National Accounting Review

NAR, 6(1): 95–115.
DOI: 10.3934/NAR.2024005
Received: 17 October 2023
Revised: 25 January 2024
Accepted: 31 January 2024
Published: 11 March 2024

https://www.aimspress.com/journal/NAR

Research article

Public investment as a growth driver for a commodity-exporting economy: Sizing up the fiscal-monetary involvement

Serhii Shvets*

Department of Modeling and Forecasting of Economic Development, State Agency "Institute for Economics and Forecasting," National Academy of Sciences of Ukraine, 26, Panasa Myrnoho, Kyiv, 01011, Ukraine

*** Correspondence:** Email: smserg@ukr.net.

Abstract: The study presents a solution to maximize public investment as a growth driver for commodity-exporting economies. The solution is to compensate for the low efficiency of public investment by drawing on internal and external factors within an active fiscal and monetary policy framework. For this, the paper introduces a quantitative model that implements a golden rule of public finance in a resource boom backed by a sovereign wealth fund under an active monetary policy stance. The modeling results show that mobilizing windfall resource revenues to finance increased public investment can limit a crowding-out effect through proper resource allocation and change the sectoral structure in favor of the final goods sector. As confirmed by the sensitivity analysis, the low efficiency of public investment can be partially offset by a less restrictive monetary policy response to fiscal dominance, but this leads to excessive volatility in financial indicators. However, if the public debt burden is an issue due to a more robust fiscal dominance regime, a higher tax rate on exported raw materials can be used to maintain sustainability. By developing a policy goals domain, the paper initiates a discussion that can direct policy recommendations toward a promising growth path by maximizing the public investment driver in the complex policy environment of fiscal-monetary interaction.

Keywords: public investment; commodity cycles; fiscal policy; monetary policy; fiscal-monetary interaction; DSGE modeling

JEL Codes: H54, H12, E61, C31

Abbreviations: DSGE: Dynamic stochastic general equilibrium; GRPF: Golden rule of public finance; SWF: Sovereign wealth fund

1. Introduction

The acceleration in price dynamics that began in 2021 was exacerbated by the destabilization of energy markets following Russia's invasion of Ukraine. One explanation for the surge in inflation is the uncontrolled debt dynamics driven by anti-crisis fiscal measures to support aggregate demand during the outbreak of the COVID-19 pandemic. Given the new economic reality, the value of fiscal-monetary interaction is increasingly emphasized, and experts stress the need for monetary authorities to take proactive measures to anticipate the risk of excessive public indebtedness (Fernández et al., 2022). The situation is particularly relevant for developing economies with limited financial capacity and mobility, including commodity exporters, which have become more polarized and are seizing every opportunity to attract external funds and stimulate growth. However, the debate on commodity cycles tends to focus on policy responses, including public investment as a growth driver, and rarely on the fiscal-monetary interaction.

The present study adds to a wide range of studies on public investment by testing its value in the following specific policy environment: a golden rule of public finance (GRPF) during a resource boom backed by a sovereign wealth fund (SWF) under an active monetary stance. Since the sources of financing are critical components for the successful implementation of the GRPF regime, the mobilization of windfall resource revenues for increased public investment is more promising to absorb temporary fiscal imbalances without the risk of exceeding the threshold of the public debt-to-output ratio. The introduction of the GRPF policy in the proposed scenario is particularly relevant in light of the flexible fiscal rules that have proven to be productive during periods of fiscal consolidation when growth strategy is a priority (Ardanaz et al., 2021).

Cyclical resource booms can bring several benefits for commodity-exporting economies, such as increased competitiveness and more favorable borrowing conditions. However, these gains are rarely consolidated and internalized into positive long-term outcomes. A typical resource-rich economy must cope with fluctuations in resource prices and limited capital mobility, leading to unsustainable growth and financial fragility. Most commodity-exporting economies usually call for urgent monetary actions during resource booms, while fiscal policy is considered procyclical. Fiscal expansion is a key driver of growth in both the short run (demand-side effect) and the long run (supply-side effect). Increased public spending, especially public investment, creates a more significant multiplier effect, leading to faster growth.

The literature considers two critical points regarding the impact of public investment on growth in a commodity-exporting economy. The first is the low efficiency and absorptive capacity constraints of public investment. Low efficiency means that one dollar of investment delivers less than one dollar of capital (Pritchett, 2000). The lack of sound institutions, corruption, unstable business environment, skilled labor shortage, and improper project monitoring all have a negative impact on the efficiency of public investment and reduce its effectiveness. When constructing the public investment management index (PIMI), Dabla-Norris et al. (2012) identified the following components associated with public investment management process: strategic project guidance and appraisal, project selection and budgeting, project implementation, and project audit and evaluation. Another factor that negatively affects the efficiency of public investment is distorted tax collection,

including incentives for tax evasion and inflated budget conditions. Investment opportunities are also finite by a bottleneck issue related to absorptive capacity constraints. The drive to invest more proves no longer valid for developing economies due to diminishing returns and limited options for adding to production (Berg et al., 2013). Abiad et al. (2016) highlighted two other essential factors: the state of the economy and how the public investment scaling-up is financed. The authors found that when an economy experiences a recession and public investment is funded by debt accumulation, the outcome dynamics can be more encouraging and the debt-to-output ratio will decline more actively.

The second point on public investment relates to the so-called natural resource curse, which resource-rich countries tend to experience even with an abundance of non-renewable minerals. The given comparative advantage does not usually translate into prosperity despite windfall resource revenues and significant infrastructure needs. Reasonable explanations include a poor institutional environment, the absence of a well-targeted strategic plan, and an adequately sequenced and phased execution schedule. Although recent studies have found a less robust relationship between abundant natural resources and growth, the final decision is still open. The current point of view focuses on three main arguments: adverse effects on productivity, financial sector transformations, and human capital development (Badeeb et al., 2017).

One of the natural resource curse channels is the so-called Dutch disease effect, which negatively contributes to the transformation of the economic structure in favor of less productive sectors. The commodity boom adds to the displacement of the non-commodity production. The recent complex study by Mien and Goujon (2022) identifies the fiscal and monetary policy gains to obtain visible positive results in combating the Dutch disease effect. These include public redistribution strategies through the taxation of the resource sector, liquidity buffers by saving part of the windfall resource revenues, and monetary policy updates to fix the exchange rate regime. To complete this view, the interactive steps of fiscal and monetary policy prove to be a sizing argument and, by and large, are in order.

Windfall resource revenues are usually an impetus for misleading procyclical fiscal policy. Recent data presented by Bova et al. (2018) did not break up the emerging trend, expanding the progressive bias of procyclicality. The authors emphasize that the most important explanations of the procyclicality movement are regulatory quality, government effectiveness, and corruption control. Expanding on these factors, Richaud et al. (2019) focused on the conflicting goals for short-term macroeconomic stabilization and long-term debt sustainability. The issue of macroeconomic stabilization involves an argument primarily associated with the permanent income hypothesis. The hypothesis is invoked to preserve a positive income level amid economic volatility that smoothes consumption dividends across generations. Following this view, van der Ploeg (2012) concluded that the optimal windfall utilization strategy is to ramp up the public investment plan rather than follow the permanent income hypothesis. Moreover, even in the hope of a short-term investment plan, the optimal strategy is biased toward high-return projects to comply with a permanent income hypothesis when making consumption-investment decisions (Collier, 2010).

There have been several efforts in the literature to address the complex issue of public investment strategies for resource-rich countries in small- and medium-sized quantitative frameworks that, in one way or another, attempt to achieve the above goals. Algozhina (2021) exemplified the proactive mission of the SWF fund by examining a front-loaded investment plan. The study emphasized that the backup position of the SWFs significantly increases the welfare gains as consumption is depressed in the absence of this position. The other study by Gurara et al. (2019)

found that an expansionary fiscal stance is overly biased toward the quantity and quality of public investment, which is associated with the low efficiency and absorptive capacity constraints. A negative trade-off between the accumulated funds and the increased debt burden could be offset by the accumulation of SWFs through the benefits of the windfall resource revenues. It is essential to update the efficiency of public investment and carry out domestic revenue mobilization to catch up with an open investment schedule. This is because the SWFs duty and financial support are working to improve debt obligations and mitigate the intensity of Dutch disease. In this view, Presbitero (2016) made a value statement that a gradual increase in public investment is better than its front-loaded (aggressive) plan, given the risks of unsustainable debt dynamics and a cumbersome crowding-out effect.

