A TWO-SECTOR MODEL WITH TARGET-RETURN PRICING
IN A STOCK-FLOW CONSISTENT FRAMEWORK

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ABSTRACT 

The aim of the present paper is to build a generalized Kaleckian two-sector model with a consumption sector and an investment sector in a closed economy, on the one hand, and to explore long-run relationships with short-period and medium-period dynamics towards long-run positions, on the other hand. The model suggested here incorporates conflicting claims of labour and firms over income distribution and endogenous labour-saving technical progress. Adopting a stock-flow consistent framework that has been developed recently by Godley and Lavoie, our experiments yield interesting results as follows. First, the ‘paradox of thrift’ and the ‘paradox of costs’ would still hold, but the impact would be smaller than that in a model without conflicting-claims inflation and endogenous labour-saving technical progress. Second, the initial status of income distribution and monetary policy could play a crucial role in determining the magnitude of the impact, and those might make paradoxes disappear. Finally, changes in autonomous labour-saving innovation might explain the phenomenon of the “new economy” of the second half of 1990s within an alternative framework. Our model, therefore, reinforces a post-Keynesian growth theory where aggregate demand is the most crucial determinant of long-run positions as well as short-run positions, and shows that economic growth is demand-led, rather than supply-led, characterized by the ‘path-dependency’.
INTRODUCTION

For decades, Kaleckian growth models have contributed to the development of post Keynesian demand-led theory of growth, in which effective demand plays a crucial role in determining both short-period and long-period positions of economic activity. A Kaleckian growth model is characterized by an investment function independent of saving, a mark-up pricing formula and the existence of excess capacity. In a canonical Kaleckian model such as that of Amadeo (1986a), Dutt (1990), Lavoie (1992) and Rowthorn (1981), the realized rate of capacity utilization is endogenously determined by effective demand, and actual is not necessarily equal to the normal or standard degree of utilization, which is given exogenously, even in the long run. With the existence of undesired excess capacity, a low propensity to save and high real wages are associated with faster rates of capital accumulation in the long run (‘demand-led’ and ‘wage-led’ growth), in contrast to results shown in Classical models. However, while the Kaleckian framework has been popular in various one-sector models, there are very few multi-sector models.¹

The aim of the present paper is to build a generalized Kaleckian two-sector model with a consumption sector and an investment sector, on the one hand, and to explore long-run relationships with short-period and medium-period dynamics towards long-run positions, on the other hand. Whereas most of Kaleckian literature uses a simple investment function and a simple mark-up pricing, in the present paper we adopt more realistic behavioural equations, both for investment, in line with Lavoie and Godley (2001-2002), and for pricing, with a target-return pricing formula in line with Lavoie and Ramírez-Gastón (1997). The model also incorporates conflicting claims of labour and firms over income distribution and endogenous labour-saving technical progress.

In the present paper, in addition, we use a stock-flow consistent framework that has been developed recently by Godley and Lavoie.² A coherent stock-flow framework allows

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¹ A reason might come from the fact that Kaleckians in general use specific behavioral equations so that in a multi-sector model those make the system very complex. Under the author’s knowledge, exceptional studies could be found only in Dutt’s (1988) and Lavoie and Ramírez-Gastón’s (1997) two-sector models.

² For instance, see Godley (1996; 1999), Godley and Lavoie (2004; 2005), Lavoie (2001) and Lavoie and Godley (2001-2002). This approach has also been developed by several authors such as Dos Santos (2002; 2004) and Dos Santos and Zezza (2005).
us to construct a logically consistent model in the sense that ‘every flow comes from somewhere and goes somewhere’ (Godley, 1996, p. 7). Since there exist no ‘black holes’ in stock-flow accounting matrices both in flows and in stocks, as Zezza and Dos Santos (2004, p. 184) point out, these ‘frameworks not only provide a concise description of the model, but also offer a mechanism to check the consistency of its theoretical hypotheses’. Furthermore, a model presented in this framework provides fully explicit traverses towards long-run positions, that is, short-period and long-period dynamics reflecting feedback effects between stocks and flows (Turnovsky, 1977, p. xi). Therefore, adopting a stock-flow consistent framework, we can precisely examine long-run relationships and dynamics through simulation.

