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Impacts of US interest rates on growth, income distribution, and macroeconomic policy space in developing countries: a SFC supermultiplier model

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Abstract

This paper presents a stock-flow-consistent model in which growth is led by exports and government expenditure. It considers domestic and external debt dynamics and gross capital flows. Countries may choose to not fully use their external space to accumulate international reserves. The model is then applied to an exercise of comparative dynamics to look at how an external shock led by a hike in US Fed foreign interest rates may impact growth and income distribution in a developing country under different policy responses. The shock forces the country to apply at least one contractionary macroeconomic policy or lose its reserves. Countries more financially integrated may only be able to balance external accounts through contractionary monetary policy. Accumulated international reserves may help maintain expansionary policies and higher average growth rates by providing liquidity in foreign currency.

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Keywords: Supermultiplier, Structuralism, open economy growth, macroeconomic policy space, stock-flow-consistent modelling

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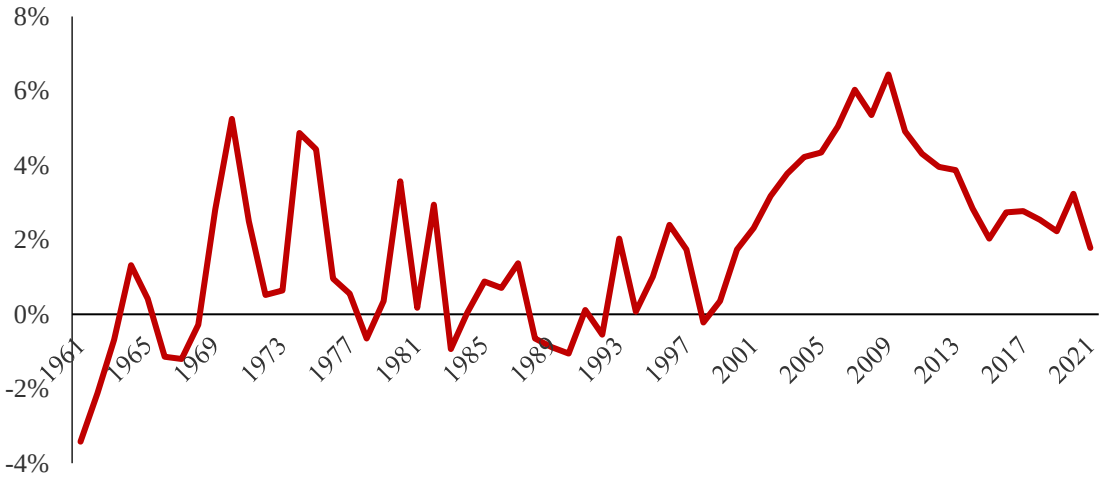
1. Introduction

In 2022, the US Fed responded to inflation pressures with the most rapid interest rate hike since the 1979-82 Volcker's disinflation. At the beginning of the 1980s, this hike was followed by harsh external crises in the developing world, especially in Latin America. The current hike happens in a new environment. On one hand, many developing countries now hold large international reserves. On the other hand, US monetary policy now plays an extra disruptive role of quickly shifting massive capital flows in a world of open and volatile capital accounts (Rey, 2015). Following the Structuralist literature on external policy space, this paper aims to understand how a shock from US rates may impact growth, income distribution, and macroeconomic policy space in developing countries, diving into the rationale behind the international reserve accumulation by these countries.

Canonical models of external crises usually relate external crises to countries' misuse of fiscal deficits (Krugman, 1979). On the other hand, recent contributions on gross capital flow determinants and Global Financial Cycles have pointed to movements on the US interest rate as primary drivers of capital outflows from developing countries (Rey, 2015; Borio and Disyatat, 2015). Under this context, a recent post-Keynesian Structuralist literature has pointed out to the opposite causality: external crises lead to fiscal constraints possibly incurring in insolvency crises (Nikiforos et al., 2015; Cline and Vernengo, 2016). Their argument is based on the identification of the balance-of-payments as the major external constraint to growth (Kaldor, 1978; Thirlwall, 1979).

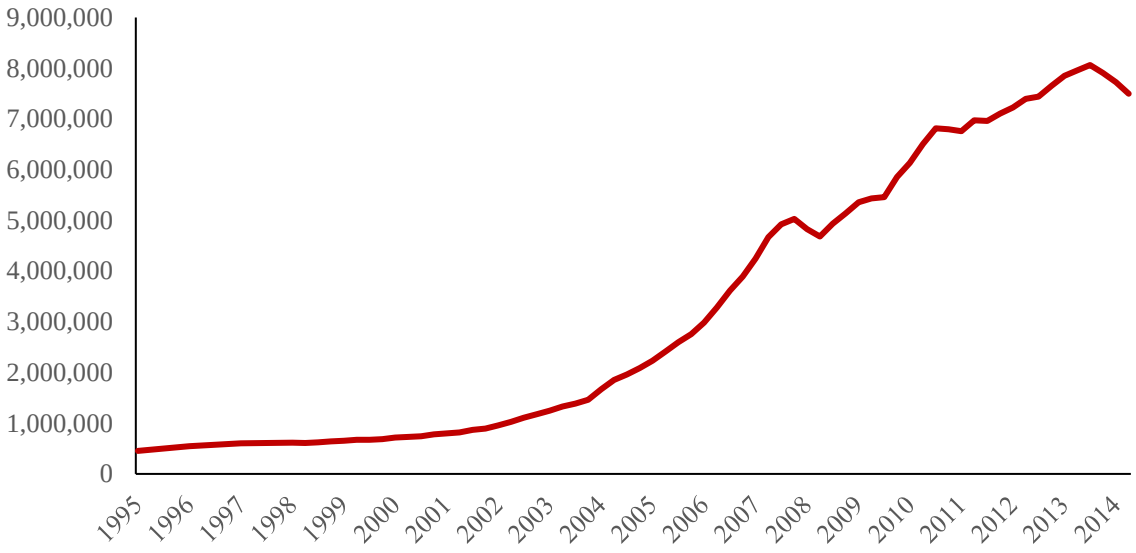
Furthermore, as seen in Figure 1, since 1997 developing countries have sustained higher growth rates than their developed counterparts for the longest period since WW2. The period also represents a record international reserve accumulation by these countries (see Figure 2).

Figure 1. Growth Rate Differentials between Low- & Middle- Income and High-Income Countries (year over year % variation, 1961-2021)



Source: World Bank (2023) | Own elaboration
Note: Aggregations by the World Bank depending on country's size and their classification

Figure 2. Total Foreign Exchange Reserves of Emerging and Developing Economies (US Dollars, Millions, 1995-2015)



Source: IMF | Own Elaboration
Note: Starting 2015Q2, the breakdown for emerging and developing economies is no longer available.

This paper explores these stylized facts by linking the literature that points to external shocks' effects on domestic policy space (especially fiscal) to the literature on open economy growth led by government expenditures and exports on supermultiplier models (Morlin, 2022; Dvoskin

and Torchinsky Landau, 2023). By doing so it aims to investigate how long-run growth is affected by external and internal policy in an open economy with open capital accounts and how the liquidity provided by reserves may mitigate the effects of possible external shocks.

Section 2 presents the discussion on growth and macroeconomic policymaking in open economies. Section 3 develops a stock-flow-consistent supermultiplier growth model led by government expenditure, exports, and consumption out of interest, with domestic and external debt dynamics that consider gross international capital flows and a balance-of-payments-constraint. Section 4 presents a comparative dynamics exercise of the effects of a foreign interest rate hike on the model and possible policy responses. Section 5 concludes.

2. Open Economy Demand-Led Growth: endogenous money, policymaking, and balance of payments constraint

Most macroeconomists now agree that in capitalist economies money is created in most part by commercial bank's loans (McLeay et al., 2014, p. 444) with most canonical models highlighting Central Bank interest setting instead of "exogenous money supply" interventions (see for example Taylor, 2000; Carlin and Soskice, 2005). However, when open-economy macroeconomics is considered, mainstream economists still follow the canonical Mundell-Fleming model, whose results intrinsically depend on exogenous money (Lavoie, 2022, Ch.7.2; Serrano and Summa, 2015). Heterodox economists, on the other hand, have extended endogenous money theory to open economies, presenting the 'Compensation Thesis' (Lavoie, 2001). While the Mundell-Fleming model finds direct causality between capital in-or-outflows to domestic money supply and domestic interest rates, the Compensation Thesis poses that an increase in money supply from the rest of the world can be compensated by changes in the Central Bank's balance sheet (an operation often called 'sterilisation'), without necessarily leading to a change in domestic money supply.[1]

After the 2008 Global Financial Crisis, the renewed attention to global capital flows has spurred a literature that gives more attention to gross capital flows and criticises the conventional Mundell-Fleming results (Rey, 2015; Borio and Disyatat, 2015). This literature has highlighted both theoretically and empirically that capital flows to developing countries follow more external than domestic conditions at receiving countries, with the US interest rate being the

[1] Some authors argue that sterilisation would not stop rentability differences which would lead to continued capital flows, heterodox authors have highlighted this result assumes free and perfectly substitutable capital assets across countries, an empirically unfound assumption (Serrano and Summa, 2015; Lavoie, 2022, Ch.7).

main determinant of these Global Financial Cycles (Rey, 2015; Anaya and Hachula, 2016). Rey (2015) argues that instead of Mundell-Fleming's policy trilemma, there is a dilemma between capital openness and monetary policy independence.