The combination of debt instruments and windfall resource revenues as a financial backup for increased public investment makes it possible to reduce the excessive volatility of financial indicators by following a sustainable investing approach to the introduction of the SWFs, as proposed by Berg et al. (2013). In light of this, the debt sustainability risk is a significant impediment to reaching the assigned growth path, given the unpredictability of commodity price movements and the rigidities of public investment regarding the issue of efficiency and absorptive capacity constraints (Melina et al., 2016). Among the options of the outlined scenario, Melina et al. (2016) also pointed out that there is a choice for accomplishing a public investment scaling-up within a time frontier to take advantage of windfall resource revenues while preserving fiscal and output sustainability in the longer term. The committed measures prove to be positive regarding countercyclical injections for Angola and the CEMAC region in converting windfall profits into a consistently higher income. Another critical point about the relatively low efficiency of public investment in developing countries is the difficulty of translating the investment expansion into visible growth indicators by simply scaling up. The main explanatory arguments are marginal capital product, financing capacity, fiscal space room, discretionary taxation effects, requisite operation and maintenance, and debt distress (Berg et al., 2019).

The above studies on the implementation of expansionary fiscal policies in the case of resource-rich economies have succeeded in developing complex solutions based primarily on practical fiscal and monetary steps. These steps include active and passive fiscal policies, but mainly passive monetary policy that do not internalize the full potential of fiscal-monetary interaction. In light of the last statement, the present study aims to compensate for the low efficiency of public investment as a driver of growth by drawing on internal and external factors with a particular focus on the active involvement of fiscal and monetary policy. The paper considers a special case of fiscal expansion (the GRPF regime) as a realistic scenario for the effective use of available fiscal space. By challenging short-term debt sustainability incentives, this regime provides more room for diversifying a debt risk over the longer horizon. If the commodity boom is accompanied by an increase in public investment, partly financed by the windfall resource revenues, the crowding-out effect on private investment may be less pronounced. In addition, the plan for the tax mobilization of the windfall resource revenues and the introduction of the SWFs should mitigate the temporary commodity shock and establish a trend of real currency appreciation. As the appreciation trend initiates a reallocation of resources, this new direction can stem the outflow of resources from the rest of the economy, thereby preserving the competitiveness of the domestic sector.

2. Materials and methods

The general idea behind the model structure presented below is to reproduce the regime of fiscal dominance by boosting public investment under the GRPF policy during resource booms for a commodity-exporting economy. The structure of the model represents a canonical New Keynesian small-scale framework for an open developing economy that behaves as a net exporter of goods. The model is an extended version of the DSGE framework introduced in the author's previous work (Shvets, 2020). The model structure has four economic agents: households, firms, government, and the external sector. Firms are engaged in the production of commodity (z) and final (f) goods. According to the model design, the first sector reflects a separate function of commodities in the economy. The volatility of commodity prices affects the allocation of resources between sectors and, ultimately, total output. The products of both sectors can be consumed, invested in, and traded domestically and internationally (Kitano and Takaku, 2021). Other details of the model structure are the low efficiency of public investment, absorptive capacity constraints, the introduction of the SWFs, and several rigidities. These rigidities include deep habit formation, staggered Calvo price setting, and wage stickiness in a world of monopolistically competitive firms that violate the principle of neutrality of money holdings. By including public capital in the production function, this model allows for a direct endogenous effect of public investment on the production of commodity and final goods. In addition, the model incorporates a negative relationship between the interest rate premium and commodity price fluctuations, which affect the economy's external competitiveness and borrowing conditions. Appendix A discloses advanced supplementary stuff not included in the model structure below.

2.1. Households

Households are populated as a continuum of infinitely-lived identical ones. The composite lifetime utility function is designed to benefit Ricardian (fraction $1-\eta$) and non-Ricardian (fraction η) households. It considers the separability of preferences between private consumption, C^p_t, and utility-generating public consumption, C^g_t, real money holdings, M_t/P_t, and labor supply, L_t. For realistic performance, the utility function incorporates habit formation. Thus, the representative household maximizes the expected discounted utility as:

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

where $\beta \in [0,1]$ is a subjective discount factor, h is a 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, χ_M is the steady-state utility of real money holdings, and χ_L is the steady-state utility of labor supply.

Ricardian households consume private goods, C^P_t, gain welfare from real money holdings, $(M_t-M_{t-1})/P_t$, invest in production, I^P_t, purchase riskless government bonds in real terms denominated in the domestic, B_t/P_t, and foreign currencies, B^*_t/P_t, benefit real domestic, i_{t-1}, and foreign, i^*_{t-1}, interest income from holding the past government bonds, earn real interest, r_t, on past capital accumulation, K^P_{t-1}, receive real compensation, W_t/P_t, and pay lump-sum taxes, T_t. The Ricardian household budget constraint is the same in each period:

$$C_t^R + I_t^P + \frac{M_t - M_{t-1}}{P_t} + \frac{B_t - B_{t-1}}{P_t} + s_t \frac{B_t^* - B_{t-1}^*}{P_t} = \frac{W_t}{P_t} L_t^R + r_t K_{t-1}^P + i_{t-1} \frac{B_{t-1}}{P_t} + i_{t-1}^* s_t \frac{B_{t-1}^*}{P_t} - T_t \quad (2)$$

Private capital is used in two sectors $K_t^p = K_t^z + K_t^f$. Assuming a depreciation rate of $\delta \in [0,1]$, the law of motion for private capital is as follows:

$$K_t^P = (1-\delta)K_{t-1}^P + I_t^P, \quad (3)$$

The non-Ricardian household budget constraint is:

$$C_t^{NR} = \frac{W_t}{P_t} L_t^{NR}. \quad (4)$$

Gross inflation rate is: $\pi_t = P_t / P_{t-1}$, and according to the rule of one price, the nominal exchange rate takes the form: $s_t = \frac{P_t^z}{P_t^{z*}} = \frac{P_t^f}{P_t^{f*}}$.

2.2. Labor market and wage setting

Labor is supplied to both commodity and final goods sectors: $L_t = L_t^z + L_t^f$. Since the competitive labor market is perfectly mobile across sectors, Ricardian and non-Ricardian households work the same hours and receive the same compensation. The households follow the Calvo rule in setting wages by granting market power to be the price-setters. In the monopolistically competitive intermediate market, a randomly selected fraction of households ($1-\theta^W$) sets the optimal nominal wage, and the other fraction (θ^W) maintains the same wage level (stickiness point) as in the previous period. As a result, the optimal wage index gives the aggregate wage definition:

$$W_t = \left[\theta^w W_{t-1}^{1-\omega^W} + (1-\theta^w) W_{t-1}^{\circ\, 1-\omega^W} \right]^{\frac{1}{1-\omega^W}}, \quad (5)$$

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

Gross wage inflation rate is $\pi^W{}_t = Wt/W_{t-1}$.

2.3. Firms

Wholesale and retail markets differ in that the former determines the price and number of factor endowments using the Cobb-Douglas production function, and the latter is subject to sector-specific Calvo price rigidities. Commodity firms exhibit constant returns to scale by utilizing labor, $L^z{}_t$, and private capital in the previous period, $K^z{}_{t-1}$, which is a qualified requirement for an endogenous setting. The production function also includes public capital in the previous period, $K^g{}_{t-1}$, which allows for a direct endogenous effect of public investment on output and shows increasing returns to scale. The output elasticity of all components is positive values, and to maintain a balanced growth path, it is assumed that $\alpha_k{}^z + \alpha_g{}^z < 1$ (Turnovsky, 2004). Thus, the production function for the commodity goods sector is:

$$Y_t^z = K_{t-1}^{z\,\alpha_k^z} L_t^{z\,1-\alpha_k^z} K_{t-1}^{g\,\alpha_g^z}, \quad (6)$$

where α_k^z and α_g^z are parameters denoting the output elasticity of private and public capital in the production of commodity goods, respectively.

