The effectiveness of monetary policy in the long run: a Kaleckian model of inflation, distributive conflict, increasing risk and credit rationing

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Resumo
O artigo apresenta um modelo macroeconômico formal na tentativa de explicar o impacto líquido das variações na taxa de juros sobre a inflação no longo prazo. No modelo proposto, o grau de endividamento das empresas é explicitamente introduzido na análise da acumulação de capital, do prêmio de risco dos bancos e da inflação. Em um ambiente marcado pela incerteza fundamental, as diferenças sobre como credores e devedores avaliam os riscos futuros tendem a emergir, e, portanto, nada garante que a quantidade de crédito concedido para as empresas que equilibra o mercado de crédito também permita uma trajetória sustentável da acumulação de capital no longo prazo. Demonstra-se que a estabilidade financeira da dinâmica da acumulação de capital está intimamente associada à estabilidade a longo prazo do processo inflacionário. Neste modelo, o impacto a longo prazo do aumento das taxas de juros sobre a inflação depende da capacidade de resposta dos preços a mudanças nos salários reais e pagamentos de juros. Em outras palavras, os preços no longo prazo podem subir ou cair em razão de uma mudança na taxa de juros, dependendo de qual efeito prevalece. Esses resultados lançam luz sobre a eficácia dos regimes de metas de inflação como forma de controlar os preços no longo prazo.

Palavras-chave: inflação; risco crescente; racionamento de crédito; acumulação de capital

Abstract
This paper sets out a formal macroeconomic model to account for the net impact of changes in the interest rate on long-term inflation. In this model the degree of firms' indebtedness is explicitly introduced in the analysis of capital accumulation, commercial banks' risk premium, and inflation. In an environment of fundamental uncertainty, differences on how lenders and borrowers assess future risks tend to emerge, and hence nothing guarantees that the market-clearing amount of credit granted to firms also guarantees a sustainable path of capital accumulation in the long run. It is shown that the financial stability of the capital accumulation dynamics is closely linked to the long-run stability of the inflationary process. In this model, the long-term impact of raising interest rates on inflation depends on the responsiveness of prices to changes in the real wages and interest payments. In other words, prices in the long run can go up or down after an interest rate shock depending on which effect prevails. These findings shed some light on the effectiveness of inflation-targeting regimes to steers prices in the long run.

Keywords: inflation; increasing risk; credit rationing; capital accumulation

JEL: E44; E12; E22; O42

Área 4 - Macroeconomia, Economia Monetária e Finanças

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1 Introduction

From the standpoint of mainstream economists, inflation is mainly caused by excess demand. According to the New Consensus Macroeconomics[1] paradigm if the market interest rate is lower than the natural interest rate, then the excess of money supply will lead to an unemployment rate that is also lower than the non-accelerating inflation rate of unemployment (NAIRU). The NAIRU is a long-run equilibrium rate of unemployment which depends exclusively on structural factors such as the labour market regulations and social programs, for instance. In this spirit, the Central Bank sets a target inflation rate and uses short-term interest rates, its main monetary policy instrument, in order to fine-tune the economy and steer prices.

Post-Keynesian economists, on the other hand, reject the idea that inflation is caused by excess money supply, once the money supply is considered to be endogenous. They also do not believe in the existence of a NAIRU, since the unemployment rate in the short and in the long run depends of firm's expectations about the effective demand. In Post-Keynesian theory inflation is caused mainly by distribution conflict between workers and capitalists instead of excess money supply. In spite of these issues, some authors have shown that inflation targeting is not completely incompatible with the Post-Keynesian theory (Davidson, 2006; Sawyer, 2006; Lima and Setterfield, 2008) and hence analyse the impact of interest rate shocks on prices.

However, the Post-Keynesian inflation-targeting policies, like the New Consensus policies, are basically concerned about the short-run time frame. Very few works examine the consequences of interest rate shocks on the inflation rate in the long run. Hein (2008) and Hein and Stockhammer (2011) developed a Kaleckian model where inflation-targeting monetary policies can control accelerating inflation in the short run by decreasing the employment rate until it matches the 'stable inflation rate of employment' (SIRE). In the long run, however, the SIRE becomes endogenous to the interest rate and hence a contractionary monetary policy, in these models, affects differently the actual unemployment rate and the SIRE. Thus, if a raising interest rate reduces more the SIRE than the actual employment rate, then the bargaining power of workers increases, wages accelerate and prices speed up. It can only happen because these models assume that wages are positively related to the gap between the actual rate of capacity utilization and the equilibrium capacity utilization that corresponds to SIRE. Therefore, in these models, long-run price instability is essentially caused by a mismatch between the actual and the equilibrium rates of capacity utilization. Nonetheless, by assuming that the amount of credit granted to firms relative to the capital stock remains constant, these models neglect the fact that changes in the price of loans (the interest rate) affect the quantity of loans.

By relaxing the assumption of a constant debt-capital ratio, this work aims to show how raising interest rates change the debt structure of firms and hence affect the long-run inflation rate. In a scenario of fundamental uncertainty, borrowers and lenders tend to form different expectations about the future. Firms and commercial banks are unable to know objectively the maximum amount of loans that firms can take without becoming insolvent, and hence lenders are likely to limit the supply of additional credit. But even if borrowers and lenders agree on the market-clearing amount of loans, nothing guarantees that the equilibrium amount of credit granted to firms also ensures their solvency over time. In times of exceedingly high optimism lenders may be willing to supply credit until the point where firms are unable to repay their debts. Since firms set a mark-up over their prime costs, raising wages and interest payments are identified in this work as the main causes of long-term inflation. As discussed below, a contractionary monetary policy is more likely to reduce wages and increase the interest payments from firms to rentiers. Therefore, only if the negative impact of raising interest rates on wages overcompensates the increase in the interest payments, then the long-term inflation will be reduced. We also show that in the case of a

[1] The New Consensus Macroeconomics models are characterised by three key components: (i) an aggregate demand curve; (ii) a short-run Phillips curve that relates the inflation rate to the output gap; (iii) a Central Bank reaction function, that is, the Taylor Rule. For more details see Clarida *et al* (1999), Taylor (2000) and Meyer (2001).

financially unstable system, a mix of expansionary fiscal and monetary policies might help to bring the economy back to a stable, solvent path.

2 The model

We assume a one-sector, closed economy. We also assume a fixed-coefficient production function where labour (L) and capital (K) are used as factors of production. Since we suppose a constant capital-potential output ratio, the capacity utilization (u) is given by the output-capital ratio. Given the existence of excess capacity, the rate of capacity utilization must adjust to accommodate excess demand or supply.

2.1 Classes

There are two classes in the economy, workers and capitalists. Workers earn only wages (W) and consume all their income. Capitalists are divided into entrepreneurs and rentiers. Entrepreneurs earn profits of enterprises and save a constant fraction of their income. Rentiers earn income from the stock of credit granted to firms at a given market interest rate (i) and also save a constant fraction of their income. Total income is given by

$$Y = (W/P)L + \Pi \quad (1)$$
$$u = \sigma u + r \quad (2)$$
$$\sigma = (W/Pa) \quad (3)$$
$$r = \Pi/K = (1-\sigma)u \quad (4)$$

where P is the price level, σ is the wage share of income, Π is total profit, r is the profit rate and $a = Y/L$ is the labour productivity. Following Hein (2008), we split total profits (Π) into profits of firms (Π_c) and income of rentiers $\left(\Pi_f\right)$

$$\Pi = \Pi_c + \Pi_f = \Pi_c + iB \quad (5)$$

where B is the stock of credit granted to firms.

The debt-capital ratio is

$$\lambda = B/K \quad (6)$$

2.2 Interest rate and the endogenous risk premium

The nominal interest rate (i_n) is given by the sum of the *ex-ante* real interest rate (i_r^e) and the expected inflation (p^e)

$$i_n = i_r^e + p^e \quad (7)$$

Following Lima and Setterfield (2008), we assume that the Central Bank is credibly committed to achieve the inflation target, p^T. This creates a conventional anchor for the expectations of decision makers, so that

$$p^e = p^T \quad (9)$$

Since there is no unexpected inflation, *ex-ante* and *ex-post* nominal interest rate are equal, and hence

$$i_n = i_r + p^T \quad (10)$$

Commercial banks calculate the nominal market interest rate (i) by marking up the benchmark nominal interest rate set by the Central Bank (i_{CB})

$$i = i_{CB} + \phi \tag{11}$$

where ϕ is the risk and liquidity premium. This mark-up is a risk and liquidity premium set by commercial banks and depends on the degree of competition in the banking sector, the debt-capital ratio, and the capacity utilization, as follows

