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The effectiveness of fiscal policy in DR congo: Spending and taxing for macroeconomic impact

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Abstract

This paper investigates the effectiveness of fiscal policy in the Democratic Republic of Congo (DRC), focusing on its impact on GDP, aggregate demand, private consumption, and investment. Employing a medium-scale dynamic stochastic general equilibrium (DSGE) model with Bayesian estimation, the study accounts for the distinct dynamics of Ricardian and non-Ricardian households within the DRC's socio-economic context. The results indicate that public investment expenditures significantly enhance GDP and household consumption, while current expenditures often fail to stimulate aggregate demand due to corruption and inefficiencies. Conversely, tax reductions are shown to positively influence macroeconomic variables, underlining their importance in fiscal policy design. The findings highlight the critical role of well-targeted fiscal strategies in promoting economic stability and growth in developing economies. Policy recommendations emphasize prioritizing public investment, implementing tax reforms during economic downturns, and addressing systemic corruption to maximize fiscal policy's macroeconomic impact.

JEL Classification: System: E32; E62

Keywords: DSGE; Bayesian estimation; Fiscal policy; Ricardian household; Non Ricardian household (rule-of-thumb); Fiscal multiplier

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1. Introduction

What are the effects of government spending or distortionary taxation (taxes on consumption, labour, and capital income) on GDP and aggregate demand in the DRC? Does a fiscal expansion lead to a crowding out of household consumption and firm investment in the DRC? These are key questions in the case of developing countries broadly and in the DRC's economy specifically. This paper aims to answer them. Indeed, on one hand, a fiscal policy (FP) is said to be effective if, following a government spending or a tax cut shock, it leads to an increase in aggregate demand, i.e. an increase in private consumption and investment. If, on the other hand, it leads to an opposite effect (a fall in aggregate demand), it is inefficient (Galì et al. 2007; Coenen & Straub, 2005; Fatás & Mihov, 2001; Baxter & King, 1993; Bouakez & Rebei,2007).

Few studies answer without ambiguity the above questions in the context of DRC, including Barhangana (2006); Diwambuena and Boketsu, (2019); Tavulyandanda, (2015); Barhangana (2006) estimates an error correction model with annual data from 1970 to 2000 and finds that FP was highly inefficient during this period. This study is complemented by that of Tavulyandanda (2015) which, unlike that of Barhangana (2006), covers the period 2001 to 2015, characterized by an unprecedented strong economic growth in the DRC. Despite the particularity of this period, his study leads to the same results as those of Barhangana (2006). Thus, for these two authors, the ineffectiveness of FP relies on the level and composition of expenditures (current expenditures in large proportion oriented towards imports and other less productive investments) and the size of the deficit. The research conducted by Diwambuena and Boketsu (2019) is also complementary, as it covers the period from 1980 to 2017. In contrast to the previous authors, it uses a combination of the TVC-SV and SVAR models and found mixed results. Fiscal policy is both strongly and partially effective between 2012 and 2015, with a multiplier fixed at 2. This partial effectiveness may be attributed to that only the household consumption component increases, while private investment is crowded out.

The above contradictory results create ambiguity about the countercyclical (or stabilizing) role of fiscal policy (FP) in DRC's economy especially in the context of the pandemic or recession for instance. It is in fact difficult to predict whether FP is effective or not because of the divergence of results on the subject. However, assessing the impact of an expenditure or tax shock on aggregate demand is relevant for public authorities to lead the economy toward low unemployment. For instance, when the government increases wages (a component of public spending) in a period of recession, the expected effects are that households would demand more goods and services, *ceteris paribus*. The private consumption would increase while leading firms to anticipate highly effective demand and to increase labor and capital inputs to meet the new demand. The result is a low unemployment rate and an increase in welfare at the societal level. Consequently, the implication of the aforementioned empirical works in the DRC is that a fiscal or tax shock will either crowd out aggregate demand (Barhangana, 2006; Tavulyandanda, 2015) or increase private consumption and crowd out investment (Diwambuena & Boketsu, 2019). Hence there is a need to reinterview the empirical facts to confirm or refute the above theses, make a contribution to the subject in developing countries based on the DRC case, and suggest political orientations.

Moreover, it is well known that an FP plays a stabilizing role in times of economic crisis, recession or depression to stabilize demand (Alesina et al., 2008; Ricci-Risquete and Ramajo, 2015; Santos and Palma, 2024). However, a number of economist historians have pointed out that the DRC's economy has suffered from an enormous colonial legacy (Marysse and Tshimanga, 2007; Nzongola-Ntalaja, 2002; Vlassenroot and Huggins, 2004). Indeed, since the

creation of the Independent State of Congo (EIC), the major role of fiscal policy has taken on different forms, depending on the political context in place. In the colonial period, it was used in particular to build infrastructure to transport minerals, ivory, and rubber to Belgium, the metropole. After independence, President Mobutu's dictatorial regime led to political choices such as nationalization, which had the major effect of further deteriorating the Congolese economy, with reliable diversification and heavy dependence on extractive activity. After the fall of Mobutu in 1997, the Congolese economy entered a phase of civil war, forcing the budgetary authority to finance peace by increasing military expenditure in the national budget (Tsasa, 2018). As a result, to date, the role of the FP in general has often been to finance government efforts to establish peace and reduce armed conflict in rebel-held areas. In this context, it is understandable that fiscal policy cannot fully fulfil its primary mission of stimulating demand in the event of an economic crisis or recession. Tsasa (2018) has shown the relationship between military spending and growth in the DRC by highlighting the effects of several episodes of civil wars in that relation. Its results clearly point out the fact that the impact of greater spending on economic growth may lead to a positive effect only if it aims at stabilizing the conflicts zones so as to extract foreign direct investment in the concerned regions.

This article aims to recall the importance of fiscal policy in the DRC, to correct past errors in its use and better plan its future as a big developing nation. As a result, the study postulates that FP in DRC should essentially target an impact on aggregate demand so that it may increase individual well-being during crisis or recession periods. To depart from previous analyses, we estimate a medium-scale dynamic stochastic general equilibrium model (DSGE), a widely used tool both by central banks and researchers for evaluating the effects of any economic policy. Unlike the models considered in previous works, it has the advantage of integrating the rational behaviors (decisions) of economic agents and thus allows us to study their reactions to the various shocks induced by the government. However, the standard DSGE model (Real Business Cycle or RBC) and the Smets and Wouters (2003) famous model predict a reduction in aggregate demand in response to an expansionary government spending shock (Galì et al. 2007; Coenen & Straub, 2005; Bouakez & Rebei, 2007; Fatás & Mihov, 2001). This crowding-out effect relies on the permanent income life-cycle hypothesis which posits that the rational agent always maintains his level of consumption unchanged over time.

Like Galì et al. (2007); Bhattarai and Trzeciakiewicz (2016); Coenen and Straub (2005) and Iwata (2009), this study intends to circumvent this crowding out effect by partially departing from the permanent income life-cycle hypothesis with a second type of household (non-Ricardian household or NRH) in the model. On one hand, the standard DSGE model and that of Smets and Wouters (2003) consider that the economy is populated only by Ricardian households (RH) that satisfy the permanent income life-cycle hypothesis. Non-Ricardian households (NRHs), on the other hand, however, behave differently: they can defer consumption into the future through savings but cannot incur debt to increase their level of consumption in the present (liquidity constraint assumption) (Costa, 2016; Torres, 2016; Galì et al. 2007; Campbell & Mankiw 1989; Coenen & Straub, 2005). Moreover, the DRC is among the world's poorest countries with low levels of public infrastructure, poor governance, and an overwhelming large informal sector that drains a number of skilled and unskilled workers (Amuli et al., 2024) that can be considered as NRHs. Thus, accounting for the effect of these NRHs is relevant to underdeveloped countries since a huge part of the workforce belong to this group. Their consumption depends only on their wage or salary income and thus do not have other sources of income. Galì et al. (2007) show that a good prediction of DSGE response to a government expenditure shock is better explained by the number of NRHs. The impact would be higher when this number exceeds 60 % in a competitive labor market structure.

