# Currency Devaluations, Aggregate Demand and External Debt Dynamics in a Post-Kaleckian Open Economy Model

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**Abstract**
The paper employs a post-Kaleckian model to address the question of how currency devaluations affect aggregate demand, capital accumulation, and external debt in small open economies with a fixed exchange rate in the short- to medium-run. In benchmark post-Kaleckian open economy models currency devaluations have two key effects. First, they change international price competitiveness and thus affect net exports. Second, devaluations change income distribution and thereby affect consumption and investment demand. The overall effect on aggregate demand and investment is ambiguous and depends on parameter values. Existing models, however, disregard balance sheet effects that arise from foreign currency-denominated external debt. The paper develops a novel post-Kaleckian open economy model that introduces foreign currency-denominated external debt and balance sheet effects. The model is then used to analyse the effects of a currency devaluation on aggregate demand, growth, and external debt dynamics. The main findings are that the existence of foreign currency-denominated debt makes contractionary devaluations more likely, and that foreign interest rate hikes, and high illiquidity and risk premia compromise debt sustainability. Devaluations only stabilise debt ratios if they succeed in boosting domestic capital accumulation.

**Keywords**: currency devaluation, external debt, balance sheet effects, Kaleckian model

**JEL classifications:** E11, E12, F36, F41

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## Introduction

The crisis of the Eurozone has once again sparked a debate about the advantages and disadvantages of monetary sovereignty. Many critics of the Eurozone pointed out that the loss of monetary sovereignty deprived weaker economies of a powerful adjustment tool – the ability to devalue their currencies. The economies that were hit hard by the euro crisis would have been better off, so the argument goes, if they still had the possibility to restore their international competitiveness through a currency depreciation.[1]

While currency depreciations eventually may succeed in improving the trade balance, the question arises whether they also sustain or even boost overall aggregate demand and growth. Indeed, the belief that devaluation is also an effective tool to raise aggregate demand is wide-spread. The theoretical argument behind this favourable view of devaluations stems from the classic Mundell-Fleming model.[2] In this framework, the real exchange has a positive effect on net exports, while the domestic components of aggregate demand are exchange rate inelastic, so that a real depreciation always boosts aggregate demand. This mechanism is sometimes also invoked by post-Keynesian economists (e.g. Bougrine and Seccareccia, 2004). However, the assumption that domestic absorption is independent of the real exchange rate is crucial for the overall effect, so that relaxing it might yield very different conclusions.

The favourable view of depreciations was challenged quite early from various authors.[3] Alexander (1952), Diaz-Alejandro (1963), and Krugman and Taylor (1978) pointed out that devaluations can also be contractionary for several reasons. Most importantly, it was argued that

a) real depreciations may fail to increase net exports, if the Marshall-Lerner condition (MLC) is not satisfied;[4] and

b) real depreciations are likely to redistribute income from workers to profit earners, who normally have a lower propensity to consume, and thereby depress consumption demand.

After the Asian financial crisis in 1997-98, adverse effects on investment from foreign-currency denominated private debt, balance sheet effects, have been added to the list of contractionary channels (e.g. Krugman, 1999; Allen et al. 2002). The effect of devaluations on externa debt and its sustainability is therefore another aspect that may be relevant for on overall assessment of the advantages of devaluations.

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[1] For an example of heterodox economists making this point, see Flassbeck and Lapavitsas (2013). From a mainstream Keynesian point of view, see Krugman (2015).

[2] For a textbook version see Gandolfo (2002, chap. 10).

[3] Broad surveys of the contractionary devaluation debate are provided by Lizondo and Montiel (1989), and Bahmani-Oskooee and Mitzea (2003).

[4] The MLC for unbalanced trade and a perfectly elastic supply of goods is given by $\left(\frac{X}{e_r M}\right)\eta_x + \eta_m > 1$, where $\eta_x$ and $\eta_m$ are the absolute values of the real exchange rate elasticities of exports and imports respectively, $X$ is exports, $e_r$ is the real exchange rate and imports is $M$. In case of a trade deficit, the ratio of exports to imports is smaller than unity. Thus, the MLC might not always be satisfied, especially in countries with strong trade deficits (see Gandolfo, 2002, pp. 82–85).

Empirical research on the effects of real depreciations on output and growth turned out to be rather inconclusive and country-specific.[5] Potential contractionary effects should thus be taken into account, before devaluations are rashly suggested as a convenient tool to adjust current account imbalances or to fight recessions.
In this paper, I employ a post-Kaleckian open economy model to discuss how currency devaluations affect aggregate demand, capital accumulation, and external debt in the short- to medium-run in small open economies with a fixed exchange rate.[6] The post-Kaleckian framework is well suited to capture several channels that have been mentioned in the debate on (contractionary) devaluations, and thereby allows for a joint assessment of the relevant mechanisms. However, so far it has not accounted for issues of external indebtedness. I contribute to the existing literature by developing an extension of the post-Kaleckian open economy model that allows for an analysis of currency devaluations in externally indebted economies whose liabilities are denominated in foreign currency – the normal case outside the financial centres and the Eurozone (Eichengreen et al., 2007). The model firstly captures balance sheet effects that arise from changes in the nominal value of foreign currency-denominated debt due to depreciations. Secondly, the paper analyses the dynamics of external and domestic debt, and derives the conditions under which indebtedness becomes unstable. Moreover, it shows how devaluations affect the stability of debt in the medium-run. The main findings are that the existence of foreign currency-denominated debt makes contractionary devaluations more likely, and that foreign interest rate hikes, and high illiquidity and risk premia compromise debt sustainability. Devaluations only stabilise debt ratios if they succeed in boosting domestic capital accumulation.
The paper is structured as follows: The second part provides a brief review of the existing post-Kaleckian literature on currency devaluations. The third part develops a novel post-Kaleckian model with balance sheet effects and uses it to analyse the effect of a depreciation on aggregate demand, growth and external debt dynamics. The last section concludes.

## 2. Currency devaluations, distribution and aggregate demand in post-Kaleckian open economy models

The majority of contributions to the open economy version of the post-Kaleckian model focus on the relation between currency devaluations and functional income distribution and subsequent effects on aggregate demand and growth. While the profit share is fully exogenous in the benchmark closed economy version of the model, this assumption is somewhat relaxed in its open economy extensions. Blecker (2011, p. 229) points out that in an open economy the 'source of the change in distribution', e.g. nominal appreciations/depreciations, changes in nominal wages or changes in the pricing mark-up, matters for the relationship between changes in the profit share and aggregate demand, due to different consequences for international competitiveness.

[5] Bahmani-Oskooee and Mitzea (2003, p. 23). A recent study (An et al., 2014) with 16 high and middle income countries also finds mixed results.

[6] I do not address the question whether a long-term undervaluation strategy is conducive to long-run growth. This is a separate topic that requires a different theoretical framework (e.g. Razmi et al., 2012). Furthermore, I restrict the focus to small open economies whose domestic policies have no or negligible effects on the rest of the world. An analysis of large economies would require a multi-country framework.

In an early contribution, Blecker (1989; see also Blecker, 2002) argues that the pricing mark-up may be flexible in an open economy in which firms are subject to international competition. A reduction in international competitiveness, e.g. due to an increase in nominal wages, might force firms to reduce the mark-up in order to maintain their share in international markets. By the same token, a real depreciation would ameliorate competitive pressures, as it improves international price competitiveness, and thus allows for higher mark-ups. Blecker (1989) thus supposes that a devaluation raises the mark-up and the profit share.

Other authors (Bhaduri and Marglin, 1990; Lopez and Perrotini, 2006; Hein and Vogel, 2008; Hein and Vogel, 2009) argue that a real devaluation affects functional income distribution through imported raw materials. Bhaduri and Marglin (1990) leave the overall effect of a devaluation induced increase in the cost of imported inputs on the profit share open and argue that it depends on the relative ability of firms and workers to roll over the cost increase on prices and nominal wages, respectively. Lopez and Perrotini (2006), and Hein and Vogel (2008; 2009), in contrast, assume that nominal wages are inelastic with respect to the exchange rate so that a real depreciation always raises the profit share due to a reduction in real wages.

Blecker (1999; 2011) follows the idea of Bhaduri and Marglin (1990) that a real devaluation induces a phase of conflict inflation in which firms and workers try to shift the burden of increased import costs on the other party. In the steady state, the effect of a real devaluation on distribution is therefore ambiguous and depends on the relative bargaining power of both groups. Blecker (1999; 2011) was also the first author who explicitly addressed the effect of currency devaluations on aggregate demand in a post-Kaleckian framework. Depending on the relative bargaining power of workers and firms, a depreciation will either increase or reduce the profit share. In a domestically profit-led demand regime, an increase in the profit share increases domestic demand through its strong expansionary effect on investment, while it reduces domestic absorption in a domestically wage-led demand regime due to a strong contraction of consumption. Lastly, the effect on the trade balance is assumed to be positive, provided that the MLC holds. The overall effect on aggregate demand is thus ambiguous and depends on the relative size of the effects on consumption, investment and net exports.

Sasaki et al. (2013) and Rezai (2015) develop the analysis further by considering more complicated cases. Sasaki et al. (2013) draw on Blecker (2011), but add feedback effects from the goods market to the labour market fuelling conflict inflation and inducing Kaldor-Verdoorn-type technical progress. However, in the steady state, the effect of a depreciation on the rate of capacity utilisation depends on the same mechanisms as in Blecker (2011) (see Sasaki et al., 2013, pp. 701-702). Rezai (2015) analyses the effects of a devaluation in a two-country framework. In his model, a devaluation redistributes income from domestic to foreign workers due to higher import prices as mark-ups are fixed and there is no conflict inflation. In such a set-up, devaluations can only be expansionary for the domestic economy if foreign workers have a significantly lower propensity to save than domestic workers and thereby compensate for the decline in domestic consumption demand.