$$\phi = \phi_0 + \phi_1\lambda - \phi_2 u \tag{12}$$

where $\phi_0, \phi_1, \phi_2 > 0$. The intercept ϕ_0 stands for the degree of monopoly in the banking system. We follow Charles (2008) and assume that the risk premium is positively related to the debt-capital ratio. From the perspective of the bankers, and assuming the size of all firms of the economy are identical, the higher the firms' debt as a proportion of their stock of capital, the higher the default risk perceived by the banks, and hence the higher the risk and liquidity premium lenders will require in order to financing new capital goods. Accordingly, the increasing risk, from the lenders' standpoint, due to a raising debt-capital ratio can be seen as a constraint to the supply of loans to firms and hence to the process of capital accumulation itself. This mechanism is inspired by Kalecki's (1937) principle of increasing risk. According to the author, as investments grow, this happens because: i) the greater is the investment the more is his wealth position endangered in the event of unsuccessful business; ii) the greater is the investment the more is the danger of illiquidity. Even though, in this case, Kalecki's (1937) principle refers to the risk perception from the firms' standpoint, in this work we suggest it also can be used to understand how lenders perceive risk. As Kalecki himself pointed out, "[i]f, however, the entrepreneur is not cautious in his investment activity it is the creditor who imposes on his calculation the burden of increasing risk charging the successive portions of credits above a certain amount with rising rate of interest" (Kalecki, 1937, p. 442). Moreover, it is worth noting that in this work the principle of increasing risk is not used with respect to the capital stock, as in Kalecki (1937). Instead, here, this principle is associated with the proportion of capital goods financed by loans in the total capital stock. In this way, a more accurate relationship can be stablished between the capital accumulation and the borrowers' solvency, as perceived by lenders. The equation (12) also assumes that the capacity utilization is positively related to the risk premium (Lima and Meirelles, 2007). More buoyant demand conditions reduce the bank's liquidity preference and hence lower ϕ.

By assuming that the risk and liquidity premia is positively related to changes in the amount of credit granted to firms, we follow the Post-Keynesian structuralist endogenous money theory (Minsky, 1975; Palley, 1996). Here it is assumed that any increase in the demand for loans and, consequently, deposits with commercial banks is fully accommodated by the central bank's supply of monetary reserves. This assumption falls in line with the horizontalist view developed by Kaldor (1982) and Lavoie (1984). However, unlike the horizontalist view, where the risk and liquidity premium set by commercial banks over the benchmark interest rate is unaffected by increasing credit demand, we follow the structuralists by claiming that, as the credit supply granted to firms increase, commercial banks start to worry about the liquidity of their own portfolios and of their borrowers. This leads commercial banks to restrict the amount of loans by raising the market interest rate. In other words, it is assumed that an increase in the credit supply granted to firms increases the liquidity and risk premia of commercial banks, even if the base rate set by the central bank remains constant[2]. Following Hein (2008), Figure 1 represents the structuralist endogenous money theory with complete accommodation of the central bank.

[FIGURE 1]

[2] For a survey of the debate between accomodationists and structuralists see Arestis and Sawyer (2006), Hein (2008) and Lavoie (2014).

where B^S and B^D are the supply and demand for loans respectively, D is the deposits with commercial banks, M is the money reserves and M^S is the money supply. Figure 1 illustrates how the demand for credit creates deposits which, in turn, make reserves.

Nevertheless, borrowers and lenders may disagree about how much credit should be granted to firms (Wolfson, 1996). There is a difference between the firms' demand for loans, according to the firms' own perception, and the firms' demand for loans, from the rentiers' standpoint. In Figure 2 below the borrower's demand for credit is represented by the notional demand curve, B^{DN}, and the credit demand by creditworthy borrowers from the lender's perspective is represented by the effective demand curve, B^{DE}. This difference exists because, in a scenario of fundamental uncertainty, borrowers and lenders tend to form asymmetric expectations about the future. By fundamental uncertainty, we mean that, due to sudden and constant transformations in the world, there is always a great amount of information about the future that cannot be known *ex ante* by decision makers, since the future is yet to be created; therefore, probabilities, whether objective or subjective, cannot be attributed to a list of possible future events as this list itself cannot be known[3]. In this scenario, banks manage to set a series of creditworthiness criteria based on, for instance, the expected profitability of the investment project to be financed, the value of the firms' collateral, the firms' past projects history, and so on. However, the capacity of lenders to thoroughly evaluate the firms' demand for loans that maximises firms' rate of capital accumulation and rentiers income in an environment where decision makers face fundamental uncertainty with respect to the outcomes of current investments remains partly subjective. In this scenario, rentiers may constrain the amount of credit granted to firms even when still there are profitable investment projects to be undertaken. If banks relax those creditworthiness criteria, the risk premium and the market interest rate are reduced, thus allowing an increase in the firms' demand for loans, which raises total profits and capital accumulation. However, if banks relax excessively those criteria, then credit will be granted to firms that should be turned down.

[FIGURE 2]

Figure 2 illustrates an economy where banks are more risk-averse than firms. At a given market interest rate i_0 banks are willing to grant credit to firms up to the point B_E, which means that $B_E B_N$ is equal to the amount of credit rationed. Commercial banks will refuse to finance any investments beyond this point, regardless of the firm's predisposition to pay higher interest rates, up to i_1. Note that the gap between the effective and the notional demand curves widens as the interest rate increases; it happens because the higher the interest rate the more difficult it is for borrowers to pay their debts[4].

Even though it is more plausible to assume that banks are more risk-averse than firms, as the latter tend to be more optimistic about their investments whereas the former is usually more prudent, we can imagine that there are times when we find the opposite. This phenomenon is particularly true during periods of crisis, preceded by a rapid expansion of credit. The optimism in the economic boom is abruptly stopped during the crisis, causing the Central Bank to act in an attempt to prevent (or minimise the effect of) credit crunch. However, even in the event of a quick and effective action of the monetary authorities in containing these effects on the financial system, there is no guarantee that firms are willing to take on new debt. It is worth mentioning that in such situations in which the Central Bank was able to re-establish the conditions of liquidity and solvency of the banking sector and hence make it apt to the beginning of a new credit cycle, it is possible that firms still evaluate more carefully the use of external funds. The increased uncertainty generated by the crisis and the possible need to reduce debt in a context which is expected a fall in future demand mean that, despite the recovery of the banking system and liquidity offered, firms are afraid to take more external financing. The following proverb captures with relative accuracy this general framework: "you can lead a horse to water, but you can't make it drink".

[3] For more details about fundamental uncertainty see Dequech (1999).

[4] According to New Keynesians, it may also happen due to adverse selection problem. Higher interest rates attract mostly firms willing to undertake excessively risky investments and with no intention to refund the loan in case the profits obtained from these investments are insufficient (Wolfson, 1996).

2.3 Capital accumulation

Now we assume that the rate of capital accumulation desired by firms depends on the profit rate retained by firms, and a quadratic function of the debt-capital ratio. The linear function of the capital accumulation plans is given by

$$g^d = \frac{\Delta K}{K} = \frac{I}{K} = \alpha_0 + \alpha_1(r - i\lambda) + \alpha_2(\psi - \lambda)\lambda \tag{13}$$

where $\alpha_0, \alpha_1, \alpha_2, \psi > 0$. Following Kalecki (1971) and Dutt (1984) we argue that the higher the expected profit rate, the higher the propensity of firms to invest. For convenience, we assume that profits expected by firms are equal to current profits. Assuming a bank-based financial system, there are two main forms in which capital goods can be financed: internal funds constituted by retained profits and external funds constituted by debts. Hein (2007) claims that the debt-capital ratio, associated with the interest rate, can only have a negative impact on investments due to its discount effect on profits. More formally, in Hein (2007) and Hein (2008), the partial effect of an increased debt-capital ratio on investments is negative.

Contrastingly, other things held constant, in equation (13) we assume that, in the space (λ, g^d), g^d is concave down on its relevant domain $\lambda \in \mathbb{R}^+$. In this quadratic term we also find the parameter ψ. An increase in the entrepreneurs' animal spirit, higher expected and current profit rates, and more favourable demand conditions tend to encourage borrowers to take more risks and increase the demand for loans, which in turn raises the value of ψ. More formally, it can be said that ψ can be better described by an implicit function $\psi(\psi_0, r, u)$ where ψ_0 is the entrepreneurs' animal spirit. However, let us assume ψ is constant and normalised to unity ($\psi = 1$) – this assumption can be relaxed at the expense of simplicity. With this assumption we can focus more on the effects of credit rationing on the dynamics of the economy. Figure 3 below illustrates equation (13) in the space (λ, g^d), as follows

[FIGURE 3]

In this context, prime investments financed by credit manage to boost profits and capital accumulation. In this stage, within the solvency region, an increase in the amount of loans to firms boosts retained profits and capital accumulation. Firms' willingness to borrow more money increases, and so does the investment rate. This dynamics goes until firms reach the critical debt-capital ratio where any additional credit granted to firms is only enough to sustain the maximum rate of capital accumulation. If firms continue to borrow money, any increase in the debt-capital ratio beyond its critical point will reduce firms' retained profits and the investment rate; in this case, firms will fall into the default region. In other words, the principle of increasing risk also holds from the firms' standpoint. However, as aforementioned, there is an important qualification with respect to Kalecki's (1937) original use of the principle of increasing risk. Either from the perspective of lenders or from the perspective of borrowers, here, the risk increases due to a raising debt-capital ratio instead of the expansion of the capital stock. It follows from that that there is a debt-capital ratio, λ_{maxg^d}, that maximises the aggregate investment rate, other things held constant. However, in an environment of fundamental uncertainty, it is impossible for borrowers and lenders to know the maximum amount of loans granted to firms that guarantees solvency over time.

