Growth and distribution in a Two-Country Supermultiplier Stock-Flow Consistent model

[First Draft: work in progress, please do not quote]

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Abstract

The paper proposes to extend the Supermultiplier model to an open economy framework by means of a two-country Stock-Flow Consistent (SFC) model in which private business investment is completely induced by income in both economies and non-capacity creating autonomous expenditures are endogenous to the system, namely exports and consumption out of wealth. Based on this, the paper investigates the effects of changes in income distribution and in the propensities to spend on growth in the long run and compares the results with those obtained for a similar closed economy Supermultiplier model. Results from the simulation experiments suggest that an increase in the propensity to consume out of after-tax wages or a reduction in firms' mark-up in one of the economies has a positive growth effect in the two economies under both fixed and flexible exchange rate regimes. Besides that, provided the Marshall-Lerner condition holds, the economy which expands its domestic demand will gain relatively more (lose relatively less) in the system's capital stock in relation to the benefiting economy. At last, coordinated stimuli to demand makes both economies grow at a faster pace in the short and in the long run in comparison to an isolated shock to demand in one of the economies, reinforcing the case for policy coordination among countries.

Keywords: Super-multiplier; two-country SFC model; autonomous expenditures; paradoxes of thrift and costs; growth theories.
JEL classification codes: B59, E11, E12, E25, O41.

1 Introduction

A common ground of the Supermultiplier approach (Serrano, 1995a; Bortis, 1997) and of the Balance-of-Payment Constraint growth theory as put forward by Thirlwall (1979) is the claim that growth is led (constrained) by demand factors in the long run. For the first approach, growth is exogenously given by autonomous expenditures and capital accumulation will adjust, through induced business investment, to match demand

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in the long run. As for the second approach, the ultimate limit to growth, which helps to explain why countries have different growth rates[1] in the long run, is to be found in the restriction to demand imposed by disequilibrium in the balance-of-payments.

We can see an intersection also in the origins of both approaches going back to Kaldor (1970), who argued that autonomous demand emanating from exports would lead growth in the long run and would have an impact on capital accumulation through the investment accelerator, representing the foreign trade multiplier in a dynamic framework.[2]

This said, it seems rather logical that Supermultiplier models – in its most recent versions (Freitas and Serrano, 2015; Lavoie, 2016; Allain, 2015) characterized by a non-capacity creating autonomous expenditure component combined with an expected trend growth of sales which changes endogenously due to changes in demand (giving rise to a Harrodian behaviour of firms) in a growing economy setting – should be extended to (and its results analysed under) an open economy framework. Nah and Lavoie (2017) work in this direction bringing the supermultiplier model to a small open economy setting and evaluating the results of the model in terms of the paradoxes of thrift and costs once the effects of the profit share on the exchange rate are accounted for.

We intend to further contribute on the subject by addressing the supermultiplier features in a two-country Stock-Flow Consistent (SFC) model, in which both economies, with similar size and structure[3], are fully integrated. The assumption of two fully integrated economies allows for exports to be endogenous and, consequently, for demand feedbacks from one economy to the other. The paper innovates by making two components of the non-capacity creating autonomous expenditures endogenous, namely exports and consumption out of wealth in both economies. The system is analysed under both fixed and floating exchange rate regimes. The aim of the paper is twofold: (1) to investigate the effects of a change in income distribution and in the propensities to spend on growth in the long run and (2) to compare the results with those obtained in a similar closed economy model.

The subsequent sections of the paper are organized as follows. Section 2 reviews the heterodox literature on growth and distribution in open economy models in what they relate to the subject of the paper. Section 3 presents the framework and main features of the model. Section 4 briefly describes the short and long run conditions for the system to be in equilibrium. In section 5, we run some simulation experiments to assess the long run results of the model. The shocks are a reduction in the firms' mark-up, an increase in the propensity to consume out of after-tax wages and a reduction in the propensity to import in one of the countries. At last, section 6 presents a general assessment of the results and concludes the paper.

[1]Prebisch (1959) and other researchers from CEPAL, as Celso Furtado, were already concerned with the reasons why countries have different growth rates and found in the balance-of-payments a constraint to growth and development for underdeveloped countries.

[2]Lavoie (2014, ch.7) explains that Kaldor when discussing development linked the ideas of Harrod (1933)'s trade multiplier and of Hicks (1950)'s supermultiplier with external demand coming from outside a region or country.

[3]Both economies are identical for the case of flexible exchange rate regimes, but that cannot be said for the case of a fixed exchange rate regime, since we assume one of the economies accumulates international reserves.

2 Income distribution and growth in heterodox open economy models

It is well-known that discussing income distribution is markedly more difficult to do in an open economy setting. Even more so if we are to take into account the relation between distribution and growth. The different sources of distributional shocks that arise in an open economy – which certainly may originate different feedbacks and results in terms of domestic and international demand – could help to explain why the literature under this scope is so scattered around different assumptions regarding firms' pricing decisions and exchange rates (Lavoie, 2014; Hein and Vogel, 2008).

A great deal of the post-Keynesian open economy literature on income distribution and growth has assumed a single economy setting with an exogenous rest of the world (Lavoie, 2014; Blecker, 2012). Within this apparatus, we are allowed to analyse just the response of domestic variables to an isolated increase (decrease) in external demand. That may be appropriate to deal with small economies, in the sense that they are not able to influence external demand, being constantly submitted to shocks coming from fluctuations in world economy (Nah and Lavoie, 2017).[4]

However, in a context of large openness and spillovers between countries, even the smaller ones may have an influence in the global economy, say, through a financial crisis. Thus, ignoring the feedbacks between countries in an open economy setting could be understood as a shortcoming of the analysis. In a two-country model with the full accounting of international trade, the exchange rate becomes a distributive variable between two economies (La Marca, 2010; Rezai, 2015; Von Arnim et al., 2014). Besides that, the openness of a country to trade may have a stabilizing effect on each country's demand since part of the demand leaks from one country to the other (Blecker, 2012). Yet that is not the whole story provided the leakage from one country will stimulate demand in the other country which might foster or further dampen domestic output in the former.

To be fair, in the Kaleckian approach there have been some efforts to extend closed or single economy models to two-country growth models. McCombie (1993) extends the Balance-of-Payment constraint growth theory to a system of two advanced countries and advocates for the complementarity of growth between two countries. This conclusion was based on the fact that the growing inter-linkages between advanced countries through trade could limit the scope for individual domestic policies to expand demand, which would translate into balance-of-payment constraints, depending on the income elasticities of exports and imports, and could also lead to competitive growth (one country growing at the expense of its partners). However, as usual in the Thrilwallian tradition, the model does not take capital accumulation into account.

Dutt (2002) builds a growth model with two different regions interacting in order to assess the convergence of growth rates between the economies. Region North grows with excess capacity and defines prices by mark-up, while region South produces at full capacity. Trade is balanced between the two regions, so capital flows and net financial transfers are ignored. Similarly to Dutt (2002), Vera (2006) also builds a model in which

[4]See Blecker (2012) for a survey on neo-Kaleckian open economy models.

there are asymmetries between the two countries (or regions), but it analyses the trade imbalances and the role of financial transfers between the two economies in the long run. The main finding of the paper is that changes in the rate of net financial transfers from the South to the North region may generate three different growth regimes – reinforcing contractionary, reinforcing expansionary or conflicting growth regimes.

More recently, there can be found some papers which try to assess the effects of a expansion in wages over domestic and global demand in a two-country growth model (Von Arnim et al., 2014; Capaldo and Izurieta, 2013). Rezai (2015) also analyses the relation between income distribution and output in a two-country model, but his analysis is restrained to the short run. Von Arnim et al. (2014) stress the likelihood of emergence of a fallacy of composition in a system of two countries: if both countries expand domestic demand (through a redistribution towards labour), aggregate demand will be higher in both countries. If just one of the countries redistribute towards labour, again both countries will see an increase in their aggregate demand levels, however, the country which redistributes income may see a decrease in its share of the global demand. This would help to explain why countries would prefer to adopt a relative wage suppression, even if both economies end up in a lower growth path. Based on this, the authors also make the case for policy coordination, since both countries would be better off on such a scenario. Capaldo and Izurieta (2013) reaches similar conclusions and stresses that if countries pursue competitive flexibilization of labour markets, there may be a reinforcement of the contractionary effects on demand.

When it comes to the post-Keynesian SFC approach, open economy models with systems of two or three countries are more abundant. According to Caverzasi and Godin (2015, p.172), the open economy modelling in this tradition can be divided in three phases: the first one identified with Godley's model of world imbalances; the second one which concentrates on establishing a formal representation of an open economy, summarized in the open economy chapters of Godley and Lavoie (2007); and a last phase, in which there are several papers analysing specific open economy issues based on the framework of the second phase. Among the issues addressed in the last phase, two can be highlighted: the effects of monetary and fiscal policies and the constraints of a monetary union (Duwicquet and Mazier, 2011, 2012; Khalil and Kinsella, 2010; Kinsella et al., 2012); and the concerns with world imbalances, exchange rates, foreign reserves (Lavoie and Zhao, 2010; Lavoie and Daigle, 2011; Carvalho, 2012; Mazier and Tiou-Tagba Aliti, 2012).

We notice that income distribution is hardly a main concern in post-Keynesian open economy SFC models. An exception is found in Bortz (2014) which addresses the growth and distribution implications of a country issuing debt in a foreign currency and embedded in a framework which allows domestic firms to get loans abroad. The author presents a model led by government expenditures growing at an exogenously given rate and in which firms investment is based on the accelerator principle. This brings the model closer to the recent supermultiplier models under the neo-Kaleckian approach. However, the model does not deal explicitly with the Harrodian instability problem, since the utilization rate is endogenous and the expected trend growth rate of sales does not change with the changes in demand.

2.1 Perspective for Open Economy Supermultiplier models

Since supermultiplier models were brought to the neo-Kaleckian framework, Nah and Lavoie (2017) is the major attempt to extend the model to an open economy setting. Still assuming a single economy, the authors deal with a small open economy in which the component of demand which grows at an exogenously given rate is autonomous exports and address the paradoxes of thrift and costs. Regarding the results of the model, the paradox of thrift holds in level terms; whether the paradox of costs holds or not will depend on the sensitivity of the real exchange to changes in income distribution: if the real exchange rate is not too sensitive to changes in income distribution, the paradox of costs is also likely to hold. The main drawback of the analysis, as acknowledged by the authors, is that it does not take into account explicitly the flows generated by financial assets and the feedbacks from changes in the exchange rates to income distribution.

Clearly, there is plenty of room to analyse the implications of supermultiplier models in more complex settings, as a two-country growth model which accounts for financial assets. Provided that demand spillovers are allowed into the analysis, both capacity utilization and growth rates are interdependent, which might change or complement the results obtained in a supermultiplier model for a closed or single economy. Moreover, if the model is built adopting the SFC methodology, the implications of changes in the observed exchange rate – through the inclusion of financial assets internationally traded between the economies – on income distribution and growth can be more easily addressed. In what concerns long run growth, if in addition to this, autonomous expenditures are allowed to be endogenous, permanent growth effects may arise from demand expansions. A model along these lines is proposed in the next section.

3 A Two-Country Super-multiplier Stock-Flow Consistent growth model

We build a two-country Super-multiplier Stock-Flow Consistent (SFC) growth model in which autonomous expenditures – exports as well as consumption out of wealth – are endogenous to the system. We are assuming two advanced (large) and financially integrated economies with mostly the same features, there are no structural differences between them. For the system as a whole autonomous injections only arise from both countries household wealth, considering that exports depend on firms' production decisions in the other country. However, at each country's level, autonomous expenditures comprise consumption out of household wealth and exports, since exports are independent from domestic firms' production decisions.[5] The model combines these autonomous expenditures with induced business investment and Harrodian behaviour of firms in both countries, extending the essential features of supermultiplier models to an open economy

[5]We call "autonomous" the expenditure decisions that cannot be directly deduced from the circular flow of income (Serrano, 1995b), following Freitas and Serrano (2015, p. 4) when they state that consumption has an autonomous component (in their case, loosely related to credit and not functionally connected to wealth, as in our model) "unrelated to the current level of output resulting from firms' production decisions".

Table 1: Balance sheet matrix

	Country 1					Country 2					
Assets	Household	Firms	Banks	Government	Central Bank	Household	Firms	Banks	Government	Central Bank	$\sum$
1. HPM	$+H_1$				$-H_1$	$+H_2$				$-H_2$	0
2. Deposits	$+D_1$		$-D_1$	$+D_{G_1}$	$-D_{G_1}$	$+D_2$		$-D_2$	$+D_{G_2}$	$-D_{G_2}$	0
3. Loans		$-L_1$	$+L_1$				$-L_2$	$+L_2$			0
4. Fixed capital		$+K_1$					$+K_2$				$+K_1 + K_2$
5. Equities	$+pe_1.E_1$	$-pe_1.E_1$				$+pe_2.E_2$	$-pe_2.E_2$				0
6. Government 1 Bills	$+Bh_{1,1}$		$+Bb_{1,1}$	$-B_1$	$+Bcb_{1,1}$	$+Bh_{2,1}$				$+Bcb_{2,1}$	0
7. Government 2 Bills	$+Bh_{1,2}$					$+Bh_{2,2}$		$+Bb_{2,2}$	$-B_2$	$+Bcb_{2,2}$	0
8. Advances			$-A_1$		$+A_1$			$-A_2$		$+A_2$	
9. Net worth	V_{h1}	V_{f1}	0	$-B_1 + D_{G_1}$	V_{cb1}	V_{h2}	V_{f2}	0	$-B_2 + D_{G_2}$	V_{cb2}	$+K_1 + K_2$

setting.