This literature, however, implicitly still assumes exogenous money because capital movements are still assumed to change interest rates through monetary base movements. Lavoie (2022, Ch.7) highlights that when endogenous money is considered, there is no mechanical adjustment from capital flows to interest rates but depends on a policy choice by the monetary authority. Under this context, while capital inflows may be sterilised by the central bank an outflow of capital could impose a balance of payments constraint. That is, the real external constraint to the domestic economy is the balance of payments – accessing the foreign currency necessary to sustain foreign transactions. Capital flows may restrain domestic economies to the extent they create balance of payments problems.

With this consideration, we can now connect the 'dilemma' literature with fiscal policy. While canonical models of external crisis since Krugman (1979) point to fiscal mismanagement at the core of these events, the recent empirical literature finds robust evidence that external conditions are more determinant for capital outflows than domestic ones. This ties to the heterodox literature that argues the causality goes from external to a fiscal crisis (Nikiforos et al., 2015; Cline and Vernengo, 2016) and to the structuralist literature that highlighted that the balance of payments poses a narrower external space for fiscal policy in developing countries (Vernengo and Perez-Caldentey, 2020; Porcile and Yajima, 2021; Botta et al., 2023). If the outflow of capitals constrains the economy through the balance of payments, it also constrains fiscal policy, as higher fiscal policy and income would lead to more foreign currency demand for imports.[2]

This paper thus aims at looking at the effect of an external shock on macroeconomic policy space through the balance of payments channel. Linking the Compensation Thesis, the literature on the external dilemma, and the structuralist literature on external constraints to fiscal policy. To take full account of policy effects, we shall use a growth model to look at how policymaking directed at increasing growth and decreasing inequality may be affected.

[2] Some authors have highlighted the special importance fiscal policy has in emerging economies both as a source of demand (Akcay et al., 2022; Campana et al., 2023) and as a motor of structural change (Mazzucato, 2011).

There is an extensive literature that emphasises the balance of payments as the main external constraint to growth in open economies (McCombie and Thirlwall, 1999; Thirlwall, 1979; Thirlwall, 2012). This has recently been linked to supermultiplier models[3], in which corporate investment is completely induced and growth is led by government expenditure and exports (Morlin, 2022; Dvoskin and Torchinksy, 2023). Although first called Sraffian supermultiplier (Serrano, 1995), the mechanisms of the model have been applied to neo-Kaleckian growth models (Allain, 2015; Lavoie, 2016; Nah and Lavoie, 2017; Hein, 2018), which include an autonomous investment component in the short-term. The neo-Kaleckian tradition has drawn influence from the New Cambridge School's argument of the importance of stock-flow relations on expenditures (Cripps and Godley, 1976) highlighting the relevance of stock-flow-consistent (SFC) modelling (Godley and Lavoie, 2007; Nikiforos and Zezza, 2018). Some SFC models have been developed to look at debt relations in supermultiplier models (Brochier and Silva, 2019; Pedrosa et al., 2023) and to look at financial aspects of developing countries (Nalin and Yajima, 2022; Perez Caldentey et al., 2023). But the interaction between balance-of-payments constraint (and its related stocks) and autonomous demand-led growth has not yet been explored in a SFC framework for small open economies, to the extent of our knowledge. By extending the literature in this direction we aim to give new insights to the dynamic of growth and foreign assets/liabilities observed in developing countries in the past decades and how they could affect the relationship between 'semi-autonomous' expenditures (Fiebiger and Lavoie, 2019; Allain, 2022).

3. A Stock-Flow Consistent Supermultiplier Growth Model led by Public Expenditure and Exports

To study the effects of external constraints on growth, distribution, and policy space we build upon the open-economy demand-led growth literature to present a supermultiplier model in which growth is led by public expenditure and exports. It builds upon the open economy neo-Kaleckian supermultiplier model by Nah and Lavoie (2017) while including the public sector as in Hein (2018). We also consider the role of external debt and financial flows inspired by the work of Morlin (2022) and Dvoskin and Torchinsky Landau (2023), but further considering results of taking full consideration the stock-flow dynamics in line with the tradition after Godley and Lavoie (2007).

[3] See Serrano (1995), Freitas and Serrano (2015), and Lavoie (2016) for throughout discussions of the supermultiplier model.

3.1. Economic environment

Following Nah and Lavoie (2017), we assume an open economy that imports intermediate and capital goods and sells in both domestic and international markets. We assume firms' price-setting powers are dependent on international and national competition environment and worker's bargaining power, such that national prices and income distribution between capital and labor are jointly determined exogenously, through this political process of dispute over the shares of production. With these conditions given, prices are inelastic with respect to demand. Changes in demand will then lead to movements in total output and capacity utilisation. For this to hold in an open economy context, we also assume the international market is competitive in such a way that the domestic country actors cannot affect import and export prices. We also assume our economy is too small to affect its own export demand through income flows to the rest of the world. Tables 1 and 2 present the balance sheet and transaction matrices that synthesise the environment of this modelled economy.

Table 1. Balance Sheet Matrix

	Workers	Rentiers	Firms	Government	Central Bank	RoW	Σ
Domestic Loans		$+B$		$-B$			0
Foreign Loans				$-D$	$+R$	$+D-R$	0
Equities		$+E$	$-E$				0
Capital			K				K
Σ	0	$+B+E$	0	$-B-D$	$+R$	$+D-R$	$K=E$

Variables: domestic public debt (B), net external debt(D), international reserves (R), equities(E), and capital stocks(K).

Table 2. Transaction Flow Matrix

	Workers	Rentiers	Firms		Treasury		Central Bank	RoW	Σ
			Current	Capital	Domestic	Foreign			
Private Domestic Consumption	$-C_w$	$-C_r$	$+(C_w+C_r)$						0
Private Investment expenditure			$+I$	$-I$					0
Imports			$-M$					$+M$	0
Exports			$+X$					$-X$	0
Government Expenditures			$+G_C$		$-G_C$				0
Taxation	$-\tau W$	$-\tau(\Pi+iB)$			$+T$				0
Wages	$+W$		$-W$						0
Profits		$+\Pi$	$-\Pi$						0
Domestic Interest Payments		$+iB$			$-iB$				0
Foreign Interet Payments						$-i_xD$	$+i_fR$	$+i_xD-i_fR$	0
Change in Equity				$+\dot{E}$					0
Change in Domestic Loans		$-\Delta B$			$+\Delta B$				0
Change in Foreign Loans						$+\Delta D$		$-\Delta D$	0
Change in International Reserves							$-\Delta R$	$+\Delta R$	0
Σ	0	0	0	0	0	0	0	0	0

Variables: worker's consumption (C_w), rentier's consumption (C_r), investment (I), imports (M), exports (X), government consumption (G_C), tax revenue (T), wages (W), profits (Π)domestic public debt (B), net external debt(D), international reserves (R), equity (E), tax rate (τ), domestic interest rates (i), US Fed interest rates (i_f), interest rates on external debt (i_x).

We focus on the role of government policies, so we keep our private sector simple. Workers consume all their after-tax income domestically, such that wages (W) are divided between (C_w) and taxation (τW). All profits (Π) are distributed to rentiers as dividends. For simplification, we do not consider private debt or portfolio choices, and we assume investment decisions do not depend on previous savings. Apart from profits, domestic rentiers also receive interest on their domestic bonds (iB). Rentiers consume a share of their disposable income domestically and save the other share, which can be held as equity issued by firms (dE) or bonds issued by the government (dB).[4]

[4] Rentiers consume out of interest income, but they do not consume out of wealth in our model. This simplification was chosen due to our focus on the role of the government. Adding another exogenous expenditure would complicate the algebra without much change to our main results.

We then include the public sector. Government consumption[5] (G_C) and interest payments may be financed by taxation or by issuing debt. Taxation shares of income are the same for all different forms of income, such that tax does not hold any directly redistributive role on income. The government can issue both domestic debt (B) and foreign currency-denominated (net) external debt (D). Although the interest rates on both forms of assets are determined by the government, they are different. The domestic interest rate (i) is the basic rate on government bonds and is assumed to be set by the central bank, although it will reflect domestic conditions and the country's position in the currency hierarchy. The dynamics of foreign debt and the interest rate on it will be introduced in section 4.4.4. when we present the balance of payments dynamics. Furthermore, we assume all export proceedings in dollars are sold to the Central Bank, which is the case in most countries and often mandatory (Dvoskin and Torchinsky Landau, 2023). Imports are also done by buying dollars from the Central Bank, such that only the public sector holds external assets and liabilities, with the government holding external debt and the central bank holding international reserves.[6] Each one paying and receiving interest payments on such stocks, respectively. Although this is obviously a simplification, it focuses on the government action which is the main purpose of our investigation.[7]

Exports are separated into a portion that is exogenously determined (X_0) and one that depends positively on short-run variations in the real exchange rate ($X_1(e_R)$). Imports are also distinguished between a part that varies proportionally to income (M_0) and a part that diminishes with short-run increases in the real exchange rate ($M_1(e_R)$). Financial flows' dynamics are introduced in section 4.4.4. As presented in section 3.1., it is assumed countries may respond to money inflows by changes in Central Banks' balance sheets as stated by the Compensation Thesis. Under this assumption, the model considers that the country is under a fixed or managed exchange rate regime such that nominal exchange rates are exogenous and a policy variable.