Several studies have already evaluated the effectiveness of FP using the VAR or DSGE approach in other countries including developed and developing countries. For the VAR (or SVAR) among others: Kuttner and Posen (2002) for Japan; Mountford and Uhlig (2009) in the United States; Perotti (2004) for the OECD; Giordano et al. (2007) in Italy; Angullo-Rodriguez et al. (2011) in Mexico; Afonso and Sousa (2009) in Portugal; De Castro (2013) in Spain; Santos and Palma (2024) in Brazil. For the DSGE: Drygalla et al. (2018) for Germany; Djinkpo (2019) for the Gambia; etc. Most of the conclusions are almost identical: a shock to spending or taxes leads to an increase in aggregate consumption. Very few authors have analyzed this effectiveness by considering the effect of Non-Ricardian Households (NRHs): among others, Coenen and Straub (2005) and Galì et al. (2007) for the Euro area; Iwata (2009) for Japan, Bhattarai and Trzeciakiewicz (2016) in the United Kingdom. Their results are consistent: accounting for the effect of these agents in analysis makes FP effective.

This research draws from Galì et al. (2007); Bhattarai and Trzeciakiewicz (2016); Coenen and Straub (2005) and Iwata (2009), but departs from them in three major ways. First, it does not incorporate all shocks as considered by Smets and Wouters (2003). Second, rather than considering a simple expenditure shock or a lump-sum tax form (see Galì et al 2007; Coenen & Straub, 2005) that follows an AR(1), the FP is decomposed into two groups: the first includes a current expenditure shock and a public investment shock. The second group includes fiscal shocks related to taxation on consumption, labor income, and capital as do Bhattarai and Trzeciakiewicz (2016) in the UK and Iwata (2009) in Japan. None of the identified studies on the subject has analyzed the effects of an increase in public investment or a tax-cut policy on the Congolese economy using a general equilibrium model. Finally, as in Iwata (2009); Djinkpo (2019) and Bhattarai and Trzeciakiewicz (2016), all of these shocks are conducted by examining the effects of debt-to-GDP ratio growth in each. This allows us to take into account the suggestions of Havemann and Hollander (2024) regarding the dynamics of high deficits and to draw policymakers' attention to the effects of deficits on tax revenues. In addition, this work analyzes the sources of fluctuations in GDP and computes government spending and tax multipliers.

The rest of the work is structured as follows: in addition to this introduction and conclusion, the methodology and the interpretations and discussions of the results are stated in the second and third sections respectively.

2. Model

The model presented here is inspired by that of Costa (2016), pretty similar to the extended version of Smets and Wouters (2003) considered by Bhattarai and Trzeciakiewicz (2016) and Iwata (2009). The latter is constructed for a closed economy reduced to four agents: households, firms, the monetary authority and the fiscal authority. In addition, this model features real and nominal rigidities: habit formation, investment adjustment cost and the capacity underutilization cost. Similar to Coenen and Straub (2005); Iwata (2009); Galì et al. (2007) and Bhattarai and Trzeciakiewicz (2016), the model includes non-Ricardian households and following Iwata (2009) and Djinkpo (2019), we introduce three distortionary taxes (consumption, labor and capital income taxes) and feedback policy rules for each. Furthermore, the model has been linearized around its steady state using Uhlig (1999) method.

2.1. Households

Following Campbell & Mankiw (1989) and Mankiw (2000), there are two types of households in the economy: a fraction ω_R of Ricardian households (RHs) who offer work, earn a

wage, have access to financial markets and can thus save, buy and resell government securities and acquire capital. The other fraction $1 - \omega_R$ represents the non-Ricardian households (NRHs) who are excluded from financial markets, provide labor but consume only their disposable or wage income. Each group is represented by a single household (representative household).

2.1.1. Ricardian household (RH)

The RH problem consists of setting in each period t the quantity of goods and services to be consumed $C_{R,t}$, the physical capital K_t, the capital stock utilization rate U_t, the financial wealth in the form of government bonds B_t, and the level of investment I_t^P to maximize his lifetime utility.

The intertemporal utility function[1] for this household is given by:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^t U(C_{R,t}, L_{R,t}) \tag{1}$$

Where

$$U(C_{R,t}, L_{R,t}) = \frac{(C_{R,t} - \phi_c C_{R,t-1})^{1-\sigma}}{1-\sigma} - \frac{(L_{R,t})^{1+\varphi}}{1+\varphi}$$

And $\mathbb{E}_t$ reflects the mathematical expectation. The latter reflects the value of expected future utility resulting from consumption and labor given all the information held at time t. β reflects the individual discount factor; σ the inverse of the intertemporal elasticity of substitution (or relative coefficient of risk aversion); φ the inverse of the elasticity of labor effort with respect to the real wage; and ϕ_c measures the magnitude of the consumption pattern. These show that current utility arises from current consumption given past consumption (Bouakez and Rebei, 2007; Torres, 2016).

The Ricardian household faces the following intertemporal budget constraint:

$$\begin{aligned} &P_t(1+\tau_t^c)(C_{R,t} + I_t^P) + P_t K_t^P \Psi(U_t) + \frac{B_{t+1}}{R_t^B} \\ &\quad = W_t L_{R,t}(1-\tau_t^l) + (1-\tau_t^k) R_t U_t K_t^P + B_t + D_t \end{aligned} \tag{2}$$

The left-hand side represents expenditures and the right-hand the agent's resources. In this constraint, $C_{R,t}$ represents the consumption of RHs; $L_{R,t}$ his number of worked hours; $U_{R,t}$ rate of utilization of capital stock; I_t^P induced private investment; R_t^P interest rate on private capital; R_t^B rate of return on government securities (or treasury bills); P_t aggregate price level; W_t hourly wage rate; D_t dividend received from firms. The parameters τ_t^c, τ_t^w and τ_t^k denotes consumption, labor and capital income tax rates respectively.[2]

The function $\Psi(.)$ represents the changing cost of the utilization degree of installed capital over time (Smets & Wouters, 2003). This function takes the following form

[1] This function admits certain assumptions not included here. For more details, see Acemoglu (2009), chapter 5; Costa (2016), chapter 2, and Torres (2016), chapter 2.

[2] The DRC's General Tax Code groups these taxes into five categories depending on the property under consideration: (i) real taxes (on land concessions, vehicles, mining concessions, etc.); (ii) taxes on income (rental, movable and professional); (iii) taxes on turnover; (iv) and other specific levies and regimes (road traffic tax, registration tax, etc.) (Dj'andima, 2007). These taxes are grouped here into three as suggested by Torres (2016); Costa (2016); Coenen and Straub (2005) and Iwata (2009). Like Djinkpo (2019), the dividend tax is omitted since it is does not affect the empirical results

$\Psi(U_t) = \Psi_1(U_t - 1) + \frac{\Psi_2}{2}(U_t - 1)^2$. While the physical capital accumulation law over time is expressed by:

$$K_{t+1}^P = (1 - \delta)K_t^P + \left[1 - \frac{\chi}{2}\left(\frac{I_t^P}{I_{t-1}^P} - 1\right)^2\right] I_t^P \tag{3}$$

With δ the rate of depreciation of the capital stock, ψ_1, ψ_2 and χ are sensitivity parameters. The coefficient of I_t^P, represented by $f(.)$, describes the adjustment cost function of the investment. According to Smets and Wouters (2003) and Iwata (2009), the capital utilization rate and the corresponding installed capital utilization cost are zero at the steady state: $U_{ss} = \Psi(U_{ss}) = 0$. Moreover, the adjustment cost of capital function satisfies the following conditions $f(1) = f'(1) = 0$, i.e. at the steady state, the adjustment cost of capital is zero but increases with more investment.