Despite all these rich extensions, monetary aspects, in particular those arising from external indebtedness, have been strikingly absent from the Kaleckian literature on the topic. Such an omission is unsatisfactory in an era of financial globalisation as expressed by a steep rise of external assets and liabilities in relation to GDP (Lane and Milesi-Ferretti, 2007), and strong evidence of contractionary effects of devaluations in externally indebtedness economies through balance sheet effects (Galindo et al., 2003; Allen et al., 2002; Frankel, 2005; Bebczuk et al., 2007; Blecker and Razmi, 2007; Janot et al., 2008). In the next section, I propose a simple post-Kaleckian model that captures these phenomena.

## 3. Currency devaluations in a post-Kaleckian open economy model with balance sheet effects

The model I propose in this paper draws on the existing contributions to the post-Kaleckian open economy model,[7] but introduces balance sheet effects and analyses the dynamics and stability of domestic and external debt. The kind of economy this model seeks to analyse is a small open economy with a fixed exchange rate regime that is integrated into international financial markets through an open financial account. It is an economy whose currency does not function as an international reserve and is of lower quality. As a consequence, foreign debt can only be obtained in foreign currency – a phenomenon which is often called 'original sin'[8] (Eichengreen *et al*., 2007). Moreover, the focus of the model is on the short- to medium-run, so that unutilised capacities and unemployment (or an elastic labour supply) are present.

The section is structured as follows: The next sub-section introduces the concept of balance sheet effects and highlights its empirical relevance. The second sub-section presents the goods market of the model. The third sub-section discusses the exchange rate regime and interest rate determination. In the fourth sub-section, I examine how a real devaluation affects aggregate demand and growth, and the dynamics and stability of debt.

### 3.1 Balance sheet effects

The importance of balance sheet effects was fiercely brought to attention after the South East Asian crash in the late 1990s, during which the affected countries experienced severe drops in output after their currencies depreciated. These contractionary effects arose from large degrees of currency mismatch[9] in the financial and business sector (Allen et al., 2002, p. 17). The depreciation led to a nominal jump in foreign currency-denominated debt, which pushed many banks into bankruptcy and caused a decline in capital formation. Subsequently, several attempts to cast these contractionary balance sheet effects of depreciations into economic models have been made, mostly by New Keynesian authors (Krugman, 1999; Aghion et al., 2000; Céspedes et al., 2003; Céspedes et al., 2004; Cook, 2004; Gertler et al., 2007; Gatti et al., 2007).

Most of these studies employ some version of Bernanke et al.'s (1999) financial accelerator model, in which the costs of external finance depend inversely on the net worth of firms because of asymmetric information between borrowers and lenders. Since lenders don't possess perfect information about the profitability of investment projects, they incur higher agency costs the higher the leverage ratio of the firm due to rising risks of bankruptcy. This information problem translates into higher costs of capital for the borrowing firm. In the case

[7] For benchmark versions see Hein (2014, pp. 286–297) and Lavoie (2014, pp. 532–536).

[8] The 'inability of a country to borrow abroad in its own currency' (Eichengreen et al., 2007, p. 122). Original sin is pervasive in developing countries, but also significant in developed countries outside the financial centres (USA, UK, Switzerland and Japan) and the Eurozone (ibid., p.134).

[9] '[D]ifferences in the values of foreign currency-denominated assets and liabilities on the balance sheets of households, firms, the government, and the economy as a whole' (Eichengreen et al., 2007, p. 130).

of a foreign currency-indebted firm, a devaluation of the currency reduces its net worth, thereby increasing its costs of capital, which in turn depresses investment.[10] Several empirical studies confirm this mechanism by showing that devaluations are more likely to have a negative effect on output (and/or growth) in countries with high external debt burdens (Galindo et al., 2003; Bebczuk et al., 2007; Blecker and Razmi, 2007; Janot et al., 2008).

### 3.2 Short-run goods market equilibrium

The model economy[11] consists of one sector that produces a homogenous good (*Y*) using capital (*K*) and labour, which can be used for consumption and investment. For simplicity, there is no depreciation of the capital stock and no overhead labour. The technical coefficients of labour ($a$) and capital (*v*) are assumed to be constant in the short-run, so there is no substitution between capital and labour and no technical progress. The rate of capacity utilisation ($u$) is an endogenous adjustment variable of the model, implying that there are excess capacities that allow for quantity adjustments if demand changes. It is also assumed that there is either unemployment or an elastic labour supply that can be easily mobilised. For the sake of simplicity, there is no government sector, no inflation, and the open economy is small, so that all foreign variables are exogenously given. There is no substitution between the imported good and the domestic good.

Pricing, the real exchange rate, the mark-up, the wage and profit share are given by equations (1)-(5):

(1) $p = (1 + m)wa; \qquad m > 0$

(2) $e_r \equiv \frac{e}{p}$

(3) $m = m(e_r, \delta, \eta); \qquad \frac{\partial m}{\partial e_r} \lesseqgtr 0; \frac{\partial m}{\partial \delta} > 0; \frac{\partial m}{\partial \eta} < 0$

(4) $(1 - \pi) \equiv \frac{wa}{p} = \frac{1}{1+m(e_r,\eta,\delta)}$

(5) $\pi \equiv \frac{R}{pY} = \frac{m(e_r,\eta,\delta)}{1+m(e_r,\eta,\delta)}$

In incompletely competitive markets, prices ($p$) are set by firms who charge a mark-up ($m$) on nominal unit labour costs ($wa$) which are constant up to full capacity utilisation. I abstract from raw material inputs for simplicity. The real exchange rate ($e_r$) is defined in equation (2), setting the foreign price level to unity. Note that the nominal exchange rate ($e$) is defined as the domestic price of foreign currency, so that a depreciation implies an increase in the exchange rate. The mark-up is mainly determined by the degree of concentration and price competition in the respective sector.[12] Moreover, I follow Blecker's (1989) assumption that the real exchange rate affects the mark-up through its effect on international competitiveness. However,

[10] This idea is also common among post-Keynesians, going back to Kalecki's (1937) 'principle of increasing risk' and Keynes' (2013[1936], pp. 144–145) 'borrowers and lenders' risk'. There is ample empirical evidence for a negative effect of firm indebtedness on investment, see Fazzari et al. (1988), Ndikumana (1999), and Davis (2013).

[11] A list of definitions of all symbols used in this paper can be found in the appendix A2.

[12] Some Kaleckian authors (e.g. Hein, 2014, chap. 9) argue that the mark-up may also be a function of the interest rate. A permanent increase in the rate of interest then raises the mark-up in order to cover financial overhead costs. The integration of this mechanism into the present model is left for further research.

capturing another idea from Blecker (2011), I assume that the distributional effect of a real depreciation is unclear a priori and depends on the relative bargaining power of firms ($\delta$) and workers ($\eta$). If the bargaining power of firms is larger $(\delta > \eta)$, a depreciation raises the mark-up $\left(\frac{\partial m}{\partial e_r} > 0\right)$ as firms are successful in using the leeway that has been created by the improvement in their international competitiveness for raising the mark-up. If, however, trade unions are very strong and/or nominal wages are indexed to the exchange rate $(\delta < \eta)$, a real depreciation might lead to aggressive nominal wage increases, which compromise firms' international competitiveness and force them to reduce the mark-up. In this case, a real devaluation reduces the mark-up $\left(\frac{\partial m}{\partial e_r} < 0\right)$. According to Blecker (2011, pp. 225-226), the case of a positive relation between the real exchange rate and the mark-up is empirically more likely, so I consider this to be the typical case.[13] The mark-up fully determines the profit share ($\pi$). Since there are only two types of income streams in the model, wages and profits, the wage share $(1 - \pi)$ is implied by the profit share. A rise in the mark-up (e.g. due to a devaluation) increases the profit share, and reduces the wage share proportionally.

In order to analyse balance sheet effects in the model, the distribution of assets and liabilities between the sectors of the model has to be made explicit. Table 1 contains the balance sheet matrix of the model. Plus signs denote assets, while minus signs indicate liabilities. There are four economic sectors: workers, firms, banks, and the external sector. Workers neither hold assets nor liabilities, so there are no domestic deposits. Firms' liabilities consist of foreign credit denominated in foreign currency ($eB^f$) and loans denominated in domestic currency ($B$). For simplicity, there is no equity (the net worth of the firm sector, $NW_F$, is kept within the firm sector).

[13] Although many authors have claimed that a devaluation typically worsens income distribution (Alexander 1952; Diaz-Alejandro 1963; Krugman and Taylor 1978), there is little empirical research on this question. Bahmani-Oskooee (1997) finds that devaluations increase income inequality measured as the ratio of the income of the top 20% to that of the bottom 40% of the population. Dünhaupt (2013) estimates the effect of various financialisation variables on the wage share and finds import prices to exercises a negative effect on the wage. Hence, there is some indirect evidence that devaluations more commonly raise the profit share.

*Table 1: Balance sheet matrix*

| | Workers | Firms | Banks | External | $\sum$ |
|---|---|---|---|---|---|
| **Fixed Capital** | | $+pK$ | | $+K^f$ | $+pK+K^f$ |
| **Foreign currency-denominated foreign loans** | | $-eB^f$ | | $+eB^f$ | 0 |
| **Domestic currency-denominated loans** | | $-B$ | $+B$ | | 0 |
| **Domestic currency-denominated deposits of foreigners** | | | $-D$ | $+D$ | 0 |
| $\sum$ | 0 | $+NW_F$ | 0 | $+NW_{EXT}$ | $pK+K^f=NW_F+NW_{EXT}$ |

Banks are pure intermediaries, which give loans in domestic currency to domestic firms ($B$) and take deposits from abroad ($D$). Although there is a monetary authority which controls the exchange rate, I abstract from its balance sheet for simplicity. Lastly, the external sector holds the bonds that have been issued by domestic firms in foreign currency ($eB^f$), and holds deposits ($D$) at domestic banks in domestic currency. Subtracting liabilities from assets yields the net worth ($NW$) of the respective sectors. If $eB^f+B>pK$, the domestic firm sector faces insolvency. Note that a country can also be in a positive net foreign asset position if $eB^f+B<0$. $B$ and/or $eB^f$ would then be liabilities of the external sector. I will restrict the focus on the case where $eB^f$ is positive, but $B$ may become negative. In this case, domestic banks would lend to foreigners, while domestic firms hold deposits at domestic banks.
We now turn to the transaction flows of the model.

