by empirical evidence. The positive foreign price dynamics restore the competitiveness and borrowing conditions of the economy. Thus, the foreign interest rate, i_t^*, consists of four components: the (exogenous) constant risk-free world interest rate, $i_t^w = \bar{\imath}^*$, the exchange rate gap between two adjacent periods, $\frac{s_{t+1}}{s_t}$, the country risk premium terms, $e^{B_t^* - \bar{B}^*} - 1$, and the incomplete sharing of the foreign price risk, $log\, P_t^* - \bar{log}\, P^*$:

$$i_t^* = \bar{\imath}^* + E_t\, log\left(\frac{s_{t+1}}{s_t}\right) + \rho_{B^*}\left(e^{B_t^* - \bar{B}^*} - 1\right) + \rho_{p^*}\left(log\, P_t^* - \bar{log}\, P^*\right) \tag{15}$$

4.2.5. Equilibrium and aggregation

In equilibrium, all goods produced in the economy should be sold at home and abroad:

$$Y_t = C_t^P + I_t^P + C_t^G + I_t^G + NX_t \tag{16}$$

The external account sets up the sources of foreign exchange inflows: net exports, the sum of government bonds sold abroad, and the source of foreign exchange outflows: the interest payments, i_{t-1}^*, on the public debt in the foreign currency issued in the previous period, B_{t-1}^*:

$$NX_t P_t^* + B_t^* - B_{t-1}^* = i_{t-1}^* B_{t-1}^* \tag{17}$$

There is one violation in the model, which has a typical DSGE framework format and reproduces the AR (1) process, including the degree of autoregression persistence, $\kappa^g < 1$, and stochastic component, $v_t^g \sim i.i.d.N\left(0, \sigma_g^2\right)$:

$$log\ G_t = \kappa^g\ log\ G_{t-1} + v_t^g \tag{18}$$

Taking into account the presence of Ricardian and non-Ricardian households, aggregate private consumption and labor supply are interpolated as follows:

$$C_t^P = (1-\eta)C_t^R + \eta C_t^{NR} \tag{19}$$

$$L_t = (1-\eta)L_t^R + \eta L_t^{NR} \tag{20}$$

4.2.6. Calibration

The solution of the represented above equations is provided by numerical methods using calibrated benchmark values with a subsequent log-linearization procedure around a zero-inflation steady-state. The decided parameters are vaguely credible and are intended primarily to explain mechanisms rather than to fit data. Consequently, the model is calibrated for a developing economy where public debt and sustainability issues are widely discussed concerning the fiscal-monetary interaction. The time observation unit is a quarter. According to the baseline calibration, the subjective discount factor, β, equals 0.9828, implying an annualized real interest rate is 7%. The inverse of the Frisch elasticity of labor supply, φ, follows higher labor mobility and equals 2. The degree of elasticity substitution between private and government consumption, ϕ, is fixed at 0.3, which is relatively low, considering the output elasticity of productive government spending is 0.15. The steady-state utility of real money holdings, χ_M, is 0.4, which corresponds to the inverse of the average velocity of the monetary base. The steady-state disutility of labor supply, χ_L, is set at 0.3, consistent with the steady-state work hours, about eight hours per day. The linear term in the utilization cost function, δ, is set at 0.025 per quarter, implying the steady-state annualized depreciation rate of 10%. The elasticity of substitution between wholesale goods, ω, is level and equal to 6, so the steady-state markup in the goods market is 20%. The fraction of firms (θ) that keep their prices unchanged has a baseline value of 0.75, corresponding to the average price duration of one year. The degree of nominal wage stickiness, θ^w, equals 0.75, implying an average immobile wage bill charge of one year. The share of rule-of-thumb households corresponds to a typical value for developing countries of 0.6 (Table 2).

Table 2. Baseline calibration.