Knowing that $\Lambda_{R,t}$ and Q_t are the Lagrange multipliers associated to the budget constraint and the capital accumulation equation respectively, the first-order conditions for maximizing the intertemporal utility of the Ricardian household with respect to $C_{R,t}$, K_{t+1}^P, U_t, I_t^P and B_{t+1} in this order give:

$$\Lambda_{R,t} = \frac{(C_{R,t} - \phi_c C_{R,t-1})^{-\sigma}}{P_t(1 + \tau_t^c)} - \phi_c\beta\frac{(\mathbb{E}_t C_{R,t+1} - \phi_c C_{R,t})^{-\sigma}}{P_t(1 + \tau_t^c)} \tag{4}$$

$$Q_t = \beta\mathbb{E}_t\Big[(1 - \delta)Q_{t+1} + \Lambda_{R,t+1}R_{t+1}U_{t+1}(1 - \tau_{t+1}^k) - \Lambda_{R,t}P_{t+1}\left(\psi_1(U_{t+1} - 1) + \frac{\psi_2}{2}(U_{t+1} - 1)^2\right)\Big] \tag{5}$$

$$\frac{R_t}{P_t} = \left(\frac{1}{1 - \tau_t^k}\right)[\psi_1 + \psi_2(U_t - 1)] \tag{6}$$

$$\Lambda_{R,t}P_t - Q_t\left[1 - \frac{\chi}{2}\left(\frac{I_t^P}{I_{t-1}^P} - 1\right)^2 - \chi\left(\frac{I_t^P}{I_{t-1}^P}\right)\left(\frac{I_t^P}{I_{t-1}^P} - 1\right)\right] = \chi\beta\mathbb{E}_t\left[Q_{t+1}\left(\frac{I_{t+1}^P}{I_t^P}\right)^2\left(\frac{I_{t+1}^P}{I_t^P}\right) - 1\right] \tag{7}$$

$$R_t^B\beta\mathbb{E}_t\left(\frac{\Lambda_{R,t+1}}{\Lambda_{R,t}}\right) = 1 \tag{8}$$

Under these conditions, Q_t represents Tobin's Q, which is a ratio between the market value of a company (market capitalization) and its real assets. It allows to make a decision regarding the investment to be made.

2.1.2. Non-Ricardian Household

The rest of the households $1 - \omega_R$ is the number of NRHs. These offer labor to firms and are modeled as non-optimizing agents because they face liquidity constraints that do not allow them to borrow neither to stabilize their consumption level over the life cycle. Similar to Galì et al. (2007); Coenen and Straub, 2005; Djinkpo, 2019; Iwata, 2009, these households allocate all

their periodic wage income to consumption. Since they do not have access to financial markets and do not acquire capital, they face the following budget constraint:

$$(1 + \tau_t^c) C_{NR,t} = (1 - \tau_t^l) W_t L_{R,t} \tag{9}$$

2.1.3. Wage setting

Following Galì et al. (2007), it is assumed that the labor market operates in an imperfect structure. In this market, there is a continuum of unions indexed by j which may or may not fix the wages W_t of the Ricardian and non-Ricardian employees they represent (with $j \in [R, NR]$). On the one hand, the number of hours $L_{j,t}$ offered is determined by the firms. On the other hand, the unions, which cannot fix the wage rate, are constrained to adjust it period after period according to the following scheme, taking into account the rigidity of wages[3]:

$$W_{j,t} = W_{j,t-1} \tag{10}$$

On the other hand, according to Calvo's rule, other unions are allowed to optimally set the nominal wage rate of their agents at a period t with probability $1 - \theta_w$. They all choose an identical level W_t^*. Thus, each union j, having received permission to set the optimal wage rate in period t, maximizes the utility of the household it represents, given by equation [1], taking into account the wage [10] and the demand for differentiated labor offered by household j, which is written as:

$$L_{j,t} = \left(\frac{W_t}{W_{j,t}}\right)^{\psi_w} L_t \tag{11}$$

Where ψ_w measures the elasticity of substitution between differentiated labor services. The following first-order condition follows:

$$W_t^* = \left(\frac{\psi_w}{\psi_w - 1}\right) \mathbb{E}_t \sum_{i=0}^{\infty} (\beta\theta_w)^i \left[\frac{L_{j,t+i}^{\varphi}}{\Lambda_{j,t+i}(1 - \tau_{t+i}^l)}\right] \tag{12}$$

With θ_w the probability that the chosen optimal wage level W_t^* remains effective during the next i periods (Iwata, 2009).

Finally, the aggregate real wage level is written:

$$W_t = \left[(1 - \theta_w)(W_t^*)^{1-\lambda_w} + \theta_w W_{t-1}^{1-\lambda_w}\right]^{\frac{1}{1-\lambda_w}} \tag{13}$$

2.1.4. Aggregation

The aggregation of each specific variable $x_{i,t}$ for the consumer, where $i \in [0, 1]$, is given by (Torres, 2016):

$x_t = \phi x_{r,t} + (1 - \phi) x_{nr,t}$

Therefore, the aggregate value of consumption (i.e. the sum of RH and NRH consumption) and labor are written as:

$$C_t = \omega_R C_{R,t} + (1 - \omega_R) C_{NR,t} \tag{14}$$

[3] Wage indexation (taking into account past inflation in wage negotiations) was not considered in this study for a simple reason. Most unions represent households whose wages are paid in foreign currency (U.S. dollars in the specific context of the DRC). This greatly reduces the effects of inflation on the incomes of economic agents.

$$L_t = \omega_R L_{R,t} + (1 - \omega_R) L_{NR,t} \tag{15}$$

2.2. Firms

There are two types of firms: perfectly competitive final-good firms and monopolistically competitive intermediate-good firms indexed by $j \in [0, 1]$. The latter sell their differentiated intermediate products to the former firms, which use them as factors to generate the final goods. As with households, all firms in the two groups are represented by two firms to simplify the analysis[4]

2.2.1. Final-good firms

The final good Y_t is produced by combining a continuum of differentiated intermediate goods (inputs) $Y_{j,t}$ produced by intermediate firms j. The aggregate production technology of the final good is given by:

$$Y_t = \left(\int_0^1 Y_{j,t}^{\frac{\psi-1}{\psi}} dj \right)^{\frac{\psi}{\psi-1}} \tag{16}$$

Where ψ indicates the elasticity of substitution between different inputs or intermediate goods. The producer of the final good sells his product on a perfectly competitive market and maximizes his real profits given [16], and considers as given the prices of the inputs $P_{j,t}$ and the price of the final good P_t. Its input demand function is written as:

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{-\psi} Y_t \tag{17}$$

2.2.2. Intermediate-good firms

These producers use their own factors of production (labor and capital) and public goods (road infrastructure, etc.) to produce differentiated-goods (which are not identical). Each intermediate-good firm j produces its differentiated output using an increasing-returns-to-scale Cobb-Douglas technology:

$$Y_{j,t} = (K_{j,t}^P)^{\alpha_1} (L_{j,t})^{\alpha_2} (K_t^G)^{\alpha_3} 0 < \alpha_j < 1 \tag{18}$$

Where $K_{j,t}^P$ and $L_{j,t}$ denote respectively the capital and labor held by firm j and K_t^P the aggregate public capital. α_1, α_2 and α_3 represent, respectively, the shares of private capital $K_{j,t}$, labor input and public capital K_t^G in the output of firm j.

Each firm j determines the level of the factors capital and labor to use in order to minimize the total cost under the constraint of the production function [18]. Using the Lagrangian function to solve this problem, the following factor demands result:

$$U_t K_{j,t}^P = \alpha_1 MC_t \frac{Y_{j,t}}{R_t} \tag{19}$$

[4] For more details on explanations of hypothesis, see Acemoglu (2009), chapter 5..

$$L_{j,t} = \alpha_2 MC_t \frac{Y_{j,t}}{W_t} \tag{20}$$

The marginal cost MC_t of firms is obtained by:

$$MC_t = \frac{1}{(K_t^G)^{\alpha_3}} \left(\frac{W_t}{\alpha_2}\right)^{\alpha_2} \left(\frac{R_t}{\alpha_1}\right)^{\alpha_1} \tag{21}$$

2.2.3. Price setting

Since the firms are in monopolistic competition, the price of the output thus generated must be determined. Some of the firms have the probability θ of keeping the price of the output unchanged and another has the probability $1 - \theta$ of setting this price in an optimal way. Based on Calvo's rule, the firms that cannot set the output price follow the law:

$$P_{j,t} = P_{j,t-1} \tag{22}$$

For the category of firms that can change their price, the price is set to meet the demand [17]; this leads to the following law:

$$P_{j,t}^* = \left(\frac{\psi}{\psi - 1}\right) \mathbb{E}_t \sum_{i=0}^{\infty} (\beta\theta)^t mc_{t+i} \tag{23}$$

Finally, the general aggregate price level of the two firms is:

$$P_t = [(1 - \theta)(P_t^*)^{1-\psi} + \theta P_{t-1}^{1-\psi}]^{\frac{1}{1-\psi}} \tag{24}$$

2.3. Government

The government is represented by a fiscal authority and a monetary authority (Central Bank).