2.4 Aggregate saving

Assuming that excess capacity prevails, capacity utilization adjusts to equalise investments and savings. In this scenario, we have

$$g^s = \frac{S}{K} = \frac{S_c + S_f}{K} \tag{14}$$

It is assumed that entrepreneurs save a constant fraction, s_c, of the retained profits. From equations (4), (5) and (6), we obtain

$$\frac{S_c}{K} = s_c \frac{\Pi_c}{K} = s_c \frac{\left(\Pi - \Pi_f\right)}{K} = s_c[r - i\lambda] \tag{15}$$

Rentiers also save a constant fraction, s_f, from the income they receive from the stock of credit granted to firms

$$\frac{S_f}{K} = s_f \frac{\Pi_f}{K} = s_f i\lambda \tag{16}$$

Substituting (16) and (15) in (14), we have

$$g^s = s_c[r - i\lambda] + s_f i\lambda = s_c r + \left(s_f - s_c\right) i\lambda \tag{17}$$

Assuming, for simplicity, $s_f = s_c$, we obtain the so-called Cambridge equation

$$g^s = s_c r \tag{18}$$

2.5 The goods market equilibrium capacity utilization and growth

When there is excess capacity, capacity utilization adjusts to equalise the desired and the actual rates of capital accumulation so that in the goods market equilibrium we have $g^d = g^s$. From equations (18), (13), (12), (11) and (4), we have

$$\alpha_0 + \alpha_1[(1-\sigma)u - (i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u)\lambda] + \alpha_2(1-\lambda)\lambda = s_c(1-\sigma)u \tag{19}$$

Solving for u we have the equilibrium capacity utilization:

$$u^* = \frac{\alpha_0 - (i_{CB} + \phi_0 + \phi_1\lambda)\lambda + \alpha_2(1-\lambda)\lambda}{(s_c - \alpha_1)(1-\sigma) - \alpha_1\phi_2\lambda} \tag{20}$$

The stability conditions for the equation above is $(s_c - \alpha_1)(1-\sigma) - \alpha_1\phi_2\lambda > 0$. Since $u^* \in (0,1)$ the inequality $\alpha_0 + \alpha_2(1-\lambda)\lambda > (i_{CB} + \phi_0 + \phi_1\lambda)\lambda$ must be fulfilled. From equation (20), we can see that the partial derivatives $u^*_\sigma > 0$ and $u^*_{i_{CB}} < 0$ are unambiguously signed. As for the partial u^*_λ, other things being equal, since the quadratic term of the equation (20) is negative, there must be a critical value of debt-capital ratio in the relevant domain, say λ_{maxu^*}, that maximises u^*. Therefore, if $\lambda < \lambda_{maxu^*}$, then $u^*_\lambda > 0$; and if $\lambda_{maxu^*} < \lambda$, then $u^*_\lambda < 0$.

If we substitute the equation (20) either in (18) or in (13), we obtain the equilibrium investment rate. Thus, plugging (20) and (4) into (18), we obtain

$$g^* = \frac{s_c(1-\sigma)[\alpha_0 - (i_{CB} + \phi_0 + \phi_1\lambda)\lambda + \alpha_2(1-\lambda)\lambda]}{(s_c - \alpha_1)(1-\sigma) - \alpha_1\phi_2\lambda} \tag{21}$$

Equation (21) follows the same conditions of stability and existence of equation (20). Like the goods market equilibrium capacity utilization, u^*, we can also say that there must be a critical value, say λ_{max}, that maximises the equilibrium rate of investment. From equation (21), we can see that the partial derivatives can be signed as $g^*_\sigma = s_c[(1-\sigma)u^*_\sigma - u^*] \gtreqless 0$, $g^*_{i_{CB}} < 0$, and $g^*_\lambda > 0$ for $\lambda < \lambda_{max}$ and $g^*_\lambda < 0$ for $\lambda_{max} < \lambda$. Equation (21) is also represented by an inverted U-shaped curve as in Figure 3. The only difference now is that equation (21) describes the equilibrium investment rate, g^*, instead of the aggregate investment function, g^d. Please note that, since $g^* = s_c r^*$, the critical values that maximise the investment and profit rates under the goods market equilibrium condition are the same.

3 Monetary policy and long-run inflation rate

In this section we will analyse the impact of changes in the interest rate on the long-run inflation rate.

3.1 Wages

Following Dutt (1994), we claim the growth rate of nominal wages is positively related to the gap between the wage share desired by workers (σ_w) and the actual wage share, as follows

$$w = \beta_w(\sigma_w - \sigma) \tag{22}$$

where w is the rate of change in the nominal wage, $\beta_w > 0$ is a parameter.

The wage share desired by workers depends on bargaining power of workers which, in turn, is positively related to the rate of employment. A tighter labour market increases the bargaining power of workers. Following Hein and Stockhammer (2011), let us assume a proportional relationship between the rate of employment and the rate of capacity utilization.
Thus, we can say that there is a positive relationship between the rate of capacity utilization and the wage share desired by workers, as follows

$$\sigma_w = \beta u \tag{23}$$

where β is a constant.

3.2 Prices

Drawing upon the work of Kalecki (1971), we state that in an oligopolistic market firms set the price level (P) according to a mark-up (μ) over prime costs. Therefore, at a point in time, price level is given by

$$P = (1+\lambda)\frac{W}{a} \Rightarrow \frac{1}{1+\mu} = \sigma \tag{24}$$

Equation (24) demonstrates an inverse relationship between mark-up and the wage share.

At a point in time the price level is given by the equation (24), but over time we follow Dutt (1994) and hence the inflation rate can be given by

$$p = \gamma_m(\sigma - \sigma_c) \tag{25}$$

where p is the rate of inflation, that is, the inflation rate, $\gamma_m > 0$ is a parameter, and σ_c is the wage share desired by firms. Equation (25) states that the larger the gap between the actual wage share and the wage share desired by firms, the larger the gap between the actual mark-up and the mark-up desired by firms.

Given the introduction of interest in the model, the mark-up must be able to cover the profits of enterprises and interest payments. Hence, the mark-up and the wage share desired by firms change due to two factors, i.e., the capacity utilization and the interest payments, as follows

$$\sigma_c = \gamma_0 - \gamma_1 u - \gamma_2 i\lambda \tag{26}$$

where $\gamma_0, \gamma_1, \gamma_2 > 0$ are parameters. Firms will be able to set a higher mark-up and hence a lower σ_c if they increase their perception of their monopoly power. It is assumed here without loss of generality that $\gamma_1 > 0$, since a stronger demand increases the capacity utilization, and thus encourage firms to target a lower σ_c. Nonetheless, it is worth noting that Kalecki (1954) also argued that an increase in the excess capacity could induce firms to increase the mark-up because of an increase in overhead costs, thereby implying that $\gamma_1 < 0$. An increase in interest payments also increases the overhead costs, which may or may not induce firms to raise their mark-up. Here the mark-up is interest-elastic, as we are assuming $\gamma_2 > 0$.

Substituting equation (26) in (25), we obtain

$$p = \gamma_m(\sigma - \gamma_0 + \gamma_1 u + \gamma_2 i\lambda) \tag{27}$$

Equation (27) describes the extended inflation rate equation. If there exists excess capacity, then $u = u^*$, as discussed in equations (19) and (20). Since u^* is a function of σ, λ and i_{CB}, if we want to demonstrate the impact of the interest rate on the inflation rate, then we must be able to analyse first how changes in the interest rate set by the Central Bank affect the long-run dynamics between the wage share, σ, and the debt-capital ratio, λ.