Parameter	Description	Value
β	Subjective discount factor	0.9828
h	Measure of private consumer's habit formation	0.7
ϕ	Elasticity of substitution between private and government consumption	0.3
χ_M	Steady-state utility of real money holdings	0.4
χ_L	Steady-state disutility of labor supply	0.3

Continued on next page

Parameter	Description	Value
φ	Inverse of the Frisch elasticity of labor supply	2
δ	Depreciation rate	0.025
α_k	Capital income share in production	1/3
α_g	Output elasticity to productive government spending	0.15
ω	Elasticity of substitution between wholesale goods	6
ω^w	Elasticity of substitution between differentiated labor	20
θ^w	Degree of nominal wage stickiness	0.75
θ	Degree of price stickiness	0.75
η	Share of rule-of-thumb households	0.6
Policy parameters		
ρ_i	Persistence of interest rate	0.6
ρ_π	Response of interest rate to inflation	1.5
ρ_Y	Response of interest rate to output	0.1
ρ_B	Response of interest rate to the public debt-to-output ratio	0.15
ε^0	Marginal efficiency of public investment	0.5
ε^1	Exceeding adjustment costs of public investment	0.1
k^{fd}	Degree of fiscal dominance	1.5
σ_g	Elasticity of lump-sum taxes to public spending	0.2
σ_b	Elasticity of lump-sum taxes to public debt in domestic currency	0.3
ρ_{B^*}	Elasticity of the international external premium to public debt in foreign currency	0.003
ρ_{P^*}	Elasticity of the international external premium to foreign prices	−0.02
Steady-state and violation		
υ	Initial public investment share of public spending	0.08
κ^g	Degree of autoregressive public spending shock	0.9

Source: Author's decision.

The policy block consists of monetary and fiscal parameters. The Taylor rule parameters regarding the persistence of the interest rate and the response to inflation and output are standard values widely applicable in DSGE literature: 0.6, 1.5, and 0.1, respectively. Fiscal policy parameters include investment efficiency settings, fiscal dominance, and public debt sustainability constraints. The marginal efficiency of public investment and the exceeding adjustment costs of public investment are 0.5 and 0.1, respectively. These are typical values for a developing economy. The degree of fiscal dominance is set at 1.5, the average value indicated in Table 1. The elasticity of lump-sum taxes to public spending and public debt are 0.2 and 0.3, respectively, with the preference adopted and referred to empirical evidence that upholds in favor of public debt sustainability. As will be discussed later, it is worth noting that the degree of fiscal dominance, the response of the interest rate to the public debt-to-output ratio, and the elasticity of lump-sum taxes to public debt are interrelated. Fiscal and monetary policies are unified concerning the public debt ratio. Given the above, the interest rate response to the ratio of total public debt-to-output, ρ_B, is set at 0.15. The elasticities of the international external premium to public debt in foreign currency and foreign prices are 0.003 and −0.02, respectively, the values often used in the DSGE literature if a developing economy is a case.

The initial public investment as a share of public spending, υ, is chosen concerning the report "Government at a Glance 2021." It finds that government investment as a share of government expenditure in OECD countries fell from 9.3% in 2007 to 8.1% in 2019. This reflects the rapid increase in public spending due to the COVID-19 pandemic. The persistence of the public spending shock is 0.9, implying that fiscal dominance is assumed to be high and long-lasting.

5. Results

The Matlab/Octave package and the Dynare add-on are used for the numerical simulations. The impulse response horizon is limited to 40 quarters (10 years long-run span). The economy responds to public spending shock rising by 1%. Prompted by comprehensive fiscal measures, including public capital accumulation, the shock induces rapid output growth, requiring additional fiscal stimuli to service the increased public spending. Taxes react first, fixing a radical jump within a brief time. Seigniorage and debt growth are the following policy instruments to meet the fiscal demand to finance the increased public spending. The fiscal stimuli for demand activation are short-lived, so the output dynamics are also accelerated temporarily. Price and wage rigidities limit a positive price response, making the output growth slows down longer than would otherwise be the case. In addition, the relatively low efficiency of public investment does not contribute dramatically to output dynamics, and absorptive capacity constraints also limit the growth incentives. Private consumption differs in that it allows for the presence of non-Ricardian and Ricardian households. While the initial reaction of non-Ricardian households to the increased tax pressure is adverse, these consumers quickly re-establish a positive trend. Ricardian consumers, on the other hand, are cautious and expect massive fiscal consolidation shortly (Figure 2).