2.3.1. Fiscal authority

This authority purchases final goods (G_t), issues bonds (B_t) and finance public investment expenditures (I_t^G). These expenditures are financed for the most part by tax revenues (collected on household consumption, private investment, wage and physical capital) or by public debt (internal debt or treasury bills, B_t). The real flow budget constraint for this authority is expressed as follows:

$$\tau_t^c P_t (C_t + I_t^P) + \tau_t^l W_t L_t + \tau_t^k (R_t - \delta) K_t^P + \frac{B_{t+1}}{R_t^B} - B_t = P_t G_t + P_t I_t^G \tag{25}$$

The law of motion of the public capital stock is written as:

$$K_{t+1}^G = (1 - \delta_g) K_t^G + I_t^G \tag{26}$$

With δ_g the rate of depreciation of the public capital stock.

It has also been said that the government resorts to the FP mainly for economic stability purpose (countercyclical FP). This action can be taken either through tax revenues or through budgetary expenditure. Thus, the budgetary authority conducts the FP using two groups of instruments (or shocks): those related to public spending (I_t^G and G_t) and those based on fiscal

measures (τ_t^c, τ_t^k, τ_t^l). Fiscal shocks are reduced to increases in current expenditure G_t and public investment I_t^G[5]. According to Iwata (2009) and Djinkpo (2019), we imposed feedback from government debt to all instruments, thus all instruments are affected by a change in the debt-to-GDP ratio of the previous period. In other words, a change in the level of debt has a direct influence on the rate of taxation in the current period and the level of spending in the same period. Thus, all shocks follow a log-linearized AR(1) with an error $\varepsilon_t^x \sim N(0, \sigma_x^2)$:

$$\hat{X}_t = \gamma_x \hat{X}_{t-1} + (1 - \gamma_x)\phi_x(\hat{B}_t - \hat{Y}_{t-1} - \hat{P}_{t-1}) + \varepsilon_t^x \tag{27}$$

where the hats above variables denote log-deviations from steady state and $X \in [\tau_t^c, \tau_t^k, \tau_t^l, G_t, I_t^G]$. The coefficient γ_x of each shock refers to as the persistence of the considered shock over time. The factor $(1 - \gamma_x)\phi_x$ in each equation reflects the speed of repayment of the public debt. The fiscal policy rules described here allow partial debt finance, while the debt is to be repaid through tax revenue over time. (Iwata, 2009).

2.3.2. Monetary Authority

The monetary authority's overall goal is price stability. To achieve this, it uses monetary policy (MP) to set nominal interest rates. This authority adopts a behavior guided by the following Taylor rule, linearized around its steady state (Costa, 2016; Iwata, 2009):

$$\hat{R}_t^B = \gamma_R \hat{R}_{t-1}^B + (1 - \gamma_R)(\gamma_{pi}\hat{pi}_t + \gamma_y \hat{Y}_t) + \hat{\varepsilon}_t^m \tag{28}$$

γ_{pi} and γ_y reflect the sensitivities of the basic interest rate in relation to output and the rate of inflation; while γ_R stands out as the smoothing parameter over time.

2.4. Market clearing

The labor market is in equilibrium when the demand for labor by intermediary firms is equal to the labor services offered by households $L_t = \int_0^1 L_{j,t}dj$. Similarly, the capital market is in equilibrium if the demand for the capital factor by intermediate firms equals the supply of capital by Ricardian consumers $K_t^R = \int_0^1 K_{j,t}dj$. The markets for final goods and services are also in equilibrium when the production of firms offering final goods corresponds to the demand of households and the government. This last equilibrium condition is expressed by the equation:

$$Y_t = C_t + I_t + G_t + I_t^G \tag{29}$$

The model linearized around its steady state is summarized in Appendix 1 (online).

[5] This subdivision arises from the fact that public expenditure in the DRC is divided into two parts: (i) current expenditure, which can be divided either according to its nature (purchases of government goods and services, interest payments on the public debt and subsidies and transfers) or according to its function (common services, political institutions, finance, national defense, etc.); and (ii) capital expenditure. In this work, these expenditures include those related to investment in the physical capital that the state acquires (public works such as buildings, roads, etc.)

3. Estimation method, data and calibration

3.1. Estimation Methodology

Computing the parameter values of a DSGE model requires to proceed either by calibration or estimation. For calibration, the structural parameters of a DSGE model are calibrated in such a way that selected theoretical moments match nearly those observed in the data. Whereas the estimation method (maximum likelihood or Bayesian) computes the parameters using full information provided by observed data series (Smets & Wouters, 2003). We use Bayesian estimation techniques for several reasons. According to Smets and Wouters (2003), employing Bayesian inference methods allows the use of prior information from both micro- and macroeconometrics previous studies both for the DRC or other economies. Thereby, it establishes a direct link with previous calibration-based literature and it is particularly well suited in the context of this study where the sample period of data is short (Coenen & Straub, 2005). Finally, it is worth noting that DSGE models have a singularity problem. There are linear relationships within the model (perfect multicollinearity) between the variables. This singularity exists because the model generates predictions on a large number of observable endogenous variables compared to the exogenous shocks used. The Bayesian method applies even in the case where the variance-covariance matrix of the endogenous variables is singular, whereas this is a problem in the case where the maximum likelihood method is used (Pfeifer, 2020).

The study employs Bayesian inference via Markov Chain Monte Carlo (MCMC) methods[6] that has become a backbone tool in empirical macroeconomics. Indeed, it is a sampling-based numerical approximation technique that enables us to make inferences when the likelihood function is either analytically intractable or computationally difficult to evaluate (Iwata, 2009).

Since the model is drawn on previous analysis, we fixed the prior distributions and several parameters that are difficult to identify based on the estimated models of Smets and Wouters (2003); Iwata (2009); Coenen and Straub (2005) and Djinkpo (2019) (see Table 2).

3.2. Data used

The estimation of a DSGE model does not require all variables data on all the endogenous variables of the model. The number of observed variables should not exceed that of shocks, otherwise singularity problem arises. Since this study embodies only six shocks (τ_c, τ_k, τ_l, G_t and I_t^G), it follows that at most only six observed endogenous variables might be considered. For the purpose of estimating shock parameters, the following variables were used: domestic public debt B, tax revenue from the payroll tax τ_c and tax revenue from the consumption tax τ_l as proxies for the rates variables. GDP, private consumption C, Government expenditure G and private investment IP (measured in terms of gross fixed capital formation) were used to generate public investment and some steady-state ratios including B_{ss} and I_{ss}^G. The data are all expressed in quarterly frequencies from 1998:Q1 to 2018:Q1. The length of the sample period is mainly determined by the availability of tax data.

Data for gross fixed capital formation (private investment), household final consumption, government expenditure, and GDP (real and nominal) are from the World Bank (2019). These

[6] For more detailed information on the implementation of the bayesian technique for DSGE models, refer to Herbst and Schorfheide (2016). For a good introduction to Bayesian econometrics, see Koop (2003).

raw data were expressed in local currency (Congolese francs or CDF) using exchange rate data. Since the exchange rate is measured daily, it was captured by taking annual averages. While the data on tax revenue and internal public debt are respectively taken from the reports of the Central Bank of Congo (reports from 2007 to 2018) and the General Directorate of Public Debt (DGDP), a division of the Ministry of Finance (annual reports between 2014 to 2018). Public investment was generated using the following formula from the model equilibrium: $I^G = Y - C - I^P - G$. The data were deflated to remove the effects of inflation using the GDP deflator. The logarithm was introduced for each variable as the model was also (log-)linearized around its deterministic steady state. Finally, the stationarity tests were performed in order to avoid spurious regressions. The Augmented Dickey-Fuller and Phillips-Perron tests were used for this purpose. All the variables are stationary, except for the variables: tax revenue (τ_c and τ_l), private consumption (C) and internal debt (B). They have been made stationary after first-order integration.