In the following subsections we present the framework of the model, describe the behavioural assumptions of each sector and specify the fixed and flexible exchange rate regime closures.

3.1 Framework of the model

The model is composed by a system of two countries, Country One and Country Two, whose economies present five institutional sectors: Households, Firms, Banks, Government and Central Bank. Table 1 presents the balance sheet of these institutional sectors. To make the notation clear since the beginning, each i as a subscript of a stock or a flow in the matrices or in the following equations denotes the country it belongs to. The subscript j alone refers to the stocks and flows of the other economy as opposed to i. When there are stocks (flows) issued (generated) by one country and held (received) by the other one, i denotes the country in which the stock (flow) is held (received) and j denotes the country in which it is issued (generated). For instance, $Bh_{1,2}$ accounts for the bills issued by government two and held by households of country one. The subscript -1 accounts for stocks and flows at the beginning of the period.

Banks lend to firms and receive deposits from households. Banks may also take on advances at the central bank or accumulate government bills. *Households* make deposits at banks, hold money issued by the central bank, acquire domestic and foreign government bills and hold equities issued by firms. *Firms* accumulate capital, take on loans from banks and issue equities to the households. *Central banks* issue high powered money, receive deposits from the government, make advances to commercial banks and hold domestic government bills for monetary policy purposes. In the case of a fixed exchange rate regime, the central bank of country two also buys bills issued by government one (international reserves). *Governments* issue bills held by households from both countries, central banks and commercial banks and make deposits at central banks.

Table 2 shows the transactions between the sectors in the first part and the flow of funds in the second part. The equations and behavioural assumptions are presented below roughly matching each institutional sector. All variables in real terms are written in lower case, while nominal variables are written in upper case.

Table 2: Transactions and Flow of Funds matrix

	Country 1							**Country 2**						
	Household	Firms		Banks	Govt.	CB	Ex. Rate	Household	Firms		Banks	Govt.	CB	$\sum$
		Current	Capital						Current	Capital				
1. Consumption	$-C_1$	$+C_1$						$-C_2$	$+C_2$					0
2. Investment		$+I_1$	$-I_1$						$+I_2$	$-I_2$				0
3. Government expenditures		$+G_1$			$-G_1$				$+G_2$			$-G_2$		0
4. Exports/Imports		$+X_1$					$.er$		$-IM_2$					0
5. Imports/Exports		$-IM_1$					$.er$		$+X_2$					0
6. Wages	$+W_1$	$-W_1$						$+W_2$	$-W_2$					0
7. Taxes	$-T_1$				$+T_1$			$-T_2$				$+T_2$		0
8. Profit	$+FD_1$	$-F_1$	$+FU_1$					$+FD_2$	$-F_2$	$+FU_2$				0
9. Profit of the CB					$+FB_1$	$-FB_1$						$+FB_2$	$-FB_2$	0
10. Deposits interest	$+r_1.D_{1_{-1}}$			$-r_1.D_{1_{-1}}$	$+r_1D_{G_{1_{-1}}}$	$-r_1D_{G_{1_{-1}}}$		$+r_2.D_{2_{-1}}$			$-r_2.D_{2_{-1}}$	$+r_2D_{G_{2_{-1}}}$	$-r_2D_{G_{2_{-1}}}$	0
11. Loans interest		$-r_1.L_{1_{-1}}$		$+r_1.L_{1_{-1}}$					$-r_2.L_{2_{-1}}$		$+r_2.L_{2_{-1}}$			0
12. Bills interest Country One	$+r_1.Bh_{1,1_{-1}}$			$+r_1Bb_{1,1_{-1}}$	$-r_1.B_{1_{-1}}$	$+r_1.Bcb_{1,1_{-1}}$	$.er$	$+r_1.Bh_{2,1_{-1}}$					$+r_1.Bcb_{2,1_{-1}}$	0
13. Bills interest Country Two	$+r_2.Bh_{1,2_{-1}}$						$.er$	$+r_2.Bh_{2,2_{-1}}$			$+r_2Bb_{2,2_{-1}}$	$-r_2.B_{2_{-1}}$	$+r_2.Bcb_{2,2_{-1}}$	0
14. Advances interest				$-r_aA_{1_{-1}}$		$+r_aA_{1_{-1}}$					$-r_aA_{2_{-1}}$		$+r_aA_{2_{-1}}$	
15. Subtotal	S_{h1}	0	S_{f1}	0	S_{g1}	0		S_{h2}	0	S_{f2}	0	S_{g2}	0	0
16. Δ HPM	$-\Delta H_1$					$+\Delta H_1$		$-\Delta H_2$					$+\Delta H_2$	0
17. Δ Deposits	$-\Delta D_1$			$+\Delta D_1$	$-\Delta D_{G_1}$	$+\Delta D_{G_1}$		$-\Delta D_2$			$+\Delta D_2$	$-\Delta D_{G_2}$	$-\Delta D_{G_2}$	0
18. Δ Loans			$+\Delta L_1$	$-\Delta L_1$						$+\Delta L_2$	$-\Delta L_2$			0
19. Δ Equity	$-pe_1.\Delta E_1$		$+pe_1.\Delta E_1$					$-pe_2.\Delta E_2$		$+pe_2.\Delta E_2$				0
20. Δ Bills Country One	$-\Delta Bh_{1,1}$			$-\Delta Bb_{1,1}$	$+\Delta B_1$	$-\Delta Bcb_{1,1}$	$.er$	$-\Delta Bh_{2,1}$					$-\Delta Bcb_{2,1}$	0
21. Δ Bills Country Two	$-\Delta Bh_{1,2}$						$.er$	$-\Delta Bh_{2,2}$			$-\Delta Bb_{2,2}$	$+\Delta B_2$	$-\Delta Bcb_{2,2}$	0
22. Δ Advances				$+\Delta A_1$		$-\Delta A_1$					$+\Delta A_2$		$-\Delta A_2$	0
23. $\sum$	0	0	0	0	0	0		0	0	0	0	0	0	0

3.1.1 Government

Governments issue bills (1) to finance their expenditures (3) which are not covered by the taxation of household income (4) and by the transfers of Central Banks' profits and (if necessary) to provide the respective Central Bank the bills they must have to implement monetary policy (to be detailed in the section on central banks).

$$B_i = B_{i_{-1}} + G_i - (T_i + Fcb_i) + r_i.B_{i_{-1}} - r_i D_{G_{i_{-1}}} + \Delta D_{G_i} \tag{1}$$

$$g_i = \sigma_i y_{i_{-1}} \tag{2}$$

$$G_i = g_i p_{s_i} \tag{3}$$

$$T_i = \tau_i Y_{h_i} \tag{4}$$

3.1.2 Households

Household income is composed by wages and financial income (5) – dividends and interests on held assets. Nominal wage is defined by equation (7). We assume that the nominal wage rate (ω_i) is constant and exogenously given. Real wage is given by nominal wage divided by the domestic sales price level (8). Household disposable income is the household after-tax income (9). Households in both countries consume a fraction (α_{1i}) of their after-tax wages and a fraction (α_{2i}) of their stock of wealth at the beginning of the period (10). The savings are defined by equation 12.

Households are allowed to hold foreign assets (21), namely, the bills issued by the other country's government, on which they receive interest. Besides the capital gains on equities, households may have capital gains accruing from the value of these foreign assets in the domestic currency, which may change due to fluctuations in the exchange rate, in the case of a floating exchange rate regime (13).

The stock of wealth changes due to household savings and due to capital gains (equation 14). Households allocate their wealth based on a Tobinesque portfolio choice framework – meaning that the increase in one asset's profitability, and hence demand, will come along with a decrease in other assets' demand. The deposits are the buffer of the household sector, which means that after households decided how much to invest in equities, domestic and foreign bills, and how much to keep as cash for precautionary reasons, they will allocate the rest of their wealth in the form of deposits at banks (equations 16–26). The return on equity is defined as the sum of dividends and of a fraction (ρ) of capital gains divided by the market value of outstanding equity stock (equation 27), similarly to van Treeck (2009).

In the case of a fixed exchange rate regime, the supply of foreign assets to households will be matched by their demand times (divided by) the exchange rate of the foreign currency (of the home currency) (equation 22). The exchange rate is defined as the number of units of the domestic currency that can be bought by one unity of the foreign currency. So an increase in the exchange rate of country 1 means the currency of country 1 is depreciating in relation to the currency of country 2.

$$Y_{h_i} = W_i + FD_i + r_i(Bh_{i,i_{-1}} + D_{i_{-1}}) + r_j Bh_{i,j_{-1}} e_{n_i} \tag{5}$$

$$y_{h_i} = \frac{Y_{h_i}}{p_{s_i}} \tag{6}$$

$$W_i = \omega_i Y_i \tag{7}$$

$$W_{R_i} = \frac{W_i}{p_{s_i}} \tag{8}$$

$$Yd_i = (1 - \tau_i) Y_{h_i} \tag{9}$$

$$C_i = \alpha_{1i}(1 - \tau_i) W_i + \alpha_{2i} V_{hi_{-1}} \tag{10}$$

$$c_i = \alpha_{1i}(1 - \tau_i) w_i + \alpha_{2i} v_{hi_{-1}} \tag{11}$$

$$Sh_i = Yd_i - C_i \tag{12}$$

$$CG_i = \Delta pe_i E_{i_{-1}} + \Delta en_i Bh_{i,j_{-1}} \tag{13}$$

$$V_{hi} = V_{hi_{-1}} + Sh_i + CG_i \tag{14}$$

$$v_{hi} = \frac{V_{hi}}{p_{s_i}} \tag{15}$$

$$D_i^D = V_{hi} - H_i - pe_i E_i - Bh_{i,i} - Bh_{i,j} \tag{16}$$

$$Bh_{i,i}^S = Bh_{i,i}^D \tag{17}$$

$$H_i^D = \phi_{1i} V_{hi} \tag{18}$$

$$pe_i = \phi_{2i} \frac{V_{hi}}{E_i} \tag{19}$$

$$Bh_{i,i}^D = \phi_{3i} V_{hi} \tag{20}$$

$$Bh_{i,j}^D = \phi_{4i} V_{hi} \tag{21}$$

$$Bh_{i,j}^S = Bh_{i,j}^D en_j \tag{22}$$

$$\phi_{1i} = \lambda_{10} + \lambda_{11} r_{d_i} + \lambda_{12} r_{e_i} + \lambda_{13} r_i + \lambda_{14} r_j \tag{23}$$

$$\phi_{2i} = \lambda_{20} + \lambda_{21} r_{d_i} + \lambda_{22} r_{e_i} + \lambda_{23} r_i + \lambda_{24} r_j \tag{24}$$

$$\phi_{3i} = \lambda_{30} + \lambda_{31} r_{d_i} + \lambda_{32} r_{e_i} + \lambda_{33} r_i + \lambda_{34} r_j \tag{25}$$

$$\phi_{4i} = \lambda_{40} + \lambda_{41} r_{d_i} + \lambda_{42} r_{e_i} + \lambda_{43} r_i + \lambda_{44} r_j \tag{26}$$

$$re_i = \frac{FD_i + \rho CG_i^{eq}}{pe_{i_{-1}} Eq_{i_{-1}}} \tag{27}$$

3.1.3 Firms

We suppose that firms from both countries have a propensity to invest out of income (29) which is endogenous to the model and reacts according to the discrepancies between the utilization rate and the normal utilization rate (30), following a Harrodian investment behaviour as in Lavoie (2016), Nah and Lavoie (2017), and Freitas and Serrano

(2015). γ_i represents the speed of adjustment of the propensity to invest to the discrepancies between the actual and the desired utilization rate. We further assume that if the utilization rate is inside a certain range, represented by θ_i, firms will want to keep their investment strategy unchanged, not triggering changes in the propensity to invest, as in Pedrosa and Macedo e Silva (2014); Brochier and Macedo e Silva (2016) (for a justification of such a band see Hein et al. (2012) and Dutt (2011)).