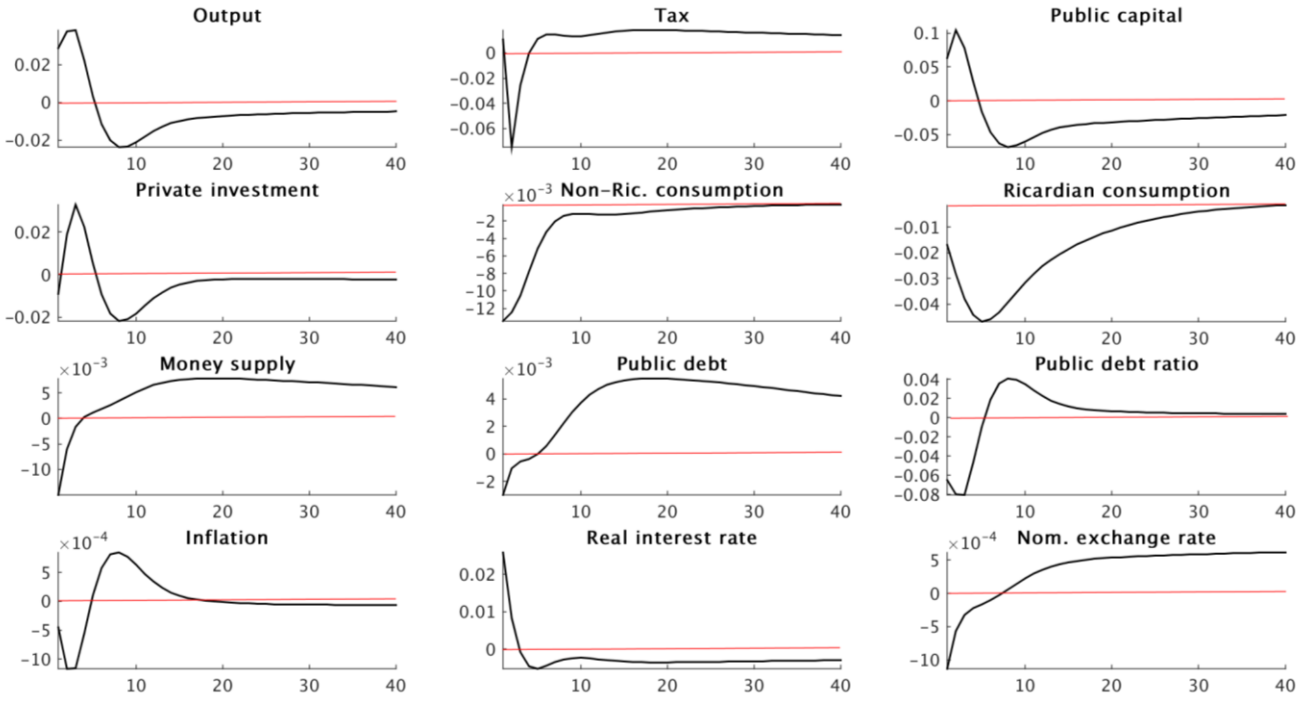

Figure 2. Integrated responses to the public spending shock (percentage deviations from the steady states). Source: Author's calculation.

Output rises, and the public debt-to-output ratio is smaller in the initial response to the public spending shock. However, the increased public debt induces a crowding-out effect that reduces private demand for credit by raising the nominal prices for borrowing. Given the relatively high share of non-Ricardian households (0.6), the crowding-out effect is less pronounced, approximately two times lower in output units. Despite the crowding-out effect, private investment reestablishes its positive dynamics and gradually drifts back to the initial level. The ongoing monetary response to the public spending shock actively absorbs the issuance of government bonds in domestic and foreign currency and the corresponding seigniorage effect. Monetary policy is less accommodative as it monitors the degree of fiscal expansion and more strictly the public debt-to-output ratio. The monetary targeting regime prevents excessive inflationary pressures, causing the real interest rate to react positively. This reaction is a forced measure, as a temporary fiscal imbalance makes it difficult to achieve sufficient revenue mobilization and provides a strong dominant position. The result of these factors is tight monetary policy accommodation with a downward effect on prices.