[5] For matters of simplicity, we do not differentiate between different types of government expenditure, Deleidi and Mazzucato (2019, 2022) have worked theoretically and empirically on new versions of the supermultiplier that find different multipliers for different types of government expenditures, focusing on advanced economies.

[6] We do not consider corporate external debt nor external debt in foreign currency for simplicity. For a model specification which includes both see Dvosking and Torschinky Landau (2023).

[7] Although not explored throughout in this paper, the transaction matrix sheds light on possible conflicts of interest between governments and independent central banks when it relates to foreign financial position. For simplification, from here on we consider the government controls both entities such that it chooses policies from both.

The total disposable domestic income (Y) in our model will be composed of productive income (Y_P) and financial income (Y_F), with Ψ representing the ratio of financial to productive income ($\Psi = \frac{Y_F}{Y_P} = \frac{ib}{u}$). We can describe total income distribution as: $Y = Y_P + Y_F = W + \Pi + iB$. The worker's share of income, our distribution variable of interest, can be defined:

$$\omega = \frac{W}{Y} = \frac{(1-\pi)Y_P}{(1+\Psi)Y_P} = \frac{1-\pi}{1+\Psi} \tag{1}$$

Productive wages depend on the exogenous profit share of productive income (π). The shares of all groups depend on the domestic debt to capital ratio (b) and the utilisation of installed capacity ($u = \frac{Y_P}{K}$),[8] because of their impact on Ψ.

3.2. Dynamics of the model

We can now describe the dynamics of the expenditures in the model:

$$g = \frac{I}{K} = \gamma + \gamma_u(u - u_n) \tag{2}$$

$$tb = \frac{TB}{K} = x + \phi_e e_R - \phi_u u \tag{3}$$

Capital accumulation (equation 2) depends positively on the difference between u and u_n, the current and normal rates of capacity utilisation, and on the parameter γ, which indicates the expected growth of sales by the capitalists, or their "animal spirits" (Nah and Lavoie, 2017). Equation 3 represents the trade balance in proportion to the capital stock. It depends positively on $x = \frac{X_0}{K}$ and on a Marshall-Lerner-like positive effect of exchange rate depreciation on net exports ($\phi_e e_R$). The real exchange rate is defined as $e_R = \frac{ep_f}{p}$, where p and p_f are the domestic and foreign price levels, respectively. It is important to notice that ϕ_e represents both the variation of exports and of imports to a depreciation of the domestic currency (that is both X_1 and M_1 in proportion to capital), representing the total Marshall-Lerner effect. Following the canonical Neo-Kaleckian open economy models we assume its value is positive in our basis model for the short-run, but we loosen this assumption when we apply the model to developing

[8] For simplicity we assume the proportion of installed capital to potential output to remain constant and equal to unit.

countries in section 4. ϕ_u represents the propensity to import in aggregate demand, which we assume is a constant parameter.

We can now describe the government and savings to capital equations:

$$gov = \frac{Gov}{K} = \vartheta - \tau u + ib \tag{4}$$

$$\sigma = \frac{S}{K} = s_r(\pi u + ib) \tag{5}$$

ϑ denotes the government-consumption-to-capital ratio, which is assumed to be autonomous from current income and a policy variable. τ is the tax rate on income. We assume that all sources of income are taxed proportionally, so taxation does not have a directly redistributive role.[9] Furthermore, equation 5 represents the savings-to-capital ratio, which depends on the share of profits on productive income (π) and on the interest on domestic public bonds received by rentiers. s_r is the tax-adjusted savings rate of the rentiers, such that $s_r = s(1-\tau)$, where s is the general propensity to save of the rentiers which is the same for all their sources of income. It is assumed, as usual in this literature, that workers as a group do not save.

By using the macroeconomic equilibrium characterised by the fundamental identity dictating that saving should equal the sum of investment expenditures, the trade balance, and the total government deficit or surplus, we can combine equations 2 to 5 as:

$$s_r\pi u = \gamma + \gamma_u(u - u_n) + x + \phi_e e_R - \phi_u u + \vartheta - \tau u + (1 - s_r)ib \tag{6}$$

3.3. Short-run equilibrium:

3.3.1. Deriving the equilibrium values

From equation 6 we can find the short-term equilibrium rate of capacity utilisation 7, and by applying that to equation 2 we have the short-run equilibrium rate of accumulation 8. Equation 9 gives the equilibrium share of wages:

$$u^* = \frac{\gamma + x + \phi_e e_R + \vartheta + (1 - s_r)ib - \gamma_u u_n}{s_r\pi + \phi_u + \tau - \gamma_u} \tag{7}$$

[9] A progressive taxation could imply higher aggregate demand levels, while the opposite applies for regressive taxation.

$$g^* = \gamma + \gamma_u \left(\frac{\gamma + x + \phi_e e_R + \vartheta + (1 - s_r) ib - (s_r \pi + \phi_u)\, u_n}{s_r \pi + \phi_u + \tau - \gamma_u} \right) \tag{8}$$

$$\omega^* = \frac{1 - \pi}{1 + \frac{ib}{u^*}} \tag{9}$$

3.3.2. Properties of short-run equilibrium:

As traditional in the literature, it is assumed that the Keynesian stability condition holds. That is, that the sum of savings, net exports, and tax revenues respond more strongly to changes in the rate of utilisation than investment. Which guarantees short-term stability by making the denominator of equations 11 and 12 positive. That is, when $s_r \pi > \gamma_u - \phi_u - \tau$.

We can also look at whether the main Kaleckian results of the paradox of savings – the notion that higher saving rates decrease aggregate income -, and the paradox of profits[10] - the notion that higher profit shares decrease aggregate income – still hold in the short-run. We have:

$$\frac{\partial u^*}{\partial s_r} = -\frac{(\pi u^* + ib)}{s_r \pi + \phi_u + \tau - \gamma_u} < 0 \tag{10}$$

$$\frac{\partial u^*}{\partial \pi} = \frac{\phi_e \frac{\partial e_R}{\partial \pi} - s_r u^*}{s_r \pi + \phi_u + \tau - \gamma_u} \tag{11}$$

We can see from inequalities 10 and 11 that when the Keynesian stability condition holds the paradox of savings is maintained, while the paradox of profits depends on the parameters. On one hand a higher profit share decreases domestic consumption. On the other hand, it may also cause a real exchange rate depreciation with a positive effect on aggregate demand. The result would then depend on the related parameters. When $\frac{\partial e_R}{\partial \pi} < \frac{s_r u^*}{\phi_e}$, the economy is wage-led and if the opposite inequality holds then the economy would be profit-led. A finding in line with neo-Kaleckian open economy models (Blecker, 1989; Hein and Vogel, 2008).

[10] Here the paradox of profits is taken as the proportion of profits in productive income and not on total income as in Hein (2018) and Hein and Woodgate (2020).

3.4. Long run equilibrium:

3.4.1. Aggregate demand growth and capital accumulation

The short-run equilibrium represents the adjustment of capacity utilisation to the given aggregate demand, so it assumes x, ϑ, b and foreign asset positions do not change.[11] After this quick adjustment, however, it is expected that these ratios start to change. To look at the long run equilibrium, we assume γ changes and adjusts to the growth rate of the autonomous components as expressed by Dutt (2019, p. 17).[12] We also assume Marshall-Lerner effect does not hold in the long-run[13], so $\phi_e = 0$ in the dynamic equations. We are left with three autonomous non-capacity creating components of demand (Z):

$$Z = G_C + (1 - s_r)iB + X_0 \tag{12}$$

With equation 12, we can rewrite equation 7 in terms of the supermultiplier, the autonomous non-capacity-creating (excluding $\phi_e e_R$ in this version) and the autonomous capacity-creating autonomous component of demand (I_A). We would have:

$$u^* = \left(\frac{Y_P}{K}\right)^* = \frac{I_A + Z}{K(s_r\pi + \phi_u + \tau - \gamma_u)} = \frac{\gamma - \gamma_u\, u_n + z}{s_r\pi + \phi_u + \tau - \gamma_u} \tag{13}$$

In which $z = \frac{Z}{K}$ and equation 13 corresponds to an alternative short-run equilibrium in which $\phi_e = 0$. We can see the supermultiplier $\left(\frac{1}{s_r\pi + \phi_u + \tau - \gamma_u}\right)$ increases the effect of variations on autonomous components, both capacity-creating and non-capacity-creating. The term I_A, which indicates the part of the investment of the firms that is independent of current income, is common in the neo-Kaleckian supermultiplier literature (Allain, 2015; Lavoie, 2016).