The production function for the final goods sector is similar to that for the commodity goods sector, but with one additional factor, the resource input, Z_t. Similar to the commodity goods sector, the output elasticity of all components is also positive values, and also $\alpha_k^f+\alpha_g^f<1$ (Turnovsky, 2004). So, the production function for the final goods sector takes the form:

$$Y_t^f = K_{t-1}^{f\ \alpha_k^f} Z_t^{\alpha_z^f} L_t^{f\ 1-\alpha_k^f-\alpha_z^f} K_{t-1}^{g\ \alpha_g^f}, \tag{7}$$

where α_k^f, α_z^f, and α_g^f are parameters denoting the output elasticity of private capital, resources, and public capital in final goods production, respectively.

Retailers, which are identical and operate in a perfectly competitive market, behave as Calvo price-setters. In each period t, a randomly selected fraction of firms $(1-\theta^{z,f})$ adjusts its prices to obtain the highest discounted value of the current and future profits. The other fraction of firms ($\theta^{z,f}$) maintains the prices of the previous period. The aggregate price levels for the commodity (z) and final goods (f) firms are:

$$P_t^{z,f} = \left[\theta^{z,f} P_{t-1}^{z,f\ 1-\omega^{z,f}} + \left(1-\theta^{z,f}\right) P_t^{z^\circ,f^\circ\ 1-\omega^{z,f}}\right]^{\frac{1}{1-\omega^{z,f}}}, \tag{8}$$

2.4. Fiscal authority

The tax system includes lump-sum taxes, T, and a special tax, T^{z*} – the windfall resource mobilization plan. The special tax is levied on the export products of the commodity goods sector, Y^{z*}, at the rate of τ^{z*}:

$$T_t^{z^*} = \tau^{z^*} P_t^{z^*} Y_t^{z^*}, \tag{9}$$

Public spending tends to rise during commodity price booms and fall during busts. Such a procyclical policy transfers the volatility of foreign commodity prices directly to the domestic economy. To mitigate the given volatility, a part of the windfall resource revenues will be saved in the introduced SWFs, according to a countercyclical rule that links spending to a long-run (rather than current) tax level: $F_t^* = \bar{F}^*$. The introduction of the SWFs follows the so-called all-investing approach proposed by Berg et al. (2013). The general idea of this approach is that a government combines investment spending with savings in a resource fund. The measurement of a steady-state level in the introduction of SWFs as a fiscal buffer is intended to capture the full potential of public investment a driver of growth while mitigating fiscal imbalances and Dutch disease associated with the negative spillovers of commodity booms.

Government finances are (all in real terms) public spending, G_t, the domestic, i_{t-1}, and foreign, i^*_{t-1}, interest payments on the domestic, B_{t-1}/P_t, and foreign, B^*_{t-1}/P_t, borrowings in the previous period, and the refill of the SWFs, $F_t^*/P_t - F^*_{t-1}/P_t$. The sources of financing are (all in real terms): lump-sum taxes, T_t, the tax on exported raw materials, T_t^{z*}, the interest repayment, i^*_{t-1}, of the SWFs raised in the previous period, F^*_{t-1}/P_t, one-period bonds denominated in national, $(B_t-B_{t-1})/P_t$, and foreign currency, $(B_t^*-B^*_{t-1})/P_t$, and seigniorage, $(M_t-M_{t-1})/P_t$. For simplicity, all bonds issued are assumed to mature at the end of the period. Thus, the fiscal authority's budget constraint is as follows:

$$\frac{B_t - B_{t-1}}{P_t} + s_t \frac{B_t^* - B_{t-1}^*}{P_t} + \frac{M_t - M_{t-1}}{P_t} + T_t + s_t \frac{T_t^{z^*}}{P_t} + s_t i_{t-1}^* \frac{F_{t-1}^*}{P_t} = G_t + i_{t-1} \frac{B_{t-1}}{P_t} + s_t i_{t-1}^* \frac{B_{t-1}^*}{P_t} + s_t \frac{F_t^* - F_{t-1}^*}{P_t} \quad (10)$$

The typical commodity-exporting economy experiences low efficiency and absorptive capacity constraints for public investment. Shen et al. (2018) addressed the efficiency threshold for public investment, while van der Ploeg (2012) found a negative relationship between public investment and the ratio of public investment to public capital. To capture the efficiency and absorptive capacity issues, the law of motion for public capital conforms to the specification proposed by Agenor (2016) with two crucial parameters: marginal efficiency, $\varepsilon^0 \in (0,1)$, and exceeding adjustment costs, $\varepsilon^1 > 0$:

$$K_t^g = (1-\delta) K_{t-1}^g + \varepsilon^0 \left(\frac{I_{t-1}^g}{K_{t-1}^g} \right)^{-\varepsilon^1} I_t^g, \quad (11)$$

Public spending, *G*, consists of public consumption, C^G, and public investment, I^G. The implementation of the GPRF policy envisages an increase in the share of public investment in the distribution of public spending. In this environment, the ratio of public investment to public spending may exceed ($k > 1$) its steady-state level υ (Zeyneloglu, 2018). That is, public investment matches:

$$I_t^G = k \upsilon G_t. \quad (12)$$

Given the implementation of the GPRF regime, public investment is financed at the expense of the budget revenues but only to a small extent, which corresponds to the parameter $0<\sigma<1$ (Zeyneloglu, 2018). Thus, the distribution of government revenues satisfies the following condition:

$$T_t + s_t i_{t-1}^* \frac{F_{t-1}^*}{P_t} = \sigma I_t^g + C_t^g + i_{t-1} \frac{B_{t-1}}{P_t} + s_t i_{t-1}^* \frac{B_{t-1}^*}{P_t}. \quad (13)$$

2.5. Monetary authority

The monetary authority sets the nominal interest rate and follows a forward-looking rule consistent with an inflation-targeting regime. In this sense, the monetary authority becomes one of the decision-making agents and follows an alternative specification of the Taylor rule. The alternative assumes that, in addition to the lagged inflation, interest rate, and output, the Taylor rule also responds to the public debt-to-output ratio (Kumhof et al., 2010):

$$i_t^n = \bar{i}^n + \rho_i \left(i_{t-1}^n - \bar{i}^n \right) + \rho_\pi \left(\pi_{t-1} - \bar{\pi} \right) + \rho_y \left(Y_{t-1} - \bar{Y} \right) + \rho_b \left(\frac{B_{t-1} + s_{t-1} B_{t-1}^*}{P_t \bar{Y}} - \frac{\bar{B} + \bar{s} \bar{B}^*}{\bar{P} \bar{Y}} \right), \quad (14)$$

where i_t^N is the nominal interest rate and ρ_i, ρ_π, ρ_Y, and ρ_b are positive parameters that measure the degree of reaction to deviations from the steady state of the nominal interest rate, inflation, output, and the public debt ratio, respectively.

Including the monitoring of public debt dynamics in the Taylor specification changes the balance of monetary policy priorities by incorporating fiscal indicators. It is an important measure that transforms the passive stance of monetary policy into an active one, as discussed in detail in the sensitivity analysis section.

2.6. Rest of the world

The world economy consists of many small open economies, so small that they do not affect the rest of the world. This means that the world output and the world interest rates are constantly approaching their steady-state levels: $Y_t^* = \bar{Y}^*$ and $i_t^w = \bar{i}^*$. Domestic demand is determined by the decisions of households and firms in the country. The domestic economy takes the prices of commodities, P_t^{z*}, and final goods, P_t^{f*}, in foreign currency, as given. Foreign demand considers external disturbances and their impact on the economy through flexible price conditions. The specifications of foreign demand for the commodity and final goods production take into account the transmission effect of external disturbances to the domestic economy through the additional flexibility of price conditions. It depends on the relative prices of the commodity and final goods sectors abroad, $P_t^{z*,f*}/P_t^*$, and the total foreign aggregate demand, Y_t^* (Monacelli, 2005):

$$Y_t^{z^*,f^*} = \left(\frac{P_t^{z^*,f^*}}{P_t^*} \right)^{-\varsigma^{z^*,f^*}} Y_t^*, \tag{15}$$

where $\varsigma^{z*,f*}$ is the price elasticity of foreign demand for commodity and final goods.