In the short run, the response of monetary policy shifts to a less restrictive position as inflationary pressures reduce, and prices begin to move in the opposite direction. The money supply expands to meet the need for fiscal dominance, undertaking, and the public debt uploads again. As a result, the public debt-to-output ratio resumes a positive trend, further drifting towards a steady state. To simultaneously meet the fiscal and monetary sustainability objectives, the economy responds to the public spending shock with excessive macroeconomic volatility, especially regarding public debt and price dynamics. Embedding a negative relationship between interest rate premium and foreign prices fluctuation makes borrowing conditions variable and affects the external competitiveness of the economy. This modulates a less conservative response of public debt to external conditions, including exchange rate dynamics. The exchange rate reacts promptly to the shock but ends up in a permanent depreciation area. The same applies to the dynamics of taxes, money supply and public debt, which are unfavorable due to the expected costs of the consolidated monetary and fiscal stabilization efforts.

6. Discussion

Discussing the modeling results takes up the complex topic of fiscal and monetary policy interaction and its link to growth. Two main points, the degree of fiscal dominance and the effectiveness of sustainability policy, are addressed in the context of growth incentives. Under a fiscal dominance regime, the response of the interest rate policy to the public debt movements can be either negative or positive. The negative case is a short-term factor that alleviates the debt burden by expanding aggregate demand in the form of rising consumption and output through a lower real interest rate. Debt movements restore a baseline position by reducing interest payments, which may take longer. The given settings are compromised by limited financial resources and the fiscal capacity to pursue expansionary policy as long as the short-term gains are accompanied by monetary accommodation. The positive response to fiscal dominance provides a less pronounced but longer-lasting effect. Monetary austerity limits uncontrolled fiscal expansion by leaving room for the correction of fiscal imbalances while maintaining liquidity and capital mobility and promoting macroeconomic stability. The possible consequences of such measures are excessive price volatility and its impact on macroeconomic dynamics. This case is considered in the current study to establish an active monetary position and promote the value of fiscal-monetary interaction. It should be noted

that, according to Davig & Leeper (2011), applying a negative mark to the parameter ρ_b in the current modeling framework puts the economy on an explosive path, unable to fix a stable state.

Accepting active steps to maintain a sustainable position swaps off the benefits of the fiscal dominance regime, but the macroeconomic volatility looks more pronounced, especially for public debt and price dynamics. Conversely, expecting a relatively high degree of fiscal dominance to reinforce output growth increases the likelihood of high inflation and an abnormally high public debt burden. Kumhof et al. (2010) come to the same conclusion when they modify the Taylor rule and adjust the fiscal policy conditions. In their modified Taylor rule specification, the response of the interest rate to the deviation of the public debt ratio from its initial state is negative. They assume the real interest rate mechanism is a helpful antidote to excessive public debt volatility. However, the macroeconomic instability in their scenarios somewhat negates the measures introduced. To replicate the results depicted above in the current model setup, the parameter related to the degree of fiscal dominance, k_{fd}, and the fiscal and monetary persistence parameters associated with public debt sustainability policy, σ_b, and ρ_b, respectively, are examined by calculating elasticity functions.

Considering a dominance-sustainability puzzle, one issue should be discussed beforehand. This issue is the modification of the specification entry on public debt sustainability, the new component of which is fixing the gap between broad money and public debt, each in its initial change. The update is linked to the empirical specification (1), which articulates the particular position of fiscal dominance in adding to the amount of money created in the open policy commitment. The introduced specification is non-linear and imposes additional conditions in the current fiscal-monetary environment studied in the elaborated DGSE framework. Bischi et al. (2022) also find it non-linear the relationship between interest rate and public debt dynamics, but the relationship is examined in real terms. Successfully tested on actual data, the arbitrary marks focus on the promising growth path in developing rigid policy rules. Completing the discussion on the empirical specification (1), one more comment should be added afterward. The public debt ratio is not a final indicator to determine fiscal sustainability conditions. The money supply is also indispensable but linked to the debt accumulation. The growth of broad money, or in this interpretation, newly created money, is a crucial indicator that fiscal and monetary authorities should consider in pursuing sustainability policy.

Four indicators are selected to calculate the elasticity function: the degree of fiscal dominance, the persistence of the fiscal and monetary sustainability (policy-driven parameters), and the maximum value of output growth. The calculation procedure includes 20 modeling scenarios that are run separately for the three policy-driven parameters. The calculation results show that the monetary policy-driven parameter is the most influential one in terms of elasticity ratio equal to −2.0. This parameter fixes the response of the nominal interest rate to the gap between broad money and public debt, each in its initial change in the Taylor rule specification (7) (the deviation of the public debt ratio from the steady state according to the Taylor rule specification (6) before the revision). The other two parameters, the elasticity of taxes to the gap between money supply and public debt, each in its initial change inversely normalized to the steady-state output in the fiscal policy specification (4) (the deviation of the public debt from the steady state according to the fiscal policy specification (3) before the revision) and the degree of fiscal dominance register the same ratios of elasticity but with the opposite effects −1.1 and 1.1, respectively (Table 3).