Consumption out of interests on domestic debt, $(1 - s_r)iB$, depends on the government current interest payments, thus representing part of the effect government expenditure has on current aggregate demand. With this in mind, we define $\alpha Z = G_C + (1 - s_r)iB$ as the government

[11] This implies the short run is like a snapshot of the economy (Nah and Lavoie, 2017) in which not even the flows (like exports or government expenditure) change. It is only the adjustment of output to the given aggregate demand.

[12] That is, that firms understand that "the expected long-run growth is equal to the known rate of growth of the exogenous component" in the long-run, such that $=0$ and animal spirits equal to the actual rate of growth of autonomous demand in the long-run.

[13] This is in line with the BPCG literature and its empirical findings that relative price changes explain little to none of the long-run movement of trade (Kaldor, 1978; Thirlwall, 2012).

expenditure contribution to autonomous demand. We also assume that the growth rate of this flow, represented by $\bar{g}_G$ is exogenous and a policy variable set by the government, such that the government consumption growth g_{G_C} accommodates the growth rate of domestic public debt and possible changes in domestic interest rates and rentiers' savings rate.[14] We also assume that exports (now only composed of X_0) grow at an exogenously given rate $\bar{g}_X$ Note that a dot above a variable represents the rate of change of that variable in time, variables with a hat represent the rate of growth of ratio variables, to avoid confusion, and g variables with subscripts represent the growth rate of other variables (with g itself representing the growth rate of the capital stock, or the rate of accumulation). We have:

$$g_z = \alpha\bar{g}_G + (1-\alpha)\bar{g}_X \tag{14}$$

$$\dot{\alpha} = \alpha(1-\alpha)(g_G - g_X) \tag{15}$$

We can now look at the dynamics of the ratio of autonomous non-capacity-creating demand to capital stocks:

$$\left(\frac{\hat{Z}}{K}\right) = \hat{z} = g_z - g^* = g_z - \gamma - \gamma_u\left(\frac{\gamma + z - (s_r\pi + \phi_u)\,u_n}{s_r\pi + \phi_u + \tau - \gamma_u}\right) \tag{16}$$

$$\frac{\partial\hat{z}}{\partial z} = -\frac{\gamma_u}{s_r\pi + \phi_u + \tau - \gamma_u} < 0 \tag{17}$$

Inequality 17 holds given the Keynesian Stability condition and it points out that the autonomous non-capacity-creating demand converges to the capital stock in growth rates, such that the ratio converges to a point in which $\dot{z} = 0$. The long-run equilibrium position also requires that $\dot{\alpha} = 0$ (Freitas and Serrano, 2015; Morlin, 2022). Which is attained either by a very specific growth dynamic of α in equation 15 or when $g_G = g_x$. The first option is discarded as it would require an arbitrary specific growth path of the economy. So, we assume the long-run equilibrium to be the one in which the different "semi-autonomous" components equalise in growth rates. This sets an equilibrium α^{**} that can assume any level between 0 and 1 as long as the different autonomous non-capacity-creating components grow at the same rate

[14] This sheds light on the fact that total government expenditure may have lower fiscal multiplier effects if the payment of interests starts to represent a larger share in total government expenditure (Canova and Pappa, 2011).

(as done in Morlin (2022, p.30)). In subsections 3.4.6 and 3.5 we further explore the interactions between these semi-autonomous components in the long run.

We can now find the long-run equilibrium levels of growth and capacity utilisation by making equations 15 and 16 equal zero:

$$g^{**} = g_z = g_G = g_x = \gamma^{**} \tag{18}$$

$$u^{**} = u_n \tag{19}$$

$$z^{**} = (s_r\pi + \phi_u)u_n - g_z \tag{20}$$

Variables with two stars represent their long-run equilibrium positions, just as one star represents short run equilibrium.

We can see the long-run growth of the economy is completely determined by the growth rate of the autonomous non-capacity-creating components of demand and the economy converges to a normal level of capacity utilisation desired by the firms. Equation 20, representing the equilibrium level of autonomous non-capacity creating components to capital can be derived from equation 13.

3.4.2. Domestic Public Debt Dynamics

We can now look at our domestic public debt dynamics:

$$\dot{B} = G_C - T + iB \tag{21}$$

Public debt increases with higher government expenditure and interest payments and decreases with higher tax revenues. It is important to take into consideration that the relevant domestic debt for most economies is not the gross domestic public debt, but its ratio to domestic production, or, as we have been considering so far, to the installed capital. We then consider the dynamics of $b = \frac{B}{K}$. Remembering that $T = \tau Y = \tau(Y_P + iB)$ and that $\vartheta = \alpha z - (1 - s_r)ib$, we have:

$$\dot{b} = \frac{\dot{B}K - B\dot{K}}{K^2} = \alpha z - \tau u + [i(s_r - \tau) - g]b \tag{22}$$

The ratio b will be stable when:

$$\frac{\partial \dot{b}}{\partial b} = i(s_r - \tau) - g < 0 \tag{23}$$

Thus, domestic public debt stability and convergence to an equilibrium value depends on $g > i(s_r - \tau)$. A condition that is less restrictive than Domar's (1944) public debt stability hypothesis of $g > i$. This is in line with the findings of the literature that takes into consideration private consumption and taxation out of interest payments on government debt (Godley and Lavoie, 2007, Ch. 11; Lavoie, 2022, Ch. 5.6.3).

We can now find the equilibrium long-run domestic debt level of our economy by equalising equation 22 to zero:

$$b^{**} = \frac{\alpha z^{**} - \tau u_n}{g - i(s_r - \tau)} \tag{24}$$

It is also important to notice that a higher public debt to capital ratio is compatible with lower wage-share in the long-run, as it increases equilibrium financial income. Public debt becomes the only endogenous variable with a distributive role in the long-run.

$$\omega^{**} = \frac{1 - \pi}{1 + \frac{ib^{**}}{u_n}} \tag{25}$$

3.4.3. Foreign Reserves and External Public Debt Dynamics:

Based on the works of Morlin (2022) and Dvoskin and Torchinsky Landau (2023), we build the behaviour of the balance of payments in our model. Our model considers the most realistic case in which current account imbalances do not mechanically determine financial flows in an economy with relatively open capital accounts. This implies that the variation in international reserves (R) is the element that accommodates changes in the current, capital, and financial accounts. Balance of payments accounting usually defines the gross external debt as the opposite to the current account, which means it incorporates changes in international reserves. It has then to be differentiated from the net external debt (D), which excludes international reserves. By these definitions, the change of the net external debt will correspond to the results of the capital and financial accounts. This can be seen in the dynamics of both stocks:

$$\dot{R} = X - M - i_x D + i_f R + F\left(i, i_f, \epsilon\right) \tag{26}$$

$$\dot{D} = F\left(i, i_f, \epsilon\right) = \delta[\left(i - i_f\right)Y_P - \epsilon] \tag{27}$$

$i_x$and $i_f$are the interest rates on external debt and on international reserves, respectively, such that $i_x = i_f + \mu$, where $\mu \geq 0$ represents a risk premium on lending to this country. This definition highlights that interest on external debt is indexed to or directly affected by the US Fed rate i_f while being higher than it. While this is a realistic case for loans from the IMF, World Bank and it may very well also be the case for bonds issued by the government to foreign creditors, as they compete in the international asset market in which the Fed interest rate serves as the base rate of return on the safest asset.[15] R is the international reserve stock which is assumed to be held in US Fed treasury bonds to not incur into opportunity costs of holding currency. We also assume there is high liquidity for these bonds, such that the reserve stocks vary with the balance of payments result, so the country can always buy or sell the reserves in each period. D represents the net external debt stocks, the foreign liabilities the domestic economy holds with the rest of the world, which in our model we assume are all held by the public sector in foreign currency (see Table 1). As discussed before, $\dot{D} = F$, in which F is the net financial inflows and represents the total result of the capital and financial accounts.[16] We build our net financial inflow function based on the literature that describes the behaviour of capital flows and their own determinants (Borio and Disyiatat, 2015; Rey, 2015; Dvoskin and Torchinsky Landau, 2023), while trying to keep it simple. Financial inflows depend on the interest rate differential (between domestic and international rates), on the country's domestic production (assuming larger economies receive more flows), and negatively on the risk assessment by the market (ϵ), assumed exogenous for matters of simplicity.[17] The parameter δ is positive and indicates how elastic financial inflows are to the other variables, which would incorporate the effects of capital account openness and the liquidity level of financial flows.

As we have done with domestic public debt, it is important to consider the relevant debt dynamic is not the one of the stocks of net external debt. While part of the literature on balance of payments constrained growth has considered external debt to GDP as the relevant variable

[15] This incorporates the usual consideration that developing countries do not control the interest rate on their external debt (Cline and Vernengo, 2016). On the other hand, if part of the external debt is held in domestic bonds, interest rates on external debt should not be completely independent from domestic interest rates, a limitation of the model. This is left for future research.