The change in the capital stock is given by equation 31, the actual utilization rate is given by the ratio of output to full-capacity output (equation 34) and full-capacity output (equation 33) is determined by the ratio of the initial capital stock to the given capital-output ratio (v_i). From these equations, we can draw the short run actual growth rate of the capital stock (35), where δ_i denotes the rate of capital stock depreciation.

$$i_i = h_i y_i \tag{28}$$

$$I_i = i_i p_{s_i} \tag{29}$$

$$\Delta h_i = \begin{cases} h_{i_{-1}} \gamma_i (u_i - u_{ni}), & \text{if } |u_i - u_{ni}| > \theta_i \\ 0, & \text{otherwise} \end{cases} \tag{30}$$

$$k_i = k_{i_{-1}} - \delta_i k_{i_{-1}} + i_i \tag{31}$$

$$K_i = k_i p_{s_i} \tag{32}$$

$$Yfc_i = \frac{k_{i_{-1}}}{v_i} \tag{33}$$

$$u_i = \frac{Y_i}{Yfc_i} \tag{34}$$

$$g_{k_i} = \frac{h_i u_i}{v_i} - \delta_i \tag{35}$$

We assume that international trade takes place within the business sector, so firms import inputs from firms in the other country and export part of its output to firms from the other country as well. Since we are dealing with a system of two countries necessarily the imports by one country are the exports by the other country (equation 36). As in Godley and Lavoie (2005), Carvalho (2012) and Bortz (2014), imports in each country are determined by the relevant prices and income elasticities (equation 37). It's import to highlight that this equation gives us the import volume in the foreign currency, so the real volume in the domestic currency of each country will be obtained multiplying it by the respective real exchange rate.

$$x_i = im_j \tag{36}$$

$$\ln(im_i) = \epsilon_{0i} - \epsilon_{1i} \ln\left(\frac{p_{m_{i_{-1}}}}{p_{y_{i_{-1}}}}\right) + \epsilon_{2i} \ln(y_i) \tag{37}$$

Firms in both countries put a mark-up on unit costs, composed by wages and im-

ported inputs, as in Godley and Lavoie (2007),Hein and Vogel (2008),Bortz (2014),Rezai (2015). Pricing decision will define the price level of sales in each country (equations 38, 42 and 43). Following (Godley and Lavoie, 2007, ch.12) and Bortz (2014), export prices will be determined in the exporting country and, as a consequence, import prices will be determined in the foreign currency (equations 39,41 and 40).

Since prices are not assumed to be constant, we are able to analyse both how a change in the nominal exchange rate and in trade terms (relative prices) will affect the real exchange rate (equation 45) and, thus, international competitiveness between countries. On the one hand, changes in firms' mark-up or in the ratio of material to direct labour unit costs may change domestic prices and then the real exchange rate (see Lavoie (2014); Hein and Vogel (2008)). On the other hand, changes in the exchange rate may feedback into income distribution, changing relative costs.

$$p_{s_i} = \frac{(1+\mu_i)(W_i + IM_i)}{s_i} \tag{38}$$

$$p_{m_i} = p_{s_j} e_{n_i} \tag{39}$$

$$IM_i = p_{m_i} im_i \tag{40}$$

$$X_i = p_{s_i} im_j \tag{41}$$

$$s_i = c_i + i_i + g_i + x_i \tag{42}$$

$$S_i = s_i p_{s_i} \tag{43}$$

$$p_{y_i} = \frac{Y_i}{y_i} \tag{44}$$

$$e_{r_i} = e_{n_i} \frac{p_{s_j}}{p_{s_i}} \tag{45}$$

Firms must also decide how they will finance their investment. We suppose firms in both countries finance their investment through retained earning, equity issuance and banks loans, which are assumed to clear firms' demand for funds (equation 46). Equities are a fixed proportion (a_i) of the capital stock at the beginning of the period (equation 47). Total nominal profits are obtained deducting total nominal wages from domestic output (equation 48). Total net profits are given by gross profit (equation 48) less interest payment on the opening stock of loans (equation 49). Firms retain a fraction of their net profits (s_{f_i}) (equation 50) and distribute the rest of net profits to households in the form of dividends to households (equation 51). Normalizing equation 48 and equation 49 by the nominal stock of capital at the beginning of the period, we get respectively the gross profit rate (52) and the net profit rate (53), where π_i represents the profit share of domestic output.

$$L_i = L_{i_{-1}} + I_i - FU_i - pe_i \Delta E_i \tag{46}$$

$$E_i = a_i K_{i_{-1}} \tag{47}$$

$$F_{G_i} = Y_i - W_i \tag{48}$$

$$F_{N_i} = F_{G_i} - r_i L_{i_{-1}} \tag{49}$$

$$FU_i = s_{f_i} F_{N_i} \tag{50}$$

$$FD_i = (1 - s_{f_i}) F_{N_i} \tag{51}$$

$$r_{g_i} = \frac{\pi_i u_i}{v_i} \tag{52}$$

$$r_{n_i} = \frac{\pi_i u_i}{v_i} - \frac{r_i l_{i_{-1}}}{1 + g_{k_{i_{-1}}}} \tag{53}$$

3.1.4 Banks

Banks in both countries lend to firms and accept all of household deposits (54). Firms are not credit constrained (55). We suppose that banks do not profit, deposits earn the same interest rate of loans granted to firms. If the amount of loans exceeds the deposits, banks take on advances from the Central Bank, on which they pay interests. Otherwise, if deposits exceed loans, commercial banks will acquire government bills (56), as in Bortz (2014). Governments provide all bills demanded by commercial banks (57).

$$D_i^S = D_i^D \tag{54}$$

$$L_i^S = L_i^D \tag{55}$$

$$\begin{cases} A_i^D = L_i^S - D_i^S, & \text{if } L_i - D_i > 0 \\ Bb_i^D = D_i^S - L_i^S, & \text{otherwise} \end{cases} \tag{56}$$

$$Bb_i^S = Bb_i^D \tag{57}$$

3.1.5 Central Banks

The Central Bank of each country provides all the cash households demand (58). It also provides advances to commercial banks, if loans exceed the deposits (59). The changes in the stock of domestic government bills held by Central Banks are equal to the net changes in their liabilities (60, 61). It is assumed that the government one provides all the bills demanded by the central bank to manage the liquidity in the economy and to keep the policy interest rate constant (62). Country one is assumed to be the holder of the internationally accepted currency, so it does not accumulate foreign reserves (it does not buy bills issued by government of country two). The Central Bank of country two holds foreign reserves, buying bills issued by the government of country one. The changes in the stock of domestic bills held by the Central Bank two must take the acquisition of international reserves into account (61).

The government of country two will supply to the central bank two all the bills which are not supplied to domestic and foreign households (and commercial banks, when this is the case) (63). As in country one, the demand and supply of domestic government bills to the Central Bank two must equal each other,but there is no need for such an equation, it will result from the other equations of the model (redundant equation). The

government of country one will supply to the central bank of country two all the bills which are not acquired by households of both countries and by the central bank of country one (64). The foreign reserves demand by country two will be equal to the supply by country one divided the exchange rate (65). As it is a regular feature of the relation between governments and central banks, central banks transfer their profits to governments (66, 67). Following one of the alternatives presented in Godley and Lavoie (2005)[6], if the bills held by each central bank do not suffice for purposes of monetary policy (keeping the policy interest rates and/or acquiring international reserves), the government will make deposits at the central bank, corresponding to the shortage of bills (68, 69).

We assume that policy interest rates are the same in both countries and that the rates of return of other assets are equivalent to the policy rates (70).

$$H_i^S = H_i^D \tag{58}$$

$$A_i^S = A_i^D \tag{59}$$

$$Bcb_{1,1}^D = Bcb_{1,1_{-1}}^D + \Delta H_1^S - \Delta A_1 + \Delta D_{G_1} \tag{60}$$

$$Bcb_{2,2}^D = Bcb_{2,2_{-1}}^D + \Delta H_2^S - \Delta Bcb_{2,1}^S.en_2 - \Delta A_2 + \Delta D_{G_2} \tag{61}$$

$$Bcb_{1,1}^S = Bcb_{1,1}^D \tag{62}$$

$$Bcb_{2,2}^S = B_2^S - Bh_{2,2}^S - Bh_{1,2}^S - Bb_{2,2}^S \tag{63}$$

$$Bcb_{2,1}^S = B_1^S - Bh_{1,1}^S - Bh_{2,1}^S - Bcb_{1,1}^S - Bb_{1,1}^S \tag{64}$$

$$Bcb_{2,1}^D = \frac{Bcb_{2,1}^S}{en_1} \tag{65}$$

$$Fcb_1 = r_1 Bcb_{1,1_{-1}} + r_a A_{1_{-1}} - r_1 D_{G_{1_{-1}}} \tag{66}$$

$$Fcb_2 = r_2 Bcb_{2,2_{-1}} + r_1 Bcb_{2,1_{-1}} en_2 + r_a A_{2_{-1}} - r_2 D_{G_{2_{-1}}} \tag{67}$$

$$D_{G_1} = \begin{cases} A_1 - H_1, & \text{if } Bcb_{1,1} < 0 \\ 0, & \text{otherwise} \end{cases} \tag{68}$$

$$D_{G_2} = \begin{cases} A_2 + Bcb_{2,1} - H_2, & \text{if } Bcb_{2,2} < 0 \\ 0, & \text{otherwise} \end{cases} \tag{69}$$

$$r_1 = r_2 = r_l = r_m = r_e = r_a \tag{70}$$

3.1.6 Current and Capital Accounts

To make the model complete, we must present the current account and the capital account of each country. The current account is the sum of net exports and the net transfer of income, which in this model is composed only by the interests paid on government bills (and include the interest paid on reserves in the case of a fixed exchange rate regime). As

[6]Godley and Lavoie (2005) also suggest that Central Banks could issue their own bills and exchange them for Treasury bills held by the private sector.

for the capital account, it represents the net changes in government bills, international reserves included in the case of a fixed exchange rate regime.

$$CA_1 = X_1 - IM_1 + r_2 Bh^S_{1,2_{-1}} e_{n_1} - r_1 Bh^S_{2,1_{-1}} - r_1 Bcb^S_{2,1_{-1}} \tag{71}$$

$$CA_2 = X_2 - IM_2 + r_1 Bh^S_{2,1_{-1}} e_{n_2} - r_2 Bh^S_{1,2_{-1}} + r_1 Bcb^S_{2,1_{-1}} en_2 \tag{72}$$

$$KA_1 = \Delta Bh^S_{2,1} - \Delta Bh^S_{1,2} e_{n_1} + \Delta Bcb^S_{2,1} \tag{73}$$

$$KA_2 = \Delta Bh^S_{1,2} - \Delta Bh^S_{2,1} en_2 - \Delta Bcb^S_{2,1} e_{n_2} \tag{74}$$

3.1.7 Floating exchange rate regime

If we move to a floating exchange rate regime, we can consider the level of international reserves held by the central bank of country two as given. This is what is shown in equation 61FL: the changes in the domestic bills held by central bank of country two no longer reflect changes in international reserves in order to keep the exchange rate constant, since the exchange rate now is endogenous and adjusts the supply and demand of foreign assets (equation 75).

While in the fixed exchange rate regime, all the demand of the central bank of country two for government bills was supplied as a result of the other equations, here we have a different closure for the economy and need to bring this equation back (63FL). Now the supply of bills to households of country two will be what is left after the government provided all the bills the central bank and foreign households demanded (and commercial banks, when this is the case) (equation 17B). Considering that the household demand for bills is determined by the portfolio equations, if the model is consistent, it should follow that the supply of bills to households and household demand for bills of country two should equal each other without the need for such an equation. So equation 17 for country two is the redundant equation when we are dealing with a floating exchange regime. The rule for government deposits will be the same for both economies in the flexible exchange rate regime (76).

$$Bcb^D_{2,2} = Bcb^D_{2,2_{-1}} + \Delta H^S_2 - \Delta A_2 + \Delta D_{G_2} \tag{61FL}$$

$$e_{n_1} = \frac{Bh^S_{2,1}}{Bh^D_{2,1}} \tag{75}$$

$$Bcb^S_{2,2} = Bcb^D_{2,2} \tag{63FL}$$

$$Bh^S_{2,2} = B^S_2 - Bh^S_{1,2} - Bcb^S_{2,2} - Bb^S_{2,2} \tag{17B}$$

$$Bh^S_{1,1} = Bh^D_{1,1} \tag{17A}$$

$$Bh^S_{1,2} = Bh^D_{1,2} e_{n_2} \tag{22A}$$

$$Bh^S_{2,1} = B^S_1 - Bh^S_{1,1} - Bcb^S_{2,1} - Bcb^S_{1,1} - Bb^S_{1,1} \tag{22B}$$

$$D_{G_i} = \begin{cases} A_i - H_i, & \text{if } Bcb_{i,i} < 0 \\ 0, & \text{otherwise} \end{cases} \tag{76}$$

4 Short-run and long-run equilibrium conditions

For each country, real domestic output is the sum of household consumption, firms investment, government expenditures and net exports (equation 77). The term $e_{r_i} im_i$ represents imports in real terms and reflects the fact that import prices are defined abroad. If we substitute equations 11, 28, 3, 36 and 37 into equation 77 and normalize it by the opening stock of capital, we get the short run capacity utilization rate for each one of the economies (equation 78). We notice that, through exports, the level of activity in one country affects the utilization rate in the other country. Besides that, the ratio of capital between the two economies – defined in equation 79 – also affects the utilization rate of each economy: that is, the larger economy two in relation to economy one, the larger the effect of external demand through exports on the domestic level of activity of country one and vice-versa. The supermultiplier appears in the large parenthesis and so far is similar to the one presented in a closed economy model, since it only considers the effects of the domestic induced expenditures, with the addition of the effect of induced imports. It's worth noticing that the capital accumulation rate appears in the multiplier due to the effect of consumption out wealth on the short-run utilization rate. Besides that, the effect of induced government expenditures appears divided by the output growth rate, since we assume governments to decide how much to spend based on the output in the beginning of the period.