(6) $$\frac{eB^f}{pK}\equiv e_r\lambda$$

(7) $$\frac{B}{pK}\equiv\tau$$

(8) $$r\equiv\frac{R}{pK}\equiv\frac{\pi u}{v}$$

(9) $$s\equiv\frac{S}{pK}=r-i^f e_r\lambda-i\tau=\frac{\pi u}{v}-i^f e_r\lambda-i\tau$$

(10) $$NX\equiv pX-eM$$

(11) $$b\equiv\frac{NX}{pK}\equiv\frac{pX-eM}{pK}=b_0u^f+b_1e_r-b_2u; \qquad b_0,b_2>0, b_1\lesseqgtr 0$$

First, I define the external debt in foreign currency to capital ratio ($e_r\lambda$), and the domestic debt in domestic currency to capital ratio ($\tau$) in equations (6) and (7), respectively. The profit rate ($r$) in equation (8) can be decomposed into the product of the profit share ($\pi$), the rate of capacity utilisation ($u$), and the inverse of capital productivity, the capital coefficient ($v$). It is assumed that workers and banks don't save, whereas firms save all their net income, i.e. their

profits after interest payments (equation 9). I also assume that lending rates are equal to deposit rates, so that banks don't make any profits. Equation (10) defines net exports in domestic currency ($NX$). Equation (11) is a behavioural function that relates the net export ratio ($b$) to the foreign rate capacity utilisation ($u^f$), the real exchange rate, and the domestic rate of capacity utilisation. The foreign rate of capacity utilisation is assumed to improve the trade balance as it translates into export demand for the home country, so the parameter $b_0$ is positive. Here, a weakness of specification (11) comes in. The inclusion of the foreign rate of capacity utilisation requires that the domestic and foreign capital stock grow at the same rate (Blecker, 2011, Fn. 8) – an assumption that might not be satisfied over longer periods. Second, whether the effect of an increase in the real exchange rate on the trade balance is positive depends on the MLC,[14] which is captured by the parameter $b_1$. The stronger the price elasticities of import and export demand, the larger the parameter $b_1$. However, it has to be noted that this linear specification only embodies the MLC for balanced trade. Capturing the MLC for unbalanced trade would entail a non-linearity, as $b_1$ would not be independent of $NX$. This limitation of the linear net exports function (9) should be kept in mind. Third, the domestic rate of capacity utilisation has a negative effect on the trade balance, as an increase in domestic demand will increase import demand. The parameter $b_2$ can thus be interpreted as a marginal propensity to import.
Equations (12), (13) and (14) specify the rate of investment, the goods market equilibrium condition and the Keynesian stability condition.

(12) $$g \equiv \frac{I}{K} = g_0 + g_1 u + g_2 \pi - g_3 e_r \lambda; \qquad g_1, g_2, g_3 > 0$$

(13) $$g + b = s + i^f e_r \lambda + i\tau = r$$

(14) $$\frac{\partial s}{\partial u} - \frac{\partial g}{\partial u} - \frac{\partial b}{\partial u} > 0 \Leftrightarrow \frac{\pi}{v} + b_2 > g_1$$

The first three components of the investment function (12) are standard in the post-Kaleckian model. First, investment is affected by a shift parameter ($g_0$) which captures 'animal spirits', i.e. the state of business confidence, changes in expectations etc. Note that there is no a priori restriction on the sign of this parameter. Second, investment is assumed to be positively related to the rate of capacity utilisation. This is because the current rate of capacity utilisation functions as an indicator of aggregate demand. A high degree of capacity utilisation induces firms to expand their productive capacities in order to be able to meet demand in the future. Third, the profit share enters the investment function. It is assumed that the profit share has a positive effect on investment; first, because it functions as a proxy for expected profitability, and second because retained profits constitute internal finance. Internal finance is often a pre-condition for access to credit in financial markets with uncertainty and asymmetric information, as discussed in the previous sub-section. Fourth, balance sheet effects enter the model through the investment function. Following Krugman (1999, pp. 456-457), I assume that investment expenditures are negatively affected by the external-debt-to-capital ratio. From a post-Keynesian perspective, this mechanism is due to 'borrower's risk', which is the subjective risk of illiquidity and bankruptcy of the entrepreneur due to the possibility of lower than expected

[14] See footnote 4.

cash flows despite fixed payment obligations (Keynes, 2013[1936], pp. 144–145; Minsky, 2008[1975], pp. 104–110). Foreign-currency denominated debt especially raises borrower's risk because it implies a currency mismatch: firms' cash flows are denominated in domestic currency, while part of their liabilities are denominated in foreign currency. Firms thus bear severe exchange rate risk. A sudden devaluation not only decreases their net worth but also makes the foreign currency they need in order to repay their debt more expensive.[15]

The goods market equilibrium condition (13) has to account for interest payments on external debt, which count as a leakage along with domestic savings. Lastly, it is assumed that the Keynesian stability condition (14) is satisfied, which requires that the marginal effect of an increase in the rate of capacity utilisation on the savings rate is larger than the respective effect on the investment rate. If an increase in the rate of capacity utilisation would increase investment more than savings, there would be excess demand which would increase the rate of capacity utilisation even more, thereby leading to explosive dynamics.[16]

The transaction flow matrix of the model is depicted in Table 2. A plus sign indicates a source of funds, while a minus sign denotes a use of funds. The rows display where the different components of national income are earned and spent, and the columns capture the budget constraints of the four sectors of the model.

[15] Domestic currency debt does not enter the investment function not only to keep the model parsimonious, but also because the profit share in the investment function already captures the ability of firms to obtain external liquid funds in domestic currency.

[16] The Keynesian stability condition may not be satisfied in the long-run (Skott, 2012). This constitutes another reason why the present model is confined to the short- and medium-run.

**Table 2: Transaction flow matrix**

| | Workers | Firms | | Banks | | External | $\sum$ |
|---|---|---|---|---|---|---|---|
| | | ***Current*** | ***Capital*** | ***Current*** | ***Capital*** | | |
| **Consumption** | $-C$ | $+C$ | | | | | 0 |
| **Investment** | | $+pI$ | $-pI$ | | | | 0 |
| **Wages** | $+W$ | $-W$ | | | | | 0 |
| **Net profits** | | $-R^{Net}$ | $+R^{Net}$ | | | | 0 |
| **Imports** | | $-eM$ | | | | $+eM$ | 0 |
| **Exports** | | $+pX$ | | | | $-pX$ | 0 |
| **Change in foreign currency-denominated foreign debt** | | | $+e\dot{B^f}$ | | | $-e\dot{B^f}$ | |
| **Change in domestic currency-denominated loans** | | | $+\dot{B}$ | | $-\dot{B}$ | | 0 |
| **Change in domestic-currency denominated deposits of foreigners** | | | | | $+\dot{D}$ | $-\dot{D}$ | 0 |
| **Interest payments on foreign currency-denominated foreign loans** | | $-ei^fB^f$ | | | | $+ei^fB^f$ | |
| **Interest payments on domestic currency-denominated loans** | | $-iB$ | | $+iB$ | | | 0 |
| **Interest payments on domestic currency denominated loans of foreigners** | | | | $-iD$ | | $+iD$ | 0 |
| $\sum$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

It is worthwhile taking a closer look at the budget constraint of the firm sector, which can be found in its capital account column:

$$pI \equiv R^{Net} + e\dot{B^f} + \dot{B} \equiv R - ei^fB^f - iB + e\dot{B^f} + \dot{B}$$

Firms can finance their investment expenditures either through net profits ($R^{Net}$), by taking out a loan in domestic currency ($\dot{B}$), or by issuing bonds denominated in foreign currency ($e\dot{B^f}$). As I will argue in more detail in the next sub-section, firms have a preference for foreign debt because the foreign interest rate ($i^f$) is lower than the domestic rate ($i$). The higher domestic interest rate also motivates foreigners to hold deposits at domestic banks that are denominated in domestic currency. The change in foreign currency-denominated debt will therefore be determined by a behavioural equation. If firms choose the level of investment expenditures, their savings, as well as their issuance of foreign currency-denominated bonds independently, domestic lending ($\dot{B}$) has to function as a residual variable, which accommodates autonomous changes in investment expenditures and ensures that the budget constraint of the firm sector is always met. The dynamics of domestic currency-denominated debt are then given by:

$$\dot{B} \equiv pI - R + ei^f B^f + iB - e\dot{B^f} \equiv pI - R^{Net} - e\dot{B^f}$$

We can now examine the goods market equilibrium of the model. Making use of equations (9), (11), (12) and (13), the equilibrium rate of capacity utilisation is given by:

$$(15) \qquad u^* = \frac{b_0 u^f + b_1 e_r + g_0 + g_2 \pi - g_3 e_r \lambda}{\frac{\pi}{v} + b_2 - g_1}$$

We can also derive an equilibrium rate of profit by plugging (15) into (8):

$$(16) \qquad r^* = \frac{\frac{\pi}{v}(b_0 u^f + b_1 e_r + g_0 + g_2 \pi - g_3 e_r \lambda)}{\frac{\pi}{v} + b_2 - g_1}$$

Lastly, the equilibrium rate of capital accumulation can be obtained by substituting equation (15) into (12). Note that because the capital-output ratio is assumed to be constant, capital stock growth directly translates into output growth. The rate of capital accumulation is thus equal to the rate of growth of the economy.

$$(17) \qquad g^* = \frac{g_1(b_0 u^f + b_1 e_r) + (g_0 + g_2 \pi - g_3 e_r \lambda)\left(\frac{\pi}{v} + b_2\right)}{\frac{\pi}{v} + b_2 - g_1}$$

Before we examine the effects of a devaluation on the goods market equilibrium values, we have to discuss the exchange rate regime and interest rate determination.