[16] We do not explicitly distinguish different forms of capital flows between the accounts. However, it should be the case that the composition matters, and part of its effects can be seen in our model. A country with more portfolio flows and less FDI, for example, will probably be more volatile to global financial cycles, which in our model would mean they have a higher . The composition of flows, with more FDI, for example, could also affect the structure of production and the growth rate of exports (gx) and the propensity to import (ϕu).

[17] Dvoskin and Torchinsky Landau (2023) consider the dynamics of the net external debt to international reserves as a proxy for the risk assessment. To maintain our model simple, we do not consider that.

(Moreno-Brid, 2003; Setterfield, 2012), Bhering et al. (2019) have highlighted that this view can be misleading. GDP is usually denominated in national currency, while external debt is usually denominated in foreign currency, what matters in terms of liquidity to service the debt would be the access to this foreign currency, not the GDP in national currency. This has led some contributions to consider the ratio of external debt (and international reserves) to exports as the relevant variable to look at debt dynamics (Morlin, 2022; Dvoskin and Torchinsky Landau, 2023). Dividing equations 26 and 27 by exports we:

$$\dot{r} = \left(\frac{\dot{R}}{X}\right) = \frac{\dot{R}X - R\dot{X}}{X^2} = 1 + \frac{Y_P}{X}\left(\delta\left(i - i_f\right) - \phi_u\right) - i_x d + \left(i_f - g_x\right)r - \delta\varepsilon \tag{28}$$

$$\dot{d} = \left(\frac{\dot{D}}{X}\right) = \frac{\dot{D}X - D\dot{X}}{X^2} = \frac{Y_P}{X}\delta\left(i - i_f\right) - \delta\varepsilon - g_x d \tag{29}$$

In which $\varepsilon = \frac{\epsilon}{X}$, and r and d are the international reserves and net external debt to export ratios. The individual stabilities of the international reserves and net external debt to exports ratios will then depend on the inequalities:

$$\frac{\partial \dot{r}}{\partial r} = i_f - g_x < 0 \tag{30}$$

$$\frac{\partial \dot{d}}{\partial d} = -g_x < 0 \tag{31}$$

Since we are considering the realistic scenario in which $i_f \geq 0$, we can see the stability of both ratios are met when $g_x > i_f$. Although the net external debt has a less restrictive stability condition of $g_x > 0$ when taken individually. Considering the stability and convergence of both equations as a dynamic system, the system will only converge to an equilibrium if $g_x > i_f \geq 0$ (see Appendix for proof). This is in line with the findings of the theoretical literature that explore models of external debt dynamics (Cline and Vernengo, 2016; Morlin, 2022).

We can then derive the long-run equilibrium positions in which $\dot{r} = \dot{d} = 0$:

$$r^{**} = \frac{1 + \frac{Y_P}{X}\left(\delta\left(i - i_f\right) - \phi_u\right) - i_x d^{**} - \delta\varepsilon}{g_x - i_f} \tag{32}$$

$$d^{**} = \frac{\frac{Y_P}{X}\delta\left(i - i_f\right) - \delta\varepsilon}{g_x} \tag{33}$$

Finally for a full appreciation of the effect of our parameters on the equilibrium of balance of payments we can use equations 13 and 33 to rewrite $\frac{Y_P}{X}$ and d^{**} on equation 32 and have:

$$r^{**} = \left[1 + \frac{(\gamma^{**} - \gamma_u\, u_n + z^{**})[\delta(i - i_f)(1 - \frac{i_x}{g_x}) - \phi_u]}{(1-\alpha)z^{**}(s_r\pi + \phi_u + \tau - \gamma_u)} - \delta\varepsilon(1 - \frac{i_x}{g_x})\right]\frac{1}{(g_x - i_f)} \quad (32A)$$

Equilibrium international reserves and net external debt depend on a series of parameters. For example, an increase in aggregate demand affects international reserves positively through higher financial inflows, but negatively through higher imports and higher net external debt, with its net effect depending on parameters. The interest rate differential between domestic and foreign interest rates and the risk perception also both affect reserves and debt, having a general effect on long-run equilibrium depending on $\frac{i_x}{g_x}$. We do a thorough analysis of the effects of different variables on the balance of payments dynamics in section 4.

3.4.4. A limit to external indebtedness and Thirlwall's law

Until now we assumed the trade imbalance can be always financed by financial flows, with no limit to r or d. As done by Bhering et al. (2019) and Morlin (2022), we now consider the more plausible situation in which international creditors will not indefinitely finance the country's indebtedness, imposing a maximum level of external debt to exports ratio $\bar{d}$. This level would then be associated with a minimum level of international reserve stocks $\bar{r}$ through equation 32. Apart from interest on a maximum net external debt, a minimum positive level of international reserve stocks has also to be considered for the maintenance of a fixed or managed exchange rate regime. We can then define the minimum level of international reserves required as the one that allows the country to serve both needs. Below this level, the country would enter a balance of payments crisis. We have:

$$\bar{r} = \frac{1 + \frac{Y_P}{X}\left(\delta(i - i_f) - \phi_u\right) - i_x\bar{d} - \delta\varepsilon}{g_x - i_f} \quad (34)$$

Because $\frac{Y_P}{X}$ depends on the share of government expenditure in autonomous non-capacity generating demand (α), we can use equation 32A to derive a maximum level of government expenditure in autonomous demand associated with balance of payments equilibrium:

$$\bar{\alpha} = 1 - \left[\frac{(\gamma - \gamma_u\, u_n + \ z)\left[\phi_u - \delta\left(i - i_f\right)(1 - \frac{i_x}{g_x})\right]}{z(s_r\pi + \phi_u + \tau - \gamma_u)[\left(i_f - g_x\right)\bar{r} - \delta\varepsilon(1 - \frac{i_x}{g_x}) + 1]} \right] \tag{35}$$

We can see from equation 35 that the country might be faced with a balance of payments limit to the level of government expenditure (its share on autonomous demand). This may force the government to decrease $\bar{g}_G$ temporarily to bring the economy to a level of public expenditure aligned with the balance of payments constraint, also affecting growth in the traverse between short and long-run. It is important to notice that this constraint is also affected by monetary and exchange rate policies which may change the external space of fiscal policy. We explore these policy relations in section 4.

3.4.5. Long-run convergence to equilibrium, some considerations

Our final long-run equilibrium presents the conditions $\dot{\gamma} = \dot{z} = \dot{\alpha} = \dot{b} = \dot{d} = \dot{r} = 0$. The conditions $\dot{\gamma} = \dot{z} = 0$ are typical of all neo-Kaleckian supermultiplier models (while Sraffian versions have $\dot{h} = \dot{u} = 0$ (Freitas and Serrano (2015)). In our model $\dot{\gamma} = 0$ is obtained by the mechanism proposed by Dutt (2019) as we chose not to deal with Harrodian instability in this model.[18] The stability of the debt dynamic $\dot{b} = 0$ and of the dynamic system in which $\dot{d} = \dot{r} = 0$ were examined separately from income, and individually in each subsection, as there is no feedback effect of the dynamic system of r and d nor of b in $\dot{\gamma}$ and $\dot{z}$ or in each other.[19] The condition $\dot{\alpha} = 0$ was already pointed out by Allain (2022) and Morlin (2022) as a necessary condition for analytically examining long-run equilibriums with more than one autonomous component. While $\dot{\alpha} = 0$ is an assumption, it does not impose a specific equilibrium value, with any α between 0 and 1 possible for our equilibrium, but it imposes that $g_G = g_X$ in our equilibrium. This is compatible with the investigations of the relationship between semi-autonomous variables done by Allain (2022) and with the simulations done by Morlin (2022) for a model without portfolio flows. From equation 35, we can see that when $g_G > g_X$ increasing α would take the country to a balance of payment crises which would force the government to decrease the growth rate of government expenditure and the share of

[18] Nah and Lavoie (2017) present a Harrodian mechanism in which there are two different periods of adjustment with $\dot{\gamma}$ adjusting in the second period. This method could be applied to this model, we chose not to do so for matters of simplicity.

[19] Note that the independence between the dynamics z and b differs from the contributions of Hein (2018) and Hein and Woodgate (2020) which focus on stability constraints set by these expenditures. This difference emerges from our choice of specification of the growth of government expenditure effect on demand.

government expenditure on aggregate demand. There is a clear adjustment mechanism in this case. However, for the opposite case, in which $g_G < g_x$, there is no clear adjustment mechanism. Allain (2022) points out that the government could decide to expand expenditure as there is more fiscal space (by balance of payments or/and higher tax revenues from exports) or there could be a slowdown of productivity gains by Kaldor-Verdoon effects if the government maintains expenditures low, diminishing exports. In any of these mechanisms, however, the adjustment is less obvious than in the opposite case and not mechanical. Which means the disequilibrium could possibly last much longer. This result leads us to the finding of an open-economy asymmetry of demand-led growth. Which we discuss in depth in the next subsection.