Financial markets may be unpredictable and subject to inherent risks, such as the endogenous risk premium on foreign borrowing. According to this assumption, the commodity boom brings the interest rate on foreign borrowing closer to the world interest rate. Thus, positive commodity price dynamics restore the competitiveness and borrowing conditions of the commodity-exporting economy. Following Drechsel and Tenreyro (2018), four different factors are involved in the definition of the foreign interest rate, i_t^*: the constant risk-free world interest rate, which is exogenous, $i_t^w = \bar{i}^*$, the exchange rate gap between two consecutive periods, s_{t+1}/s_t, the terms of the country risk premium, $e^{B_t^* - \bar{B}^*} - 1$, and the imperfect sharing of the commodity price risk, $\log P_t^{z^*} - \log \bar{P}^{z^*}$:

$$i_t^* = \bar{i}^* + E_t \log\left(\frac{s_{t+1}}{s_t} \right) + \rho_{B^*}\left(e^{B_t^* - \bar{B}^*} - 1 \right) + \rho_{p^{z^*}}\left(\log P_t^{z^*} - \log \bar{P}^{z^*} \right), \tag{16}$$

where ρ_{B^*} is the elasticity of the international external premium on public debt in foreign currency and ρ_{Pz^*} is the elasticity of the international external premium to external commodity prices.

2.7. Equilibrium and aggregation

All produced goods should be sold either domestically or abroad at equilibrium:

$$Y_t = C_t^P + I_t^P + C_t^G + I_t^G + NX_t, \tag{17}$$

Net exports of goods and services, *NX*, measured in real terms, are the sum of two components: the production of commodity goods, Y^{z*}, and the production of final goods, Y^{f*}, intended for foreign trade:

$$NX_t = Y_t^{z^*} \frac{P_t^{z^*}}{P_t^*} + Y_t^{f^*} \frac{P_t^{f^*}}{P_t^*}, \tag{18}$$

The aggregate real output of domestic economy is the output of the final goods sector, Y^f, and the output of the commodity sector, Y^z, less the raw materials, *Z*, used in the production of final goods:

$$Y_t = \frac{P_t^f}{P_t} Y_t^f + \frac{P_t^z}{P_t}\left(Y_t^z - Z_t\right). \tag{19}$$

The external account shows the sources of foreign exchange inflows and outflows. The sources of inflows are net exports, NX_t, the sum of government bonds sold abroad, B^*_t-B^*_{t-1}, the tax rate on exported raw materials, $T_t^{z^*}$, and the interest repayments, i^*_{t-1}, of the SWFs raised in the previous period, F^*_{t-1}. The sources of foreign exchange outflows are the refill of the SWFs, F^*_t-F^*_{t-1}, and the interest repayments, i^*_{t-1}, of the public debt issued in foreign currency in the previous period, B^*_{t-1}:

$$NX_t P_t^* + \left(B_t^* - B_{t-1}^*\right) + T_t^{z^*} + i_{t-1}^* F_{t-1}^* = i_{t-1}^* B_{t-1}^* + \left(F_t^* - F_{t-1}^*\right). \tag{20}$$

The model includes two violations related to the commodity boom and the public spending shock. The violations have a typical DSGE framework format. Each violation reproduces the AR(1) process, including the degree of autoregressive persistence, $\kappa<1$, and the stochastic component $\nu_t \sim \text{i.i.d.N}\left(0, \sigma_g^2\right)$. The impact of the commodity boom is normalized to its steady-state level. Since the economy is more sensitive to price volatility than quantity dynamics, the intensity of the resource boom is ten times lower than that of the public spending shock. The descriptions of the commodity boom and the public spending shock are:

$$\log \frac{P_t^{z^*}}{\overline{P}^{z^*}} = \kappa_1^{p^{z^*}} \log \frac{P_{t-1}^{z^*}}{\overline{P}^{z^*}} + \nu_t^{p^{z^*}}, \tag{21}$$

$$\log G_t = \kappa^g \log G_{t-1} + \nu_t^g. \tag{22}$$

The presence of intertemporal and liquidity-constrained households implies that aggregate private consumption and labor supply are interpolated as follows:

$$C_t^P = (1-\eta) C_t^R + \eta C_t^{NR} \tag{23}$$

$$L_t = (1-\eta) L_t^R + \eta L_t^{NR} \tag{24}$$

2.8. Calibration

The object of the modeling is a typical commodity-exporting economy with low public investment efficiency, starting at 0.5 and below. Most of the calibrated parameters are normal values, often used in the DSGE literature for developing economies. A full report of the parameter calibration, consistent with the author's previous work (Shvets, 2020), is provided in Appendix B. There are several parameters that still need to be explained. One of them is the tax rate on exported raw materials, τ^{z^*}, that varies widely in the literature. It is set at 0.05, which is a matter of policy objectives. This is a compromise between exploiting the full potential of revenue mobilization in recourse booms and avoiding fiscal distortions in resource cycle busts. The initial values of the public investment as a share of public spending, υ, and public debt-to-output ratio, B^{tot}/Y, are chosen with reference to the report "Government at a Glance 2021". Among other things, the report finds that government investment as a share of government spending in OECD countries has fallen from 9.3% in 2007 to 8.1% in 2019. The data presented reflect the rapid increase in current government

spending due to the COVID-19 pandemic. For the same reason, public debt has increased substantially, reaching on average 115% of GDP for the 22 OECD and EU member countries in 2020.

3. Results

The model described above is solved by numerical methods using calibrated benchmarks followed by a logarithmic linearization around a steady state with zero inflation. The log-linearization of the model structure is disclosed in Appendix C. Matlab/Octave package and Dynare add-on are used for numerical simulations. The impulse response horizon is limited to 24 quarters (6-year midterm forecast). The commodity-exporting economy is hit by two shocks: a 0.1% increase in foreign commodity prices (external impact) and a 1% increase in public spending (internal impact). The combination of internal and external shocks induces rapid output growth. The increase in government revenue is insufficient to finance the increase in public spending, which requires extra fiscal stimulus. A smaller part of public spending, public investment, is financed through the issuance of government bonds due to the implementation of the GPRF regime. Beyond the debt instrument, additional tax revenues are mobilized to finance the increased public investment and the introduction of the SWFs. The object of the additional tax revenues is the export of raw materials. The demand stimulus from higher commodity prices and the public spending shock are short-term factors, so the increase in output is only temporary. However, increasing public investment is a powerful supply-side trigger that can prolong the growth trajectory. In addition, the favorable price response is limited by the introduction of price and wage rigidities. The result is a less severe slowdown in total output growth, which can be more pronounced in other cases (Figure 1).