### 3.3 Exchange rate regime and interest rate determination

The domestic economy is a small open economy that is integrated into international financial markets through an open financial account. The central bank keeps the exchange rate fixed, perhaps because it seeks to improve the trust in the currency or in order to prevent economic uncertainty due to exchange rate volatility. The fixed exchange rate regime is credible in the sense that agents do not hold concrete expectations about future changes in the exchange rate. Occasional currency devaluations enacted by the central bank are a possibility private agents are aware of, but they cannot predict them. Under these circumstances, the domestic central bank loses its monetary autonomy. It has to adjust the domestic interest rate to the foreign interest rate in order to maintain the peg. However, foreign and domestic assets are imperfect substitutes as the domestic currency is of lower quality.[17] Moreover, agents may be worried about default risks. The domestic interest rate therefore has to offer a monetary premium to

[17] This idea is prominent in post-Keynesian work on currency and exchange rate issues (e.g. Herr, 2008; Andrade and Prates, 2013; Kaltenbrunner, 2015). Some of these authors use the notion of a 'currency premium', which is a subjective international liquidity premium that hard (e.g. reserve) currencies offer because they function as relatively safe stores of wealth. The interest rate premium of the present model can be regarded as the inverse of such a currency premium and thus has opposite effects. Essentially both notions express the same idea.

incentivise foreigners to hold deposits with domestic banks. It is therefore assumed that the domestic interest rate is determined by uncovered interest rate parity (UIP) plus a premium that reflects default risks and the low quality of the currency:[18]

(18) $i = i^f + \rho; \qquad \rho > 0$

where $i$ is the domestic rate of interest, $i^f$ is the exogenous foreign interest rate, and $\rho$ the premium domestic currency assets have to offer to make foreign investors indifferent between foreign and domestic assets.

What determines the interest rate premium? There is an exogenous component that compensates for the low quality and liquidity of the currency due to its low position in the international currency hierarchy (i.e. it is neither an international means of payment, nor unit of credit contracts, nor store of value). Moreover, the premium may be affected by the total stock of foreign currency-denominated external debt. Being aware of the possibility of balance sheet effects due to devaluations, foreign depositors interpret a high burden of external debt as a high risk of default. Unlike default risks arising from domestic currency-denominated debt, these risks cannot as easily be mitigated by domestic authorities acting as a lender of last resort as foreign reserves are limited and needed to stabilise the currency. I thus follow Rocha and Oreiro (2013, p. 607) and propose a simple linear function for the illiquidity and risk premium, $\rho = \rho_0 + \rho_1 e_r \lambda$, so that we get:

(18') $i = i^f + \rho_0 + \rho_1 e_r \lambda; \qquad \rho_0, \rho_1 > 0$

The effect of a real devaluation[19] on aggregate demand in externally indebted economies with balance sheet effects can now be analysed. I discuss the effect on short-run goods market equilibrium aggregate demand and growth first, and then take a look at the medium-run external debt dynamics.

### 3.4. Real devaluations, aggregate demand and external debt dynamics

#### 3.4.1 The short-run goods market effect

Suppose the central bank decides to adjust the peg by devaluing the currency, perhaps in order to improve the current account. It announces a new real exchange rate target, which is instantly reached. A devaluation can thus be simply treated as a direct manipulation of the real exchange

[18] UIP is not an uncontested theorem among post-Keynesians. Horizontalists such as Lavoie (2000; 2002) reject UIP and hold that even in fixed exchange rate regimes the central bank enjoys significant monetary autonomy. Smithin (2002), in contrast, argues that in a fixed exchange rate the central bank loses its autonomy. Harvey (2004) discusses several factors such as capital controls, transactions costs, the desire for portfolio diversification, sterilisation and a lack of confidence in forecasts that might cause deviations from UIP, risk being only one of them. UIP with a premium is invoked by Herr (2008) and Rocha and Oreiro (2013) to explain interest rates in peripheral economies. Although UIP, even with a premium that allows for deviations from the parity, is certainly a strong assumption that can only approximate reality, it captures the empirical fact that monetary autonomy in fixed exchange rate regimes is significantly constrained (Obstfeld et al., 2005; Hosny et al., 2015; Klein and Shambaugh, 2015).

[19] Although exchange rate policy can only manipulate the nominal exchange rate, the real exchange rate follows the nominal exchange rate quite closely, so that a nominal devaluation usually translates into a real devaluation (Razmi et al., 2012, p. 152).

rate, while the domestic interest rate is kept constant. The effect of a real depreciation on the equilibrium rate of capacity utilisation is then given by:

(19) $$\frac{du^*}{de_r} = \frac{b_1 + \frac{\partial \pi}{\partial e_r}\left(g_2 - \frac{u}{v}\right) - g_3 \lambda}{\frac{\pi}{v} + b_2 - g_1} \lesseqgtr 0$$

$$\Rightarrow \frac{du^*}{de_r} > 0, if: b_1 + \frac{\partial \pi}{\partial e_r}\left(g_2 - \frac{u}{v}\right) - g_3 \lambda > 0$$

The denominator contains the Keynesian stability condition which is assumed to be positive. The overall sign of the derivative thus depends on the numerator. The first term in the numerator captures the effect of a depreciation on the trade balance. The coefficient $b_1$ can be positive or negative, depending on whether the MLC is satisfied or not.[20] This makes the sign of the first term in the numerator ambiguous.

The partial derivative in the second term captures the effect of a devaluation on the profit share. It can be positive or negative, depending on the relative bargaining power of workers and firms. I have argued above that the effect is normally positive. The term in squared brackets captures whether domestic aggregate demand is wage- or profit-led. If it is profit-led, the term is positive because a redistribution in favour of profit earners boosts investment more than it depresses consumption. A devaluation then has an expansionary effect on domestic absorption, if it raises the profit share. If, however, the term in brackets is negative so that the economy is wage-led, and the devaluation raises the profit share, the devaluation depresses domestic absorption. Contractionary effects on domestic absorption arise when the depreciation raises the profit share but the domestic demand-regime is wage-led, and vice versa.

The post-Kaleckian model hence accounts for the net exports channel, as well as the distributional channel, which in turn affects the domestic components of aggregate demand. It is therefore able to capture the competitiveness effect highlighted by the Mundell-Fleming model, but also the distributional effect emphasised by Alexander (1952), Diaz-Alejandro (1963), and Krugman and Taylor (1978). Unlike these authors, however, it also takes endogenous effects on investment into account. Moreover, it allows for contractionary effects on the trade balance, if the MLC is unsatisfied, although it fails to precisely model this effect for unbalanced trade. It thus neatly captures several key channels that have been mentioned in the literature on devaluations.

A major novelty for the post-Kaleckian approach is the balance sheet effect, which is captured by the last term. External debt in foreign currency exercises an unambiguously negative effect on the rate of capacity utilisation, which is the stronger, the higher the external debt ratio ($\lambda$), and the larger the sensitivity of investment with respect to foreign currency-denominated debt

[20] Andersen (2004) finds low price elasticities using a data set of 16 rich economies and concludes that the MLC is only satisfied in two countries. In an impressive survey of empirical studies on the MLC over the past 50 years, Bahmani et al. (2013) show that empirical estimates of the MLC have often been either contradictory or changed over time. They conduct a meta-analysis of existing studies and find that the MLC is only statistically significantly satisfied in just under 30 percent of 92 estimated elasticities for which standard errors were reported. Moreover, the authors conduct their own empirical analysis for a set of 29 countries over the period 1971-2009 and find the MLC to be met in only three countries. The case assumed by elasticity pessimists, where $b_1 \leq 0$, is therefore entirely possible, if not likely.

($g_3$). Balance sheet effects increase the overall likelihood of contractionary devaluations, as they potentially turn the numerator negative.
The model can also be used to analyse the effect of a real depreciation on the equilibrium rate of capital accumulation:

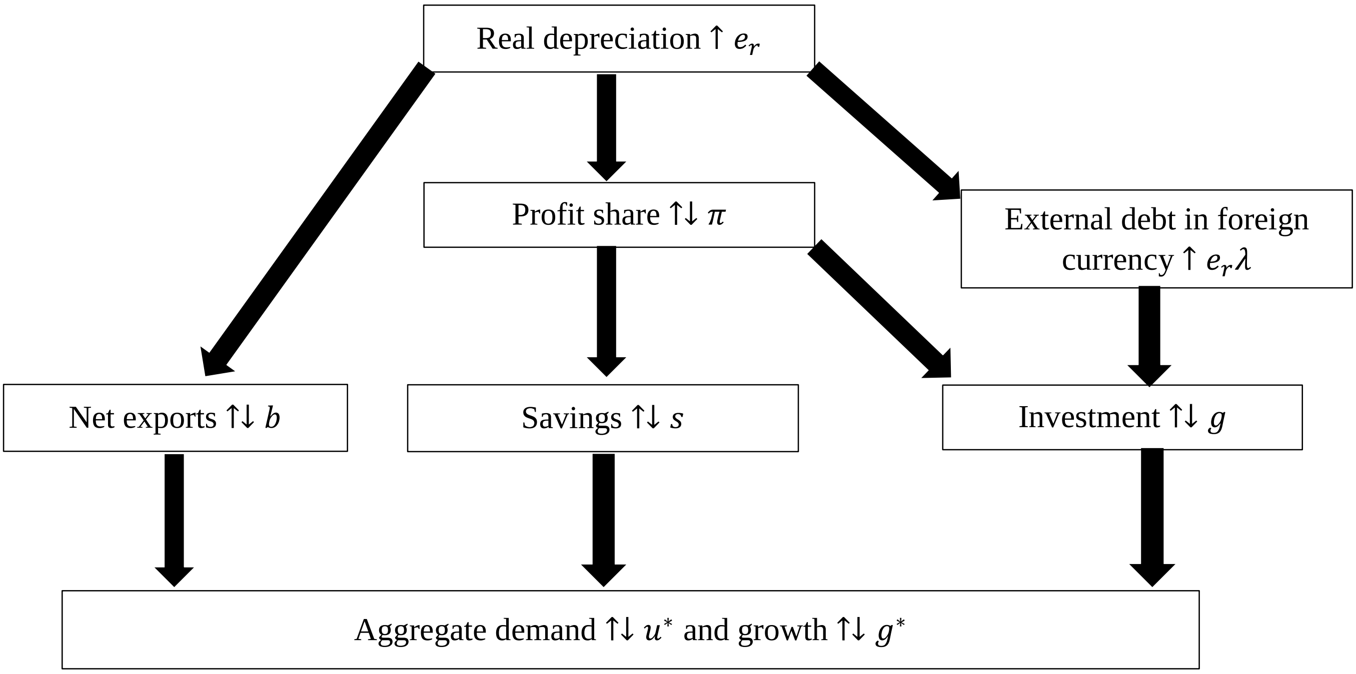
(20) $$\frac{dg^*}{de_r}=\frac{g_1\left(b_1-\frac{u}{v}\frac{\partial\pi}{\partial e_r}\right)+\left(g_2\frac{\partial\pi}{\partial e_r}-g_3\lambda\right)\left(\frac{\pi}{v}+b_2\right)}{\frac{\pi}{v}+b_2-g_1}\lesseqgtr 0$$

$$\Rightarrow \frac{dg^*}{de_r}>0, if: g_1\left(b_1-\frac{u}{v}\frac{\partial\pi}{\partial e_r}\right)+\left(g_2\frac{\partial\pi}{\partial e_r}-g_3\lambda\right)\left(\frac{\pi}{v}+b_2\right)>0$$