$$y_i = c_i +_i i + gi + x_i - e_{r_i} im_i \tag{77}$$

$$u_i = \left(\frac{1}{(1+gk_{i_{-1}}) \left[1 - \alpha_{1i}(1-\tau_i)(1-\pi_i) - h_i + er_i m_i - \frac{\sigma_i}{1+g_{y_{i_{-1}}}} \right]} \right) \left[\alpha_{2i} v h_{i_{-1}} + m_j \frac{u_j}{v_j} \kappa_i (1 + g_{k_{i_{-1}}}) \right] \tag{78}$$

$$\kappa_i = \frac{k_{j_{-1}}}{k_{i_{-1}}} \tag{79}$$

We can go a little bit further if we substitute the utilization rate of the other economy into equation 78. After some algebraical manipulation, we get equation 78A. To simplify the reading of equation 78A, we grouped the inverse of each country's domestic multiplier in the variable β_i (equation 80). This equation shows that, since we are now in an open economy, part of the domestic autonomous expenditure (consumption out of wealth) will leak to abroad, which is represented by the term β_j (which we assume to be lower than one and positive if savings react more than investment to changes in output and capacity in each economy) multiplying domestic consumption out of wealth. On the

other hand, the consumption out of wealth of foreigners will also have a positive impact in the domestic utilization rate through exports, coet. par.. This impact will be larger, the larger the relative size of the other economy, the other economy's propensity to import and the domestic capital accumulation rate. The supermultiplier now is a combination of both economies domestic multipliers and, as a consequence, both endogenous investment accelerators (h_i, h_j) have a role to play in each country's level of activity.

$$u_i^* = \frac{v_i \left[\beta_j \alpha_{2i} v h_{i_{-1}} + m_j \kappa_i (1 + g_{k_{i_{-1}}})(\alpha_{2j} v h_{j_{-1}})\right]}{\beta_i \left[\beta_j - m_j m_i (1 + g_{k_{i_{-1}}})(1 + g_{k_{j_{-1}}})\right]} \tag{78A}$$

$$\beta_i = \left(1 + gk_{i_{-1}}\right) \left[1 - \alpha_{1i}(1 - \tau_i)(1 - \pi_i) - h_i + e_{r_i} m_i - \frac{\sigma_i}{1 + g_{y_{i_{-1}}}}\right] \tag{80}$$

For the system of two-countries to be in equilibrium in the long run, two conditions must be satisfied: (a) both utilization rates should converge to the normal utilization rate (or inertia zone); (b) all stocks and flows in both economies must grow at the same rate. Bearing these conditions in mind, we move directly to simulation experiments to analyse how growth in both countries is affected by the expansion in demand in one of the countries in the long run – provided that the dynamics of the model is too complex to explore the system of dynamic equations of the stocks or to find an equation for the long-run equilibrium growth rate.

5 Experiments

We run simulation experiments from a system's steady growth state, in which both economies are growing at the same initial rate, to evaluate the long run aspects of the model. We run the same experiments for both exchange rate regimes. We present the results for the shocks to a fixed exchange rate regime in what they differ from the results of the same shock to a flexible exchange rate regime. The three experiments are: (a) a reduction in firms' mark-up in one of the countries; (b) an increase in the propensity to consume out of after-tax wages in one of the countries; (c) a reduction in the propensity to import in one of the countries.

5.1 A decrease in the mark-up of firms in one of the economies

5.1.1 Flexible exchange rate

In a flexible exchange rate regime, a decrease in the mark-up on unit costs of the firms of country one[7] will raise the wage share of workers of country one and, consequently,

[7] In the flexible exchange rate regime, we phrase the results considering a shock to the economy one to render the text easier to read, but it's indifferent which economy is shocked in that case. This means

consumption out of after-tax wages. This will boost activity, increasing the utilization rate above the normal rate of utilization (figure 1a), which will make firms react through a higher propensity to invest, culminating in a accelerating rate of capital accumulation (figures 1b and 1c). So far, there is no difference from what would happen in a closed economy. However, the initial boost in activity also stimulates the imports made by firms of country one, which will have an impact on the exports of country two. The increase in the exports of country two will warm up the economy two leading, on the one hand, to an increase in capacity utilization (figure 1a) which will change firms expected rate of growth, boosting the capital accumulation rate (figures 1b and 1c); and, on the other hand, to an increase in imports of country two, which will expand the exports of country one as well, diminishing the initial gap on the trade balance (figure 1d).

This process is accompanied by a depreciation of the exchange rate of country one (figure 1e), since the supply of bills by the government of country one (two) is higher (lower) than the foreigner households demand for these assets. The increase in the exchange rate will increase the 'competitiveness' of country one reversing part of the decrease in the profit share due to the reduction in the mark-up (figure 1f). The depreciation will also contribute to diminish the trade deficit of country one (combined with the stimulus to the other economy), since it negatively affects the imports of country one, until it reaches the baseline equilibrium (though this is not a necessary outcome). We must also consider that the opposite happens to the economy two: the appreciation of its currency reduces its firms profit share (even if there is an increase in the material input-output ratio), which has a negative effect on its trade surplus but a positive effect on domestic demand since the reduction in the profit share will translate into higher wages and consumption.

Government debt to capital ratio in both economies is reduced in relation to the baseline due to the decrease in the profit shares, since it increases the taxed income in the system. The reduction in the normalized stock of bills also reduces relatively the amount each government pays as interest to households. The government debt ratio in each country is also negatively affected by the firms loans to capital ratio, which increases in both countries as well. We notice that government debt to capital ratio in country one is higher in comparison to the same ratio in country two. This happens due to the higher amount of deposits government one has to keep at the central bank to cover the shortage of bills at this institution for keeping interest rates constant. This shortage is a result of the larger advances the central bank passes on to banks which keep on accommodating the firms demand for loans (figure 1g).

As for the case of firms, in both economies the loans to capital ratio is larger than in the baseline due to the increase in the propensities to invest along with lower wealth to capital ratio, which reduce the equities as a source of finance. These effects are larger than the impact of higher accumulation rates, which increase profit income (figure 1h).

Household wealth to capital ratio will also be lower in comparison to the baseline in both countries, but the ratio of country one will be lower than the ratio of country two due to the larger initial shock to the profit share which will translate into higher multiplier and accelerator effects in the short run, as can be seen from the utilization rates – utilization rate of economy one reaches a higher peak – and the higher gap between the accumulation

where it is written economy one could be read economy two and vice-versa.

rate and the wealth growth rate in country one (figures 2a, 2b and 2c).

It's worth to highlight that household wealth in country one will be higher than in country two, so household demand for domestic and foreign assets will also be higher in country one. This combined with the higher supply of government bills in country one than in country two, will culminate in a depreciation (appreciation) of currency one (two). The depreciation of currency one will contribute to reduce the current account deficit (surplus) in country one (two), since it will increase (reduce) relatively the amount received as interest on foreign assets by households of country one (two) (figure 2d).

Regarding the profit rates, we notice that firms in country two observe higher net and gross profit rates in the short run, since the initial positive effect on the utilization rate is larger than the decrease in the profit share due to the appreciation of the country's currency, which prevails in the long run. In the case of country one, the increase in the utilization rate and the depreciation of the currency counterbalance the negative effect of the reduction in the mark-up in the short run (figures 2e and 2f).

It's important to mention that economy one increases its relative share in the system's capital stock (there is a decrease in the ratio κ_1). As firms of country one increase investment to reply to the expanding domestic demand, they also increase the amount of imported inputs, leaking part of its demand to abroad. However, since we assume the Marshall-Lerner condition to hold ($\epsilon_{11} + \epsilon_{12} > 1$), the depreciation of the currency that follows the shock will minimize this effect through the positive effect on net exports (reducing the trade deficit). If we do the same experiment assuming the Marshall-Lerner condition does not hold ($\epsilon_{11} + \epsilon_{12} < 1$), the country which expands its domestic demand would see its capital decreasing in relation to the capital stock of the other economy, due to the predominant effect of demand leakage [8], giving rise to what Von Arnim et al. (2014) call a fallacy of composition: both economies grow faster if one of the economies expand its demand, however, the economy which benefits from the other's expansion may benefit relatively more; if this same economy decides to contract demand in order to avoid the other's relatively larger gain, both economies will lose (figure 2g).

As in the case of a closed economy, income distribution still has a permanent effect on growth in the long run, since the growth rate in both countries is permanently higher after a decrease in the mark-up of economy one. Through trade relations and through the financial movements represented by the exchange rate, activity and growth in one country are able to affect activity and growth in the other country. Smaller profit shares are still associated to larger capital accumulation rates in the long run, though not with higher profit rates.

We should further stress that if firms in both countries reduce their mark-ups (in the same proportion of the shock to an individual economy), growth in both economies will be higher than if only firms in one country reduce the mark-up. This reinforces the case for coordination among countries for expanding domestic expenditures (see La Marca (2010); Von Arnim et al. (2014)), which might lead to faster growth and to higher long

[8] It's not always the case that the country which expands domestic demand will see it's share in the system's capital stock decreasing considering that the Marshall-Lerner condtion does not hold. However, it will gain relatively less in comparison to the benefiting economy when this is the case. Whether the benefiting economy will increase its share in the system's capital stock or not is a matter of degree.

run growth rates (figure 2h).

5.1.2 Fixed exchange rate

The results of the same shock for a fixed exchange regime will differ regarding: (a) the government debt dynamics, since one of the economies now acquires reserves from the other one to keep the exchange rate constant; (b) the results on the trade balance and on the current account; (c) the income distribution. Since the government and central bank of these economies now have different behaviour, the results of the shocks also depend on which economy is expanding the demand: the one which accumulates reserves or the one issuing the internationally accepted currency.

If the firms of country one, which does not accumulate reserves, reduce their mark-up, this will be accompanied by a reduction in the government debt to capital ratio in comparison to the baseline. However, the decrease in country one's government to capital ratio will be partially compensated by the process of reserve accumulation of country two to keep the exchange rate constant (figure 3a). The reduction in the mark-up in country one will reduce prices in country one, increasing the real wage share, which will boost consumption and activity in country one (figures 3b and 3c). Consequently, there will be an increase in the imports of country one and, thus, an increase in the exports of country two. This process will be just partially compensated by the income effect – the increase in the exports of country two will contribute to increase output, increasing then imports of country two and exports of country one –, meaning that country two will have a trade surplus and country one a trade deficit in the long run (figure 3d).

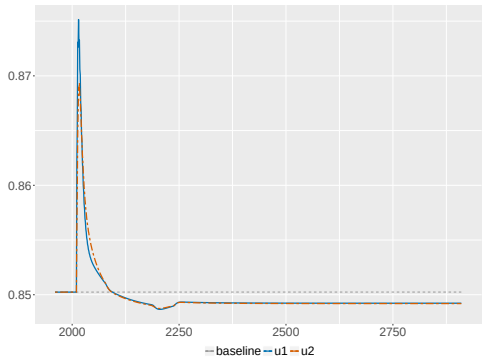
As the nominal exchange rate is fixed, the real exchange rate will be affected only by the change in relative sales prices. Since there will be a decrease in prices in country one, this will make imports by country one more expensive and imports by country two cheaper and, consequently, will reduce sales prices in country two as well. Since prices will be lower in country one than in country two, country one (two) sees a relative improvement (worsening) in its trade terms, which translates into a real depreciation (appreciation) of its currency. The reduction in prices in country two will also mean a redistribution towards wage earners. The change in income distribution in country one will still have an impact on income distribution of country two in the fixed exchange rate regime if there are changes in the trade terms.

The lower profit share in country one will contribute to increase the loans to capital ratio as in the case of flexible exchange rates. The loans to capital ratio in country two will increase to a lesser extent due to the smaller reduction in the profit share coming from the change in sales prices (figure 3e).