The degree of fiscal dominance is a crucial parameter that depends on the response of fiscal and monetary authorities in pursuing sustainability policy. This response can be suspended case-by-case,

exacerbating the negative consequences of a protracted fiscal dominance regime. The final score of the regime, resulting in the fiscal-monetary interactive steps to preserve sustainability conditions, is translated into the relationship between broad money and public debt, which is disclosed in the retrospective analysis (Appendix A). The different situations identified in the analysis produce the abnormal resilience of the economy in its individual response to the public debt burden, which concludes in the degree of fiscal dominance according to the empirical specification (1). Given the above comments, it is not surprising that all three parameters shown in Table 3 are found to be interrelated. Measured in units of fiscal dominance, the tax elasticity to the gap between broad money and public debt and the nominal interest rate response to the gap between broad money and public debt are 0.2 and 0.1, respectively. Since the elasticities of output at the maximum growth rate to each selected parameter differ twice in favor of preserving monetary sustainability conditions, the evaluated parameters in the units of fiscal dominance also differ twice, but in reverse order (see Table 3).

Table 3. The elasticity of output to the selected parameters regarding the degree of fiscal dominance and the fiscal and monetary sustainability conditions.

Description	Parameter	Elasticity of output at the maximum growth rate to parameter adjustment	Parameter evaluated in the units of fiscal dominance degree
Degree of fiscal dominance	k_{fd}	1.1	1
The elasticity of taxes to the gap between money supply and public debt, each in its initial change and inversely normalized to the steady-state output in the fiscal policy specification (4) (the deviation of the public debt from the steady state according to the fiscal policy specification (3) before the revision)	σ_b	−1.1	0.2
Nominal interest rate response to the gap between broad money and public debt, each in its initial change in the Taylor rule specification (7) (the deviation of the public debt ratio from the steady state according to the Taylor rule specification (6) before the revision)	ρ_b	−2.0	0.1

Source: Author's calculation.

The three indicators considered in the elasticity analysis, the maximum output growth, the degree of fiscal dominance, and the fiscal and monetary sustainability conditions, are integrated into a single plan ordered to show their interrelationship (Figure 3). Since the sustainability incentives of the fiscal and monetary authorities are similar in their response to the policy of fiscal dominance, they are presented as a joint parameter. In pursuing growth incentives, the fiscal authority calls for active expansionary steps linked to the dominance regime. That is, the degree of fiscal dominance is directly correlated with output in the short run, as fiscal dominance is a short-term stimulus. However, the monetary and fiscal authorities should actively respond to the consequences of the aggressive dominance steps and provide a joint sustainable position. The effectiveness of the joint fiscal-monetary sustainability measures prevents an excessive public debt burden but does curb the

growth movement. Dufrénot et al. (2018) also highlight the negative relationship between the output and debt gaps in case an active monetary policy is applied in a fiscal dominance regime. Under the given policy conditions, the monetary authority effectively monitors the output and the public debt burden and makes a final decision on a comparative basis. In this context, it is acceptable to allow a more resilient increase in the public debt burden to transform the tight steps of fiscal dominance into a rapid economic recovery, but the policy steps must be well-controlled. The upward trend in public debt dynamics is a mere price to pay for stimulating recovery, and this price has to be paid for no reason. The question is whether the debt trend is well-controlled, as it is difficult to eliminate the possible consequences of protracted fiscal dominance, especially in the near future. What matters in this regard is the degree of fiscal dominance, not the dynamics of public debt. Blanchard et al. (2021) also emphasize the secondary place of the public debt ratio in determining the conditions of fiscal sustainability, relying instead on the position of the primary balance and the difference between the interest rate and the growth rate. Therefore, fiscal and monetary authorities should carefully monitor the mentioned indicators to meet the sustainability conditions in the fiscal dominance regime, and the degree of fiscal dominance is crucial to prevent excessive macroeconomic volatility (Figure 3).