3.3 The long-run dynamics between the wage share and the debt-capital ratio

Let us now take the differential of λ with respect to time. From equation (6), we have

$$\dot{\lambda} = \lambda(\dot{B} - g) \tag{28}$$

Since the variation in the credit granted to firms is equal to the rentier's saving, we have

$$\dot{B} = S_f = s_f \Pi_f = s_f iB \Rightarrow \frac{\dot{B}}{B} = s_f i = s_c i \tag{29}$$

Substituting (29), (21), (12), and (11) in (28), we have

$$\dot{\lambda} = \lambda s_c[(i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u^*) - (1 - \sigma)u^*] \tag{30}$$

It follows from equation (3) that the differential of the wage share with respect to time is given by

$$\dot{\sigma} = \sigma(w - p - \dot{a}) \tag{31}$$

where $\dot{a}$ are the rate of change of the labour productivity, a. Substituting (26), (25), (23), (22), and also assuming for simplicity that $\dot{a} = 0$, that is, the labour productivity remains constant over time, and $u = u^*$, we obtain

$$\dot{\sigma} = \sigma\{\beta_w(\beta u^* - \sigma) - \gamma_m[\sigma - \gamma_0 + \gamma_1 u^* + \gamma_2\lambda(i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u^*)]\} \tag{32}$$

In the long run both the wage share and the debt-capital ratio stabilise, that is, $\dot{\lambda} = \dot{\sigma} = 0$. Since both *loci* $\dot{\lambda} = \dot{\sigma} = 0$ yield equations of third degree, we can have up to three solutions of the non-linear dynamical system on the relevant domain. Hence, let us assume for convenience that there exists two distinct non-trivial solutions to the system, where $(\lambda, \sigma) = (\lambda_{E1} < \lambda_{max}, \sigma_{E1})$ and $(\lambda, \sigma) = (\lambda_{E2} > \lambda_{max}, \sigma_{E2})$ for all $\lambda \in \mathbb{R}^+$. It is worth noting that, by assuming $\lambda_E < \lambda_{max}$, we are saying that the financial structure of the firms is in the solvency region; if $\lambda_E > \lambda_{max}$, then firms are in the default region. That said, the Jacobian matrix of partial derivatives of the dynamical system constituted by equations (30) and (32) is given by

$$J_{11} = \frac{\partial \dot{\lambda}}{\partial \lambda} = s_c\{(i + \phi_1\lambda) - \phi_2\lambda u_\lambda^* - (1-\sigma)(u_\lambda^* + u^*)\} \lesseqgtr 0 \tag{33}$$

$$J_{12} = \frac{\partial \dot{\lambda}}{\partial \sigma} = -\lambda s_c\{[\phi_2 + (1-\sigma)]u_\sigma^* - u^*\} < 0 \tag{34}$$

$$J_{21} = \frac{\partial \dot{\sigma}}{\partial \lambda} = \sigma\{hu_\lambda^* - \gamma_m\gamma_2(i + \phi_1\lambda)\} \gtrless 0 \tag{35}$$

$$J_{22} = \frac{\partial \dot{\sigma}}{\partial \sigma} = h(u_\sigma^*\sigma + u^*) - 2(\beta_w\beta + \gamma_m)\sigma + \gamma_m\gamma_0 - \gamma_m\gamma_2\lambda(i + \phi_2 u^*) < 0 \tag{36}$$

where $h = \beta_w\beta - \gamma_m(\gamma_1 - \gamma_2\lambda\phi_2) > 0$, which means it is assumed that the responsiveness of wages $(\beta_w\beta)$ and market interest rate $(\gamma_m\gamma_2\lambda\phi_2)$ outweigh the elasticity of mark-up $(\gamma_m\gamma_1)$ to changes in the capacity utilization. In fact, none of the partial derivatives above can be unambiguously signed. Therefore, in order to examine the stability conditions of the system we must impose some constraints over the parameters.

Let us examine equation (33). Even though the sign of J_{11} can go either way, the stability condition of the partial differential (33) requires that an increase in the debt-capital ratio share reduces its own growth rate. Formally, this stability condition is satisfied if the following inequality holds: $(i + \phi_1\lambda) - \phi_2\lambda u_\lambda^* - (1-\sigma)(u_\lambda^* + u^*) < 0$. If the economy is in the solvency region on the relevant domain, that is, $\lambda_E < \lambda_{max}$, then it is more likely that this inequality will be satisfied, as $u_\lambda^* > 0$; it means that the positive impacts of an increase in the debt-capital ratio on investments exceed the increase in the premium risk. Alternatively, if the economy is in the default region, that is, $\lambda_E > \lambda_{max}$ and hence $u_\lambda^* < 0$, then it is more likely that J_{11} will be positive.

In equation (34) we assume the condition $[\phi_2 + (1-\sigma)]u_\sigma^* > u^*$ is satisfied, and hence the partial $J_{12} = \partial\dot{\lambda}/\sigma$ is negative. Given $u_\sigma^* > 0$, an increase in the capacity utilization caused by a raise in real wages encourage lenders to reduce the risk premium set over the Central Bank interest rate; increased real wages also contracts (expands) the rate of investments in a profit-led (wage-led) economy. Assuming without loss of generality that the economy is profit led, the inequality above is satisfied if the increase in the capacity utilization, induced by a redistribution of income in favour of labour, reduces more the risk premium and the market interest rate than it decreases the rate of capital accumulation. In a wage-led economy, on the other hand, it is more likely to find $J_{12} = \partial\dot{\lambda}/\sigma < 0$, as an increase in σ reduces i and increases g^* simultaneously.

Equation (35) is also ambiguously signed. Note that if the term $|\gamma_m\gamma_2(i + \phi_1\lambda)|$ is sufficiently large in absolute value, then the differential (35) is negative for all λ on the relevant domain. However, since we want to isolate the effect of increased indebtedness of firms on prices and capital accumulation, let us assume for convenience that $|hu_\lambda^*| > |\gamma_m\gamma_2(i + \phi_1\lambda)|$ for all $\lambda \in \mathbb{R}^+$. If this inequality is satisfied, and also assuming $h > 0$, then the sign of J_{21} depends exclusively on the sign of u_λ^*. It follows from equation (20) that if $\lambda < \lambda_{max}$, then $u_\lambda^* > 0$ and $J_{21} > 0$, which means that an increase in λ boosts u^* and hence raises more wages than prices; and if $\lambda_{max} < \lambda$, then $u_\lambda^* < 0$ and $J_{21} < 0$, implying that an increase in λ reduces u^* and hence lower more wages than prices.

Lastly, in equation (36), the sign of $\partial\dot{\sigma}/\sigma$ can go either way. However, the stability condition requires that an increase in the wage share reduces its own growth rate. Hence, the following condition must be satisfied: $h(u_\sigma^*\sigma + u^*) + \gamma_m\gamma_0 < \gamma_m\gamma_2\lambda(i + \phi_2 u^*) + 2(\beta_w\beta + \gamma_m)\sigma$. Please note that if the parameters measuring the speed of adjustment of the gaps between the actual wage share and the wage shares desired by workers and capitalists is large enough, β_w and γ_m, then the stability condition is fulfilled. A higher interest rate also helps to stabilise equation (36), as it increases mark-up and hence reduces the growth of real wages. Nonetheless, it is worth saying that satisfying this inequality is a necessary, but it is not sufficient condition to achieve stability for the whole system. It means that, even if a higher interest rate stabilises the equation (36), it does not necessarily stabilises the whole system of dynamical equations. In fact, as demonstrated below, it is the opposite, that is, a sufficiently high interest rate destabilises that system.

Let us analyse now the conditions under which the dynamical system is stable. Since, by assumption, $J_{11} < 0$, $J_{12} < 0$ and $J_{22} < 0$, we can say that the stability of the system depends on the sign of J_{21}. Thus, we must examine both cases, that is, $J_{21} > 0$ and $J_{21} < 0$.

In the solvency region, where $\lambda_E < \lambda_{max}$ and $u_\lambda^* > 0$, we have $J_{21} > 0$. Since the trace and the determinant of the Jacobian matrix constituted by the partials (33) – (36) are $Tr(J) = J_{11} + J_{22} < 0$ and $D(J) = J_{11}J_{22} - J_{21}J_{12} > 0$ respectively, the system is stable around the equilibrium point $(\lambda, \sigma) = (\lambda_{E1} < \lambda_{max}, \sigma_{E1})$. In the default region, on the other hand, $\lambda_E > \lambda_{max}$ and $u_\lambda^* < 0$, thus implying that $J_{21} < 0$. Note that if $u_\lambda^* < 0$, it is more likely that J_{11} will become positive. Therefore, assuming $J_{21} < 0$ and $J_{11} > 0$, the trace $Tr(J) = J_{11} + J_{22}$ cannot be unambiguously signed anymore. However, since the determinant $D(J) = J_{11}J_{22} - J_{21}J_{12}$ is negative, the equilibrium point $(\lambda, \sigma) = (\lambda_{E2} > \lambda_{max}, \sigma_{E2})$ is a saddle-point.

Figure 4 below presents the phase-diagram of the dynamical system. Both *loci* $\dot{\lambda} = \dot{\sigma} = 0$ can be represented by a third-degree equation. In equation (30), $\dot{\lambda} = 0$, the cubic term is positive, whereas in equation (32), $\dot{\sigma} = 0$, it is negative. In the solvency region, where we have $J_{21} > 0$, the *locus* $\dot{\lambda} = 0$ is downward sloping around the stable equilibrium point, as $-J_{11}/J_{12}$ is negative; whereas, given $J_{11} < 0$, the local slope of the *locus* $\dot{\sigma} = 0$, that is, $-J_{21}/J_{22}$, is positive around the stable equilibrium. In the default region, where $J_{21} < 0$ and $J_{11} > 0$, the *locus* $\dot{\lambda} = 0$ is upward sloping, since $-J_{11}/J_{12} > 0$; whereas the *locus* $\dot{\sigma} = 0$ in this region is now downward slopping around the solution of the system, and hence $-J_{21}/J_{22} < 0$ becomes positive.