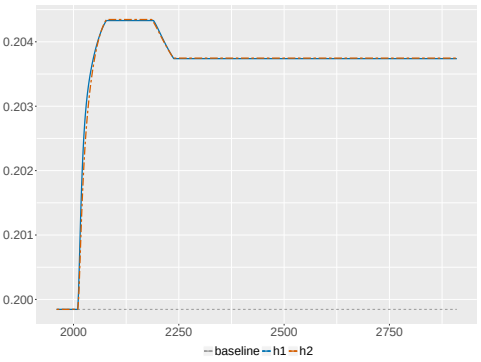
Differently from the flexible exchange rate regime case, after the shock there will be a larger difference between household wealth to capital ratios in country one and two. Household wealth in country two will be higher than in country one, due to the larger government debt in country one, due to the accumulation of reserves by country two. Since in the fixed exchange rate regime the supply of government bills to household is equal to the demand, there will be no mechanism to diminish the surplus (deficit) in the current account of country two (one). Households in country two will keep on accumulating more

Figure 1: Effects of an increase in real wages in country one (reduction in μ_1) in a flexible exchange rate regime

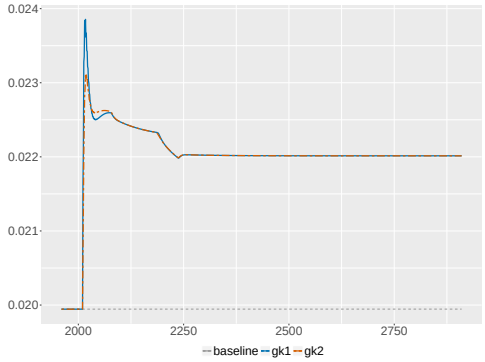
(a) Capacity utilization rates



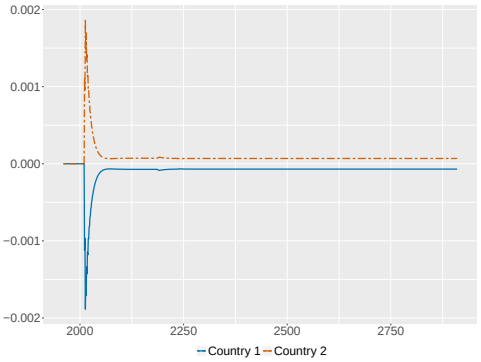
(b) Firms propensities to invest



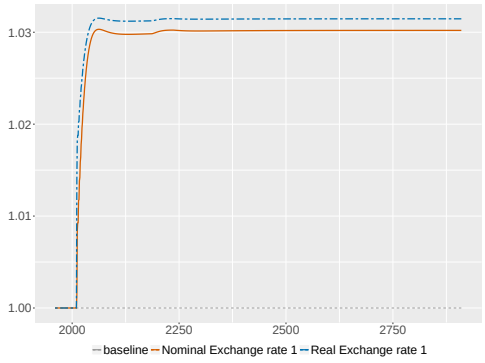
(c) Capital accumulation rates



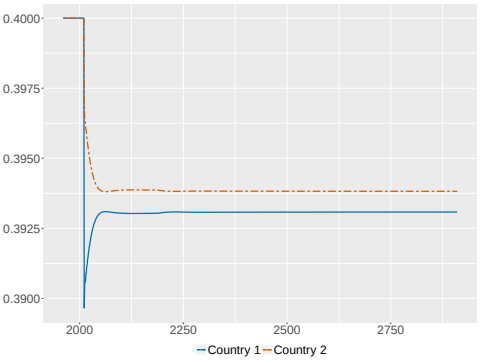
(d) Trade balance as share of output



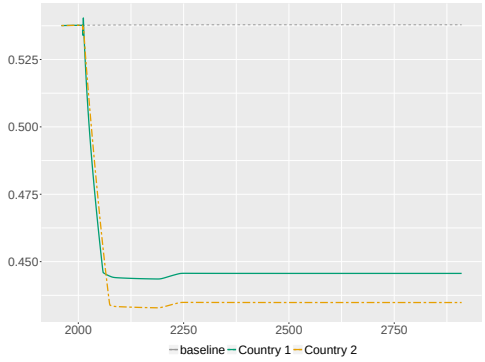
(e) Exchange rate



(f) Profit shares



(g) Government debt to capital ratios



(h) Firms loans to capital ratios

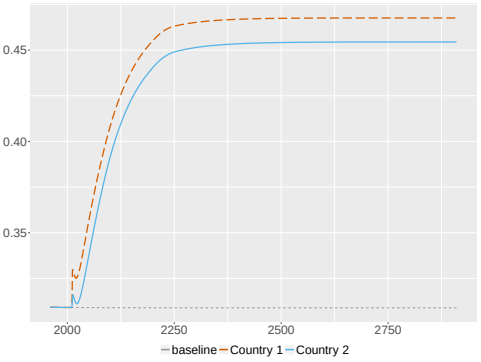
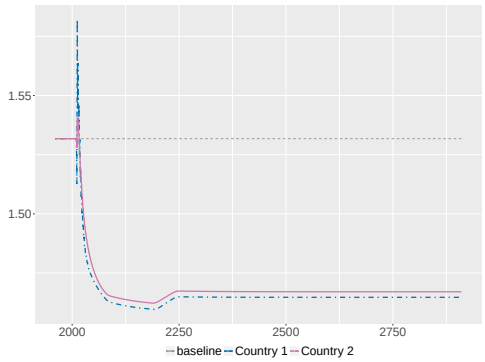
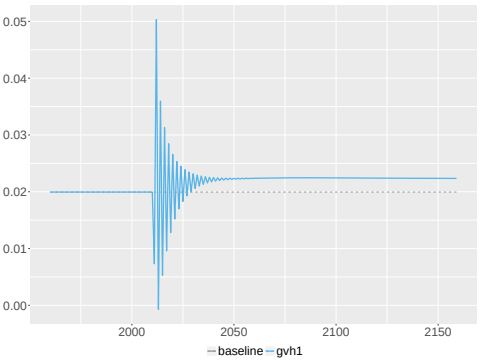


Figure 2: Effects of an increase in real wages in country one (reduction in μ_1) in a flexible exchange rate regime

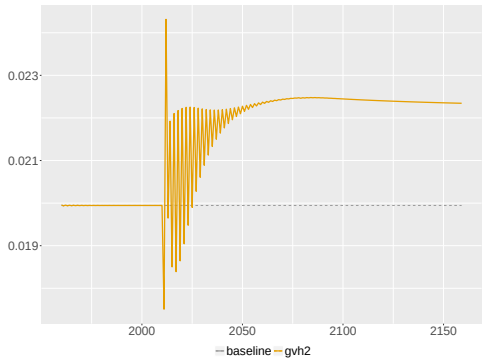
(a) Household wealth to capital ratios



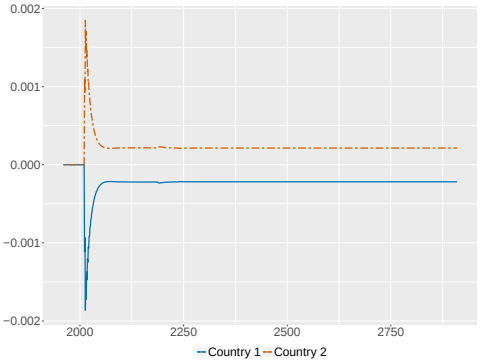
(b) Growth rates country one



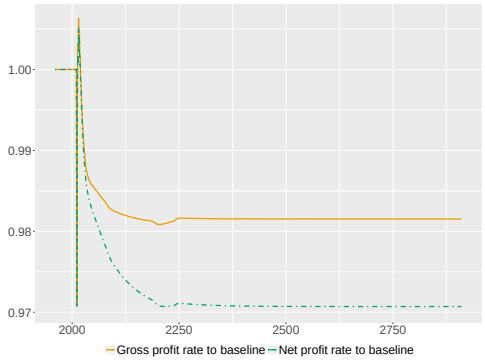
(c) Growth rates country two



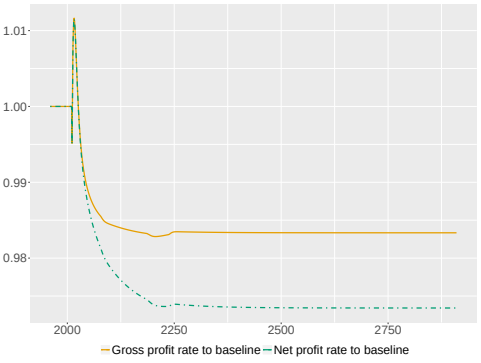
(d) Current accounts as share of output



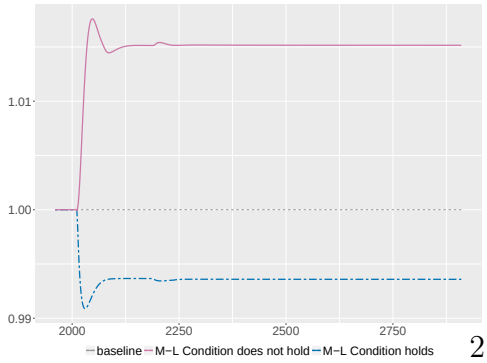
(e) Profit rates country one



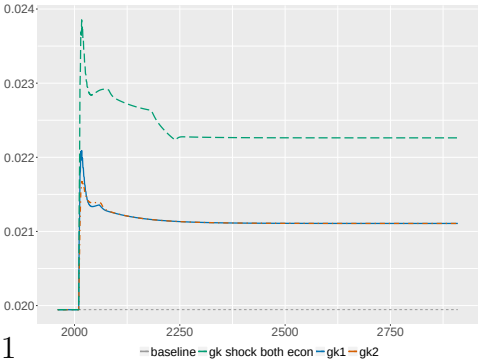
(f) Profit rates country two



(g) Ratio of capital between the two economies



(h) Compared capital accumulation rates



foreign assets and will receive a larger financial income from these assets (figures 3f and 3g).

As for the case that firms of country two, which does accumulate reserves, reduce their mark-up, this will be accompanied by a lower government debt to capital ratio in country one in comparison to the government debt to capital ratio in country two (figure 4a). Country two now presents a current account deficit caused by the trade deficit (since it expands domestic demand), by the lower interest income received by households on foreign assets and by the reduction on the supply of government bills of country one to the central bank of country two, which sees the stock of international reserves diminishing (figures 4b and 4c).

In the fixed exchange rate regime, income redistribution towards wages in one of the countries has positive growth effects in both economies through the trade channel. Growth in the economy which is benefiting from the increase in external demand will still be associated to a *domestic* income redistribution due to the change in trade terms caused by the reduction in prices of country one. The country which increases its weight on the system's capital stock is the country which expands domestic demand provided the trade gap is not wide enough. As in the case for flexible exchange rates, growth will be higher if both countries reduce their profit shares simultaneously.

5.2 An increase in the propensity to consume out of wages in one of the economies

5.2.1 Flexible exchange rate

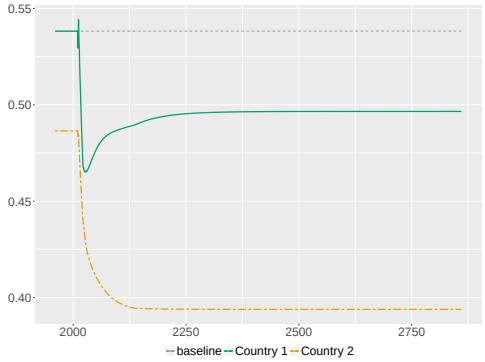
An increase in the propensity to consume out of after-tax wages in country one will increase household consumption and decrease household savings. This will slow down the growth of household wealth in the short run (figure 5a). However, as the effect of higher consumption on activity speeds up the household wealth growth of country one recovers. The higher level of activity will translate into a higher utilization rate which will make firms adjust their investment, raising the capital accumulation rate (figure 5c and d). The expansion in demand will stimulate imports of country one and, thus, exports of country two which will contribute to expand also domestic demand of country two leading to a higher utilization rate, followed by a higher propensity to invest and capital accumulation rate in country two as well (figure 5c).

As for the previous experiment, there is an increase in the exchange rate since the supply of bills by the government of country one (two) is higher (lower) than the foreigner household demand for these assets (figure 5e). The increase in the exchange rate will increase the competitiveness of country one, leading to a higher profit share in country one. The opposite happens in country two – there is a decrease in the profit share due to the appreciation of its the currency (figure 5f). The redistribution towards wages in country two will also contribute to expand its demand. The depreciation of the currency one in relation to currency two will also contribute to reduce the trade deficit of country one through its negative (positive) effect on imports of country one (two) (figure 5g).

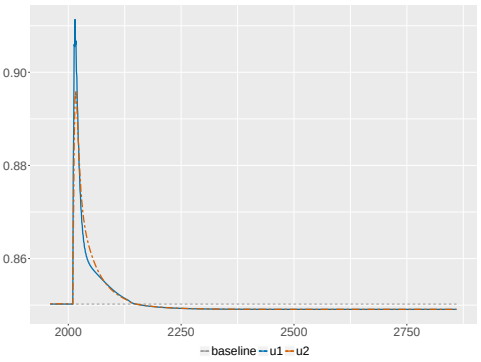
Government debt to capital ratio decreases due to the initial boost in activity

Figure 3: Effects of an increase in real wages in country one (reduction in μ_1) in a fixed exchange rate regime