3.5. Main results of the model and implications for open-economy demand-led growth

We have built a neo-Kaleckian open-economy supermultiplier model following Nah and Lavoie (2017) and extending their model in two directions proposed by them: considering interest payments from foreign debt and assets and including the government sector. Furthermore, we have also introduced a balance of payments constraint to the model. To do so we had to disregard the long-run effects of exchange rate variations on the rate of accumulation. The fact that exchange rate movements have only a short- or medium- run effect is in line not only with the large empirical evidence to which BPCG literature builds upon (Kaldor, 1978; Thirlwall, 2012), but has also been highlighted by neo-Kaleckian authors (Blecker, 2016).[20] We have thus showed the neo-Kaleckian supermultiplier model may be combined with a long-run balance of payments constraint while sustaining the canonical results of the paradox of savings and of the conditional paradox of profits as level effects, or effects on the traverse and average growth (Lavoie, 2016).

Our model has also sustained the canonical results of supermultiplier models (Freitas and Serrano, 2015; Lavoie, 2016). With the rate of accumulation converging to the growth rate of the autonomous components of demand and utilisation converging to normal utilisation levels. As in Morlin (2022), the long-run - or maximum - rate of growth is the same as defined by Thirlwall's Law (Thirlwall, 2012).[21] This result highlights the role of structural change - and

[20] Blecker (2016) argues that the competition gains from decreasing real wages (and domestic prices) that affect net exports and investment decision (Blecker, 1989) would diminish over time.

[21] Following Thirlwall (1979) we can write the balance-of-payments constrained growth rate as $g_b = \frac{g_X}{\mu}$, where μ is the income elasticity of imports. Which is equal to unit in our model since we assume the propensity to import as constant. From equation 18 we can see that $g^{**} = g_z = g_G = g_X = g_b$.

industrial and commercial policy to change it - as the ones affecting maximum growth rates. In line with Kaldorian and Latin American Structuralist traditions (Thirlwall, 2012; Setterfield, 2012; Perez-Caldentey and Vernengo, 2019).

On the other hand, the introduction of a second autonomous demand component – government expenditure – sheds light on the role of the balance of payments as a ceiling, but not a floor nor as the only determinant of growth. When government expenditure (or domestic autonomous demand more generally) grows faster than exports the economy continually accumulates external debt. This would characterise an 'unsustainable process' (Godley, 2012). However, in the opposite case, when government expenditure grows less than exports, the economy would accumulate foreign assets, a sustainable process. This would impose lower growth than "potential", but it would be feasible and stable for long periods of time.

Under these results, the economy would follow either a balance-of-payments-constrained growth regime or a policy-constrained (or pure) demand-led growth regime. The same result had been found by Morlin (2022), while the label had been used more generally by both the BPCG and Sraffian supermultiplier traditions (McCombie and Thirlwall, 1999; Freitas and Dweck, 2013). This conclusion differs from Dvoskin and Torchinsky-Landau (2023), which highlight with a Sraffian supermultiplier model that the policy-constrained regime is not an equilibrium result of the model. Although a "traverse case" and not a "long-run case", we argue the policy-constrained regime remains a relevant case to explain the growth pattern of economies as it is a sustainable process that may be maintained for long periods of time.[22] This conclusion follows the analysis of stock-flow relations proposed by the New Cambridge School (Cripps and Godley, 1976), presenting a similar argument to the one made by Godley's trade performance for a static model (Lavoie, 2022, Ch.4).

Lastly, the tradition of stock-flow-consistent modelling has also highlighted the role of *stock-flow norms* (Godley and Lavoie, 2007, p.13). Which point out that expenditure flows may be influenced by desired levels of wealth stocks related to these flows. This may provide an economic reasoning for the choice of keeping domestic expenditures low, or not using all the external space for growth. To accumulate international reserves for times of turmoil. Indeed, the record accumulation of reserves seen in past decades followed the Asian Financial Crisis of 1997-8, which was a crisis of external liquidity. To test this rationale, the next section of the

[22] "Policy constrained" may very often mean "politically constrained". As argued by Kalecki (1943) political economy interests may lead to policies that are not compatible with higher growth rates of aggregate income.

paper analyses how an external shock may affect growth, distribution, and macroeconomic policy space, taking into consideration the role international reserve stocks may play in it.

4. Effects of Deteriorating External Conditions for Developing Countries

4.1. Exercise: policy reactions to a hike in the Us Fed interest rate

Inspired by the empirical literature that finds that capital outflows from developing countries are usually led by increases in the interest rates in the US, we look at how a rise in the US interest rate may impact developing countries in our model. We do so by looking at the effects of different policy responses by the government in an exercise of comparative dynamics.

This approach may be seen as somehow innovative, as it applies a long-run growth model to a medium-run policy response environment. This is inspired by the insight of Lavoie (2016) about the importance of the traverse (the adjustment path between short-term and long-term equilibriums) in economic dynamics. The long-run equilibrium equations point to the path towards which the economy is headed after a shock, while the dynamic equations let us analyse the economic effects already in the first periods. We hold this is particularly useful to look at the balance of payments crises. An important component of such crises is the expectations of the path the economy is heading, more specifically the expectation that a lack of external liquidity may persist, leading to possible speculative attacks.[23]

To focus our analysis on developing countries some considerations must be made. We have assumed so far exchange rates have no "Marshall-Lerner" effect in the long-run, only in the short run. However, important literature following Díaz-Alejandro (1963) and Krugman and Taylor (1978) have found that exchange rate devaluations have contractionary effects on the economy also in the short-run, bringing the balance of payments to equilibrium through lower income not through higher exports.[24] Following this tradition, we consider the dominant effect of nominal exchange rates devaluation is on the productive wage share through an increase in prices, such that $\frac{\partial \pi}{\partial e} > 0$ and $\phi_e = 0$. Furthermore, since we are considering developing

[23] This possibility of speculative attacks is not formally modelled, but it is implicitly taken into consideration by assuming a minimum stock of reserves countries must hold to not enter a balance-of-payments crisis.

[24] Developing countries are often primary good exporters, so their exports have low exchange rate elasticity (Bernat, 2015) and an import substitution process is unlikely due to their lack of access to capital goods domestically, which force them to import, imposing a pass-through to prices (Dvoskin and Torchinsky Landau, 2023).

countries, it is assumed they are net debtors with the rest of the world, such that $d > r$. Since the currency crisis consists of a moment in which the country cannot intervene to sustain its desired exchange rate levels, it is assumed that the country starts with a positive level of international reserves r above this minimum level it needs to not enter such crisis ($\bar{r}$).

This exercise is constructed under the conditions in which the model presents stable dynamics, that is: when the Keynesian stability condition, $s_r\pi > \gamma_u - \phi_u - \tau$, the domestic debt stability condition, $g > i(s_r - \tau)$, and the external debt system stability condition, $g_x > i_f \geq 0$, all hold. Economic scenarios in which these conditions are broken will already lead to disequilibrium and to crises if persistent. We analyse the partial effects coming out of a situation of stability, only mentioning how changes in the variables could also affect the stability conditions, leading to fiscal crises.

We shall then look at the effects on the dynamic of international reserves between short- and long-run equilibriums, as they express the result of the balance of payments. The traverse, or the effect of the shock on dynamic equations, is interpreted as the 'medium-run dynamics', coming out of the previous equilibrium position, while on the long-run a full adjustment of all stocks to their long-run positions can be already assumed. We can then look at the impact of a variation in i_f on both the medium-run (dynamics) and the long-run (fully-adjusted) equations for the ratio of international reserves to exports:

$$\frac{\partial \dot{r}}{\partial i_f} = -\frac{Y_P}{X}\delta + (r - d) < 0 \tag{36}$$

$$\frac{\partial r^{**}}{\partial i_f} = \left[-\frac{Y_P}{X}\delta\left(1 - \frac{i_x}{g_x}\right) + (r^{**} - d^{**})\right]\frac{1}{g_x - i_f} < 0 \tag{37}$$

The Fed Funds rate has a negative impact on reserves-to-exports ratio in the period after the shock but the effect on the long-run is ambiguous. The shock has four effects: increasing (i) the interest rate received on external assets and (ii) the one paid on liabilities; and decreasing (iii) current capital inflows and (iv) the long-run volume of liabilities to which interests are paid. The first two effects have a negative balance when $r^{**} < d^{**}$ and (iii) is negative. The three first effects are seen already in the first periods (with previous level of financial stocks), while effect (iv) can only be fully considered in the long-run as it builds up in time with the progressive decrease of d between equilibriums. This effect can be positive when $i_x > g_x$ and

it highlights that lower financial inflows may have a positive effect on the long-run external constraint.[25]

This result is in line with the BPCG literature that incorporates financial flows (Moreno-Brid, 2003; Bhering et al., 2019). It reflects the dual role of financial flows: as short-term liquidity and long-term liability. In line with Bhering et al. (2019), when $i_x > g_x$ any positive level of capital inflows tightens the external constraint in the long-run because external debt created by these flows impose interest payments that grow faster than exports. However, even when $i_x > g_x$, higher US interest rates will increase reserves-to-exports ($\frac{\partial r^{**}}{\partial i_f} > 0$) only when the positive impact of decreasing the long-run volume of liabilities is stronger than the price effect of higher interest rates on those liabilities. That is, only when $\frac{i_x}{g_x} > 1 + \frac{D^{**} - R^{**}}{\delta Y_P}$.[26]

The result shows that an increase in US interest rates lead to a deterioration in the BoP which may be temporary or persistent, depending on the initial external financial stocks and interest rates on the country's external debts. If the country is running close to the external constraint ($\bar{r}$), already in the first periods after the shock the economy must choose between selling reserves or bringing BoP to equilibrium through macroeconomic policy. The modelled government has 3 macroeconomic tools to do so: the nominal exchange rate (e), domestic interest rate (i), and government expenditure (g_G).