With conflicting-claims inflation and endogenous labour-saving technical progress, our experiments yield interesting results as follows. First, the ‘paradox of thrift’ and the ‘paradox of costs’ would still hold in the present model, but the impact would be smaller than that in a model without conflicting-claims inflation and endogenous labour-saving technical progress because of inflation pressure. Second, the initial status of income distribution and monetary policy could play a crucial role in determining the magnitude of the impact, and those could make paradoxes disappear. Finally, changes in autonomous labour-saving innovation might explain the phenomenon of the “new economy” of the 1990s, but within an alternative framework.

The paper consists of the following sections. The next section presents social accounting matrices with assumptions, and the second section describes the behavioral equations of our model. In the third section, through simulations, we explore changes in the long-run positions and the traverses towards those, when exogenous variables in the model of the present paper are changed in a growing economy. The last section is a summary and conclusion.

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3 A stock-flow coherent approach fulfills the features of a consistent framework proposed by Tobin (1982) to reconstruct Keynesian macro models: precision regarding time, tracking of stocks, several assets and rates of return, modeling of financial and monetary policy operations, and adding-up constraints.
I. SOCIAL ACCOUNTING FRAMEWORK

To keep the model simple, we assume the following:

a) The economy consists of a consumption good sector (denoted \(i = 1\)), an investment good sector (denoted \(i = 2\)), a household sector, and a banking sector: there is neither a foreign sector nor a government sector.

b) There are two factors to produce goods: fixed capital and labour.

c) There is no overhead or fixed labour.\(^4\)

d) The investment good is a basic good which is non-transferable between both industrial sectors, and accumulated capital stocks in each industrial sector have no depreciation and constant efficiency.

e) Firms have excess capacity,\(^5\) but no inventory.

f) Firms issue equities and borrow money from banks to finance investment, but they neither hold money balances nor issue bonds.

g) Households take no loans, and make portfolio decisions between equities and money balances.

h) The economy is a ‘pure credit economy’.

i) Banks have zero net worth, i.e., the rate of interest on money deposits is the same as the rate of interest on loans, and there is no operating cost for the banking sector.

j) The rate of interest on bank loans is the same in both industrial sectors.

< Table 1 > Here

< Table 1 > presents the balance sheet matrix (or the stock matrix) of this economy, in which assets appear with positive signs and liabilities with negative signs, and ‘supply’ and ‘demand’ are denoted as subscripts ‘\(s\)’ and ‘\(d\)’ respectively. All rows sum to zero, except for values of tangible capital in both industrial sectors because each financial asset

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\(^4\) The presence of overhead labour might play an important role, because changes in income distribution between direct and overhead labour could have a significant impact on economic activity (Dutt, 1992; Lavoie, 1996b). This subject remains for further research.

\(^5\) The excess capacity exists because of various reasons such as expectation of demand states, entry barriers, cost minimization and time-taking production (Lavoie, 1992, pp. 124-126). If an economy arrives at a higher rate of capacity utilization than full (or maximum) capacity, there may exist ‘forced saving’, which means ‘crowding-out of consumption by a greater injection of investment demand … whereby the extra saving effort is extracted by income redistribution’, through an increase in costing margins and prices (Taylor, 2004, p. 51).
has its counterpart financial liability. The last column presents the net worth of each sector.

<Table 2> Here

The transaction matrix (or the flow matrix) is presented in <Table 2>, which illustrates all flows of current and capital transactions (‘logical interrelations’) within a given period. The sources of funds appear with positive signs and uses of funds with negative signs. Each column presents the budget constraint of each sector.

From the first column, the nominal regular income of households $Y_{hr}$ is defined as

$$Y_{hr} \equiv (W_{s,1} + W_{s,2}) + (F_{D,1} + F_{D,2}) + r_{m(-1)}M_{d(-1)} \quad --- (1)$$

where $W_s$ is the nominal wage bill, $F_D$ dividends distributed to households, $r_{m(-1)}$ the rate of interest on money deposits which is set and contracted in the previous period, and $M_{d(-1)}$ the stock of liquid deposits held at the end of the previous period. By assumption, since the wealth of households $V$ is the sum of money holdings and the value of equity holdings, $V \equiv M_d + (e_{d,1}p_{e,1} + e_{d,2}p_{e,2})$ where $e_d$ and $p_e$ are the number of equities and their price, and changes in money stock held by households can be written as

$$\Delta M_d \equiv \Delta V - (\Delta e_{d,1}p_{e,1} + \Delta e_{d,2}p_{e,2}) - (CG_1 + CG_2) \quad --- (2)$$

Capital gains on equities at the beginning of the period $CG$ and a change in wealth $\Delta V$ are defined respectively as

$$CG_i \equiv \Delta p_{e,1}e_{d,i(-1)} \quad --- (3)$$

$$\Delta V \equiv Y_{hr} - C_d + (CG_1 + CG_2) \quad --- (4)$$

where $C_d$ is consumption demand in nominal terms.