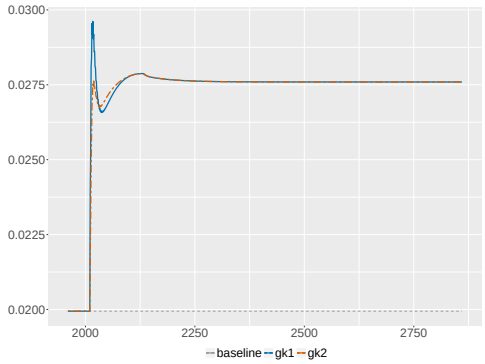
(a) Government debt to capital ratios



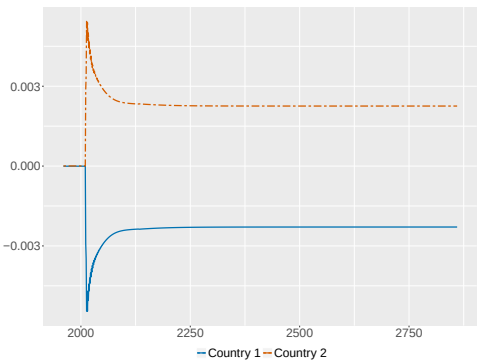
(b) Capacity utilization rates



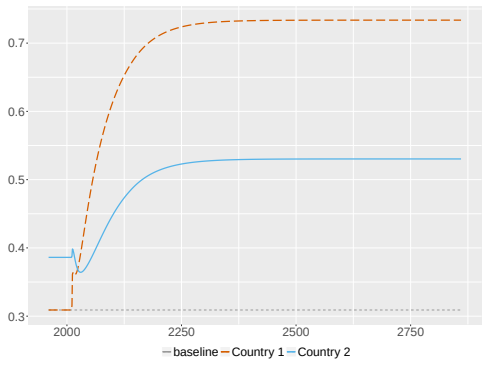
(c) Capital Accumulation rates



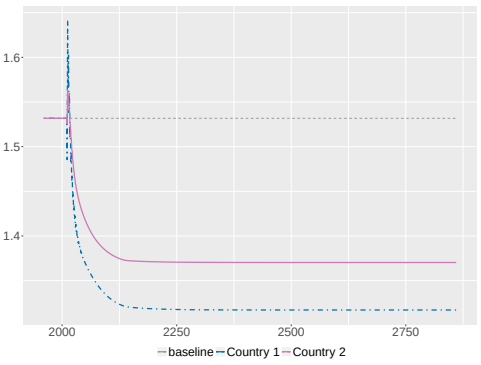
(d) Trade balance as share of output



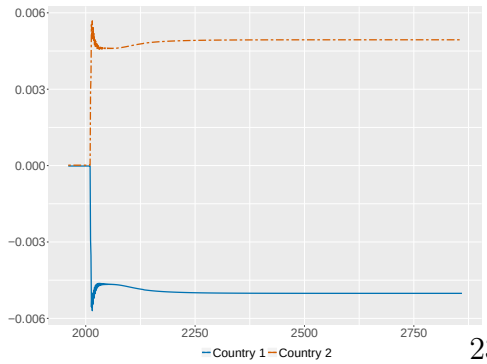
(e) Firms loans to capital ratios



(f) Household wealth to capital ratios



(g) Current accounts as share of output



(h) Ratio of capital between the two economies

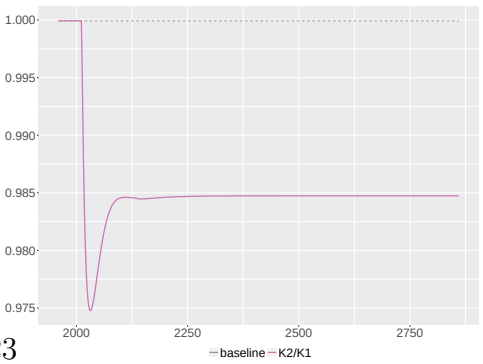
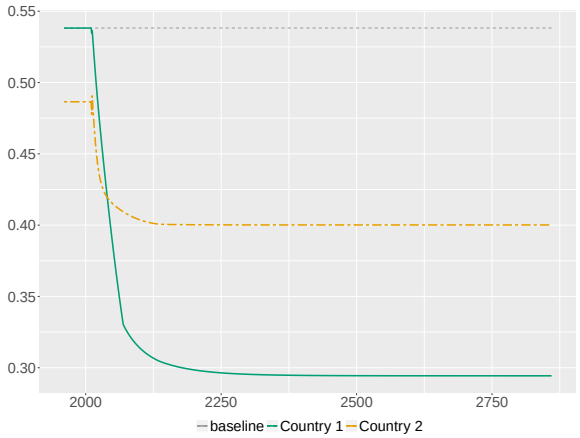
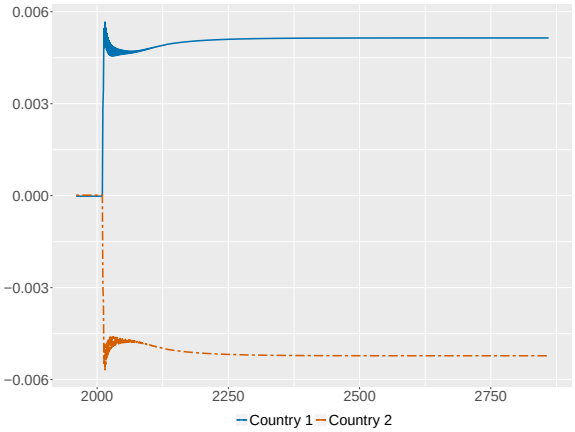


Figure 4: Effects of an increase in real wages in country two (reduction in μ_2) in a fixed exchange rate regime

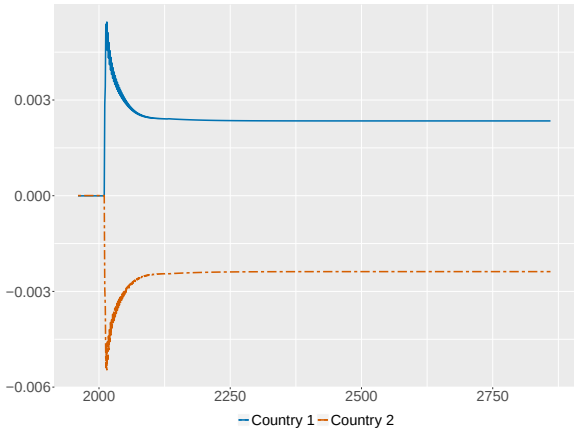
(a) Government debt to capital ratios



(b) Current accounts as share of output



(c) Trade balance as share of output



coming from the increase in the propensity to consume. This also contributes to the temporary drop in the deficit of government one (figure 5h). This initial effect is partially compensated in country one due to the depreciation of the currency (following the increase in the propensity to consume) which changes income distribution towards profit earners domestically, reducing the taxed income. In country two, the government debt to capital ratio decreases due to the decrease in the profit share and to the initial boost in demand which raises the taxed income (figure 6a).

In the case of country one, firms loans to capital ratio decreases in relation to the baseline due to the effects of a higher capital accumulation rate and profit share. As for country two, firms loans to capital ratio increases as the profit share goes down and the propensity to invest increases, compensating the downward effect of a higher capital accumulation rate (figure 6b).

Household wealth to capital ratios will be lower than in the baseline in both countries (figure 6c). As in the previous experiment, the household wealth to capital ratio will be lower in country one due to the initial shock to the propensity to consume which will generate a larger accelerator effect as can be seen through the gap between capital accumulation rates in both countries (figure 5c). It's worth to highlight that household wealth in country one will be higher than in country two, so the household demand for domestic and foreign assets will also be higher in country one. This combined with the higher government debt to capital ratio in country one in comparison to country two will culminate in a depreciation (appreciation) of currency one (two). The depreciation of currency one will contribute to reduce the current account deficit (surplus) in country one (two) (figure 6d).

In what concerns the profit rates, firms in country one observe higher gross and net profit rates in comparison to the baseline due to the higher utilization rate (in the short run) and due to the permanent increase in the profit share, while firms of country two experience higher gross and net profit rates in the short run due to the increase in capacity utilization, but in the long run these rates stablish at a lower level in comparison to the baseline due to the reduction in the profit share (figures 6e and 6f).

As in the previous experiment, considering that the Marshall-Lerner condition holds, country one increases its relative share in the system's capital stock.

In a flexible exchange rate regime, an increase in the propensity to consume may change income distribution across countries through the movements in the exchange rate. The redistribution towards profit earners domestically translates into a redistribution towards wage earners abroad. In the previous scenario, the domestic distributional shock towards wage earners originated in a decline of the mark-up was not entirely compensated by the depreciation of the currency, meaning a general redistribution in the system towards wage earners. In this scenario, as the source of income redistribution is only the movement in the exchange rate, the wage (profit) earners in one country win at the expense of wage (profit) earners in the other country.

An increase in the propensity to consume is associated to a higher growth rate domestically in the long run and has positive feedbacks to the growth rate of the other economy through the external sector. As in the previous scenario, both economies grow faster if there is an increase in the propensity to consume out of after-tax wages in both

countries than if there is an increase in the propensity to consume only in one of the countries.

5.2.2 Fixed exchange rate

For the case of fixed exchange rate regime, if households of country one increase their propensity to consume out of after-tax wages, this will boost activity in country one stimulating its imports and, consequently, the other country exports which will lead to a permanent trade deficit for country one and trade surplus for country two (figure 7a). Since country two accumulates reserves in a limitless scale, after the initial drop in the government debt to capital ratio in country one due to the increase in activity and in taxed income, there will be an increase in government debt to capital ratio in country one, however, not enough to surpass the baseline level (figure 7b). The opposite happens if households of country two increase their propensity to consume, generating a trade deficit in country two which will lead to a reduction in its stock of international reserves.

Differently from the flexible exchange rate regime case, there will be no change in the functional income distribution due to the increase in the propensity to consume out of after-tax wages – since neither the nominal exchange rate nor the relative prices are changing. This helps to explain why in this regime the firms loans to capital ratios in both countries are higher than in the baseline scenario: now in both economies the firms loans to capital ratio increases as the propensity to invest goes up due to the initial stimulus of demand in country one, compensating the initial negative effect on loans of a higher capital accumulation rate (figure 7c). For the profit rates, this means any increase will be only temporary since the utilization rate goes back to a normal range in both countries.

As we can see from figure 7d, a stimulus to domestic demand coming from a reduction in the propensity to save will have a permanent growth effect in both economies which is not accompanied by any income redistribution domestically or abroad. The country which expands demand will present, cet. par., a permanent trade deficit but will also increase its share on the system's capital stock.

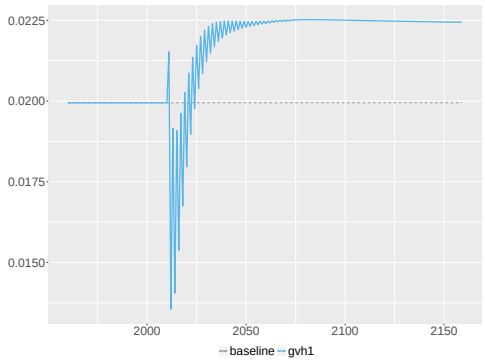
5.3 A decrease in the propensity to import in one of the economies

5.3.1 Flexible exchange rate

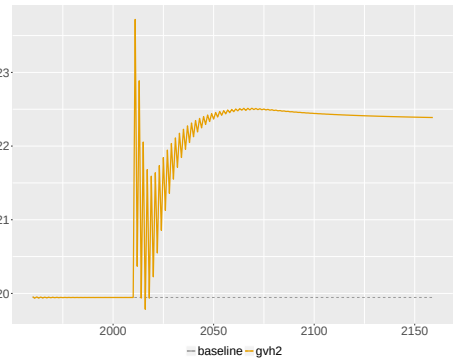
A reduction in the propensity to import of country one will, on the one hand, reduce imports of country one and exports of country two (figure 8a). This initial effect will decrease activity in the economy two, reducing the utilization rate and the capital accumulation rate in the short run (figures 8b and 8c). After this initial shock, the reduction in imports of country two and in exports of country one will reduce the trade surplus of country one and the trade deficit of country two. On the other hand, the reduction in the propensity to import in this simplified system means there is a reduction in the material input-output ratio, thus reducing the profit share of economy one (figure 8d). Thus wages and consumption increase complementing the initial positive effect of an increase in net exports in country one and partially counterbalancing the negative effect

Figure 5: Effects of an increase in the propensity to consume out of after-tax wages (increase in α_{11}) in a flexible exchange rate regime

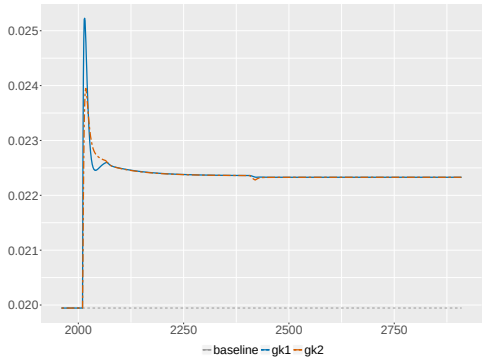
(a) Household wealth growth rate country one



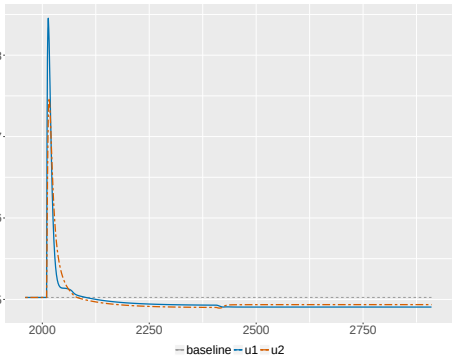
(b) Household wealth growth rate country two