[FIGURE 4]

Before we finish this subsection, we must pose the following question: what happens if the economy is in the saddle-point equilibrium? Any disturbance in the system that shifts the equilibrium solution to the left of λ_{E2} will make the system move towards the stable equilibrium in the solvency region. However, if any displacement in the equilibrium solution shifts the system to the right of λ_{E2}, then the system will fall into a trajectory of low wage share and ever-increasing debt-capital ratio. In this scenario, expansionary monetary and fiscal policies can bring the system back to the stable equilibrium in the solvency region. By reducing the benchmark interest rate the Central Bank simultaneously reduces the growth rate of loans and raises the firm's retained profit, thus boosting capital accumulation; ergo, the expansionary monetary policy reduces λ by decreasing $\dot{B}/B$ and increasing g^*. If we assume that α_0 in the aggregate investment function (13) is the government expending relative to the capital stock, then an expansionary fiscal policy increases the equilibrium capacity utilization, foments investments and hence also helps to reduce λ. Therefore, in an unstable economy, expansionary monetary and fiscal policies bring the system back to the solvency region by reducing the firm's indebtedness.

3.4 The impact of the interest rate on the wage share and the debt-capital ratio: a comparative static analysis

In this subsection we analyse how changes in the interest rate affects the wage share and the debt-capital ratio. To do this, we assume the parameters of the model satisfy the conditions of stability around the equilibrium point $(\lambda, \sigma) = (\lambda_{E1} < \lambda_{max}, \sigma_{E1})$ presented in Figure 4. That said, the dynamical system constituted by equations (30) and (32) in the *loci* $\dot{\lambda} = \dot{\sigma} = 0$ is given by

$$\dot{\lambda}\big| \quad 0 = \lambda s_c[(i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u^*) - (1-\sigma)u^*] \tag{37}$$

$$\dot{\sigma}\big| \quad 0 = \sigma\{\beta_w(\beta u^* - \sigma) - \gamma_m[\sigma - \gamma_0 + \gamma_1 u^* + \gamma_2\lambda(i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u^*)]\} \tag{38}$$

Taking the differential with respect to λ, σ and i_{CB}, and substituting the equations (33) – (36) in the differential, we have

$$J_{11}d\lambda + J_{12}d\sigma = -Adi_{CB} \tag{39}$$

$$J_{21}d\lambda + J_{22}d\sigma = -Bdi_{CB} \tag{40}$$

where, given $u_i^* < 0$, we have $A = \left[\lambda s_c(\sigma - \phi_2)u_{i_{CB}}^*\right] \gtrless 0$ and $B = \left(hu_{i_{CB}}^* - \gamma_m\gamma_2\lambda\right) < 0$.

If we rearrange the equations (39) and (40) in matrix notation and invert the system,[5] we obtain

$$\begin{bmatrix} d\lambda/di_{CB} \\ d\sigma/di_{CB} \end{bmatrix} = \frac{1}{2D(J)}\begin{bmatrix} J_{22} & -J_{12} \\ -J_{21} & J_{11} \end{bmatrix}\begin{bmatrix} -A \\ -B \end{bmatrix} \tag{41}$$

From (41) we obtain the simultaneous impact of a raise in the interest rate on the wage share and the debt-capital ratio. Here we must bear in mind that the determinant, $D(J)$, is positive, and that the stability condition implies $J_{11}, J_{12}, J_{22} < 0$ and $J_{21} > 0$. As we can see, the sign of the term A can go either way, which means we have two distinct possible cases, that is, $A > 0$, $B < 0$ and $A < 0$, $B < 0$. To keep it short, only the first case will be discussed in detail here without loss of generality. The alternative case is presented briefly in the appendix.

Therefore, given $A > 0$ and $B < 0$, the impact of a change in the interest rate on the wage share and the debt-capital ratio around the stable equilibrium point is given by

$$\frac{d\lambda}{di_{CB}} = \frac{1}{2D(J)}(J_{12}B - J_{22}A) > 0 \tag{42}$$

$$\frac{d\sigma}{di_{CB}} = \frac{1}{2D(J)}(J_{21}A - J_{11}B) \lesseqgtr 0 \tag{43}$$

See Figure 5 below for a qualitative analysis.

[FIGURE 5]

Figure 5 portrays the possible scenarios following from the differentials (42) and (43). The slopes of the curves in the *loci* $\dot{\lambda} = \dot{\sigma} = 0$ are essentially the same as in Figure 4.

We must now analyse how a raise in the interest rate shifts both curves $\dot{\lambda} = \dot{\sigma} = 0$. It follows from equation (39) that a change in the interest rate changes the intercept of the curve $\dot{\lambda} = 0$ at the rate $-A/J_{12} > 0$. In other words, a raise in the interest rate shifts the curve $\dot{\lambda} = 0$ upwards. From equation (40) it can be seen that an increase in the interest rate shifts the curve $\dot{\sigma} = 0$ downwards, as $-B/J_{22} < 0$.

Let us first analyse the unequivocal direct relationship between the interest rate and the debt-capital ratio in Figure 5. As for the relationship between interest rate and debt-capital ratio, $\lambda = B/K$, we must keep in mind that, given $\dot{B} = s_f i = s_f(i_{CB} + \phi_0 + \phi_1\lambda - \phi_2 u^*)$, an increase in the benchmark interest rate (i_{CB}) by the Central Bank always increases the growth rate of the firms' outstanding debt, as $\partial\dot{B}/\partial i_{CB} = s_f\left(1 - \phi_2 u_{i_{CB}}^*\right) > 0$ where $u_{i_{CB}}^* < 0$. Besides, in equation (21), it is demonstrated that an increased interest rate impacts negatively on the equilibrium investment rate $\left(g_{i_{CB}}^* < 0\right)$, as it reduces the capacity utilization $\left(u_{i_{CB}}^* < 0\right)$ and the retained profits of firms by increasing the interest payments in favour of rentiers. Ergo, an increased interest rate expands B, reduces g^*, and hence unequivocally raises the debt-capital ratio λ.

Now we examine the ambiguous impact of the interest rate on the wage share as presented in Figure 5. Let us examine first the impact of changes in the capacity utilization on the wage share. Since we assume that wages plus the risk premium are more elastic than prices to changes in the capacity utilization, that is, $h > 0$, the partial effect of an increase (decrease) in the capacity utilization also increases (decreases) the wage share. We know from equation (20) that the partial impact of an increased interest rate on the capacity utilization is negative, $u_{i_{CB}}^* < 0$; on the other hand, as the curve $\dot{\lambda} = 0$ moves upwards along the

[5] Let **A** be a 2x2 matrix and **x** and **b** be 2x1 matrices. If it is so, then the non-trivial solution of the linear system **Ax**=**b** is given by **x**=**A**$^{-1}$**b**, where **A**$^{-1}$ $= (1/D(\mathbf{A}))adj\mathbf{A}$.

curve $\dot{\sigma} = 0$ after an increase in the interest rate, λ raises and affects positively the capacity utilization, $u_\lambda^* > 0$, in the solvency region, as also demonstrated in equation (20). Therefore, the net effect of interest rate shocks on the rate of capacity utilization is ambiguous. If the net impact of an increased interest rate on the capacity utilization is negative, then real wages drop and income is redistributed in favour of capitalists. Moreover, the increase in λ and i also increases the firms' overhead costs, forcing entrepreneurs to set a higher mark-up over prime costs which, in turn, leads to higher inflation and reinforces the fall in the real wages. In Figure 5, this is the case where an increase in the interest rate shifts the initial equilibrium towards the solution $(\lambda, \sigma) = (\lambda_E', \sigma_E')$. Contrastingly, if the positive partial effect of an increased debt-capital ratio on the capacity utilization, u_λ^*, is sufficiently large so that it overcompensates the negative partial effect of i_{CB} on real wages, then a raise in the interest rate can in fact increase real wages, and hence the wage share. This case is a theoretical possibility, even though, from experience, it seems highly unlikely that a raise in the interest rate also raises the wage share. We have this scenario when the initial equilibrium is displaced towards the solution $(\lambda, \sigma) = (\lambda_E'', \sigma_E'')$, as portrayed in Figure 5, after a raise in the interest rate.