We look at how each policy impacts short-run capacity utilisation and wage share, the dynamics of the balance of payments, and our long-run equilibrium variables. Table 3 below summarises these effects, while each subsection next goes through them.

[25] Note that equation 32 can be written as $r^{**} = \frac{X - M + (g_x - i_x)d^{**}}{g_x - i_f}$, which highlight that when $i_x > g_x > i_f$, $\frac{\partial r^{**}}{\partial d^{**}} = \frac{g_x - i_x}{g_x - i_f} < 0$. For stability $g_x > i_f$ was assumed. Since $i_x > i_f$, so $i_x > g_x > i_f$ is possible.

[26] However, it is interesting to notice that it will be less likely the higher the net external position to productive GDP ratio, the smaller the capital openness.

Table 3. Effects of macroeconomic policy responses on key endogenous variables

Policy variables	short-run equilibrium		medium-run dynamics	long-run equilibrium				
	u^*	ω^*	$\dot{r}$	z^{**}	b^{**}	r^{**}	d^{**}	ω^{**}
$\uparrow e$	-	-	+/-	+	+	+/-	-	-
$\uparrow i$	+	+/-	+	0	+	+/-	+	-
$\downarrow \alpha$	-	0	+/-	0	-	+/-	-	+

Note: + and - represent positive or negative partial derivatives from the change in the variable on equilibrium values. +/- means the effect is ambiguous. 0 means there is no effect.
Variables: capacity utilization (u), wage share (w), international reserves to exports (r), autonomous non-capacity creating demand to capital (z), domestic debt to capital (b), external debt to exports (d), nominal exchange rates (e), nominal interest rate (i), share of government

4.1.1. Case 1: exchange rate policy ($\uparrow e$)

We shall start by considering the case in which the government lets the currency take the whole shock of capital outflows, which would be correspondent to a case in which the country had a fully flexible exchange rate. Since we assumed Marshall-Lerner effects do not hold in the case of developing countries, the effect that dominates is the shock of nominal exchange rates on domestic prices. For this reason, in the short-run the currency devaluation decreases both the equilibrium capacity utilisation and the wage share. In the long-run, the currency devaluation also decreases equilibrium wage share by increasing the equilibrium autonomous demand level and the public domestic debt stock. When it comes to the effect on balance of payments, effects depend on the parameters:

Medium-run dynamics:

$$\frac{d\dot{r}}{de} = \frac{\partial \pi}{\partial e} * \frac{-s_r(\gamma^{**} - \gamma_u u_n + z^{**})\left(\delta\left(i - i_f\right) - \phi_u\right)}{(1-\alpha)z^{**}(s_r\pi + \phi_u + \tau - \gamma_u)^2} \tag{38}$$

Long-run:

$$\frac{\partial r^{**}}{\partial e} = \left[\frac{\partial \left(\frac{Y_P}{X}\right)^{**}}{\partial e} * \frac{\left[\delta\left(i - i_f\right)\left(1 - \frac{i_x}{g_x}\right) - \phi_u\right]}{\left(g_x - i_f\right)}\right] \tag{39}$$

It is easy to see that equation 38's sign will depend on $\left(\delta\left(i - i_f\right) - \phi_u\right)$. That is, on whether the currency devaluation will have a greater effect on decreasing imports or on diminishing

capital inflows through lower income. If the latter is stronger than the former, that is, if $\delta(i - i_f) > \phi_u$, then the devaluation will have a negative effect on the balance of payments both in the traverse and in long-run equilibrium international reserves level. This result is very interesting and seems to be in line with empirical findings. As we have discussed, the empirical literature after Rey (2015) finds that global financial cycles greatly commanded by US Fed interest rate hikes often cannot be offset by exchange rate devaluations in peripheral countries. Which they call a policy dilemma between capital opening and monetary policy, as the latter would be the only policy tool capable of bringing the balance of payments to equilibrium. Indeed, in our model the greater the openness to capital flows (expressed by δ) the weaker the possibility of positive effects of nominal exchange rates on the reserves to exports ratio.

Since a devaluation decreases capital attraction, it leads to lower levels of net external debt in dollar terms in the long-run. Although they could still increase in domestic prices, given the devaluation. In the long-run, this leads to a new positive effect on reserves through lower levels of interest payments (in dollar terms). When $i_x > g_x$This effect is dominant, and reserves increase in the long-term. On the other hand, depreciation also increases the volume of domestic public debt through an increase in z, so it may lead the government to owe more externally and domestically.

4.1.2. Case 2: monetary policy (↑ i)

As an alternative to devaluing the currency, the government could choose to attract more capital by increasing domestic interest rates, thus decreasing the interest rate gap between the countries. A hike in domestic rates in our model increases short-term capacity utilisation but decreases wage share under realistic assumptions.[27] In the long-run, the negative effect of an interest rate hike on wage share is clear and is amplified by the increase in the domestic debt ratio. An increase in domestic interest rates limits fiscal policy space through two channels. On one hand, it increases the government's domestic debt while on the other hand, it can lead to a debt instability if it breaks with the stability condition $g > i(s_r - \tau)$, which would create a debt spiral unless the government takes other measures to prevent it. We shall look at the effects on the balance of payments:

[27] An increase in domestic interest rates will diminish the wage-share when its effect on increasing financial income is stronger than its effect on the wage share through higher capacity utilisation. This is always true when autonomous demand excluding consumption out of interest is positive, $\gamma + x + \vartheta - \gamma_u u_n > 0$. A condition that should be easily met by all economies.

Medium-run dynamics:

$$\frac{\partial \dot{r}}{\partial i} = \frac{Y_P}{X}\delta > 0 \tag{40}$$

Long-run:

$$\frac{\partial r^{**}}{\partial i} = \frac{Y_P}{X}\left[\frac{\delta(1 - \frac{i_x}{g_x})}{(g_x - i_f)}\right] \tag{41}$$

An increase in domestic rates will increase international reserves coming out of a short-run equilibrium. However, its effects on the BoP in the long-run is more ambiguous, given its effect on attracting capital inflows. When $i_x > g_x$, the increase in capital flows is offset in the long-run by a greater increase in debt services payment, the opposite effect of what was shown with the hike of i_f.

Given this structure of our model, a contractionary monetary policy (increase in interest rates) has only expansionary effects on output (short run increase in capacity utilisation). This should not be expected to be seen in reality. Higher interest rates associated with lower credit-based expenditures could decrease aggregate demand and imports, something left out of the model for simplicity. This would amplify the effect of higher domestic interest rates on the balance of payments by dampening growth. Consequently, however, a greater i would be associated with a lower g which would impose greater constraint on the domestic debt stability, emphasizing its effect as a fiscal constraint. This means that, depending on the parameters, a domestic interest rate hike could solve the balance of payments issue while also creating a fiscal crisis.

4.1.3. Case 3: fiscal policy (↓ α)

Now we come to the last case in which the government directly responds to the worsening of the external conditions with austerity policies to limit government expenditure.[28] The relevant fiscal variable in our BoP equations is the share of government expenditure on autonomous non-capacity generating demand (α). It is endogenous in the long-run, but the fact that it can

[28] Because we are looking at direct responses from external shocks, we do not consider the possibility of change in the tax rate, assuming tax rate policy takes longer time. The tax rate is negatively correlated with reserve accumulation in the medium-run, while long-run results are unclear and would depend on parameters, with less economic insights as the three policy tools considered here.

assume any value means the government may diminish temporarily its demand growth (g_G) to decrease the long-run share of public expenditure on autonomous demand (α), which alters the long-run international reserves equilibrium and its path.