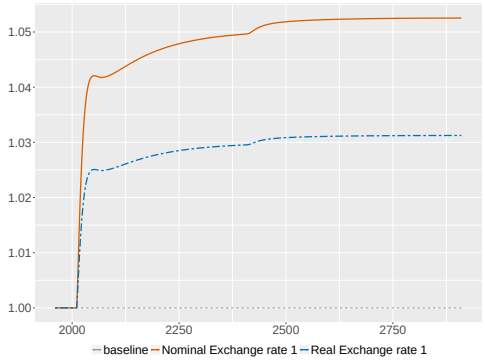
(c) Capital accumulation rates



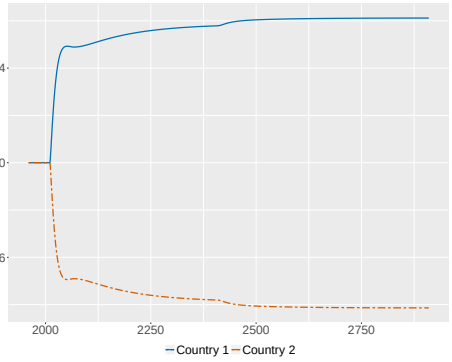
(d) Capacity utilization rates



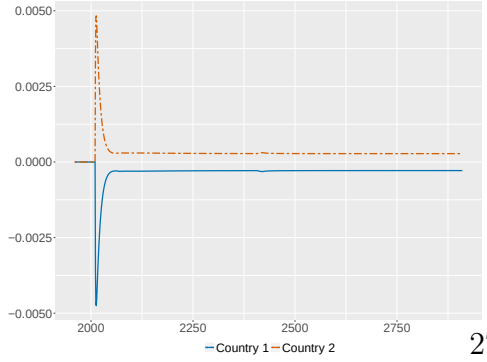
(e) Exchange rate



(f) Profit shares



(g) Trade balance as share of output



(h) Government budget deficits

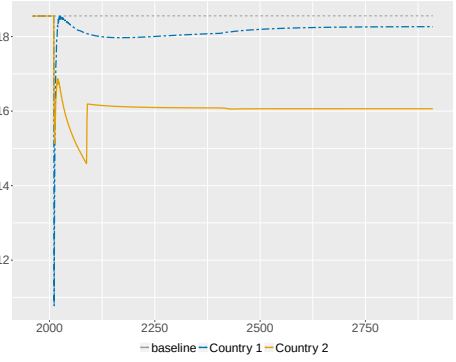
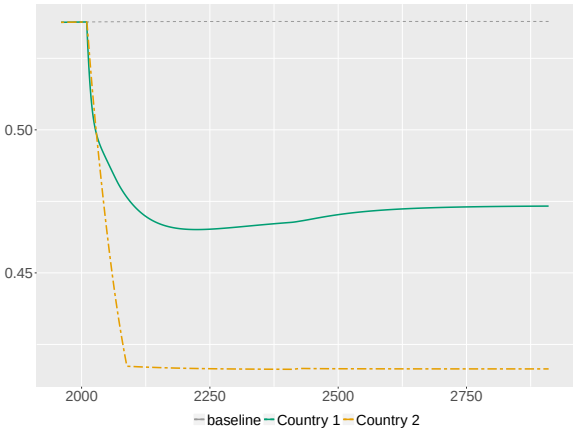
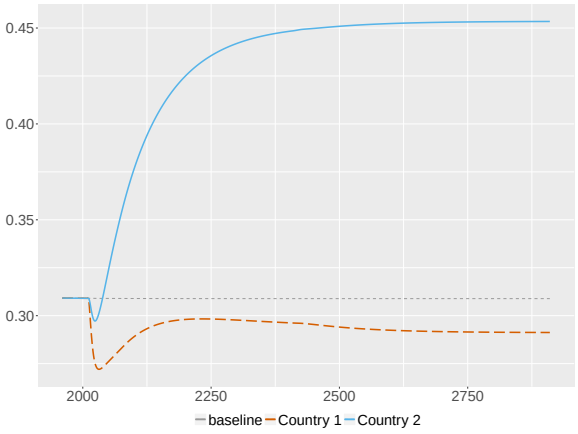


Figure 6: Effects of an increase in the propensity to consume out of after-tax wages (increase in α_{11}) in a flexible exchange rate regime

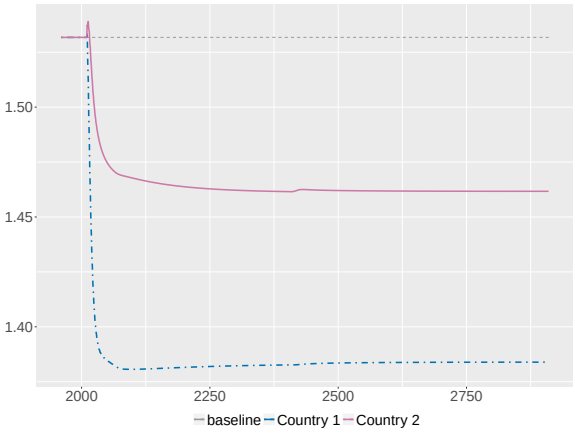
(a) Government debt to capital ratios



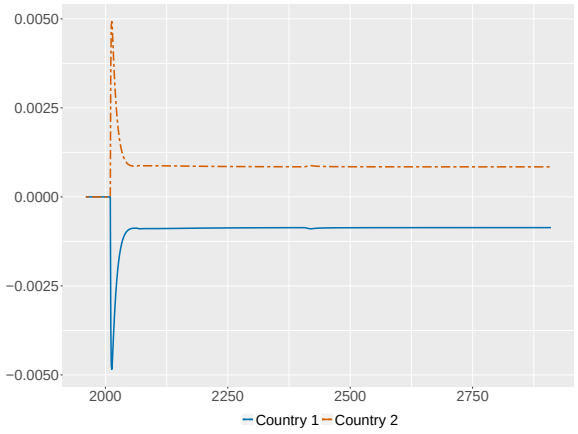
(b) Firms loans to capital ratios



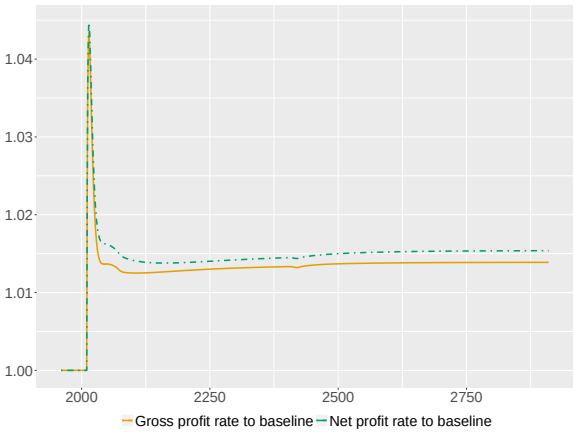
(c) Household wealth to capital ratios



(d) Current accounts as share of output



(e) Profit rates country one



(f) Profit rates country two

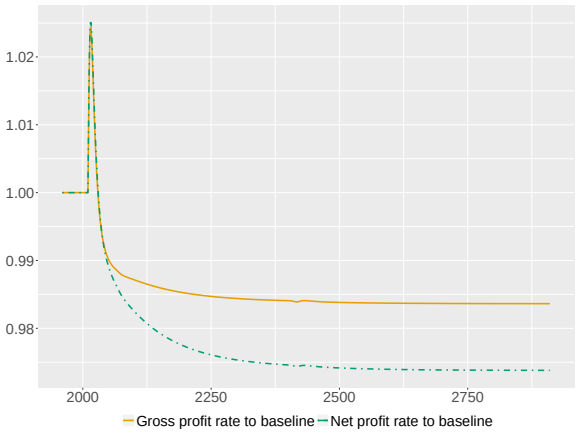
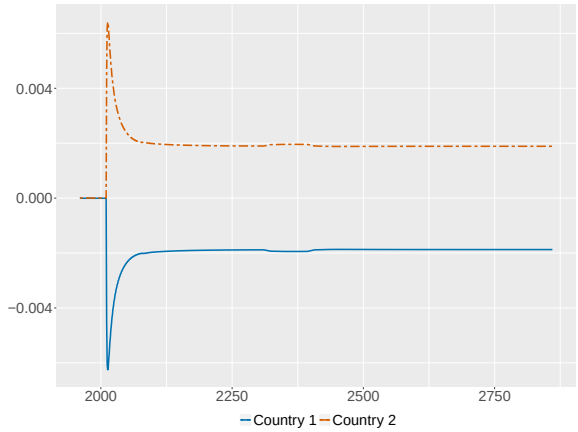
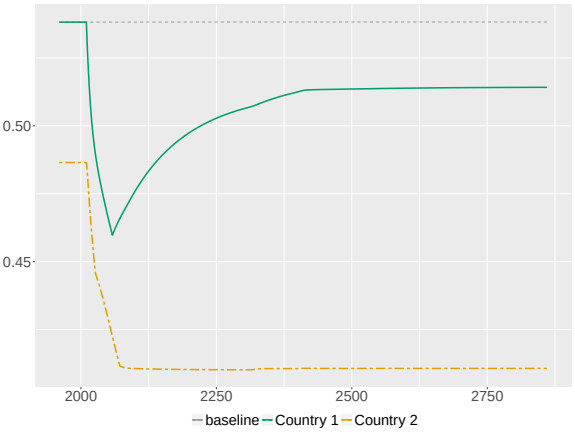


Figure 7: Effects of an increase in the propensity to consume out of after-tax wages (reduction in α_{11}) in a fixed exchange rate regime

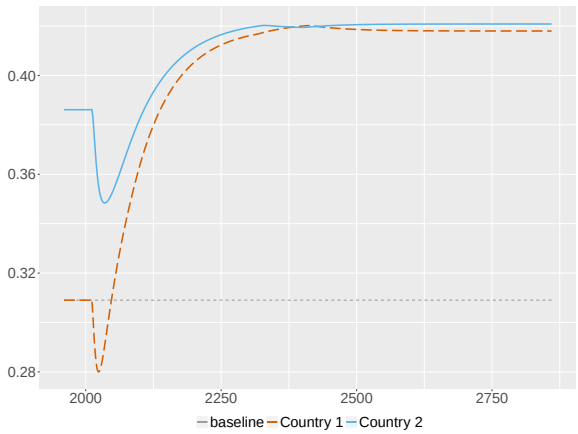
(a) Trade balance as share of output



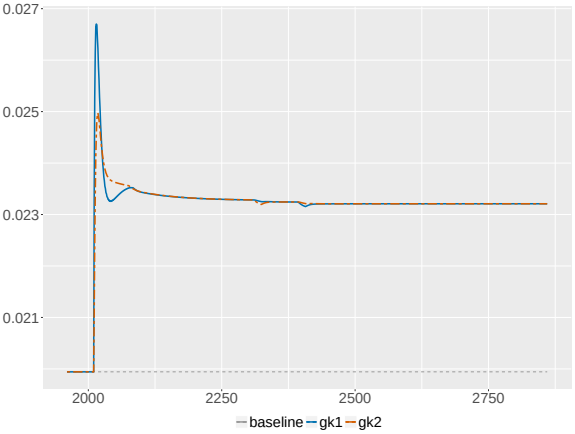
(b) Government debt to capital ratios



(c) Firms loans to capital ratios



(d) Capital Accumulation rates



of the initial slowdown in the economy two (figures 8b and 8e).

Both government debt to capital ratios decrease in relation to the baseline (figure 8f). Government debt to capital ratio of country one stabilizes at a lower level in comparison to the government debt to capital ratio of country two. In the short run, we can notice there is an appreciation of currency one since household wealth in country two grows at a faster pace than in country one. However, as economy one grows at a faster pace during the transition, household wealth in country one will be higher in relation to household wealth in country two, so there is still a depreciation of the currency one in relation to the currency two in the long run – the supply of government one bills is larger than the demand of households from country two for these bills (figures 9a and 9b).

The depreciation of the currency compensates part of the decrease in the profit share of firms in country one and reduces the profit share of firms in country two. It also has an indirect negative (positive) effect on the profit share of country one (two) since it contributes to further decrease (and to increase) the propensity to import of country one (two) (figure 8d).

The firms loans to capital ratio of country two increases more in relation to the baseline if compared to the firms loans to capital ratio of country one, this is so due to the effect of the depreciation on the profit shares (figure 9c).

We notice that due to the fact that the economy one becomes more closed, it gains while the other economy relatively loses (figures 8b, 8c and 8e). This also explains the larger increase in the share of economy one in the system's capital stock (figure 9d). However, economy two benefits from the positive spillovers that the faster growth in economy one will have on its demand.

5.3.2 Fixed exchange rate

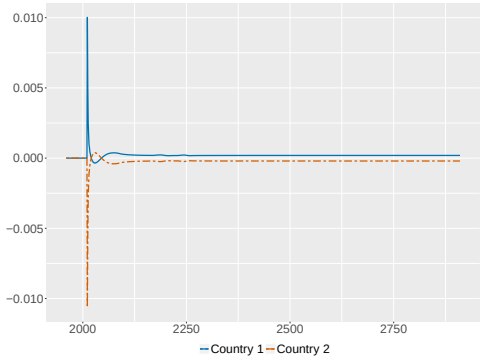
The results of a reduction in the propensity to import of the economies one and two are pretty similar to the ones presented for the reduction of the mark-up for the economies one and two respectively, with the exception of the short run impact on the current account and the trade balance (figures 10a and 10b). In the short run there is an increase in net exports of the country which reduces its propensity to import. A reduction in the propensity to import in one of the countries might have a permanent positive effect on growth as it redistributes income towards wage earners domestically – reducing the material inputs price and then sales prices – expanding demand which feedbacks into the other country's demand through the trade channel. Again the reduction in sales prices in both economies means a redistribution towards wage earners in the system as a whole.