3.5 The net impact of an interest rate shock on the long-run inflation rate

This subsection seeks to examine the conditions under which Central Banks can efficiently use interest rates to steer price increases. To do so, we analyse the transmission channels through which an interest rate shock affects the inflation rate. Equation (27) describes the inflation rate as a function of the wage share, the debt-capital ratio, and the interest rate. By taking the differential of the inflation rate with respect to the interest rate we have

$$\frac{dp}{di_{CB}} = \frac{\partial p}{\partial \sigma}\frac{d\sigma}{di_{CB}} + \frac{\partial p}{\partial \lambda}\frac{d\lambda}{di_{CB}} + \frac{\partial p}{\partial i_{CB}} \tag{44}$$

where $\partial p/\partial \sigma = (1 + \gamma_1 - \gamma_2 \lambda \phi_2)u_\sigma^*$, $\partial p/\partial \lambda = [(\gamma_1 - \gamma_2 \lambda \phi_2)u_\lambda^* + \gamma_2(i + \lambda \phi_1)]$, and $\partial p/\partial\, i_{CB} = (d\sigma/di_{CB}) + \gamma_2 \lambda + (\gamma_1 - \gamma_2 \lambda \phi_2)u_{i_{CB}}^*$. Since none of the partial differentials are unambiguously signed, we must set some constraints over the parameters. By assuming $\partial p/\partial \sigma > 0$, we are saying that, in equilibrium, the partial effect of a raise in the wage share on the inflation rate is positively, as the wage increases the prime costs of the firms. If $\partial p/\partial \lambda > 0$, then the partial effect of an increase in the debt-capital ratio also increases the amount of interest payments from firms to rentiers, thus forcing the former to raise the mark-up. Lastly, let us assume, for simplicity, that the absolute value of $\partial p/\partial\, i_{CB}$ is negligible.

Equation (44) shows that the net impact of a raise in the interest rate on prices is ambiguous. Let us assume, without loss of generality, that an increase in the interest rate displaces the initial equilibrium solution (λ_E, σ_E) towards the new equilibrium $(\lambda_E', {\sigma_E}')$ instead of $(\lambda_E'', \sigma_E'')$, as shown in Figure 5. That said, we want to know the net impact of an interest rate shock on inflation when such an increase in the interest rate raises the debt-capital ratio, $\lambda_E' - \lambda_E > 0$, and reduces the wage share, $\sigma_E' - \sigma_E < 0$ simultaneously. In this case, the Central Banks can only reduce inflation by raising interest rates if the following condition is satisfied

$$(1 + \gamma_1 - \gamma_2 \lambda \phi_2)u_\sigma^* \left|\frac{d\sigma}{di_{CB}}\right| > [(\gamma_1 - \gamma_2 \lambda \phi_2)u_\lambda^* + \gamma_2(i + \lambda \phi_1)]\frac{d\lambda}{di_{CB}} \tag{45}$$

that is, if $dp/d\, i_{CB} < 0$, then the inequality (45) is fulfilled. From equations (42) and (43) we know that, when the solution of the system shifts from (λ_E, σ_E) towards $(\lambda_E', {\sigma_E}')$, we have $d\sigma/di_{CB} < 0$ and $d\lambda/di_{CB} > 0$. Please note that if the initial level of the market interest rate is sufficiently high, then the right-hand side of the inequality (45) becomes greater than the left-hand side, and hence the condition above is not fulfilled. It means that the simple use of interest rates as a monetary policy tool to control inflation is self-undermining. That is, if Central Banks successively raise the benchmark interest rates, then firms will be forced to increasingly set higher mark-ups over prime costs, hence boosting inflation. Furthermore, countries with a sufficiently high initial level of interest rates might not be able to promote a successful reduction in inflation by raising interest rates, if such an initial level of the market interest rate does not fulfill the condition (45). This case is of paramount importance for undeveloped countries, such as Brazil and Turkey for instance, where interest rates tend to be exceedingly high. The same conclusions we drew for the initial level of interest rates also hold for the initial level of the debt-capital ratio, as the greater the λ, the lesser the left-hand side of inequality (45). It basically means that if firms in the economy are heavily indebted, then an increase in the interest rate also increases the interest payments from firms to rentiers, which forces the formers to raise mark-ups and prices.

Figures 6 and 7 below illustrate two possible scenarios we can obtain when a raise in the benchmark interest rate reduces the wage share and increases the debt-capital ratio. Based on a linear approximation described in equation (44), in the first quadrant we plotted the iso-inflation curves in the system (λ, σ). Note that, for convenience, we assume that $\partial p/\partial\, i_{CB}$ is negligible. If $\partial p/\partial\, i_{CB} < 0$, for instance, then an increase in the interest rate reduces the value of the iso-inflation curve for constant levels of the wage share and debt-capital ratio. By assuming that $(\gamma_1 u_i^* + \gamma_2 \lambda) = 0$, we are also assuming that changes in the interest rate do not affect the values of the iso-inflation curves.

That said, since $-\{[(\gamma_1 - \gamma_2 \lambda \phi_2) u_\lambda^* + \gamma_2 (i + \lambda \phi_1)]/(1 + \gamma_1 - \gamma_2 \lambda \phi_2) u_\sigma^*\} < 0$, the iso-inflation curve is downward slopping. Note that, other things equal, the more sensitive prices are to changes in the wage share (debt-capital ratio), the more gradual (steeper) the iso-inflation curve. The second and fourth quadrants only portray the relationship between interest rate and wage share and debt-capital ratio, respectively, as observed in Figure 4.

The first scenario in Figure 6 portrays the case where the Central Bank effectively reduces inflation by raising the interest rate.

[FIGURE 6]

In this case, the Central Bank successfully manages to bring the inflation back to the target.

Figure 7, on the other hand, presents the scenario where an increased interest rate actually reinforces the inflationary trend in prices.

[FIGURE 7]

In this scenario, an expansionary monetary policy might be able to reduce inflation, as the debt-capital ratio is more responsive to interest rate shocks than the wage share. That is, the negative impact of a decrease in the benchmark interest rate on the debt-capital ratio outweighs the positive impact on the wage share and hence reduces inflation. Contrastingly, the effect of an expansionary fiscal policy on prices is ambiguous. As discussed in the end of the subsection 3.3, an increase in the government expenditure relative to the capital stock reduces λ. It follows from the inequality (45) that a decrease in λ increases the left-hand side of the inequality; however, the impact of a reduced λ on the right-hand side of the inequality is ambiguous. Moreover, an increase in government spendings, α_0, would also affect the values of the partials u_σ^* and u_λ^*, thereby making it more difficult to evaluate the impact of an expansionary fiscal policy on changes in the long-term inflation rate.

4 Summary

This paper developed a formal model to account for the net impact of a raising interest rate on long-term inflation. Here we identify two basic transmission channels through which monetary policy affects prices: i) a raise in interest rates is more likely to decrease unit labour costs by reducing wages; ii) an interest rate shock is more likely to expand overhead costs by increasing interest payments. The net impact of a contractionary monetary policy on long-term inflation, then, depends on the relative responsiveness of prices to changes in the wage share and interest payments. Thus, inflation is the result of distributive conflict between workers, entrepreneurs and rentiers for a larger share of national income.

By introducing the idea that interest rate shocks also affect the amount of credit granted to firms, we demonstrate how changes in debt payments from firms to rentiers impact on firms' overhead costs and hence inflation. In a scenario where decision makers face fundamental uncertainty, firms and commercial banks tend to form different expectations about the future, which usually leads to credit rationing since banks tend to be more risk-averse than firms. Moreover, nothing guarantees *a priori* that the market-clearing amount of loans set by borrowers and lenders yields a sustainable trajectory of capital accumulation and inflation over time. In the case of a financially unstable system, we demonstrate that a mix of expansionary fiscal and monetary policies can bring the economy back to a stable path of capital accumulation and inflationary process.

It is worth noting that this is a closed economy model. In an open economy, given that relative prices do not change in the long run, the firms would hardly be able to pass on rising costs to prices indefinitely. This would squeeze the profitability of domestic firms and undermine the accumulation of capital in the long run. However, we leave the analysis of the open economy for future research.

In short, we can say that our model raises a critique with respect of the ability of central banks to effectively achieve the inflation target in the long run. In the New Consensus Macroeconomics there is a clear-cut difference between the short and the long run. The NAIRU, according to this paradigm, is a long-run equilibrium rate of unemployment which depends exclusively on structural factors and hence is not subjected to short-run fluctuations. However, as demonstrated here, the equilibrium employment rate, which is a function of the capacity utilisation, depends on the dynamics of indebtedness of firms over time. Prices are also affected by multiple factors, such as the labour cost, the level of mark-up set by firms, and market interest rates. Therefore, our model suggests that the inflation target set by the central bank may not be constant since the equilibrium employment rate, wages, firms' mark-up and market interest rates (liquidity and risk premium) also vary over time.