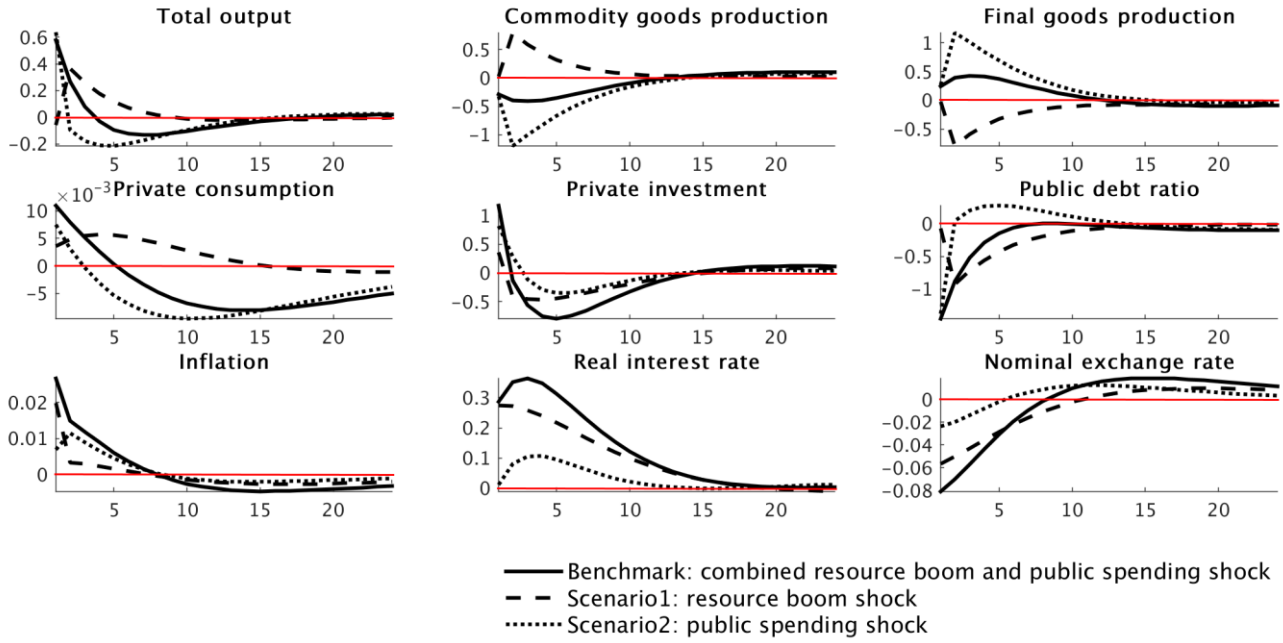

Figure 1. Scenario simulations of responses to the resource boom and public spending shock (*percentage deviations from the steady states*).

Source: Author's calculation.

Commodity and final goods production show different movements, a sectoral reallocation effect, given that the resource price shocks are sectoral in nature (Hansen and Gross, 2018). Commodity goods production increases rapidly in response to the resource boom shock. The growth breaks down very quickly, as much of the commodity goods output is a matter of foreign trade and is taxed to pay for increased public investment and the introduction of the SWFs. In addition, much of the commodity goods output used for final goods production is constrained by rising recourse prices. The development of these two factors contributes to a downward trend in the production of commodity goods, despite a good stimulus in the form of increased public investment.

In contrast to commodity goods production, the initial reaction of the final goods sector to the resource boom shock is unfavorable. Afterward, the price stabilization gives a positive signal and the situation changes. Exports of final goods are not subject to additional taxes and are accelerated by increased public investment. The established factors trigger an upward trend in the production of final goods. The response of private consumption is encouraging, as the share of non-Ricardian households is relatively high at 0.6. The final utility effect is also positive because the elasticity of substitution between private and public consumption is 0.3, which is relatively low considering that the output elasticity of productive public spending in the commodity and final goods sectors is 0.15 and 0.16, respectively. This issue was discussed by Ganelli and Tervala (2010), who examined the impact of the trade-off between utility-enhancing public consumption and productivity-enhancing public capital.

Since the opening up of the total output as an initial response to the combined resource boom and public spending shock, the public debt-to-output ratio has declined despite a temporary increase in public debt. As public debt continues to rise, it adversely affects private demand for credit by raising the nominal price of borrowing, the so-called crowding-out effect. However, due to a significant number of non-Ricardian households (0.6), the crowding out of private investment is not as strong (about six times less in terms of total output units). Following the decline in commodity goods output, private investment gradually recovers and returns to its initial position. Gurara et al. (2019) also registered a crowding-out effect in the private sector by examining the issue of public investment when applying the DIG and DIGNAR models. In particular, they point out that a pronounced impact of the front-loaded investment plan of fiscal expansion usually leads to a more significant crowding-out effect.

The ongoing monetary expansion absorbs the shock to public spending by participating in the stock market operations with government bonds issued in domestic and foreign currency to finance the increased public investment, with a corresponding seigniorage effect. This participation is a somewhat forced measure, as a temporary fiscal imbalance makes it difficult to mobilize sufficient government revenues. The reasons for this are related to the understanding that low efficiency of public investment is typical for developing economies, including commodity-exporting ones. In addition, resource booms tend to transmit external shocks to the domestic market by raising inflation. These factors push up the money supply to upgrade, which leads to higher prices.

According to the Taylor rule specification, the monetary authority prevents excessive money supply by raising the nominal interest rate. In this case, policy is more restrained as it more closely tracks the path of fiscal expansion by monitoring the public debt-to-output ratio. The real interest rate changes its active dynamics and gradually slows down, approaching the steady-state level. The foreign exchange market reacts positively to the initial positive dynamics of commodity goods production by depreciating the nominal exchange rate. The decline is less aggressive than in the case

of Dutch disease when a resource boom contributes to a dominant position in commodity goods production. Suppressing the dynamics of commodity goods production by taxing the export of raw materials dissipates the existing dominance and preserves the competitiveness of the final goods sector.

The benchmark results presented above were verified by generating two additional scenarios: a resource boom shock and a public spending shock. In the resource boom shock, the dynamics of total output are moderated with little crowding-out effect. In contrast, commodity and final goods output are pronounced and follow unfavorable structural changes. The initial growth of private investment decelerates rapidly, but not private consumption, which is positive but short-lived. The rise in commodity prices transfers price volatility to the domestic market. Without more direct monetary policy intervention, inflation and interest rates remain relatively high, as does the nominal appreciation of the exchange rate (see Figure 1).

Total output growth is the highest in the scenario of public spending shock, but the crowding-out effect is also quite noticeable. The output dynamics of commodity and final goods are striking in favor of the final goods sector. The initial reaction of private consumption is encouraging, but it quickly loses this advantage and records a negative trend. The debt burden fixes a visible moment of relief but soon returns to a negative trend without the financial support of windfall resource revenues. Fiscal dominance forces the monetary authorities to be more active in controlling the excessive money supply. As a result, volatility in the stock and foreign exchange markets is moderate, with no extreme fronts (see Figure 1).

4. Discussion

The results of the comparative analysis of individual responses to internal and external shocks are less optimistic than in the baseline scenario. The benchmark reflects the positive and improved dynamics of macroeconomic indicators and particularly the total output. Assuming that economic dynamics are primarily the result of committed internal and external shocks, Siklos (2021) examined real, financial, and monetary factors and commodity prices for 20 economies, including resource-rich countries, from 1990 to 2017. Although the results are compromised by scenario conditions and methods used, the bottom line is encouraging. Shocks can counterbalance each other, producing positive spillovers through the mixing effect. This is important when the goal is to offset a negative influence by increasing the value of positive factors, as demonstrated in the results of the present study by combining the internal shock of public spending with the external shock of a commodity boom.

The comparative analysis shows the benefits of active involvement of both fiscal and monetary policy. The success of this involvement depends largely on the correct choice of time horizons for responding to committed internal and external shocks. Without the proper interplay between fiscal and monetary policy, resource booms can wipe out the temporary competitive advantages of a commodity-exporting economy, fostering public debt growth, fiscal imbalances, undue exchange rate volatility, and other devastating consequences. Algozhina (2022) also finds it crucial for the developing oil economy of Kazakhstan to rely on the combination of fiscal and monetary policy in commodity cycles to counteract unnecessary dynamics in domestic prices, aggregate output, and the exchange rate. The researcher emphasizes the value of countercyclical fiscal policy while keeping a close eye on exchange rate volatility in the Taylor rule specification.

The value of independent fiscal and monetary authorities and the need for their coordination are demonstrated by André et al. (2023) for the resource-rich Mexican economy over the period 2001–2019.