The same mechanisms that determine the overall effect on aggregate demand are at work in the determination of the equilibrium rate of capital accumulation. However, these effects are mediated by different parameters, so that the effects on domestic investment (including the balance sheet effect) get a slightly stronger weight than the effects on net exports and consumption (remember that we assume $\frac{\pi}{v}+b_2>g_1$).[21] I introduce the following terminology: If a real devaluation increases the equilibrium rate of capital accumulation $\left(\frac{\partial g^*}{\partial e_r}>0\right)$, the economy is in a Mundell-Fleming-regime, whereas if a real devaluation reduces the equilibrium rate of investment $\left(\frac{\partial g^*}{\partial e_r}<0\right)$, the economy is classified as a Krugman-Taylor-regime.[22]
The analysis has shown that the overall effect of a real devaluation on aggregate demand and growth is ambiguous, and depends on the individual effects on net exports, consumption and investment. Introducing balance sheet effects into the Kaleckian model adds a negative effect on planned investment expenditures, which makes overall contractionary effects on the equilibrium rates of capacity utilisation and growth more likely. This effect is predicted to be strong in countries that are heavily indebted in foreign currency.
The different mechanisms are visualised in the causation chart in Figure 1:

[21] Note that the signs of (19) and (20) do not necessarily have to be the same. For the remaining analysis only the sign of the effect on growth is relevant, so I refrain from discussing the different possible regime combinations.
[22] The Mundell-Fleming model is associated with expansionary devaluations because it highlights the competitiveness effect of devaluations, while Krugman and Taylor (1978) are prominently associated with contractionary devaluations.

***Figure 1: Causation graph of the effects of a real depreciation on aggregate demand***




In the next sub-section, I address the question of how a currency devaluation affects the dynamics and stability of foreign currency denominated debt in the medium-run.

**3.4.2 Medium-run dynamics and stability of external debt**

The dynamics of debt have been discussed in the post-Keynesian literature mostly in the context of Hyman P. Minsky's Financial Instability Hypothesis (Minsky, 2008[1975]) and its various interpretations and extensions. The focus of formal models, however, has largely been restricted to domestic debt dynamics (e.g. Charles, 2008), with the exception of Foley (2003), who doesn't consider exchange rate issues and balance sheet effects, however. Porcile et al. (2011) analyse the effects of different monetary policy rules on external debt sustainability in a post-Keynesian model. However, they don't take income distribution into account, and balance sheet effects are absent. Cline and Vernengo (2015) analyse external debt dynamics in semi-fixed exchange rate regimes but neither provide an analysis of the goods market, nor propose a behavioural function for the change in external debt.

*The dynamics of debt and devaluation*

I shall start by just doing that - proposing a behavioural function for the change in foreign currency-denominated external debt. I argue that additional debt in foreign currency is issued by domestic firms in order to finance a share $\phi$ of their total nominal investment expenditures:

(21) $$e\dot{B}^f = \phi p I; \quad 0 < \phi \leq 1$$

From the point of view of external creditors, new credit is typically granted when the economy is booming. Strong capital inflows into developing and emerging market countries during boom phases are indeed a familiar phenomenon (Herr, 2008, p. 141). Debtors, i.e. firms, on the other hand, prefer external debt simply because it is cheaper[23] – a consequence of the illiquidity and risk premium $\rho$ on the domestic interest rate (cf. equation 18). The latter idea allows for an endogenisation of the parameter $\phi$. I assume that it is a function of the interest rate differential: the larger the difference between the domestic and the foreign interest rate, the larger the propensity to finance investment out of foreign currency-denominated external debt. Hence we have $\phi = \phi(i - i^f)$. From equation (18), we can derive $i - i^f = \rho$, so that we can write $\phi = \phi(\rho)$. The propensity to finance investment out of foreign currency-denominated external debt then becomes a function of the illiquidity and risk premium. Recall that the premium is determined by an exogenous component and by the external debt-to-capital ratio (cf. equation 18'). A simple linearization of the relationship between the propensity to finance investment out of foreign currency-denominated external debt and the illiquidity and risk premium yields: $\phi = \phi_0 + \phi_1 e_r \lambda$. We then have:

(21') $\quad e\dot{B}^f = (\phi_0 + \phi_1 e_r \lambda) pI; \quad 0 < \phi_0 + \phi_1 e_r \lambda \leq 1$

Hence, an increase in the premium, either because of an increase in the exogenous component that captures the low quality and illiquidity of the domestic currency, or because of an increase in the external debt ratio, translates into a higher propensity to finance investment out of foreign currency-denominated external debt because it makes domestic loans more expensive. The parameter $\phi_0$ captures an illiquidity and risk premium-independent preference for external debt and the illiquidity premium, while $\phi_1$ expresses the sensitivity of the premium with respect to external debt and the sensitivity of the propensity to finance investment out of foreign currency-denominated external debt with respect to the premium. I shall assume that the independent propensity to finance investment out of external debt is constant and the sensitivity of $\phi$ with respect to the premium is strong (i.e. close to unity), so that changes $\phi$ are mainly determined by changes in the illiquidity and risk premium.
The dynamic equation for the external debt in foreign currency-to-capital ratio can be obtained by totally differentiating equation (10) with respect to time:

(22) $\quad \frac{d\left(\frac{eB^f}{pK}\right)}{dt} \equiv \left(\frac{e\dot{B}^f}{pK}\right) \equiv \dot{e_r\lambda} = \frac{e\dot{B}^f}{pK} + e_r \lambda(\widehat{e_r} - g)$

It is assumed that the goods market has already reached its short-run equilibrium, and the real exchange rate does not change over time ($\widehat{e_r} = 0$) since we are in a fixed exchange rate regime. Inserting the behavioural function of the change in external debt in foreign currency (21'), the following first order differential equation for the rate of change of the external debt in foreign currency ratio can be obtained:

(23) $\quad \dot{e_r\lambda} = g^*[\phi_0 + e_r \lambda(\phi_1 - 1)]$

[23] This is indeed the most usual explanation for why firms borrow abroad despite exchange rate risk (Williamson, 2005, p. 60).

We see that an increase in the equilibrium rate of growth can have a positive or negative effect on the rate of change of the external debt ratio, depending on whether $\frac{\phi_0}{1-\phi_1} > e_r\lambda$ or $\frac{\phi_0}{1-\phi_1} < e_r\lambda$. Capital accumulation has a contradictory effect on the dynamics of the external debt ratio because it leads to an increase in external indebtedness in foreign currency, but it also increases the capital stock (the denominator of the ratio). It is more likely to increase external indebtedness, if the interest rate differential is large, i.e. because there is a large illiquidity premium and/or a strong sensitivity of the risk premium with respect to the stock of external debt.

Whether a real devaluation decelerates or accelerates external indebtedness in foreign currency essentially depends on whether it has an expansionary effect on growth, and whether an increase in the growth rate in turn leads to an increase or decrease in indebtedness, as can be seen from the first term in equation (24). For a positive equilibrium rate of capital accumulation, the second term of (24) is likely to be negative unless external debt has a more than proportional impact on the risk premium that is proportionally impacts on the propensity to obtain external debt ($\phi_1 > 1$) - an extreme case I rule out for the moment.

(24) $$\frac{\partial \dot{e_r\lambda}}{\partial e_r} = \frac{\partial g^*}{\partial e_r}[\phi_0 + e_r\lambda(\phi_1 - 1)] + g^*\lambda(\phi_1 - 1) \gtreqless 0$$

Let’s consider some instructive examples. First, an economy may be in a Krugman-Taylor-regime, so that real depreciations have contractionary effects on accumulation. If there is also a relatively low illiquidity premium and/or a weak sensitivity of the risk premium with respect to the stock of external debt, while the debt burden is high $\left(\frac{\phi_0}{1-\phi_1} < e_r\lambda\right)$, and the economy is in a recession ($g^* < 0$), a devaluation is a bad idea, as it increases the rate of change of external indebtedness in foreign currency. It is noteworthy that this is not an untypical scenario for a depreciation to happen. Adverse effects may also arise in a Mundell-Fleming regime $\left(\frac{\partial g^*}{\partial e_r} > 0\right)$, in which there is a low external debt burden but a high external debt sensitivity of the risk premium and/or a high illiquidity premium $\left(\frac{\phi_0}{1-\phi_1} > e_r\lambda\right)$. Second, the economy may be in a Mundell-Fleming-regime, and there is a relatively low illiquidity premium and/or a weak sensitivity of the risk premium with respect to external debt, while the debt burden is high $\left(\frac{\phi_0}{1-\phi_1} < e_r\lambda\right)$. If the economy is growing, a real devaluation is a very effective policy measure as it boosts growth and reduces external indebtedness.

The ratio of domestic currency-denominated debt is the second state variable of the model. It functions as an adjustment variable, whose dynamics are determined by balance sheet mechanics. It absorbs the expenditures of firms that exceed their retained profits, and that are not already financed through foreign currency-denominated debt.