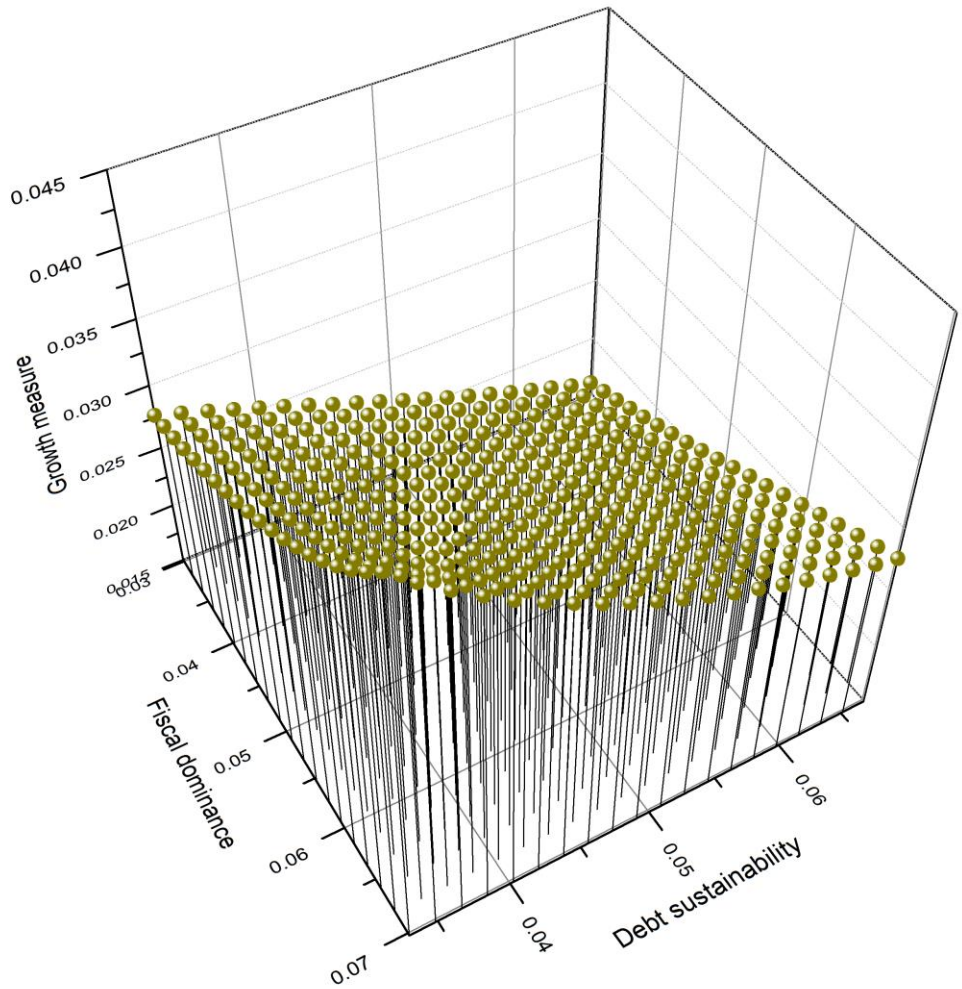

Figure 3. Dominance score in the fiscal-monetary interaction. Source: Author's calculation.

In the face of the post-Covid19 fallout, rapid price dynamics are at the center of the debates. Governments, especially those whose currency is recognized as the world's money, are doing their best to mitigate the inflationary boom and bring the price dynamics back to the target level. One of

the practical tools for identifying effective policy measures is the manipulation of the nominal interest rate, which is actively used to achieve sustainability goals. Such a predominant and expressive use of the interest rate instrument is nothing but monetary dominance, the persistence of which has much to do with the previously existing regime of fiscal dominance. The question is how long and to what extent the monetary authorities will impose the restrictions and what needs to be done to eliminate the threat of uncontrolled price dynamics in the future. The answer to this question is a matter of fiscal-monetary interaction, without referencing the authority that first opens up Pandora's box of the dominance regime. In the considered fiscal-monetary environment, the swivel stance of the policy conditions will be repeatedly changed, prolonging the upward movement of the public debt ratio, the trajectory of which turns out to be an after-effect of the dominance-sustainability puzzle.