The researchers focus on fiscal-monetary interaction by modifying the specifications of policy rules through the relation between them. The Taylor rule includes a feedback to productive public spending linked to the output gap, which translates fiscal policy objectives into the dynamics of inflation and inflation expectations. In turn, public sector demand for borrowing affects inflation through the risk premium and exchange rate channels. In the context of all the simulations conducted by the researchers, the modeling results of the response to a shock to public spending and a drop in commodity prices have led an important conclusion about the ability of policy decisions to produce acceptable results in combination with internal and external factors. These results are particularly robust when the persistence and timing of the correctly chosen shocks are consistent with the goals set. For the macro indicators shown in Figure 1, the ranked IRFs are similar to the results obtained by Medina and Soto (2016). Pursuing a zero-structural balance position, the authors intended to combat fiscal procyclicality by changing the position of net assets and adjusting endogenous fiscal policy under the scenario of commodity boom. In the current study, the implementation of the GRPF policy, the introduction of the SWFs, and the revenue mobilization plan by taxing the exports of raw materials all have much to do with an anti-procyclical strategy, which explains the replication of similar results.

4.1. Sensitivity analysis

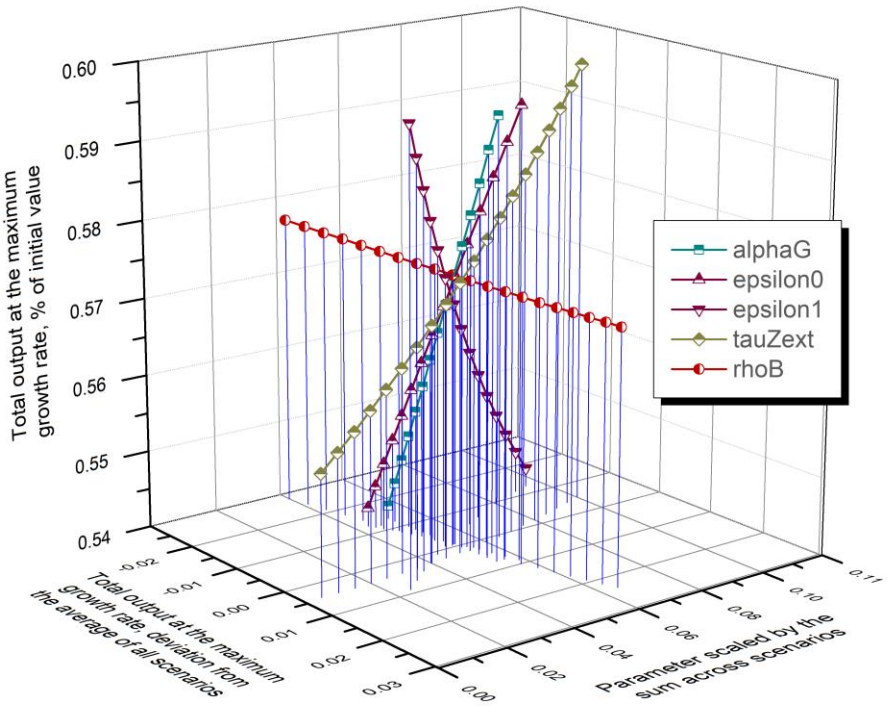

Figure 2. Results of sensitivity analysis for selected parameters.

Source: Author's calculation.

Notes: *alphaG* is the total output elasticity of public capital, *epsilon0* is the efficiency of public investment, *epsilon1* is the exceeding adjustment costs of public investment, *tauZext* is the tax rate on exported raw materials, and *rhoB* is the degree of monetary response to fiscal dominance.

Five parameters, the total output elasticity of public capital, the efficiency of public investment, the exceeding adjustment costs of public investment, the tax rate on exported raw materials, and the degree of monetary response to fiscal dominance, are deliberately selected to prove their great value in achieving policy objectives in the committed interactive fiscal and monetary policy steps. To confirm the influence of the given five parameters, the sensitivity analyses are conducted in the range of 0.15–0.16, 0.4–0.6, 0.2–0.01, 0.005–0.1, and 0.015–0.025, respectively, by fixing the maximum growth rate of the total output in 20 series of simulations for changing each parameter. The ranges of the selected parameters are chosen to ensure that the results of the scenario simulations are comparable in terms of the total output growth. The total output elasticity of public capital reflects the output of the commodity and final goods sectors with the scenario modeling range of 0.145–0.1545 and 0.155–0.1645, respectively. For sensitivity analysis, average data is used as the elasticity parameter in the range of 0.15–0.16. In addition, the efficiency of public investment is considered an integrated factor since the efficiency and the exceeding adjustment costs of public investment tend to change together. To enhance the visual comparability, the results of the sensitivity analysis are presented in a single 3D map (Figure 2).

The results of the sensitivity analysis (Figure 2) confirm that the five parameters, the total output elasticity of public capital, the efficiency of public investment, the tax rate on exported raw materials, and the degree of monetary response to fiscal dominance, all are related to fiscal and monetary policy commitments. Each of these parameters has its own set of considerations. Output growth is most sensitive to the total output elasticity of public capital. This is because the parameter is a component of the production function and directly affects the production volumes. The total output elasticity of public capital calculated at the maximum growth rate of the total output is 2.37. As the most influential factor of output dynamics, the output elasticity of public capital (public capital is productive public goods in the endogenous structure of the model) is the least applicable parameter for policy exercises when quick results are a priority. The income share of productive public goods in output is mainly determined by the structure of the economy and is not a short-term fiscal policy instrument. Achieving results takes a longer term due to the complex mechanism of economic transition, which involves at least three segments: the budget, the households, and the real sector.

In testing the output elasticity of factor endowments using dynamic GMM regressions for the efficiency-adjusted public investment management index (PIMI) compiled by Dabla-Norris et al. (2012), Gupta et al. (2014) indicated a higher marginal product of public capital equals 0.80 in low-income countries compared to 0.51 in middle-income countries. Given these results, Kamiguchi and Tamai (2023) emphasized that the relatively higher productivity of public investment is an important argument in favor of choosing debt financing instruments to accelerate economic dynamics, especially when the economy is on a dynamically efficient growth path, that is, when the interest rate exceeds the growth rate. This situation is typical for developing economies characterized by limited capital mobility, financial repression, and a high investment risk premium. Although the output elasticity of public capital has a strong positive impact on growth, the upper value of this parameter is limited by the ratio of public investment to GDP. From a welfare perspective, growth is constrained when the ratio of public investment to GDP exceeds the output elasticity of public capital (Bom and Ligthart, 2014).

The second parameter in the ranking factors affecting total output is the efficiency of public investment, which is an important factor in improving production volumes. The total output elasticity of public investment efficiency calculated at the maximum growth rate of the total output is 0.15.

Budget revenues are sensitive to the rising trend in output resulting from increased public investment. If this factor is less significant, the ability of the economy to respond to the public spending shock is more sluggish, revealing a higher sensitivity of output to the risks of a more severe fiscal imbalance. While the impact of public investment efficiency is more contrasting in the short run, it generates less inequality in the long run, producing a confident positive value, as shown by Shen et al. (2018). Considering the last comment, it is logical to count for the supply-side effect of public investment, which should offset the demand-side effect associated with the contraction of total output in the short run (Agenor, 2016). Ultimately, the public investment efficiency parameter positively impacts total output growth, which encourages the fiscal authority to address public investment issues better (Gurara et al., 2019).

An increase in the tax rate on exported raw materials has a positive impact on the financing of increased public investment by mobilizing windfall resource revenues that contribute to the development of the final goods sector. This policy creates more room for private consumption and investment activity with greater volatility in the stock and foreign exchange markets. The total output elasticity of the tax rate on exported raw materials calculated at the maximum growth rate of the total output is 0.04. A helpful guideline is that the fiscal incentives to exploit the resource boom targeted at the commodity goods sector better yield positive results and contribute to higher total output growth. Gurara et al. (2019) also favored a windfall resource mobilization plan. In particular, they emphasized that a targeted VAT uplift to increase public investment and reserve additional fiscal space can temporarily offset the fiscal pressure on non-commodity production and the inflexible consumption of liquidity-constrained households while stimulating growth and private investment. Thus, efforts to balance the efficiency of public investment with incentives to increase revenue mobilization through the taxation of exported raw materials are very welcome in elaborating countercyclical fiscal policies during resource booms.