3.3. Calibration

Bayesian estimation requires fixing the priors of the model parameters. The model includes two groups of parameters: structural parameters, i.e. which reflects the behavior of individual agents, and exogenous parameters, related to the six shocks. Not all the parameters have been estimated (see Table 1). As indicated in Appendix 1, the parameters $\phi_{B_{ss}}$ and $\phi_{I^G_{ss}}$ have been calibrated so that the empirical moments can match the theoretical moments. Thus, they were computed using the ratios of the variable means; i.e. $\phi_{B_{ss}} = B/Y = 0.1430$ and $\phi_{I^G_{ss}} = I^G/Y = 0.2010$. Moreover, at the steady state, $\chi = \psi_2 = 1$. Furthermore, it was assumed that at the steady state the tax on private consumption τ^c_{ss} or VAT is equivalent to 16 %, the tax on professional income τ^l_{ss} is on average 20 % (Ntagoma et al., 2015) and the tax on capital τ^k_{ss} is taken from Torres (2016) and is set at 22.5 %. The proportion of RHs in the DRC represents 10 percent and the rest (90 percent) is the number of NRHs, which best reflects the features of the

Table 1
Calibrated parameters and references.

Parameter	Symbol	Value	Source
Discount factor	β	0.99	Umba (2017)
Intertemporal elasticity of substitution	σ	1.3	Umba (2017)
Marginal disutility with regard to labor supply	ϕ	3	Costa (2016)
Proportion of RHs	ϕ	0.1	See text
Consumption tax rate	τ^c_{ss}	0.16	Ntagoma et al. (2015)
Labor tax rate	τ^l_{ss}	0.2	Ntagoma et al. (2015)
Capital tax rate	τ^k_{ss}	0.225	Torres (2016)
Share of private capital in production	α_1	0.329	Kabuya et al. (2019a)
Share of public capital in production	α_3	0.07	Djinkpo (2019)
Share of labor in production	α_3	0.66	Djinkpo (2019)
Elasticity of substitution between intermediate goods	ψ	10	Author
Elasticity of substitution between differentiated work	ψ_w	20	Costa (2016)
Calvo probability for prices	θ	0.65	Author
Calvo probability for wages	θ_w	0.45	Author
Rate of depreciation of private capital	δ	0.15	Kabuya et al. (2019a)
Rate of depreciation of public capital	δ_G	0.035	Djinkpo (2019)

DRC's population, which is predominantly rural and poor.[7] The rest of the parameters relating to the shocks, in particular the persistence of the shocks γ_j with $j \in [I^G, G, \tau_c, \tau_k, \tau_l, Y, \pi, R]$ and the coefficients of the debt-to-GDP ratios, ϕ_j with $j \in [I^G, G, \tau_c, \tau_k, \tau_l, Y, \pi, R]$ have been calibrated either according to Iwata (2009); Costa (2016) or resulting from Djinkpo (2019). For the rest of the parameters, see Table 1.

4. Results

4.1. Parameter Estimates

Bayesian MCMC estimation is conducted using Dynare software for MATLAB. Following Coenen and Straub (2005), the draws from the posterior distribution have been obtained by considering two parallel chains of 10,000 replications for the Metropolis-Hastings sampling algorithm. The acceptance ratios in the two parallel chains of the MH algorithm simulation are approximately on average 24.55 %, which is in line with one third or one-quarter threshold suggested in the literature. Prior distributions, posterior mean and, 90 % Bayesian credible intervals are reported in the Table 2. Most of the estimated parameters are well-identified. To assess the goodness-of-fit for DSGE Bayesian estimators, several tools may be used. Among them, it is worth noting the univariate diagnostics of Monte Carlo Markov chains (MCMC), the multivariate convergence diagnostics, the Blanchard-Kahn conditions, the matching between a priori and posterior distributions, etc. The prior and posterior distributions in Appendix 2 (online) of all estimates indicate that most of the a priori distributions match adequately with the a posteriori distribution; thus, the data used for the estimates contain sufficient information that meets the author's beliefs about the priors' distributions of the parameters (Pfeifer, 2020b). Overall, the estimated parameters are significantly different from zero. Lastly, the univariate diagnostics of the convergence of the MCMC chains, it's worth noting that the results are conclusive since the two chains relative to each parameter evolve following a constant pace and converge towards a common value. Finally, the calibrated parameter values provide non-explosive solutions to the model and thus, the Blanchard-Kahn conditions are satisfied because the estimated mode is at maximum posterior likelihood for all parameters. The Table 2 gives the prior and posterior distributions of the estimated parameters as well as their respective standard deviations.

The parameters were estimated in order to study the impulse response functions or reactions of the main endogenous variables to the FP shocks. Their interpretation does not contribute to addressing the questions raised in this study. However, a few parameters require particular attention. The estimated value of the ϕ_c parameter of 0.875 implies that a change in income will result in a very slow change in consumption over time (Torres, 2016). As a result, Congolese households exhibit very pronounced consumption patterns. This value differs from Iwata (2009) (in Japan), Smets and Wouters (2003) and Coenen and Straub (2005) (in the European Union) which found a value around 0.4. It is close to that of Burriel et al. (2010) (0.847) for the Spanish economy.

[7] Ntagoma et al. (2015) set at 30 the percent of RHs and the rest by to 70 percent the proportion of NRHs. The value set in this study remains in the neighborhood of this value, especially since it is close to the Congolese context, which includes a large part of the labor in the informal sector and in agriculture

Table 2
Priors and posteriors of estimated parameters.

Parameters	Prior		Posterior	
	Distribution	Mean	Standard deviation	Confidence interval (90 %)
Structural parameters				
α_2	beta	0.660	0.6447	[0.5679, 0.7215]
α_3	beta	0.070	0.0727	[0.0558, 0.0877]
β	beta	0.990	0.9905	[0.9875, 0.9932]
δ_G	beta	0.035	0.0354	[0.0319, 0.0386]
θ	inv. gamma	0.650	0.6397	[0.6098, 0.6712]
θ_w	inv. gamma	0.450	0.4571	[0.4233, 0.4914]
σ	gamma	1.300	1.2997	[1.2714, 1.3330]
ϕ	gamma	1.300	1.2997	[0.2517, 1.3250]
ψ	gamma	10.000	10.2266	[7.0250, 13.6827]
ψ_W	gamma	20.000	19.7896	[16.1583, 22.7895]
ϕ_c	gamma	0.900	0.8750	[0.7415, 0.9929]
ω_R	beta	0.100	0.0977	[0.0796, 0.1134]
γ_G	beta	0.500	0.5005	[0.4850, 0.5198]
γ_{IG}	beta	0.100	0.1001	[0.0828, 0.1175]
γ_{τ_c}	beta	0.507	0.6849	[0.5824, 0.7869]
γ_{τ_l}	beta	0.568	0.6490	[0.5502, 0.7586]
γ_{τ_k}	beta	0.600	0.5910	[0.4452, 0.7580]
ϕ_G	normal	0.200	0.1889	[0.0354, 0.3354]
ϕ_{IG}	normal	0.300	0.5296	[0.3744, 0.6596]
ϕ_{τ_c}	normal	0.010	0.0077	[−0.0644, 0.0913]
ϕ_{τ_l}	normal	0.010	0.0172	[−0.0589, 0.0980]
ϕ_{τ_k}	normal	0.010	0.0062	[−0.0702, 0.0972]
γ_R	beta	0.800	0.7422	[0.6449, 0.8428]
γ_Y	normal	0.500	0.5119	[0.4432, 0.5926]
γ_π	normal	1.500	1.5050	[1.4326, 1.5783]
Shocks estimated standard deviation				
e_m	inv. gamma	0.100	0.0684	[0.0262, 0.1095]
e_G	inv. gamma	0.300	0.3691	[0.0822, 0.9376]
e_{IG}	inv. gamma	0.300	0.4821	[0.3931, 0.5602]
e_{τ_c}	inv. gamma	0.100	0.4459	[0.3940, 0.5046]
e_{τ_l}	inv. gamma	0.100	0.4454	[0.3787, 0.5081]
e_{τ_k}	inv. gamma	0.400	0.2856	[0.1035, 0.5106]

Table 3
Expenditure and Tax multipliers.