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Appendix

If and $A < 0$, $B < 0$, then:

$$\frac{d\lambda}{di_{CB}} = \frac{1}{2D(J)}(J_{12}B - J_{22}A) \lesseqgtr 0$$

$$\frac{d\sigma}{di_{CB}} = \frac{1}{2D(J)}(J_{21}A - J_{11}B) < 0$$

The formal result can be illustrated by the figure below:

[FIGURE APPENDIX]

FIGURES

Figure 1 – The structuralist view with full accommodation of the money supply (Hein, 2008)

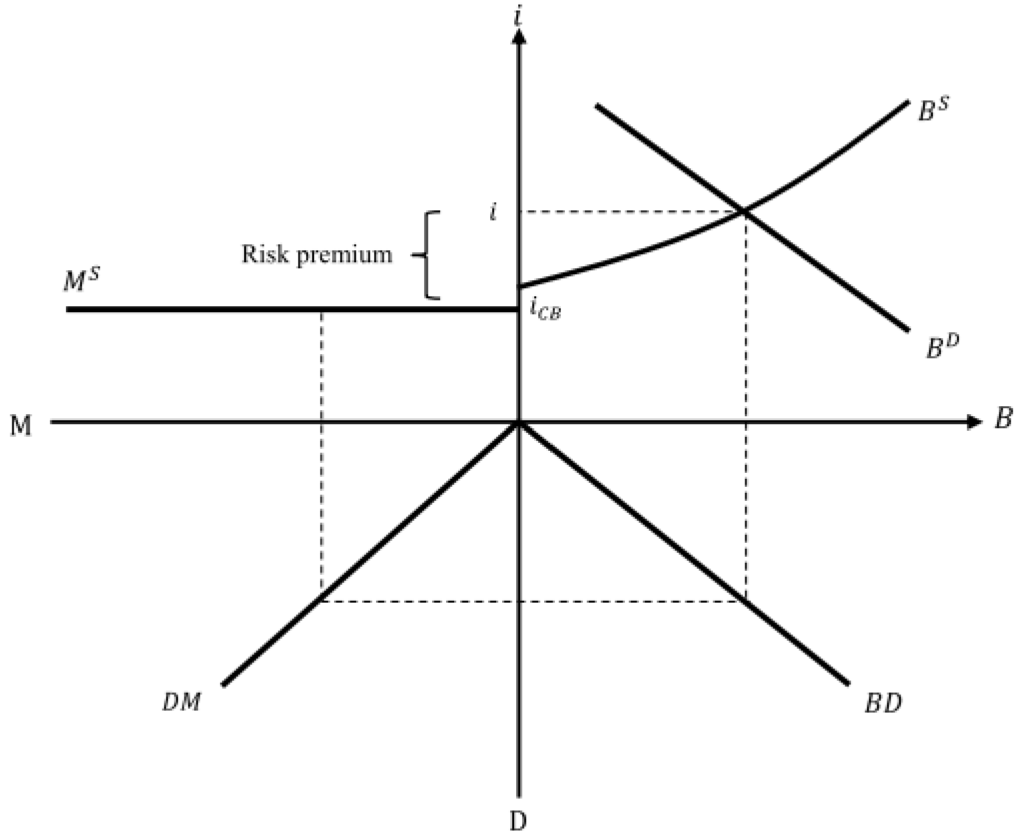


Figure 2 – Notional and effective demand curves for loans and the endogenous money supply curve

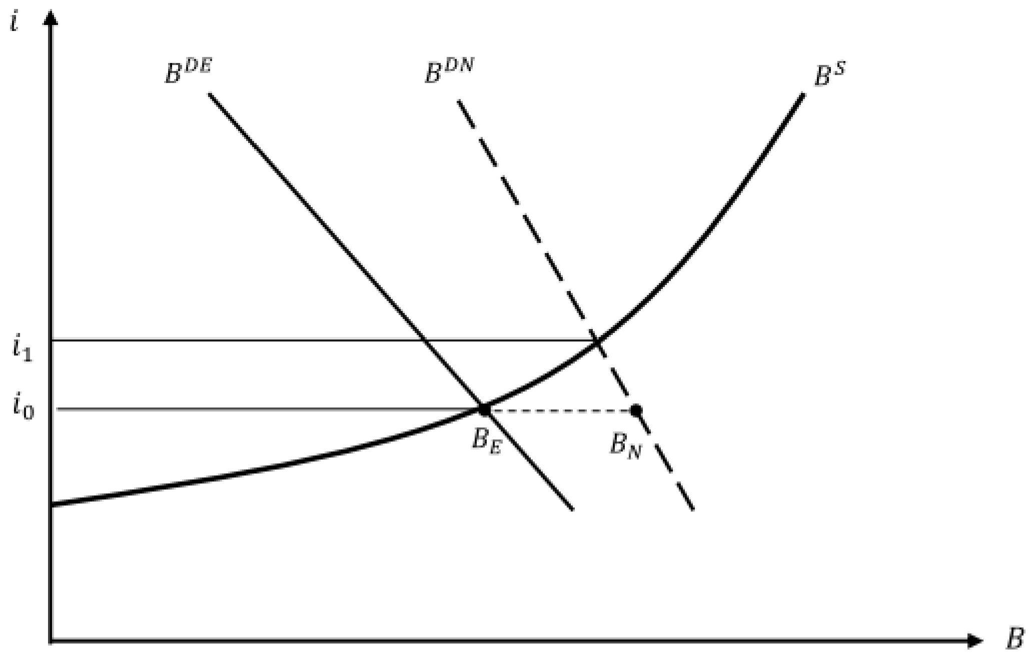


Figure 3 – Debt-capital ratio and capital accumulation

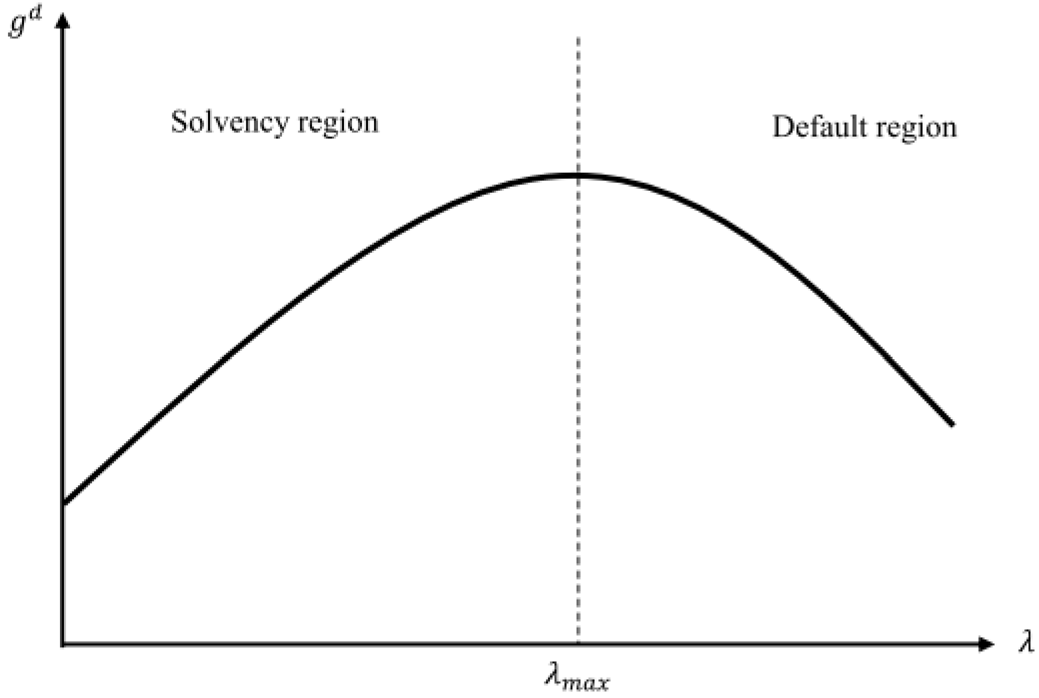


Figure 4 – The dynamical system between the debt-capital ratio and the wage share

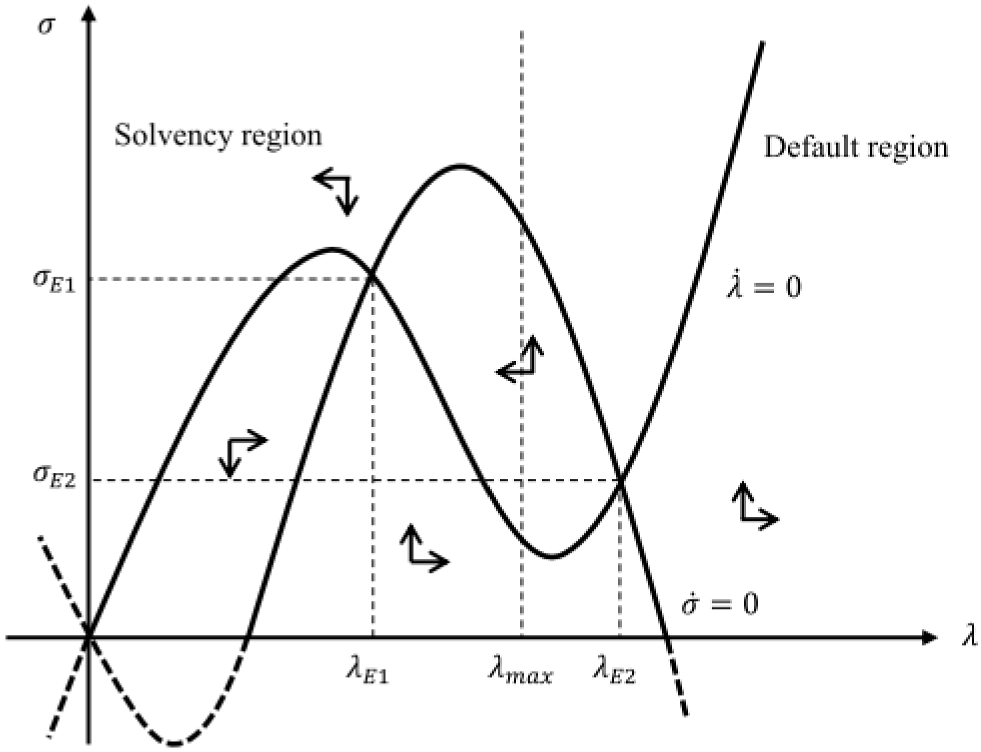


Figure 5 – The impact of a raise in the interest rate on the wage share and debt-capital ratio