6 Final Remarks

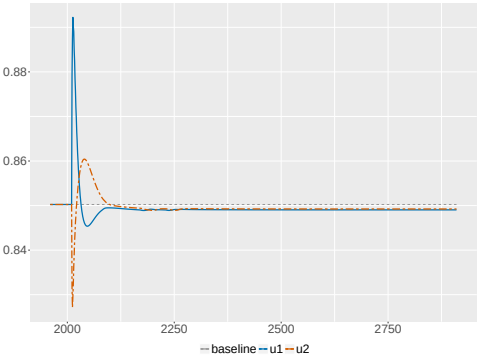
The model presented in this paper represents a first step in investigating the features of a supermultiplier model in a two-country system. Table 3 displays its main attributes in comparison with a similar model for a closed economy and in comparison with typical supermultiplier models in which there is a non-capacity creating autonomous

Figure 8: Effects of a decrease in the propensity to import of country one in a flexible exchange rate regime

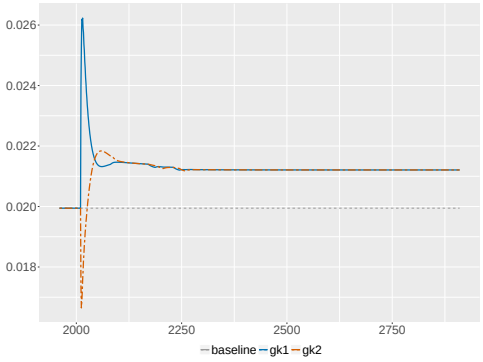
(a) Trade balance as share of output



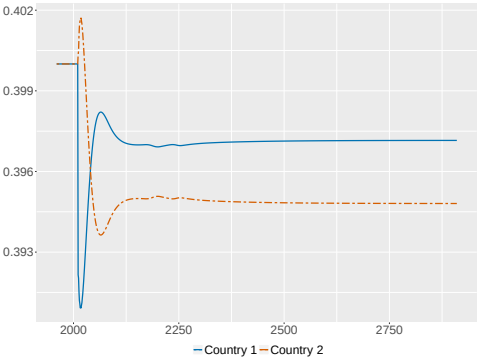
(b) Capacity utilization rates



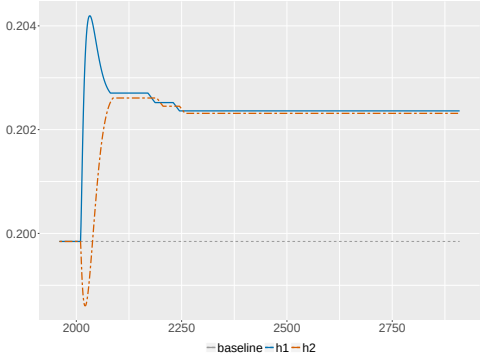
(c) Capital Accumulation rate both countries



(d) Profit shares



(e) Firms propensities to invest



(f) Government debt to capital ratios

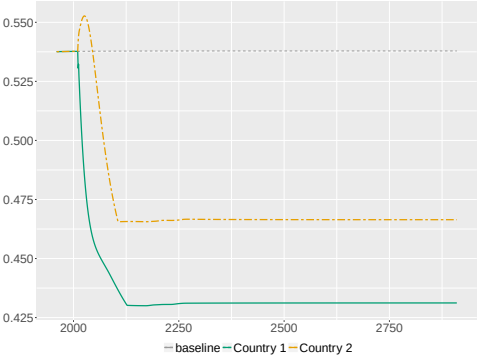
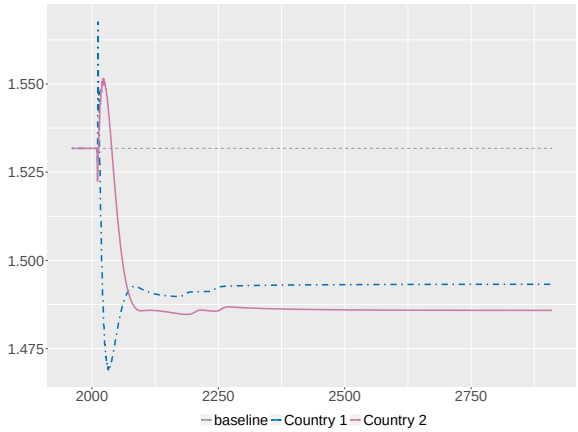
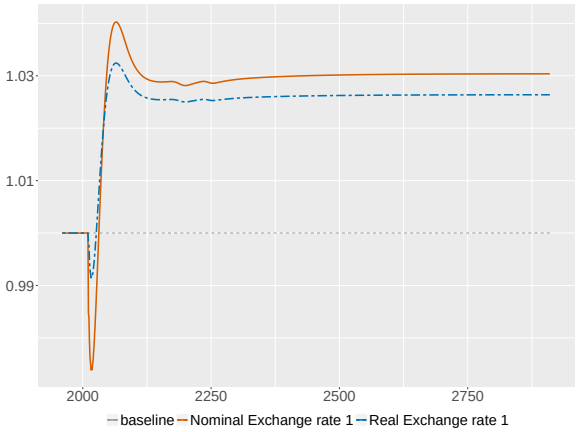


Figure 9: Effects of a decrease in the propensity to import of country one in a flexible exchange rate regime

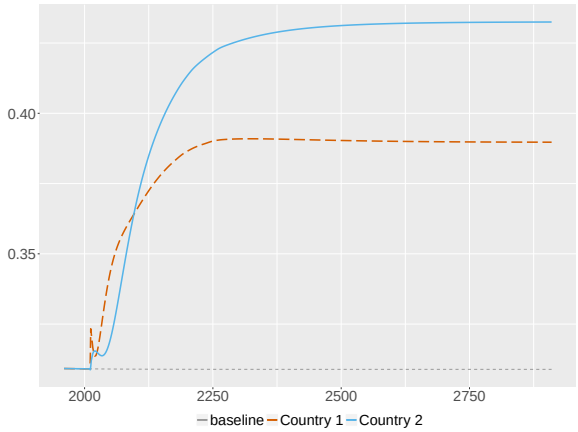
(a) Household wealth to capital ratios



(b) Exchange rate



(c) Firms loans to capital ratios



(d) Ratio of capital between the two economies

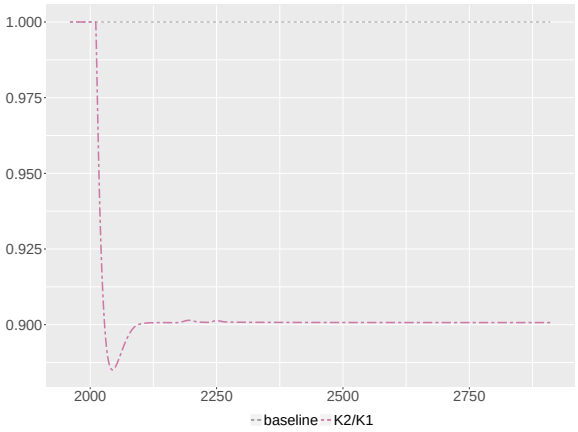
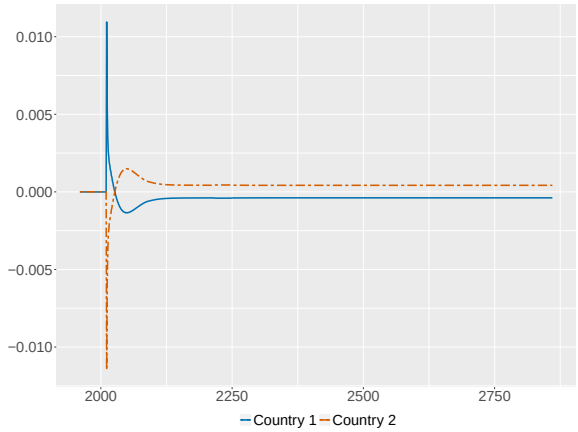
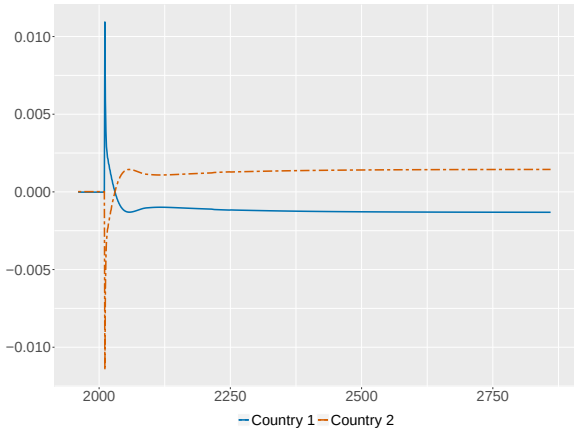


Figure 10: Effects of a decrease in the propensity to import of country one in a fixed exchange rate regime

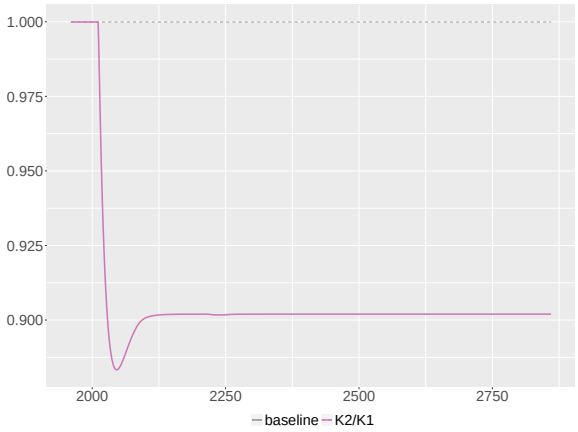
(a) Trade balance as share of output



(b) Current account as share of output



(c) Ratio of capital between the two economies



expenditure growing at an exogenously given rate in the long run. Extending the model to a two-country setting renders the analysis increasingly difficult, the more so if we are concerned with the long-run features and would like to make inferences from the dynamic ratios of the system. Due to this stumbling block, we recurred to simulation experiments to address how a change in demand would impact growth in the long run for both exchange rate regimes. The main results, which are doomed not to be general at this stage, are summarized as follows:

(i) As in closed economy supermultiplier models, a higher growth rate of autonomous expenditures (in this case, of the combined growth rates of exports and consumption out of wealth for an individual country) is still associated to a higher investment to income ratio. As investment accelerates, exports and consumption out of wealth combined represent a lower share of income;

(ii) A reduction in the profit share in one of the countries arising from a reduction in the mark-up is associated with higher growth rates in both countries in the long run and with lower profit rates in both economies due to the reduction in the system's profit share for both exchange rate regimes;

(iii) An increase in the propensity to consume out of after-tax wages in one of the countries leads to a higher growth rate in both countries in the long run. This is associated with higher profit rates in the country which expands demand due to the effect of currency depreciation on the profit share and with lower profit rates in the other country due to the effect of that country's currency appreciation on its firms profit share. This experiment shows that in an open economy, even if the economy is wage-led, growth does not need to be associated with a lower domestic profit share due to the feedbacks between the economies;

(iv) A reduction in the propensity to import in one of the economies is associated with higher growth rates in both countries since it is associated with a redistribution towards wages in the system as whole for both exchange rate regimes;

(v) Growth in both economies will be higher in the long run if both economies expand domestic demand than if only one of the economies expand domestic demand. This is a shared result with neo-Kaleckian two-country models (Von Arnim et al., 2014; Capaldo and Izurieta, 2013) and reinforces the case for policy coordination among countries;

(vi) The movements in the exchange rate have a permanent effect on growth through the indirect impact they have on income distribution. If a devaluation of the currency has no impact on income distribution, the effect on growth will be only transitory. Assuming the Marshall-Lerner condition holds, the country which depreciates its currency will see a temporary increase on its growth rate, through the higher net exports, while the country which sees its currency appreciating will experience a temporary decrease in its growth rate;

(vi) The economy which expands domestic demand will gain relatively more in relation to the economy benefiting from the increase in the external demand, the smaller

Table 3: Compared features of Supermultiplier models

Features	Sraffian and neo-Kaleckian Supermultiplier models	Closed economy Supermultiplier SFC model	Two-country Supermultiplier SFC model
Non-capacity creating autonomous expenditures	Consumption (credit or wealth), exports or government expenditures	Consumption out of wealth	Consumption out of wealth and exports in both countries
Growth	Exogenous	Endogenous	Endogenous
Income distribution effect on growth	Transient	Permanent	Permanent
Effect of propensities to consume on growth	Transient	Permanent	Permanent
Exchange rate effect on growth	Transient†	–	Permanent
Paradox of thrift	Level	Growth	Growth
Paradox of costs	Level	Growth	Growth
Utilization rate	Converges to u_n	Converges to u_n	Converges to u_{n_1} and u_{n_2}
Movements in the exchange rate	–	–	May change income distribution domestically and across countries
Financial stocks	Absent⋆	Included	Included
Output	$Y = C + I + G/XL$	$Y = C + I + G$	$Y = C + I + G + X - IM$
Supermultiplier	Domestic multiplier	Domestic multiplier	Combined –domestic and foreign – multiplier

† For Nah and Lavoie (2017). For the other models – closed economy –, it does not apply.
⋆ Some models include financial assets. See Dutt (2016) and Hein (2016).

its trade deficit. This means that for the same shock, the expanding economy will increase its relative share in the system's capital stock (or lose relatively less) if the Marshall-Lerner condition holds. It also means that for the same shock, the expanding economy should also gain relatively more in the flexible exchange rate regime, as it reduces the trade gap.

It goes without saying that the results obtained here should be reassessed once labour productivity is taken into account, since it is understood as a major source of uneven levels of competitiveness across countries. Besides, the addition of an endogenous rule for the mark-up would also contribute to evaluate another channel through which distribution can affect international competitiveness and thus possibly long run results regarding the relation between distribution and growth. At last, the discussion presented here could also be enhanced by an analysis of the interactions between two economies with different features and behaviour. These issues are subject for future research.

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