	G_t	IG_t	τ_t^c	τ_t^l
At impact	−0.02	0.22	0.04	0.013
After 3 years	−0.0765	0.512	0.371	0.143

Another parameter that attracts attention is ω_R, i.e. the number of RHs. Its estimated value of 0.0977 suggests that for the Congolese economy, the number of RHs is fixed at 9.77 %. This result confirms the evidence that in the DRC, the percentage of households that can smooth a constant level of consumption over time (by saving or borrowing) is very low, while the number

Table 4
Decomposition of the variance of forecast errors (in percent).

Periods	Shocks	Y	C	IP
$t = 1$	Current expenses	0.65	0.34	0.01
	Public investment expenditure	72.79	21.87	0.66
	Tax on consumption and investment	2.38	32.09	0.06
	Income tax	0.25	4.29	0.00
	Capital tax	0.04	0.19	0.02
	Monetary Policy	23.89	41.22	99.24
$t = 4$	Current Expenses	0.51	0.36	0.02
	Public investment expenditure	41.59	23.81	1.10
	Tax on consumption and investment	13.60	33.37	0.14
	Income tax	1.90	4.04	0.01
	Capital tax	0.14	0.18	0.02
	Monetary policy	42.26	38.24	98.71
$t = 8$	Current Expenses	0.47	0.38	0.05
	Public investment expenditure	34.78	25.06	3.36
	Tax on consumption and investment	25.27	35.56	1.78
	Income tax	3.27	4.05	0.13
	Capital tax	0.16	0.18	0.03
	Monetary policy	36.23	34.77	94.64
$t = 32$	Current Expenses	0.41	0.39	0.09
	Public investment expenditure	28.37	25.44	5.80
	Tax on consumption and investment	28.03	36.03	5.78
	Income tax	3.09	3.81	0.52
	Capital tax	0.15	0.17	0.05
	Monetary policy	39.95	34.16	87.77

of NRHs is very high (90.23 %). Therefore, a huge part of households do not have access to financial markets in other to bring their future consumption back to the present by borrowing. This highlights the exclusive nature of DRC's financial market. This value is very low compared to what we might have in developed countries: Coenen and Straub (2005) and Iwata (2009), and Bhattarai and Trzeciakiewicz (2016) have found 37 %, 25 % and 37 % in the European Union, Japan and England economies respectively.

As for the shocks, it should be noted that the consumption and income tax shocks are very persistent over time, since amongst the shocks, they have very high persistence parameter values (γ_{τ_c} and γ_{τ_l} are 0.6848, 0.649 respectively). In other words, tax shocks are more likely to influence fluctuations in macroeconomic variables over time, especially output (see the next subsection).

Moreover, the coefficients of the debt-to-GDP ratio for the shocks (G, IG, τ_c, τ_l and τ_k) are all positive but to different degrees. This result suggests that tax rates and the level of current expenditure and investment react positively to an increase in the level of debt in the economy. These reactions vary according to the type of shock: they vary between 0.006 and 0.01 in the case of tax shocks and between 0.19 and 0.59 in the case of expenditure shocks. The resulting information is that an increase in domestic debt significantly increases public and investment spending but very little the tax rate. This empirically demonstrates that the government finances most of its expenditures through borrowing and not through consistent tax revenue mobilization. As a result, the financing structure of the FP in the DRC is based on debt whereas revenue mobilization should be the most effective means of financing the economy's expenditures. This weakness can be explained in several ways: (i) income tax represents only a small percentage of

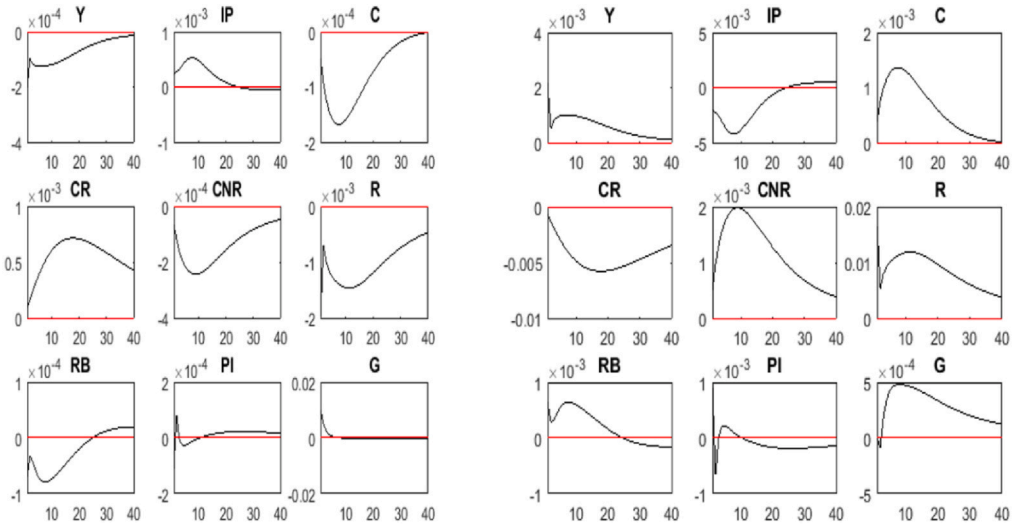

Fig. 1. Impulse functions resulting from spending shocks.

total revenue; (ii) multiple exemptions; and (iii) the development of the informal sector, which has so far escaped state control.

4.2. Analysis of FP role in DRC

The study's main goal is to analyze the effects of an increase in government spending and/or a tax cut on private consumption, private investment, and output. Five shocks have been simulated.[8] The simulations were carried out over 40 periods, each period representing one quarter.

4.2.1. Current Expenditures and Public investments

Fig. 1 show the impulse response functions of the main variables of interest. The graph on the right shows the effects of a shock on investment spending, while the graph on the left displays the effects of a shock to current spending. The x-axis represents time in quarters, while the y-axis gives the percentage deviations of the variables that experienced the shock. The red line indicates the steady state or initial equilibrium level before the shock.

A 1 % increase in current expenditure (mainly wages in the DRC) reduces national production to impact and overall household consumption. However, it increases the level of private investment and RHs consumption. This result is very different from what theory predicts: indeed, the expected outcome would be that an increase in spending ends up either increasing or reducing output and aggregate demand. What emerges from the results in fact suggests a mixed outcome. One way of explaining this is as follows. When the government votes for a higher budget for future periods (increases spending), firms anticipate a rise in demand for public goods and services, and invest more. Fiscal authorities take on debt, either through the creation

[8] Excluding the shock from monetary policy. Indeed, this shock was introduced to replace the productivity shock in the model. Thus, monetary policy matters more in explaining the fluctuations of the variables

of treasury bills or bilaterally with the private sector. However, given the high level of corruption[9] in the economy, capital is diverted, which hurts GDP and the nominal interest rate on government securities. Furthermore, in 2018, it is estimated that more than 90 % of current expenditure was allocated to common services, political institutions and ministries (BCC, 2018) rather than to investment spending, essential for increasing GDP. With the level of misappropriation observed in the political class, spending never reaches the objectives of stabilizing or increasing GDP.

Following an increase in public investment (construction of agricultural feeder roads, airports, public buildings, etc.), national production and final private consumption rise on impact. However, this shock leads companies to reduce their level of investment. Indeed, as mentioned above, the DRC government often finances its capital expenditure by borrowing through treasury bills to finance its policies. This leads to an increase in the nominal interest rate of securities and private capital in the financial markets, leading companies to reduce their level of investment. The crowding-out of private investment runs counter to the theoretical predictions of neoclassical analysis. Neoclassical analysis shows that higher spending ultimately increases the interest rate on private capital, thereby discouraging private investment (Mountford & Uhlig, 2009).

The results found here are partly similar to those of Diwambuena and Boketsu (2019) and largely different from those of Barhangana (2006) and Tavulyandanda (2015). For Diwambuena and Boketsu (2019), a fiscal shock increases private consumption and output but crowds out private investment. The results found here suggest instead that it is the public investment expenditure component that increases GDP and final consumption, but crowds out (weakly) private investment because of the rise in the interest rate on private capital. Moreover, current expenditure reduces GDP and household consumption without discouraging private investment.