Taking the time derivative of the debt in domestic currency to capital ratio (11), we obtain:

(25) $$\frac{d\left(\frac{B}{pK}\right)}{dt} \equiv \left(\frac{\dot{B}}{pK}\right) \equiv \dot{\tau} = \frac{\dot{B}}{pK} - \tau g - \tau\hat{p}$$

Making use of the rate of change of external debt in domestic currency derived from the firm sector budget constraint $\left(\dot{B} \equiv pI - R + i^f eB^f + iB - e\dot{B^f}\right)$, the interest parity equation (18'), equation (21') for the dynamics of external debt, and recalling that inflation is assumed away, we get:

(26) $\quad \dot{\tau} = \tau(i^f + \rho_0 + \rho_1 e_r\lambda - g^*) + g^*(1 - \phi_0 - \phi_1 e_r\lambda) + i^f e_r\lambda - r^*$

It can be seen that capital accumulation only has a positive effect on the rate of change of external debt in domestic currency, if the term $(1 - \phi_0 + \phi_1 e_r\lambda - \tau)$ is positive. Thus, for high levels of domestic currency debt and a large propensity to finance investment through external debt, the effect becomes negative. If these values are low, however, an increase in accumulation decelerates the rate of change of the domestic debt ratio, because its denominator grows faster than its numerator. An increase in the foreign interest rate unambiguously accelerates indebtedness in domestic currency, and this effect is stronger, the higher the initial level of external and domestic indebtedness. However, a higher gross profit rate reduces the dynamics of domestic currency-denominated debt, as it allows for a larger share of firms' expenses being financed internally.

Just as in the case of the rate of change of external debt in foreign currency, the effect of a depreciation on the change in indebtedness in domestic currency is ambiguous and depends crucially on the effect of a devaluation on growth. However, the debt levels, the foreign interest rate, and the effect of the devaluation on the gross profit rate matter as well.

(27) $\quad \frac{\partial\dot{\tau}}{\partial e_r} = \frac{\partial g^*}{\partial e_r}(1 - \phi_0 - \phi_1 e_r\lambda - \tau) + \lambda(i^f + \tau\rho_1 - g^*\phi_1) - \frac{\partial r^*}{\partial e_r} \gtreqless 0$

*Stability of debt at the steady state and devaluation*

Equations (23) and (26) form a two-dimensional dynamic system and therefore have to be analysed jointly. We want to evaluate the stability of the system and how it is affected by a devaluation in a medium-run steady state. In order to do so, steady state values that satisfy dynamic equilibrium of both ratios have to be obtained. Starting with the external debt in foreign currency ratio (23), a non-trivial steady state arises if:

(28) $\quad e_r\lambda^*{}_{|\dot{e_r\lambda}=0} = \frac{\phi_0}{1-\phi_1}$

$\phi_0$ has to be positive to ensure the existence of external debt. Moreover, $\phi_1$ has to be smaller than unity for stability, as will be demonstrated below. Under these conditions, the external debt in foreign currency ratio is positive, and we can see a devaluation has no effect on it in the steady state. The steady state external debt ratio is solely determined by the propensity to finance investment through foreign-currency denominated debt, which in turn is determined by the illiquidity and risk premium. A higher illiquidity premium, e.g. because of a loss of trust in the domestic currency, as well as a higher sensitivity of the interest rate premium with respect

to external debt, e.g. because of stronger concerns about default risks, raise the steady state external debt ratio.
The steady state of the domestic currency-denominated debt ratio is given by:

(29) $$\tau^*{}_{|\dot{\tau}=0} = \frac{g^*(1-\phi_0-\phi_1 e_r\lambda)+i^f e_r\lambda-r^*}{g^*-i^f-\rho_0-\rho_1 e_r\lambda}$$

This steady state debt ratio can become positive or negative. As will be demonstrated below, the denominator has to be positive for stability. The steady state domestic debt ratio then becomes positive, if the share of investment that is financed through domestic debt plus interest payments on external debt exceed the profit rate. The debt ratio can also become negative for a negative numerator, which occurs when profits exceed interest payments on external debt plus expenditures on investment that are not financed through external debt. Firms then save more than they spend and hold deposits at domestic banks.
The Jacobian matrix of the system in (23) and (26) is given by:

(30) $$\boldsymbol{J} = \begin{bmatrix} \frac{\partial \dot{e_r\lambda}}{\partial e_r\lambda} & \frac{\partial \dot{e_r\lambda}}{\partial \tau} \\ \frac{\partial \dot{\tau}}{\partial e_r\lambda} & \frac{\partial \dot{\tau}}{\partial \tau} \end{bmatrix}$$
$$= \begin{bmatrix} \frac{\partial g^*}{\partial e_r\lambda}(\phi_0+\phi_1 e_r\lambda - e_r\lambda) + g^*(\phi_1-1) & 0 \\ \frac{\partial g^*}{\partial e_r\lambda}(1-\phi_0-\phi_1 e_r\lambda-\tau)+i^f+\tau\rho_1+g^*\phi_1-\frac{\partial r^*}{\partial e_r\lambda} & i^f+\rho_0+\rho_1 e_r\lambda - g^* \end{bmatrix}$$

Evaluated at the steady states given by (29) and (30), the Jacobian becomes:

(31) $$\boldsymbol{J}^* = \begin{bmatrix} g^{**}(\phi_1-1) & 0 \\ \frac{\partial g^*}{\partial e_r\lambda}\left(1-\phi_0-\frac{\phi_1\phi_0}{1-\phi_1}-\tau^*\right)+\ i^f+\tau^*\rho_1+g^{**}\phi_1-\frac{\partial r^*}{\partial e_r\lambda} & i^f+\rho_0+\frac{\rho_1\phi_0}{1-\phi_1}-g^{**} \end{bmatrix}$$

The necessary and sufficient conditions for stability of a two-dimensional dynamic system are:

$$tr(\boldsymbol{J}) = J_{11}+J_{22}<0$$
$$det(\boldsymbol{J}) = J_{11}J_{22}-J_{12}J_{21}>0$$

Stability of the present system is given if and only if both diagonal elements of the Jacobian matrix are negative. The first element is:

(32) $$J_{11}^* = g^{**}(\phi_1-1) = \left\{\frac{g_1(b_0u^f+b_1e_r)+\left(g_0+g_2\pi-\frac{g_3\phi_0}{1-\phi_1}\right)\left(\frac{\pi}{v}+b_2\right)}{\frac{\pi}{v}+b_2-g_1}\right\}(\phi_1-1)$$
$$\Rightarrow J_{11}^*<0, if\colon g^{**}(\phi_1-1)<0$$

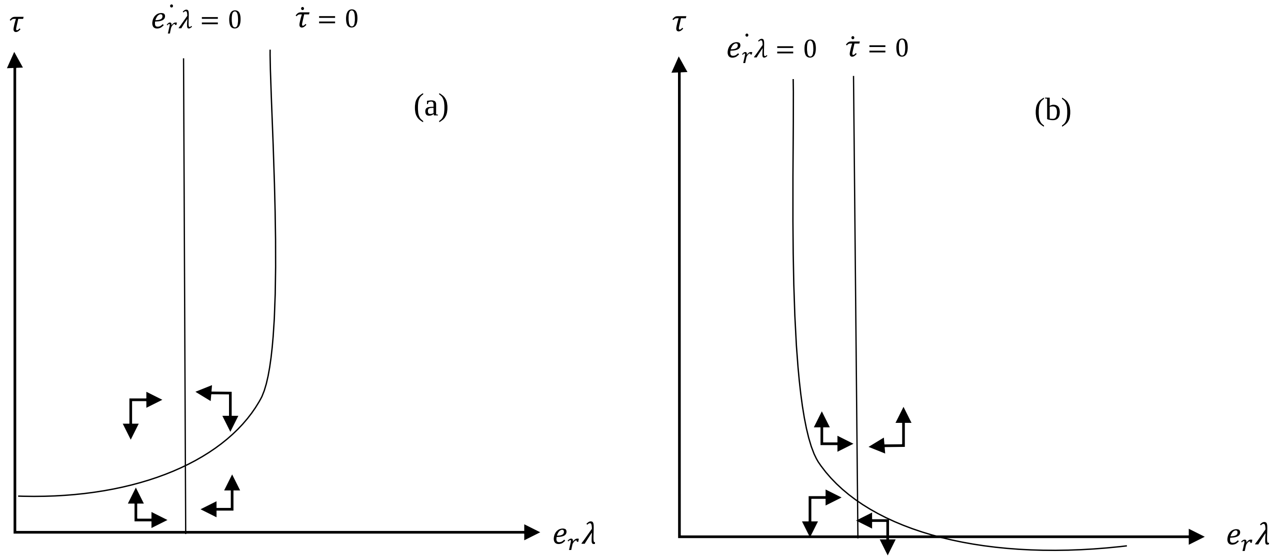
As long as the equilibrium rate of capital accumulation rate is positive and $\phi_1 < 1$, this element is negative. Instability of debt may thus arise during recessions which could occur because animal spirits ($g_0$) turn negative or exports ($b_0 u^f$) collapse, while other driving forces of capital accumulation such as export competitiveness ($b_1 e_r$) are weak and balance sheet effects $\left(\frac{g_3\phi_0}{1-\phi_1}\right)$ are strong. Instability may also occur, if $\phi_1 > 1$, i.e. when the sensitivity of the propensity to finance investment out of foreign currency-denominated external debt with respect to external debt is more than proportional. In normal times, however, $J_{11}^*$ can be assumed to be negative.
The second element of the diagonal of Jacobian matrix at the steady state is:

(33) $$J_{22}^* = i^f + \rho_0 + \frac{\rho_1\phi_0}{1-\phi_1} - g^{**}$$
$$= i^f + \rho_0 + \frac{\rho_1\phi_0}{1-\phi_1} - \left\{\frac{g_1(b_0u^f + b_1e_r) + \left(g_0 + g_2\pi - \frac{g_3\phi_0}{1-\phi_1}\right)\left(\frac{\pi}{v} + b_2\right)}{\frac{\pi}{v} + b_2 - g_1}\right\}$$
$$\Rightarrow J_{22}^* < 0, if: g^{**} > i \iff g^{**} > i^f + \rho_0 + \frac{\rho_1\phi_0}{1-\phi_1}$$