While the current research examines the scenario of fiscal-monetary policy actions to maintain sustainability conditions in the fiscal dominance regime, the future study will modulate an opposite situation: the monetary dominance is forced to eliminate excessive macroeconomic volatility and restore the growth incentives but does not move away from the sustainable goals.

7. Conclusions

The paper examines the fiscal-monetary interaction focusing on public debt volatility. The study presents the empirically established specification of the non-linear relationship between the dynamics of broad money and public debt tested in the fiscal-monetary environment. The introduced specification is verified on actual data and has allowed for interpolating the fiscal space, whose technique follows the same principles as those proposed by existing methods. The study employs a DSGE model for a small open developing economy that, in addition to several rigidities, such as deep habit formation, staggered pricing, and wage stickiness, also incorporates the extended fiscal and monetary policy blocks, a composite lifetime utility-generating function, a low level of public investment efficiency and a negative relationship between the interest rate premium and foreign price fluctuations. Using the developed DSGE framework has made it possible to outline a promising growth path in the policy trade-off between the degree of fiscal dominance and the persistence of sustainability conditions. Short-run growth outweighs the crowding-out effect, and the excessive macroeconomic volatility, especially prices and debt dynamics, is well-curbed. The analysis provided by calculating the elasticity functions has allowed for calibrating the relationship between the maximum growth rate of output, the degree of fiscal dominance, and the persistence of fiscal and monetary sustainability conditions.

The key message of the study is that the public debt ratio is not the final indicator to determine the conditions of fiscal sustainability policy. The paper concludes that the degree of fiscal dominance, not the ratio of public debt to output, matters most. Therefore, fiscal and monetary authorities should jointly monitor the effects of fiscal dominance to avoid excessive macroeconomic volatility in pursuing growth incentive policy.

Conflict of interest

The author declares no conflicts of interest in this paper.

References

Agenor PR (2016) Optimal fiscal management of commodity price shocks. *J Dev Econ* 122: 183–196. https://doi.org/10.1016/j.jdeveco.2016.05.005

Albonico A, Ascari G, Gobbi A (2021) The public debt multiplier. *J Econ Dyn Control* 132: 104204. https://doi.org/10.1016/j.jedc.2021.104204

Augustine B, Rafi OM (2023) Public debt - economic growth nexus in emerging and developing economies: Exploring nonlinearity. *Financ Res Lett* 52: 103540. https://doi.org/10.1016/j.frl.2022.103540

Bischi GI, Giombini G, Travaglini G (2022) Monetary and fiscal policy in a nonlinear model of public debt. *Econ Anal Policy* 76: 397–409. https://doi.org/10.1016/j.eap.2022.08.020

Blanchard O, Leandro A, Zettelmeyer J (2021) Redesigning EU fiscal rules: from rules to standards. *Econ Policy* 36: 195–236. https://doi.org/10.1093/epolic/eiab003

"Brad" Crayne RB, Williams X, Neupane RC (2021) The M2 money supply, the economy, and the national debt: A mathematical approach. *Appl Math* 12: 835–865. https://doi.org/10.4236/am.2021.129056

Cavalcanti MA, Vereda L, Doctors RDB, et al. (2018) The macroeconomic effects of monetary policy shocks under fiscal rules constrained by public debt sustainability. *Econ Model* 71: 184–201. https://doi.org/10.1016/j.econmod.2017.12.010

Cheng H, Pitterle I (2018) Towards a more comprehensive assessment of fiscal space. *DESA Working Paper 153*. http://dx.doi.org/10.2139/ssrn.3106767

Christiano L, Eichenbaum M, Rebelo S (2011) When is the government spending multiplier large?. *J Polit Econ* 119: 78–121. https://doi.org/10.1086/659312

Corneo G, Blanchard O (2023) Fiscal policy under low interest rates. *J Econ* 139: 89–91. https://doi.org/10.1007/s00712-023-00823-0

Corsetti G, Dedola L, Jarociński M, et al. (2019) Macroeconomic stabilization, monetary-fiscal interactions, and Europe's monetary union. *Eur J Polit Econ* 57: 22-33. https://doi.org/10.1016/j.ejpoleco.2018.07.001

Davig T, Leeper EM (2011) Monetary–fiscal policy interactions and fiscal stimulus. *Eur Econ Rev* 55: 211–227. https://doi.org/10.1016/j.euroecorev.2010.04.004