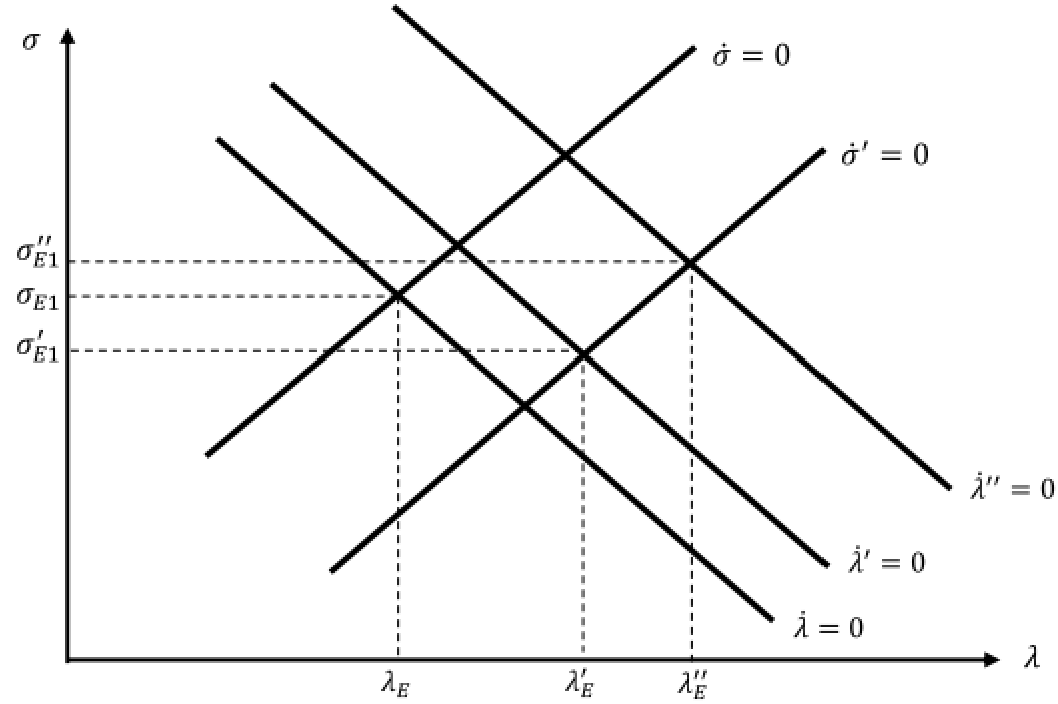


Figure 6 – Effective monetary policy

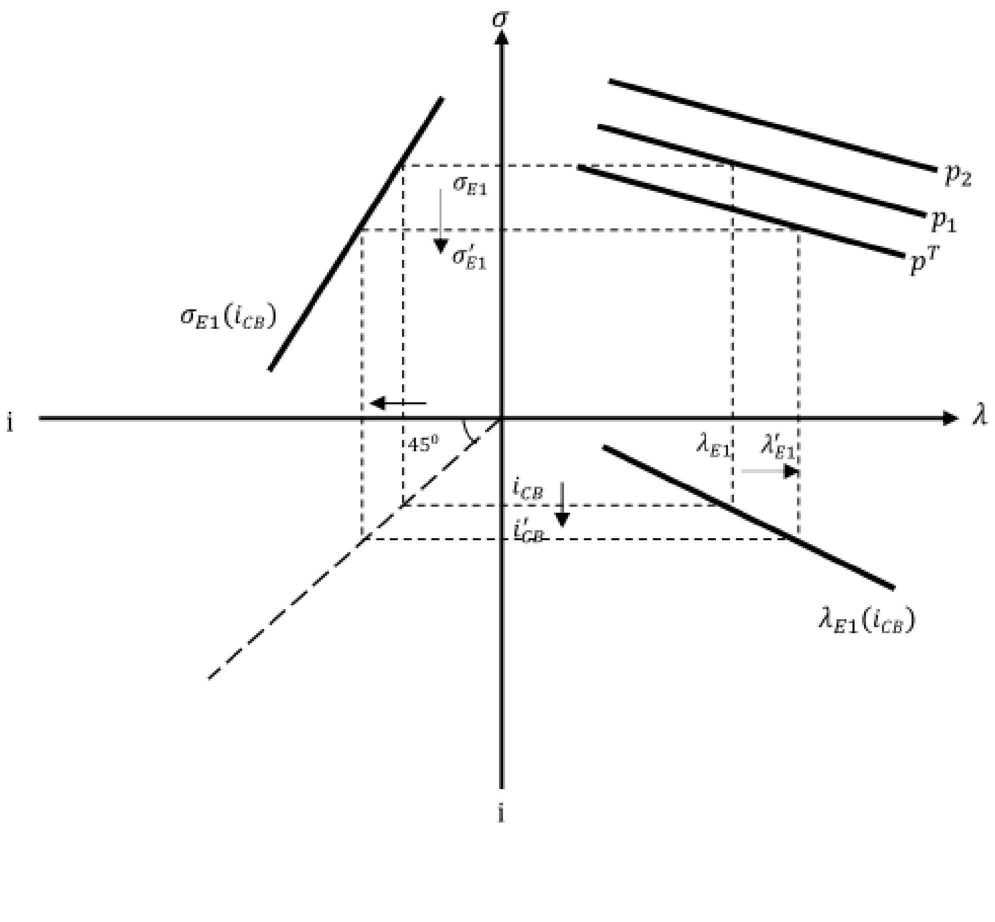
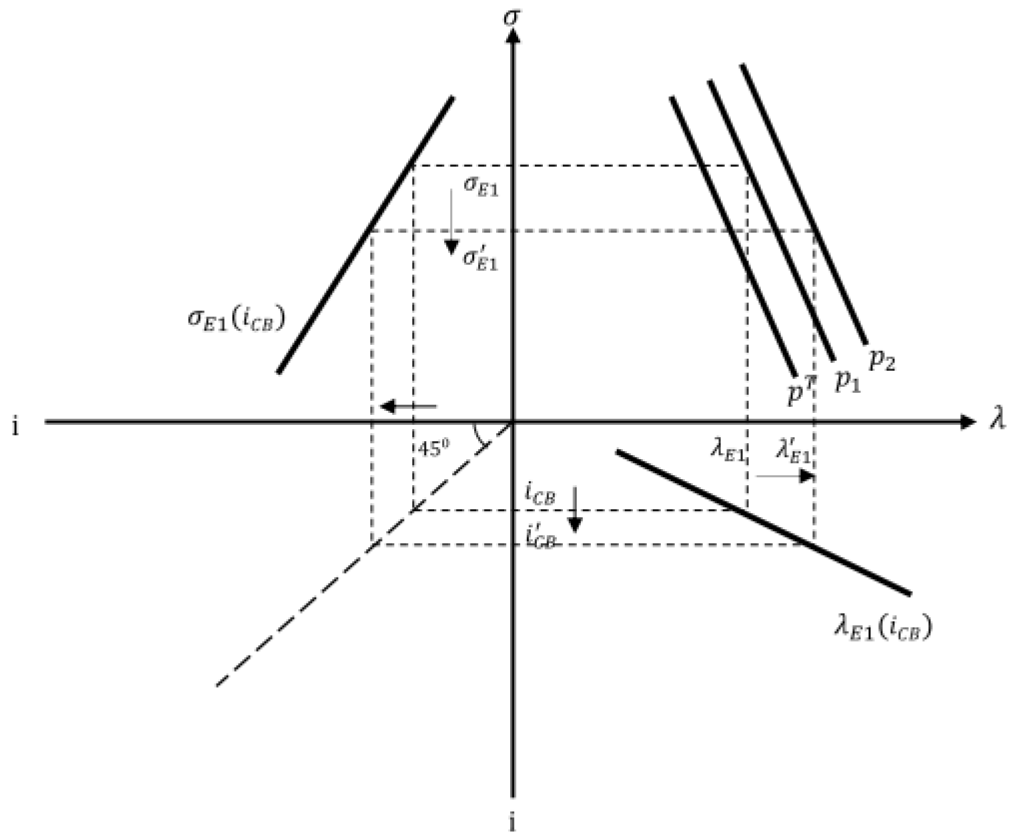


Figure 7 – Adverse monetary policy



Appendix – The impact of a raise in the interest rate on the wage share and debt-capital ratio