This element becomes negative as long as the equilibrium steady state rate of capital accumulation exceeds the domestic interest rate. This stability condition resembles earlier findings of the literature on public debt sustainability that goes back to Domar (1944), which established that the economy can grow out of the burden of debt if the condition $g > i$ is satisfied (see Taylor, 2004, pp. 211–214). However, meeting the stability condition for the non-reserve currency economy of this model is more difficult, as the domestic interest rate is determined by factors that are partly beyond the control of domestic authorities. A foreign interest rate hike, for instance, may destabilise the system and induce an external debt crisis – a familiar scenario in developing countries (Kaminsky and Reinhart, 1999; Cline and Vernengo, 2015). The Latin American debt crisis of the early 1980s is one of the prime examples of such a disaster (Errunza and Ghalbouni, 1986). Another potentially destabilising factor is a sudden increase in the illiquidity premium ($\rho_0$), e.g. because of a loss of confidence in the domestic currency or because of a rise in international liquidity preference (Dow, 1999, p. 155). Lastly, a high sensitivity of the interest rate premium with respect to the steady state external debt ratio ($\rho_1$) and a high debt ratio $\left(\frac{\phi_0}{1-\phi_1}\right)$ also compromise stability.[24]
Figure 2 displays two possible scenarios, a stable case in panel (a) and an unstable case in panel (b).

[24] Some numerical simulations that illustrate the conditions under which instability can occur are provided in appendix A1.

***Figure 2: Phase diagrams for $e_r\lambda^*$ and $\tau^*$, stable and unstable case***




*Note*: The shape of the $\tau$-isocline is based on specific parameter values discussed in appendix A1.

In the stable case in panel (a), both stability conditions are satisfied ($J_{11}^*, J_{22}^* < 0$). Once the dynamic equilibrium ($e_r\lambda^*, \tau^*$) is reached, both debt ratios do not change anymore and remain in this locally stable equilibrium even if small shocks occur. In the unstable case in panel (b) the second stability condition is not met because the domestic interest rate exceeds the equilibrium growth rate ($J_{11}^* > 0, J_{22}^* < 0$), e.g. because of an illiquidity premium shock. A small positive shock to the debt in domestic currency ratio may induce explosive dynamics, pushing the economy into a debt crisis.

How does a devaluation of the currency affect the stability of the system at the steady state? Taking the total derivatives of $J_{11}^*$ and $J_{22}^*$ with respect to the real exchange rate, we find:

(34) $$\frac{dJ_{11}^*}{de_r} = \left[\frac{g_1\left(b_1 - \frac{u}{v}\frac{\partial \pi}{\partial e_r}\right) + \left(g_2 \frac{\partial \pi}{\partial e_r}\right)\left(\frac{\pi}{v} + b_2\right)}{\frac{\pi}{v} + b_2 - g_1}\right](\phi_1 - 1) \lesseqgtr 0$$

(35) $$\frac{dJ_{22}^*}{de_r} = -\frac{g_1\left(b_1 - \frac{u}{v}\frac{\partial \pi}{\partial e_r}\right) + \left(g_2 \frac{\partial \pi}{\partial e_r}\right)\left(\frac{\pi}{v} + b_2\right)}{\frac{\pi}{v} + b_2 - g_1} \lesseqgtr 0$$

A devaluation has a stabilising effect, if it diminishes the diagonal elements of the Jacobian matrix. We see that a devaluation has a stabilising effect on the external debt in foreign currency ratio under similar conditions under which a devaluation increases the equilibrium rate of growth (cf. equation 20). A difference is that the negative balance sheet effect arising from external indebtedness in foreign currency is gone at the steady state, since the steady state external debt ratio is fixed by the parameters that determine the propensity to finance investment through external debt $\left(\frac{\phi_0}{1-\phi_1}\right)$. Contractionary devaluations are therefore less likely in the steady state. Whenever a devaluation in the steady state succeeds in boosting capital accumulation, it also improves stability of the debt ratios. In contrast, devaluations that depress investment compromise debt sustainability.

*Discussion*

The medium-run analysis has examined the dynamics of debt, under which conditions steady state debt ratios are stable, and how a devaluation affects the stability of debt. The main findings are that positive and potentially stable steady states for both debt ratios exist. Good conditions for domestic capital accumulation, i.e. strong animal spirits, high export demand and export competitiveness, generally favour stability, while strong balance sheet effects are destabilising. Furthermore, foreign interest rate shocks and increases in the illiquidity premium or sensitivity of the risk premium with respect to the steady state external debt ratio may turn a stable system unstable.

Currency devaluations are often employed to reduce current account deficits. However, the present analysis suggests that the effect of a currency devaluation on aggregate demand and capital accumulation should be taken into account as well in an indebted economy. A devaluation has distributional effects, which are likely to be regressive. In a wage-led economy this may depress capital accumulation. Moreover, the Marshall-Lerner condition may not be satisfied, in which case a devaluation would not only fail to improve the current account, but also worsen debt stability by reducing capital accumulation. An adjustment programme that seeks to improve international competitiveness at the expense of domestic capital accumulation may thus compromise debt sustainability.

The analysis also suggests some measures to reduce structural external vulnerability. Since foreign interest rate shocks are not under the control of domestic policy makers, the focus should lay on reducing the illiquidity and risk premium that drives a wedge between the domestic and foreign interest rate. A high premium not only motivates firms to take on risky foreign currency-denominated debt, but also undermines debt sustainability. A reduction of the premium and the propensity to finance investment out of foreign currency-denominated debt requires a stronger trust in the domestic currency, which can be achieved by strengthening the domestic financial sector. Investment-oriented prudent regulations and a domestic central bank that acts as a lender of last resort – in emergencies also for foreign currency-denominated debt by drawing on its foreign reserves – may be conducive to this end. This would stimulate domestic savings and make the economy less dependent on foreign savings. Public and development banks that selectively provide cheap credit for long-term investment might play an important role too, as China and the East Asian Tigers have shown (Herr and Priewe, 2005; Stiglitz and Uy, 1996).

## 4 Conclusion

The paper has addressed the question of how currency devaluations affect aggregate demand, capital accumulation and external debt in the short- to medium-run in small open economies with a fixed exchange rate. The post-Kaleckian model that has been developed for this purpose shows that devaluations induce several mechanisms that affect aggregate demand and growth, and the overall outcome cannot be established a priori. Depreciations are likely to induce a redistribution of income, which in turn can have different effects on domestic absorption, depending on whether the economy is in a wage- or profit-led regime. Moreover, the effect of a depreciation on net exports is not necessarily positive if the Marshall-Lerner condition is not satisfied. Lastly, balance sheet effects have a depressing effect on investment, so that devaluations are less likely to be expansionary in externally indebted economies. The same mechanisms determine the effect of a devaluation on the rate of capital accumulation. It is therefore necessary to empirically obtain the relevant parameters of the model for different countries before a prediction about the effectiveness of devaluations can be made. This would constitute a promising future research project.

Moreover, the paper has analysed the dynamics and stability of debt within the proposed framework. The main finding of the stability analysis is that strong animal spirits, high export demand and export competitiveness improve stability, while strong balance sheet effects compromise it. Furthermore, foreign interest rate or illiquidity premium shocks, as well as a high sensitivity of the risk premium with respect to external debt may turn a stable system unstable. Devaluations are stabilising only if they succeed in boosting domestic capital accumulation. This should be taken into account before devaluations are prematurely recommended as an adjustment tool for externally indebted economies. Moreover, if devaluations are combined with austerity policies that are likely to depress animal spirits, they can fail to pull economies out of recession, or even worsen the external debt problem. Although such an approach may eventually improve the current account, the economic and social damage that is being incurred in the meantime can be substantial.

Besides the effects of devaluations on aggregate demand, capital accumulation and debt sustainability, the distributional effects should be evaluated in their own right. Especially if there are strong regressive distributional effects, and the expansionary effects are small, devaluations might do more harm than good. However, more empirical research on the distributional effects of devaluations is needed to make more informed statements in this regard.

In a longer term perspective, externally indebted countries are advised to reduce the illiquidity and risk premium on the domestic interest rate to reduce foreign-currency denominated debt and enhance debt sustainability. This can be accomplished by strengthening the domestic financial system through prudent regulations and a central bank acting as a lender of last resort. Moreover, a long-term investment-oriented public banking system may be helpful too.

In sum, the proposed model provides a rich framework for further research. It may help provide a more nuanced view on the benefits and costs of currency devaluations. However, it should be borne in mind that there are still limitations of the present approach. The model is only applicable to small open economies and disregards feedback effects from the rest of the world. The exchange rate is fixed, so that flexible exchange rate complications are ruled out. There are no feedback effects from domestic demand or the interest rate on distribution. Inclusion of these mechanisms into the present framework is left fur future research.

## Appendix

### A1. Numerical examples and the shape of the $\tau$-isocline in Figure 2

The following exogenous parameter values have been used to construct a benchmark economy and expose it to foreign interest rate, and illiquidity and risk premium shocks. The parameter values of the benchmark scenario (1) yield the qualitative shape of the $\tau$-isocline in panel (a) of Figure 2. The qualitative shape of the $\tau$-isocline in panel (b) of Figure 2 is based on the illiquidity premium shock scenario (3).