Drechsel T, Tenreyro S (2018) Commodity booms and busts in emerging economies. *J Int Econ* 112: 200–218. https://doi.org/10.1016/j.jinteco.2017.12.009

Dufrénot G, Jawadi F, Khayat GA (2018) A model of fiscal dominance under the "Reinhart Conjecture". *J Econ Dyn Control* 93: 332–345. https://doi.org/10.1016/j.jedc.2018.01.046

Ferrer J, Kireyev A (2022) Policy space index: short-term response to a catastrophic event. *IMF Working Paper 123*. http://dx.doi.org/10.2139/ssrn.3106767

Filiani P (2021) Optimal monetary–fiscal policy in the euro area liquidity crisis. *J Macroecon* 70: 103364. https://doi.org/10.1016/j.jmacro.2021.103364

Galí J (2020) The effects of a money-financed fiscal stimulus. *J Monet Econ* 115: 1–19. https://doi.org/10.1016/j.jmoneco.2019.08.002

Gali J, Lopez-Salido J, Valles J (2004) Understanding the effects of government spending on consumption. *ECB Working Paper* 339. http://dx.doi.org/10.2139/ssrn.532982

Di Giorgio G, Traficante G (2018) Fiscal shocks and helicopter money in open economy. *Econ Model* 74: 77–87. https://doi.org/10.1016/j.econmod.2018.05.005

Gómez-Puig M, Sosvilla-Rivero S, Martínez-Zarzoso I (2022) On the heterogeneous link between public debt and economic growth. *J Int Financ Mark I* 77: 101528. https://doi.org/10.1016/j.intfin.2022.101528

Iiboshi H, Iwata Y (2023) The nexus between public debt and the government spending multiplier: fiscal adjustments matter. Available from: https://mpra.ub.uni-muenchen.de/116355/1/MPRA_paper_116355.pdf.

IMF (2018) Assessing fiscal space: An update and stocktaking. Available from: https://www.imf.org/en/Publications/Policy-Papers/Issues/2018/06/15/pp041118assessing-fiscal-space.

Kumhof M, Nunes R, Yakadina I (2010) Simple monetary rules under fiscal dominance. *J Money Credit Bank* 42: 63–92. https://doi.org/10.1111/j.1538-4616.2009.00278.x

Kwon G, McFarlane L, Robinson W (2009) Public debt, money supply, and inflation: A cross-country study. *IMF Staff Papers* 56: 476–515. https://doi.org/10.1057/imfsp.2008.26

Leeper E, Traum N, Walker T (2017) Clearing up the fiscal multiplier morass. *Am Econ Rev* 107: 2409–2454. https://doi.org/10.1257/aer.20111196

Leeper EM (1991) Equilibria under 'active' and 'passive' monetary and fiscal policies. *J Monet Econ* 27: 129–147. https://doi.org/10.1016/0304-3932(91)90007-B

Leeper EM, Zhou X (2021) Inflation's role in optimal monetary-fiscal policy. *J Monet Econ* 124: 1–18. https://doi.org/10.1016/j.jmoneco.2021.10.006

Ma Y, Lv L (2022) Money, debt, and the effects of fiscal stimulus. *Econ Anal Policy* 73: 152–178. https://doi.org/10.1016/j.eap.2021.11.005

Panizza U, Presbitero AF (2013) Public debt and economic growth in advanced economies: A survey. *Swiss J Econ Stat* 149: 175–204. https://doi.org/10.1007/BF03399388

Philippopoulos A, Varthalitis P, Vassilatos V (2015) Optimal fiscal and monetary policy action in a closed economy. *Econ Model* 48: 175–188. https://doi.org/10.1016/j.econmod.2014.10.045

Sargent TJ, Wallace N (1981) Some unpleasant monetary arithmetic. *Quarterly Review (Fall)*, 1–17. Available from: file:///C:/Users/zhuan/Downloads/qr531.pdf.

Turnovsky S (2004) The transitional dynamics of fiscal policy: long-run capital accumulation and growth. *J Money Credit Bank* 36: 883–910.

Woodford M, Xie Y (2022) Fiscal and monetary stabilization policy at the zero lower bound: Consequences of limited foresight. *J Monet Econ* 125: 18–35. https://doi.org/10.1016/j.jmoneco.2021.11.003

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