In short, the current expenditure and public investment components of FP generally fail to achieve the objectives of increasing GDP and aggregate demand, due to the level of corruption, political instability and misappropriation of public funds. Since independence in 1960, increased spending has always been conceived as a channel for enriching the political class, whereas it should be used to build infrastructure, the foundation for economic take-off.

4.2.2. Tax reduction

The impulse response graphs for fiscal shocks are given in Fig. 2 below. The graphs above (left and right) show the effects of a reduction in the consumption tax and the capital tax, respectively, while the one below describes the effects of a reduction in the income tax. In contrast to expenditure shocks, in sum, a reduction in tax rates is highly effective because it increases both the level of output, final consumption and private business investment. By the Ricardian equivalence hypothesis, RHs reduce their level of consumption.

These results are consistent with those found in the literature, except for the effect of the current expenditure shock on private investment. Indeed, literature shows that an increase in public spending in general raises output and aggregate demand (Bouakez and Rebei, 2007; Iwata, 2009; Mountford and Uhlig, 2009; Galì et al., 2007, among others). However, as mentioned above, this efficiency is explained differently by the authors. For Galì et al. (2007);

[9] According to the 2019 Transparency International report, cited by Radio Okapi on January 25, 2020, the DRC is ranked 168 out of 180 countries in the Corruption Perceptions Index, making it one of the most corrupt countries in the world in almost every sector

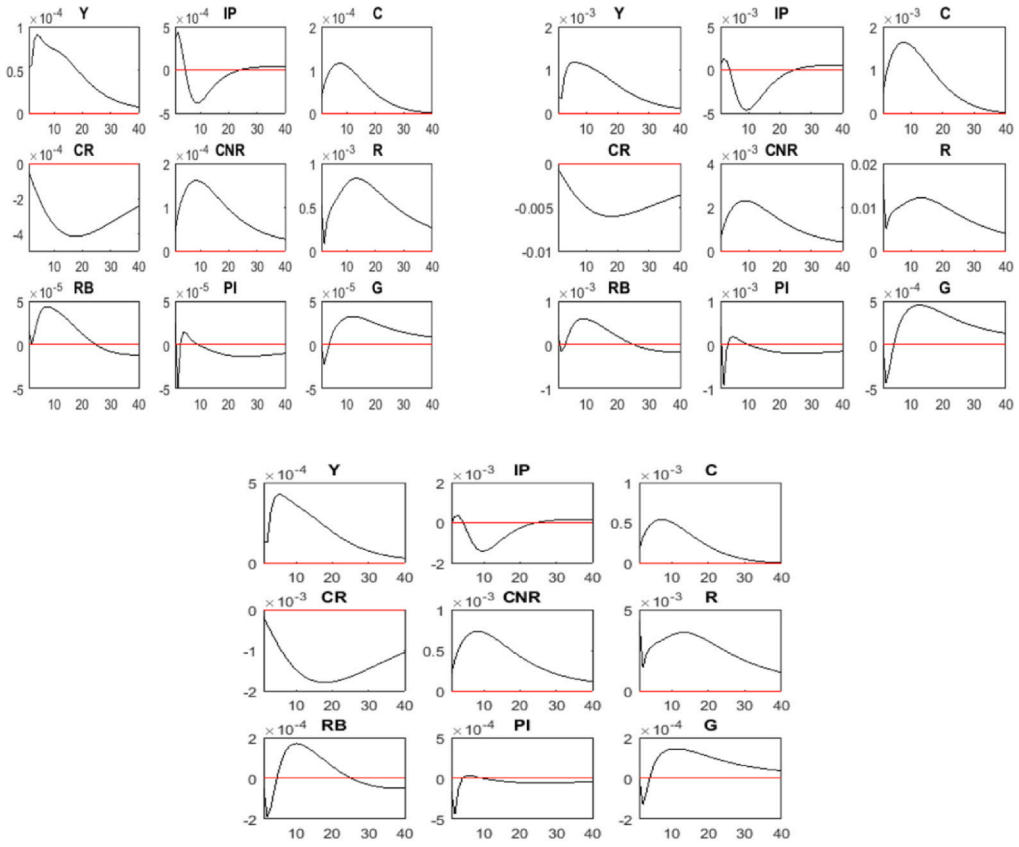

Fig. 2. Impulse functions of fiscal shocks.

Iwata (2009) and Coenen and Straub (2005), this stimulus effect (or "crowding-in effect") depends on the number of NRHs in the economy, because the impact of the FP depends upon their number in order to affect production. In other words, when the government increases spending or decrease taxes, the NRHs that always think in the short term, take advantage of this by consuming more and thus create a strong demand for businesses if their number is above 60 percent compared to RHs in the economy. Thus, the effect of the FP depends on their proportion. However, this is low in several industrialized countries: 37 % in the European Union, 25 % in Japan and 12 % in the United Kingdom. According to Coenen and Straub (2005), this weakness explains why FP is not effective in the European Union. In this study, it was shown that the proportion of NRHs exceeds 90 %, which explains the effectiveness of FP in the DRC and thus confirms the hypothesis initially set.

In summary, the responses of the variables to the monetary and fiscal shocks are conclusive and allow us to affirm that FP in the DRC is effective since it increases the level of national production, private investment and final consumption of households. However, this effectiveness depends heavily on the component of the FP considered. On the one hand, the fiscal component shows that an increase in public spending in general has positive effects on the economy only if a large proportion of this spending is allocated to public investment, i.e. infrastrures in the DRC's context. On the other hand, the fiscal side shows that a tax cut has major effects on production, household consumption and

business investment. In times of recession or economic crisis, budgetary authorities should consider reducing taxes to stimulate aggregate demand and increasing investment spending. Current expenditures such as increasing the budgets of political institutions and ministries should be reduced sufficiently to avoid cases of embezzlement. As indicated by Tsasa (2018), given the level of insecurity that hinders the inflow of foreign capital, military spending should increase to promoting security and stability in regions affected by armed conflict and restoring peace. According to its findings, this will certainly have a positive effect on the macroeconomic level. As a result, the FP should be used to bring more economic growth, reduce unemployment and stabilize the economy during crisis/recession.

4.3. Expenditure and Tax multipliers

To quantitatively evaluate the impact of FP on output, this work uses the Keynesian multiplier. This is an indicator measuring the increase of output in response to a 1 percent change in one of the components of GDP given by $\Delta F_t \in [G_t, IG_t, \tau_t^c, \tau_t^l and\ \tau_t^k]$ resulting from k periods ahead: $\Delta Y_{t+k}/\Delta F_t$ (Zubairy, 2010). These multipliers are derived from IRFs:

On impact, a 1 percent increase in current expenditure reduces national output by 0.02, while a 1 percent increase in public investment increases it substantially by 0.22. This result suggests that investment spending should represent a significant share of public spending for two reasons. On the one hand, it can serve to stabilize economic activity in the short term and thus make the FP countercyclical. On the other hand, their effects become larger after three years and multiply GDP by 0.512, while current spending reduces it even more. As for fiscal shocks, a reduction in the consumption tax and the payroll tax multiplies output by 0.04 and 0.013 respectively. However, these shocks make a strong contribution to boost GDP after three years with marginal impacts estimated at 0.4 and 0.14 for the first and second shocks respectively.

These results are consistent with those found in the literature. Indeed, Mineshima et al. (2014) show that in developed countries, the multiplier lies between 0.3 and 1 in normal times, and can exceed 1 in abnormal times when economies are in deep recession. Moreover, in these countries, expenditure multipliers (0.75) are often higher than fiscal multipliers (0.25). For developing countries, however, these multipliers are lower compared to the former, varying in the short term between 0.1 and 0.3 for expenditure multipliers and between 0.2 and 0.4 for fiscal multipliers (Bhattarai and Trzeciakiewicz, 2016; Ilzetzki, 2011). The results found in this paper suggest that the public expenditure multiplier is on average (after three years) 0.366 if a significant proportion of this expenditure is allocated to public investment, mainly infrastructure like roads for instance. However, if current expenditure predominates, then this multiplier may reach 0.16. These results confirm the conclusions of previous studies in developing countries, particularly those of Batini et al. (2014) and Diwambuena and Boketsu (2019). For Diwambuena and Boketsu (2019), the expenditure multiplier in DRC varies between −0.15 and 0.35. As for the fiscal multiplier, this study finds that it is fixed at 0.14 on average over three years. These conclusions are within the acceptable limit according to previous studies (Batini et al., 2014; Diwambuena and Boketsu, 2019; Djinkpo, 2019; Iwata, 2009).