In the short-run, a decrease in government expenditure decreases capacity utilisation which decreases the wage-share. However, in the long-run it increases the wage-share by decreasing the level of public domestic debt to GDP. This is a formal implication of the specification of the model but should be taken with attention. It is often the case that government expenditure has redistributive roles in decreasing inequality, when that is the case cuts in public expenditure may increase inequality in the real world (Lavoie, 2022, Ch.5). We then look at the balance of payments:

Medium-run dynamics:

$$\frac{\partial \dot{r}}{\partial \alpha} = \frac{(\gamma^{**} - \gamma_u\, u_n + \, z^{**})\big(\delta\big(i - i_f\big) - \phi_u\big)}{(1-\alpha)^2 z^{**}(s_r \pi + \phi_u + \tau - \gamma_u)} \tag{42}$$

Long-run:

$$\frac{\partial r^{**}}{\partial \alpha} = \frac{\partial \left(\frac{Y_P}{X}\right)^{**}}{\partial \alpha}\left[\frac{\left(\delta\big(i - i_f\big)(1 - \frac{i_x}{g_x}) - \phi_u\right)}{g_x - i_f}\right] \tag{43}$$

A decrease in the share of government expenditure on autonomous demand may only increase international reserves if its impact diminishing imports is higher than its impact diminishing financial inflows. While in the long-run, this effect is coupled with the impact of lower long-run external debt, through less capital attraction. The same result we found for the devaluation of exchange rates, given their similar effect on supermultiplier.

4.2. Policy Takeaways and the Current Situation of the 2022-23 hike

Our exercise leads us to the conclusion that an increase in foreign interest rates constrains macroeconomic policies. Already in the first periods after the shock the country must choose whether to sell its reserves or implement contractionary measures with at least one of its macroeconomic policy tools - fiscal, monetary, and exchange rate policy (are the ones considered here).

For the first periods after the shock, higher domestic interest rates ease the external constraint by attracting capital flows. Exchange rate devaluations and fiscal contraction may ease balance

of payments disequilibrium through contractionary effects on aggregate demand and imports. But they might not even be effective in bringing balance of payments to equilibrium.

When $\left(i - i_f\right) > \phi_u$, that is, when the response of financial flows to changes in output is stronger than the one from imports, neither devaluing nominal exchange rates nor austerity policies have any positive effect on balance of payments and might even just aggravate the loss of reserves. This is the dilemma observed by the literature following Rey (2015). In a country with greater capital account openness (high value of δ) only monetary policy improves short-term balance of payments results. It is important to highlight, that this is a short- to medium-run policy dilemma in the case of an outflow of capitals but not necessarily in the boom phase of a Global Financial Cycle, when a government could sterilise, inflows as described by the Compensation Thesis (Lavoie, 2022, Ch. 7).

The model highlights 4 channels through which a deterioration of external conditions might limit fiscal policy: (1) through a devaluation that increases the value of (net) external debt in domestic currency levels potentially to unsustainable levels; (2) through an increase in domestic interest rates or a (3) decrease in GDP growth that lead domestic debt to GDP ratio to spiral up; or (4) directly through the need to keep fiscal expenditure low to keep aggregate demand within the balance of payments limit. The first three are channels in which negative balance of payment results can lead to fiscal crises.[29] While the latter channel corresponds to a choice of policy-constrained growth explored in section 3, possibly linked to desired levels of public debt (as it is the only option that diminishes it). This adds further support to the argument that external shocks lead to fiscal crises (Cline and Vernengo, 2016).

In the long-run, impacts on financial flows are offset by an (opposite) effect on interest payments on the new volume of external debt. When $i_X < g_X$, the effect is just partially offset and the sign of the effect of the medium-run dynamics still holds in the long-run. However, when $i_X > g_X$, the immediate short-to-medium run effect on financial flows is reversed in the long-run for all policies. Higher interest rates tighten the long-run constraint, while devaluation and austerity loosen it. This result highlights the dual role of financial flows: providing short-term liquidity but increasing long-term liability. Which is in line with the BPCG literature that considers capital flows (Moreno-Brid, 2003; Bhering et al., 2019) and points to a possible policy trade-off between short and long run results. In terms of income distribution, higher

[29] Here a fiscal crisis is understood as the instability of (public) external debt to exports or domestic debt to GDP, leading to exploding debt levels.

interest or nominal exchange rates lead to lower wage-shares in the long-run. While lower government expenditures have a positive effect on the wage-share through lower public debt.

We have shown a negative shock of interest rates could be temporary depending on the parameters. The shock could also be temporary depending on US monetary policymaking. In both cases, the country could be able to sustain expansionary policies for a longer time if it has foreign reserves to spare. The massive accumulation of foreign reserves since 1997 and their partial expenditure by many countries during the interest rate hikes started in 2015 and in 2022 may point to strategies used by countries to avoid the harsh consequences of the contractionary policies we have just analysed. They may choose to not make use of full external space in periods of good external conditions to be able to have external liquidity to maintain economic policy space and higher growth rates against external shocks. Low interest rates and more capital flows to emerging economies in the beginning of the 21st century may have allowed some developing countries to grow faster while accumulating reserves for times of turmoil. This goes in the opposite direction of common interpretations (and empirical studies) on reserve accumulation which only looks at the effect of reserves on growth through the losses of not using the whole external space (Cruz and Walters, 2008).

Lastly, it is important to mention that all findings from our model and exercise are based on a balance-of-payments-constraint which has in its core the necessity of access to a currency not issued domestically to trade abroad. The recent expansion of trade on local currencies under current exchange rates may also represent a way out of the constraint. We also have not dealt in depth with capital flows management policies in this work, but they could help diminish the magnitude of external shocks on the balance of payments (through lower δ).[30]

[30] See Botta et al. (2023) for more on this.

5. Conclusion

This paper presents two main contributions to the field of open-economy Macroeconomics of growth and distribution. First, it presented a stock-flow-consistent supermultiplier model in which growth is led by exports, government consumption and consumption out of interest. The model extends the work of Nah and Lavoie (2017) considering the public sector, (domestic and external) debt dynamics, portfolio flows, and a balance-of-payments-constraint. Our model is compatible with the main findings from several open economy post-Keynesian strands – namely neo-Kaleckian, Sraffian, Kaldorian, Structuralist, and the New Cambridge school. It argues the balance of payments poses an open economy asymmetry of demand-led growth to countries trading majorly on foreign currency. While it represents a ceiling to growth it does not necessarily represent a floor, with economies being able to grow below balance-of-payments-constrained growth rates for a long time (although not indefinitely), thus posing a policy-constrained growth regime. Industrial and commercial policy play a central role in this maximum long-run growth rate by affecting export and import content. Macroeconomic policies have important effects on the traverse (on average growth rates). Decisions on expenditures tied to these policies may be influenced by stock-flow norms related to desired stock levels of public debt and/or international reserves. The model also highlights that domestic debt stability depends on higher GDP (or capital) growth than domestic interest rates, attenuated by consumption and tax payments out of interest. While external debt stability depends on higher export growth than foreign interest rates.

Secondly, the paper contributes to the understanding of external constraints to macroeconomic policymaking in developing countries with a comparative dynamics exercise of different domestic policy responses to a hike in US interest rates. We used an innovative methodology as it applies a long-run growth model to the analysis of medium-run policy reactions through the modelled growth path dynamics. Which we hold is particularly useful for the analysis of balance of payments dynamics and external crises, given the nature of these crises. An increase in foreign interest rates imposes limitations to countries already after the shock. The government must choose between selling its reserve stocks or implementing contractionary measures. Rey's (2015) dilemma arises as currency devaluation and fiscal contraction may be unable to bring BoP to equilibrium because of its effects on capital attraction. Monetary policy being the only tool able to do so. Attracting financial flows may allow greater external space in the short-run while imposing higher constraints in the future, posing a policy trade-off. Three channels of transmission from external constraint to fiscal crises can also be distinguished.

Expansionary macroeconomic policies and higher average growth can be maintained if countries have enough reserves to spend. Presenting a rationale for the accumulation of reserve stocks.

These results highlight the balance of payments as a constraint also on average growth and not only on long-run growth rates. Giving centrality to external financial liquidity on growth patterns. They also present a possible explanation for the dynamics observed in the 2000s. A period when external conditions may have allowed emerging countries to conciliate high growth rates with the accumulation of large reserve stocks, which now provide some liquidity against future external shocks.

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7. Appendix

Equations 28 and 29 form a dynamic system, which imposes that local stability of the long-run equilibrium depends on a negative trace and a positive determinant of its Jacobian matrix. We have:

$$J = \begin{pmatrix} \frac{\partial \dot{r}}{\partial r} & \frac{\partial \dot{r}}{\partial d} \\ \frac{\partial \dot{d}}{\partial r} & \frac{\partial \dot{d}}{\partial d} \end{pmatrix}$$

Which impose the inequalities:

$$Det_J = \frac{\partial \dot{r}}{\partial r} * \frac{\partial \dot{d}}{\partial d} - \frac{\partial \dot{r}}{\partial d} * \frac{\partial \dot{d}}{\partial r} = -g_x(i_f - g_x) > 0$$

$$Tr_J = \frac{\partial \dot{r}}{\partial r} + \frac{\partial \dot{d}}{\partial d} = i_f - 2g_x < 0$$

The first inequality will hold if $i_f < g_x > 0$ or if $i_f > g_x < 0$. On the other hand, inequality 2 will only hold if $\frac{i_f}{2} < g_x$, which imposes $g_x > 0$, since $i_f \geq 0$. Then we can see both inequalities for the determinant (Det) and the Trace (Tr) of the Jacobian matrix for the dynamic system will only hold when $g_x > \ i_f \geq 0$.

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