$\pi = 0.3$
$v = 2.5$
$\frac{\pi}{v} = 0.12$
$g_0 = 0.03$
$g_1 = 0.1$
$g_2 = 0.1$
$g_3 = 0.06$

$b_0 u^f = 0.15$
$b_1 e_r = 0.01$
$b_2 = 0.35$
$\frac{\pi}{v} + b_2 - g_1 = 0.37$ (Keynesian stability condition)
$e_r \lambda = 0.4$
$\tau = 0.2$

***Table A1: Numerical simulations. Exogenous parameters/variables***

| **Case/Parameter** | $\boldsymbol{i^f}$ | $\boldsymbol{\rho_0}$ | $\boldsymbol{\rho_1}$ | $\boldsymbol{\phi_0}$ | $\boldsymbol{\phi_1}$ |
|---|---|---|---|---|---|
| (1) Benchmark | 0.03 | 0.02 | 0.04 | 0.4 | 0.036 |
| (2) Foreign interest rate increase | **0.04** | 0.02 | 0.04 | 0.4 | 0.036 |
| (3) Foreign interest rate shock | **0.10** | 0.02 | 0.04 | 0.4 | 0.036 |
| (4) Illiquidity premium shock | 0.03 | **0.05** | 0.04 | **0.427** | 0.036 |
| (5) Risk premium shock | 0.03 | 0.02 | **0.5** | 0.4 | **0.45** |

*Note*: Bold numbers highlight changes in exogenous parameters with respect to the benchmark scenario

*Table A2: Numerical simulations. Endogenous parameters/variables*

| **Case/Parameter** | $\boldsymbol{i}$ | $\boldsymbol{\phi}$ | $\boldsymbol{u}^*$ | $\boldsymbol{g}^*$ | $\boldsymbol{r}^*$ | $\boldsymbol{r^* - g^* = b^*}$ | $\dot{\overline{\boldsymbol{e_r\lambda}}}$ | $\dot{\boldsymbol{\tau}}$ |
|---|---|---|---|---|---|---|---|---|
| (1) Benchmark | 0.066 | 0.41 | 0.53 | 0.089 | 0.064 | -0.025 | 0.001 | -0.004 |
| (2) Foreign interest rate increase | 0.076 | 0.41 | 0.53 | 0.089 | 0.064 | -0.025 | 0.001 | 0.001 |
| (3) Foreign interest rate shock | 0.136 | 0.41 | 0.53 | 0.089 | 0.064 | -0.025 | 0.001 | 0.038 |
| (4) Illiquidity premium shock | 0.096 | 0.44 | 0.53 | 0.089 | 0.064 | -0.025 | 0.004 | -0.0005 |
| (5) Risk premium shock | 0.25 | 0.58 | 0.53 | 0.089 | 0.064 | -0.025 | 0.016 | 0.018 |
| Case/Parameter | $\boldsymbol{e_r\lambda}^*$ | $\boldsymbol{\tau}^*$ | $\boldsymbol{g}^{**}$ | $\boldsymbol{J_{11}^*}$ | $\boldsymbol{J_{22}^*}$ | **Stable?** | **Bankruptcy?** | |
| (1) Benchmark | 0.415 | 0.023 | 0.088 | -0.085 | -0.02 | Yes | No | |
| (2) Foreign interest rate increase | 0.415 | 0.603 | 0.085 | -0.082 | -0.01 | Yes | Yes | |
| (3) Foreign interest rate shock | 0.415 | -0.607 | 0.085 | -0.082 | 0.05 | No | No | |
| (4) Illiquidity premium shock | 0.443 | 0.014 | 0.083 | -0.08 | 0.01 | No | No | |
| (5) Risk premium shock | 0.727 | 0.088 | 0.064 | -0.035 | 0.35 | No | No | |

The benchmark economy (1) is growing fast at almost nine percent and invests more than it saves ($g^* > r^*$). It therefore exhibits a trade deficit ($b^* < 0$) and relies on capital inflows. The inherited stock of debt amounts to 40 percent of the capital stock in the case of foreign-currency denominated debt ($e_r\lambda$), and is 20 percent in the case of domestic currency-denominated debt ($\tau$). Due to the existence of an illiquidity ($\rho_0$) and risk premium ($\rho_1$), there is a differential between the domestic and foreign interest rate of more than three percentage points. This induces firms to finance a share ($\phi$) of about 41 percent of their investment expenditures through foreign currency-denominated debt, and the external debt-to-capital ratio is increasing. The domestic debt ratio, in contrast, is on a declining trajectory. In the steady state, the foreign debt ratio has reached about 42 percent, whereas the domestic currency debt ratio is down to about two percent. Since $\phi_1 < 1$, and the steady state equilibrium growth rate exceeds the domestic interest rate, this benchmark scenario is stable.

In the second scenario, we consider the benchmark economy under an increase in the foreign interest rate by one percentage point. The resulting proportional increase in the domestic rate of interest rate raises the steady state domestic currency-denominated debt ratio to about 60 percent of the capital stock. While this scenario is still stable, it would push the domestic firm sector into bankruptcy, as the sum of the two steady state debt ratios exceeds unity.

Thirdly, we examine what happens to the benchmark economy under a fierce foreign interest rate shock. In this scenario, the foreign interest rate increases to ten percent, so that it exceeds the growth rate of the economy. As a result, debt dynamics become unstable ($J_{22}^{*} > 0$). Instability also arises in the last two scenarios, which simulate an illiquidity premium shock and a shock to the sensitivity of the risk premium with respect to foreign currency-denominated debt. Again instability results from a corresponding jump in the domestic interest rate which exceeds the rate of capital accumulation. The last example also shows that instability in this numerical example arises way before the parameter $\phi_1$exceeds unity, which would also turn $J_{11}^{*}$ positive.

## A2. Variable and parameter definitions

**Table A3: Variable and parameter definitions**

| Symbol | Mathematical Definition | Conceptual Definition |
|---|---|---|
| $p$ | | Price level |
| $e$ | | Nominal exchange rate |
| $e_r$ | $\frac{e}{p}$ | Real exchange rate |
| $K$ | | Real capital stock |
| $K^f$ | | Foreign capital stock |
| $B$ | | Domestic currency-denominated loans |
| $B^f$ | | Foreign currency-denominated external debt |
| $D$ | | Domestic currency-denominated bank deposits of foreigners |
| $NW_F$ | | Net worth of domestic firms |
| $NW_{EXT}$ | | Net worth of external sector |
| $Y$ | | Total real income |
| $R$ | | Total nominal profits |
| $R^{Net}$ | $R - iB - i^f eB^f$ | Net profits |
| $W$ | | Total wage bill |
| $S$ | | Total nominal savings |
| $C$ | | |
| $I$ | | Total real investment |
| $X$ | | Real exports |
| $M$ | | Real imports |
| $i$ | | Interest rate on domestic currency debt |
| $i^f$ | | Interest rate on foreign currency debt |
| $\dot{B}$ | $\frac{dB}{dt}$ | Change in domestic currency-denominated loans |
| $e\dot{B^f}$ | $e\frac{dB^f}{dt}$ | Change in foreign currency-denominated foreign loans |
| $\dot{D}$ | $D$ | Change in domestic-currency denominated deposits of foreigners |
| $m$ | | Mark-up |
| $w$ | $\frac{W}{number\ of\ employees}$ | Nominal wage rate |
| $a$ | $\frac{number\ of\ employees}{Y}$ | Labour coefficient |
| $wa$ | $\frac{W}{Y}$ | Nominal unit labour costs |

| | | |
|---|---|---|
| $\delta$ | | Ability of firms to roll over import cost on prices |
| $\eta$ | | Ability of workers to roll over import cost on nominal wages |
| $\pi$ | $\frac{R}{pY}$ | Profit share |
| $(1-\pi)$ | $\frac{W}{pY}$ | Wage share |
| $e_r\lambda$ | $\frac{eB^f}{pK}$ | Foreign currency-denominated external debt-to-capital ratio |
| $\tau$ | $\frac{B}{pK}$ | Domestic currency-denominated debt-to-capital ratio |
| $r$ | $\frac{R}{pK}$ | Rate of profit |
| $v$ | $\frac{K}{potential\ output}$ | Capital coefficient |
| $u$ | $\frac{Y}{potential\ output}$ | Rate of capacity utilisation |
| $s$ | $\frac{S}{pK}$ | Rate of savings |
| $NX$ | $pX - eM$ | Nominal net exports (trade balance) |
| $b$ | $\frac{NX}{pK}$ | Net export rate |
| $u^f$ | | Foreign rate of capacity utilisation |
| $b_0$ | | Sensitivity of net exports w.r.t foreign capacity utilisation (~income elasticity of export demand) |
| $b_1$ | | Sensitivity of net exports w.r.t real exchange rate (~Marshall-Lerner condition) |
| $b_2$ | | Sensitivity of net exports w.r.t domestic rate of capacity utilisation (~income elasticity of import demand) |
| $g$ | $\frac{I}{pK} \equiv \hat{K} \equiv \frac{\dot{K}}{K}$ | Rate of investment, growth rate of capital stock |
| $g_0$ | | Animal spirits |
| $g_1$ | | Sensitivity of investment w.r.t. rate of capacity utilisation |
| $g_2$ | | Sensitivity of investment w.r.t. profit share |
| $g_3$ | | Sensitivity of investment w.r.t. foreign currency-denominated external debt (balance sheet effect) |
| $\rho$ | | Domestic interest rate premium |
| $\rho_0$ | | Illiquidity premium |
| $\rho_1$ | | Sensitivity of domestic interest rate premium w.r.t. foreign currency-denominated external debt (risk premium) |
| $\phi$ | | Propensity to finance investment out of foreign currency-denominated external debt |

| | | |
|---|---|---|
| $\phi_0$ | | Illiquidity and risk premium-independent preference for external debt and illiquidity premium |
| $\phi_1$ | | Sensitivity of illiquidity and risk premium w.r.t. external debt and sensitivity of the propensity to finance investment out of foreign currency-denominated external debt w.r.t. the illiquidity and risk premium |
| $\dot{e_r\lambda}$ | $\left(\frac{e\dot{B}^f}{pK}\right)$ | Rate of change of the foreign currency-denominated external debt-to-capital ratio |
| $\dot{\tau}$ | $\left(\frac{\dot{B}}{pK}\right)$ | Rate of change of the domestic currency-denominated debt-to-capital ratio |
| $\widehat{e_r}$ | $\frac{\dot{e_r}}{e_r}$ | Growth rate of the real exchange rate |
| $\hat{p}$ | $\frac{\dot{p}}{p}$ | Inflation rate |

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