4.4. Business Cycle fluctuations

This section highlights the sources of output fluctuations using the historical variance decomposition and the forecast error variance decomposition. The latter tool is complementary

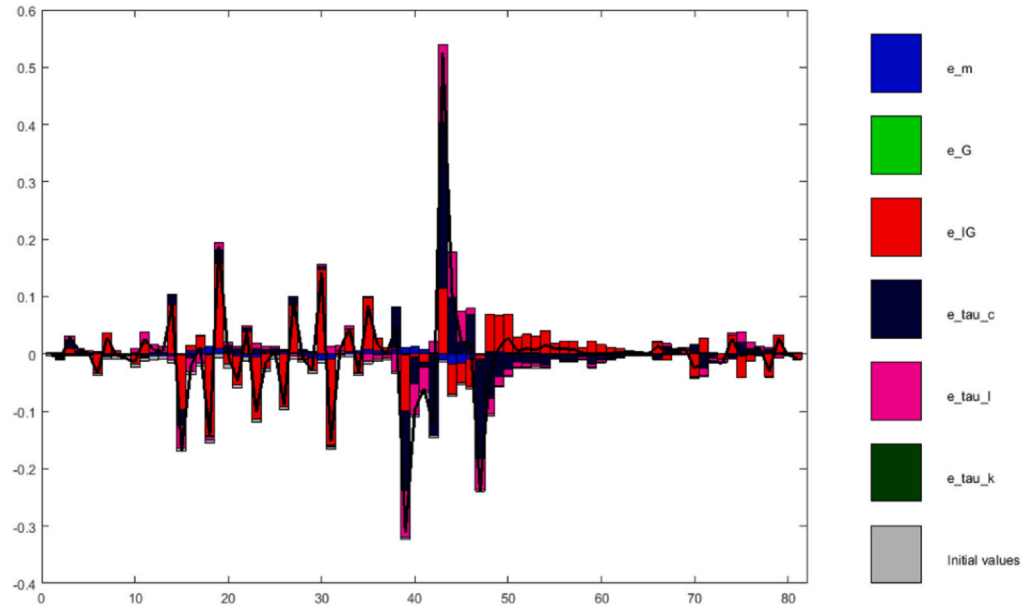

Fig. 3. Decomposition of historical variance of GDP.

because it studies these determinants in the short, medium and long term. It also allows us to identify the main shocks that cause fluctuations in private consumption and investment.

4.4.1. Historical variance decomposition

Analysis of the historical decomposition (Fig. 3) of output reveals that since the first quarter of 1998, the cyclical (periodic) variation in GDP is mainly explained by the public investment shock. This shock is followed by the tax on final consumption and the tax on salaried income. The large peak shows that between 2008Q1 and 2010Q1, a period marked by the subprime economic and financial crisis, a reduction in these two rates alone was able to generate a tax multiplier exceeding 0.5. Monetary policy comes in fourth place in the explanation of GDP variations.

The results found here seem to contradict those found by Kabuya et al. (2019b). Indeed, for these authors, productivity and public expenditure shocks explain most of the fluctuations in GDP in the DRC. Fiscal shocks play a minor role in these fluctuations. The major difference with this study is that the productivity shock was ignored because innovations are not very significant or at low levels in developing countries compared to developed ones. In this respect, the DRC consumes more imported technology from industrialized countries but innovates and produces little. Thus, this component has been explicitly ignored in the model to retain only the likely shocks to the DRC economy. The resulting general information can be formulated as follows: the government should focus more on increasing public investment and reducing taxes in times of crisis, or economic recession in particular, to revive economic activity or maintain it at a stable level.

4.4.2. Variance Decomposition of forecast errors

As in the previous exercise, the forecast error variance decomposition is an instrument for identifying shocks that determine output fluctuations in the future. To this end, this study of output variability is spread over a 32-quarter horizon to establish a comparison with the results

of Diwambuena and Boketsu (2019). The need to use this tool stems from the concern to be able to confirm or refute whether shocks to public and fiscal investment spending (on consumption and wage income) really do explain output variability in the short (1 year), medium (2 years) and long (8 years) terms.

This table shows that, overall, the variability of output and private consumption is largely due to public investment and consumption tax shocks, and this effect is persistent and significant over time. The effects of the public investment shock diminish significantly over time, while those of the consumption tax increase. For Diwambuena and Boketsu (2019), however, the productivity and government spending shocks contribute the most to output changes. As mentioned above, the productivity shock has not been considered; it has been replaced by the monetary shock. Moreover, the two shocks explain very little of the fluctuations in investment. Indeed, the latter is better explained by the recessionary monetary policy that encourages firms to invest. The shock to wage income contributes to variations in household consumption, but this effect is reduced in the short to the long run. In sum, in the short term, the contribution of public investment shocks and the consumption tax is estimated at nearly 75 % of variations in output in the very short term, reducing to 66 % in the long term. As a result, these two shocks explain significantly the variations in GDP in the simulated periods. Although monetary policy makes a strong contribution to the fluctuations of all the aggregates, it explains more the fluctuations of private investment, with decreasing effects over time (from 99% to 87 %).

5. Conclusion and Recommendations

This article highlights the role of fiscal policy in the DRC. Since its creation as the Independent State of the Congo (EIC), fiscal policy instruments have been used either to build infrastructure to transport minerals to the metropole, as a means of financing war or as a tool for enriching the political class. However, fiscal policy has a counter-cyclical role, i.e. stabilizing the economy in times of economic crisis/recession and promoting growth. Previous studies carried out in the DRC have shown that FP is not effective, or is only partially effective. FP in the DRC, as in many developing countries, is not fulfilling this function. This study therefore set out to revisit the data and assess the impact of FP on GDP, private household consumption and private business investment, to highlight its importance in a large developing economy like the DRC. More specifically, it highlights the role played by heterogenous agents and public investment in terms of infrastructure in the effectiveness of FP in developing world. The subsidiary objectives were to quantitatively evaluate this impact through the multiplier and to study the main shocks that have contributed to GDP fluctuations in the DRC.

The main results reveal that an expansion of public spending increases the output, the private consumption and investment on one condition: the public investment must represent a significant proportion of overall expenditures. This expansion leads to an expenditure multiplier estimated at 0.366, a value within the range found in the literature (between 0.1 and 0.3) for developing countries. On the fiscal side, a cut tax policy increases the three major variables with a fiscal multiplier estimated on average to 0.14 (less than 0.4 of literature) in three years. The results show that a debt-financed FP significantly stimulates economic activity in recession in developing countries. The decomposition of the historical variance of GDP shows that most of these fluctuations, observed since the first quarter of 1998, are the result of public investment shocks and the consumption tax. Moreover, over 40 simulated quarters, the variance decomposition shows that the two previous shocks contribute significantly and persistently to changes in GDP and private consumption, while private investment are conducted by monetary policy.

The emerging and developing countries should (i) increase the share of capital expenditure/ public infrastructure and undertake tax cut instruments to increase both aggregate demand and output, as this has a significant and persistent effect on economic activity in times of recession.This could considerably reduce the unemployment rate in times of crisis. (ii) The governments should finance its FP from tax revenues collected during periods of overheating and fight against corruption, embezzlement, etc.

The analysis made, however, has not integrated financial system or related frictions and opened the economy. Future research could integrate these aspects to bring out the Keynesian multiplier in an open economy considering developing world. Moreover, Kaminsky et al. (2004) and (Alesina et al. 2008) have shown that in developed countries, the FP is procyclical, whereas it is often countercyclical in developing countries. The present work has not been able to specify this fact empirically from the data used.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jpolmod.2025.01.002.

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