The degree of monetary response to fiscal dominance is the most crucial parameter, as it addresses a fiscal-monetary interaction through the link between public debt and market fluctuations. Ahmed et al. (2021) emphasized the importance of an effective interest rate policy, which should include monitoring the public debt ratio, especially for those emerging market economies that are highly exposed to commodity booms and busts (commodity-intensive economies). Given the choice between inflation and non-inflation targeting, the final score is left for the former, which is seen as an alternative to exchange rate targeting in the face of global financial crises. Currency factors induced by the fiscal dominance regime and the risk premium effect should be balanced by an appropriate interest rate policy that can prevent unnecessary inflation and exchange rate volatility.

The total output elasticity of the monetary response degree to fiscal dominance calculated at the maximum growth rate of the total output is negative and equal to −0.02. This means that a more direct response of interest rate policy to debt movements leads to a lower debt burden, implying a less fiscal dominance (Kumhof et al., 2010). It should be noted that in the modified specification of the Taylor rule, the parameter responsible for monitoring public debt dynamics can take negative and positive values. If it is negative, the lower nominal interest rates lead to higher inflation, which expands aggregate demand and leads to a reduction in public debt and output in real terms. It may take some time for the debt to retrieve its initial position through the lower interest payments. The situation is complicated by the limited time horizon of windfall resource revenues and the fiscal capacity to implement expansionary policy, especially if short-term gains are accompanied by monetary easing. As a result, financial indicators may be more volatile than usual.

According to Choudhri and Malik (2012), the dynamics of the stock and foreign exchange markets also tend to be more volatile when the Taylor rule specification includes controls on public debt growth. Considering the evolution of real public debt, the fiscal dominance parameter varies from negative to zero in two scenarios for the Pakistani economy, revealing higher inflation variability than in the benchmark scenario. Substantial fiscal pressure due to a more robust dominance regime increases the money supply, further transmitting the accelerated money dynamics to the foreign exchange market. It should be noted that there is also an option to monitor the public debt ratio in the fiscal sustainability rule. Jin and Xiong (2021) considered such a case where an outstanding public debt ratio is included in the lump-sum transfer/tax feedback policy rule. By testing the policy-switching regime between active and passive fiscal and monetary policy scenarios, the researchers argue for the need to monitor the public debt ratio while emphasizing the advantage of the variability of the policy stance as a presiding factor of the productive response to commodity cycles.

When a positive value is chosen in the Taylor specification of the interest rate policy response to fiscal dominance, the announced monetary tightening helps to restrain extreme fiscal expansion by supporting liquidity and capital mobility and promoting macroeconomic stability. The possible outcome is lower consumption and production accompanied by confident movements in financial indicators. This case is examined in the current study, which strongly supports the value of fiscal-monetary interaction. In its efforts to reduce the volatility of financial indicators and the debt burden, the monetary authority creates more disorder in private consumption and investment, leading to more conservative growth. Conversely, a looser monetary policy response to fiscal dominance is associated with more promising output growth. The dynamics of private consumption and investment are also encouraging. However, the debt burden, inflation, and interest rates are less reliable because they exhibit less controlled dynamics. Thus, the stimulus to growth comes at a high price, which is often unacceptable given the goals set and the policy adopted to achieve them.

The above discussion of the degree of monetary response to fiscal dominance has revealed a dilemma of policy goals between promising growth with pronounced volatility in the stock and foreign exchange markets and conservative growth with confident movements in financial indicators. Intentionally included in the modified specification of the Taylor rule, the monetary response to fiscal dominance nevertheless contributes positively to accelerating growth. On the one hand, an appropriate monetary policy response prevents excessive volatility in stock and foreign exchange markets. On the other hand, it provides a link between fiscal and monetary policy. The manipulation of well-targeted fiscal and monetary policy instruments, weighted according to their contribution to the total output dynamics, is intended to resolve the above dilemma. Therefore, the degree of fiscal dominance and other fiscal policy instruments, such as the efficiency of public investment and the tax rate on exported raw materials, should be consistent with an active monetary policy steps.

The relationship between the three parameters described above, which are short-term policy instruments, the efficiency of public investment, the tax rate on exported raw materials, and the degree of monetary response to fiscal dominance, transforms into the domain of policy goals expressed in a 3D map (Figure 3). According to this domain, under the given scenario conditions and model settings, the low efficiency of public investment can be partially offset by a less restrictive monetary policy response to fiscal dominance, but this leads to a more pronounced volatility in financial indicators. However, if the public debt burden is an issue due to a more robust fiscal dominance regime, a higher tax rate on exported raw materials can be used to maintain sustainability. Thus, in the case of a typical commodity-exporting economy with low public investment efficiency,

maximum growth during resource booms can be achieved if a less restrictive monetary policy response to fiscal dominance is combined with more fiscal pressure on the commodity goods sector. The proposed fiscal and monetary policy scenarios aim at finding a reasonable balance between maximum growth rates and excessive volatility of financial indicators. The developed domain of policy goals can help calibrate the crucial policy parameters and provide a practical guideline to achieve the most promising growth path by maximizing the public investment driver in the complex policy environment of fiscal-monetary interaction.

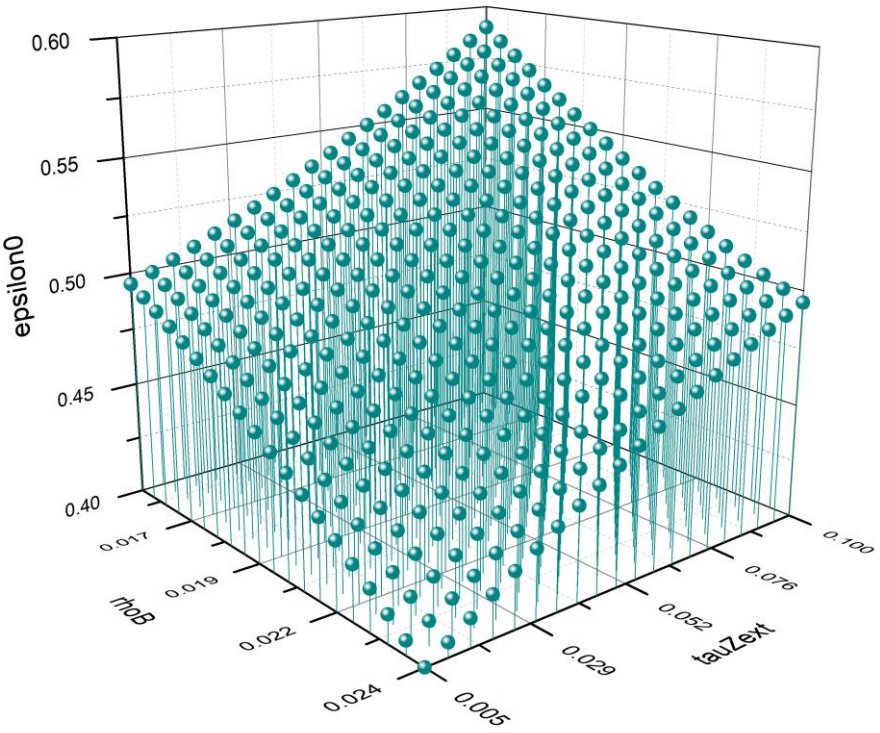

Figure 3. Policy goals domain for setting the interactive fiscal and monetary policy parameters.
Source: Results of sensitivity analysis and author's calculation.
Notes: *epsilon0* is the efficiency of public investment, *tauZext* is the tax rate on exported raw materials, and *rhoB* is the degree of monetary response to fiscal dominance.

5. Conclusions

The study presents a solution to compensate for the low efficiency of public investment as part of a growth strategy for a commodity-exporting economy. The solution involves maximizing public investment as a growth driver by drawing on internal and external factors within an active fiscal and monetary policy framework. For this, the paper introduces a DSGE model that implements the GRPF regime in a resource boom backed by the SWFs as a fiscal buffer under an active monetary stance. The model also incorporates a countercyclical fiscal policy that increases fiscal pressure on commodity exports and mobilizes windfall resource revenues to finance increased public investment. The modeling results show that this approach can mitigate a crowding-out effect and change the sectoral structure in favor of the final goods sector. In addition, a less restrictive monetary policy response to fiscal dominance can partially offset the low efficiency of public investment. However,

this may increase the volatility of financial indicators. To maintain debt sustainability, a higher tax rate on exported raw materials can counterbalance the less severe monetary response to fiscal dominance. Reviewing crucial policy parameters makes it possible to develop a policy goals domain. By focusing on this domain, policymakers can direct policy recommendations toward the most promising growth path by making the most out of the public investment driver in the complex policy environment of fiscal-monetary interaction.

Further research should focus on other critical issues of commodity-exporting economies, such as technology input and the attractiveness of labor supply, which could be addressed through the interactive steps of fiscal and monetary policy, taking into account internal and external factors and their cyclicality.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The authors declare no conflict of interest.

References

Abiad A, Furceri D, Topalova P (2016) The macroeconomic effects of public investment: evidence from advanced economies. *J Macroeconomics* 50: 224–240. https://doi.org/10.1016/j.jmacro.2016.07.005

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

Ahmed R, Aizenman J, Jinjarak Y (2021) Inflation and Exchange Rate Targeting Challenges Under Fiscal Dominance. *J Macroecon* 67: 103281. https://doi.org/10.1016/j.jmacro.2020.103281

Algozhina A (2021) Optimal public investment in resource-rich low-income countries. *J Afr Econ* 31: 75–93. https://doi.org/10.1093/jae/ejab016

Algozhina A (2022) Monetary policy rule, exchange rate regime, and fiscal policy cyclicality in a developing oil economy. *Energy Econ* 112: 106–126. https://doi.org/10.1016/j.eneco.2022.106126

André M, Armijo A, Espidio S, et al. (2023) Policy mix in a small open emerging economy with commodity prices. *Lat Am J Cent Bank* 4: 100082. https://doi.org/10.1016/j.latcb.2022.100082

Ardanaz M, Cavallo E, Izquierdo A, et al. (2021) Growth-friendly fiscal rules? Safeguarding public investment from budget cuts through fiscal rule design. *J Int Money Financ* 111: 102319. https://doi.org/10.1016/j.jimonfin.2020.102319

Badeeb R, Lean H, Clar J (2017) The evolution of the natural resource curse thesis: a critical literature survey. *Resour Policy* 51: 123–134. https://doi.org/10.1016/j.resourpol.2016.10.015

Berg A, Portillo R, Yang SC, et al. (2013) Public investment in resource-abundant developing countries. *IMF Econ Rev* 61: 92–129. https://doi.org/10.1057/imfer.2013.1

Berg A, Buffie EF, Pattillo C, et al. (2019) Some misconceptions about public investment efficiency and growth. *Economica* 86: 409–430. https://doi.org/10.1111/ecca.12275

Bom P, Ligthart J (2014) Public infrastructure investment, output dynamics, and balanced budget fiscal rules. *J Econ Dynam Contr* 40: 334–354. https://doi.org/10.1016/j.jedc.2014.01.018

Bova E, Medas P, Poghosyan T (2018) Macroeconomic stability in resource-rich countries: the role of fiscal policy. *J Bank Financ Econ* 1: 103–122.

Choudhri E, Malik H (2012) Monetary policy in Pakistan: a dynamic stochastic general equilibrium analysis. *International Growth Centre (IGC) Working Paper* 0389, London School of Economics and Political Science, UK.

Collier P, van der Ploeg R, Spence M, et al. (2010) Managing resource revenues in developing economies. *IMF Staff Papers* 57: 84–118.

Dabla-Norris E, Brumby J, Kyobe A, et al. (2012) Investing in public investment: an index of public investment efficiency. *J Econ Growth* 17: 235–266. https://doi.org/10.1007/s10887-012-9078-5

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

Fernández M, Alonso S, Forradellas R, et al. (2022) From the great recession to the COVID-19 pandemic: The risk of expansionary monetary policies. *Risks* 10: 23. https://doi.org/10.3390/risks10020023

Ganelli G, Tervala J (2010) Public infrastructures, public consumption, and welfare in a new-open-economy-macro model. *J Macroecon* 32: 827–837. https://doi.org/10.1016/j.jmacro.2009.09.009

Gupta S, Kangur A, Papageorgiou C, et al. (2014) Efficiency-adjusted public capital and growth. *World Dev* 57: 164–178. https://doi.org/10.1016/j.worlddev.2013.11.012

Gurara D, Melina G, Zanna LF (2019) Some policy lessons from country applications of the DIG and DIGNAR models. *IMF Working Pap* 62, Washington, DC, IMF, ZDB-ID 2108494-4.

Hansen J, Gross I (2018) Commodity price volatility with endogenous natural resources. *Eur Econ Rev* 101: 157–180. https://doi.org/10.1016/j.euroecorev.2017.10.006

Jin H, Xiong C (2021) Fiscal stress and monetary policy stance in oil-exporting countries. *J Int Money Financ* 111: 102302. https://doi.org/10.1016/j.jimonfin.2020.102302

Kamiguchi A, Tamai T (2023) Public investment, national debt, and economic growth: The role of debt finance under dynamic inefficiency. *J Macroecon* 77: 103535. https://doi.org/10.1016/j.jmacro.2023.103535

Kitano S, Takaku K (2021) Effect of sovereign wealth funds in commodity-exporting economies when commodity prices affect interest spreads. *Discussion Pap Ser* 22, Research Institute for Economics & Business Administration, Kobe University.

Kumhof M, Nunes R, Yakadina I (2010) Simple monetary rules under fiscal dominance. *J Money Credit Bank* 42: 63–92. https://www.jstor.org/stable/20685088

Medina J, Soto C (2016) Commodity prices and fiscal policy in a commodity exporting economy. *Econ Model* 59: 335–351. https://doi.org/10.1016/j.econmod.2016.08.002

Melina G, Yang SC, Zanna LF (2016) Debt sustainability, public investment, and natural resources in developing countries: the DIGNAR model. *Econ Model* 52: 630–649. https://doi.org/10.1016/j.econmod.2015.10.007

Mien E, Goujon M (2022) 40 Years of Dutch disease literature: lessons for developing countries. *Comp Econ Stud* 64: 351–383. https://doi.org/10.1057/s41294-021-00177-w

Monacelli T (2005) Monetary policy in a low pass-through environment. *J Money Credit Bank* 37: 1047–1066. http://www.jstor.org/stable/3839027

Presbitero A (2016) Too much and too fast? Public investment scaling-up and absorptive capacity. *J Dev Econ* 120: 17–31. https://doi.org/10.1016/j.jdeveco.2015.12.005

Pritchett L (2000) The tyranny of concepts: CUDIE (cumulated, depreciated, investment effort) is not capital. *J Econ Growth* 5: 361–384. https://doi.org/10.1023/A:1026551519329

Richaud C, Galego A, Ayivodji F, et al. (2019) Fiscal vulnerabilities in commodity exporting countries and the role of fiscal policy. *MTI Discussion Paper* 15, World Bank, Washington, DC. http://hdl.handle.net/10986/32180

Shen W, Yang SC, Zanna LF (2018) Government spending effects in low-income countries. *J Dev Econ* 133: 201–219. https://doi.org/10.1016/j.jdeveco.2018.02.005

Shvets S (2020) The golden rule of public finance under active monetary stance: endogenous setting for a developing economy. *Invest Manag Financ Innov* 17: 216–230. https://doi.org/10.21511/imfi.17(2).2020.17

Siklos PL (2021) The macroeconomic response to real and financial factors, commodity prices, and monetary policy: International evidence. *Econ Syst* 45: 100850. https://doi.org/10.1016/j.ecosys.2020.100850

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

Van der Ploeg F (2012) Bottlenecks in ramping up public investment. *Int Tax and Public Financ* 19: 509–538. https://doi.org/10.1007/s10797-012-9225-0

Zeyneloglu I (2018) Fiscal policy effectiveness and the golden rule of public finance. *Cent Bank Rev* 18: 85–93. https://doi.org/10.1016/j.cbrev.2018.08.001

AIMS Press

© 2024 the Author(s), licensee AIMS Press. This is an open access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0)