From the second and the fourth columns of <Table 2>, the identity between national product and national income is satisfied such that

$$C_s + (p_1I_{s,1} + p_2I_{s,2}) \equiv (W_{d,1} + W_{d,s}) + (F_{T,1} + F_{T,2})$$

where $p_1I_s$ is investment and $F_T$ total profits. Since total profits are divided into dividends, retained earnings $F_U$ and interest commitments on bank loans up to the end of previous period $r_{l(-1)}L_{d(-1)}$, retained earnings in sector $i$ can be written as

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6 Capital gains do not appear in the transaction matrix while they are embodied as a change in the net worth of each sector (i.e. net worth of households and firms in this model) in the balance sheet matrix.
where \( r_{l(-1)} \) is the rate of interest on loans which is set in the previous period.

From the third and fifth columns in Table 2, the financial constraint of a firm is

\[
\Delta L_{d,i} = p_{2} I_{d,i} - F_{U,i} - \Delta e_{s,i} p_{e,i} \quad --- (6)
\]

where the additional borrowing from banks plays the role of a residual in the investment finance of firms in both sectors - the ‘residual buffer finance’ (Godley, 1996).

As in Lavoie and Godley (2001-2002, p. 283), we postulate a ‘pure Wickselian credit economy, where all money takes the form of bank deposits’. Hence, the balance sheet of banks is

\[
M_{s} = L_{s,1} + L_{s,2} \quad --- (7)
\]

Since an assumption in the present model is that the rate of interest on money deposits is equal to that on bank loans, we have

\[
r_{m} = r_{l} \quad --- (8)
\]

so that the flow accounting constraint of the banking sector is necessarily satisfied, i.e., \( r_{m} M_{s} = r_{l} (L_{s,1} + L_{s,2}) \).

II. BEHAVIORAL RELATIONSHIPS

2.1 Firms

The distinguishable features of Kaleckian growth models are markup pricing, the investment function being independent of savings and the rate of capacity utilization being below unity even in the long run (Lavoie, 1992, p. 297; 1995).

We assume that firms in both industrial sectors set prices of their products, in particular following target-return pricing procedures, in line with Lavoie and Ramírez-Gastón (1997). While many Kaleckian models assume that a costing margin is applied to average direct costs, i.e., simple markup pricing, empirical studies show that most firms set

\[\text{Kalecki (1954, pp. 11-12) distinguishes ‘cost-determined’ from ‘demand-determined’ prices: the former is applied to most finished goods in modern capitalism, while the latter is adopted only to raw materials.} \]
prices on the basis of standard unit costs, i.e., normal cost pricing (Lee, 1994; 1998). Target-return pricing is a specification of normal cost pricing (Lavoie, 1992, p. 131) and its formula is based on a standard rate of profit corresponding to a standard rate of capacity utilization. In addition to its realistic feature, target-return pricing allows explicitly for the intersectoral dependence of cost margins among sectors (Lavoie and Ramírez-Gastón, 1997, p. 150).

To derive the target-return pricing formula, first let us consider a simple markup pricing rule which can be described for each sector as

\[ p_1 = (1 + \theta_1)w\alpha_1 \quad (9.1) \]
\[ p_2 = (1 + \theta_2)w\alpha_2 \quad (9.2) \]

where \( \theta \) is the costing margin, \( \alpha \) the ratio of labour-output and \( w \) the rate of nominal wage. We assume that nominal wage rates are the same in both sectors and that all wages are simultaneously changed in the same proportion.

The demand for labour \( N_d \), the nominal labour wage \( W_s \) and the actual real output \( S \) are defined respectively as

\[ N_{d,i} \equiv \alpha_i S_i \quad (10) \]
\[ W_{s,i} \equiv w N_{s,i} \quad (11) \]
\[ S_i \equiv C_i / p_i \quad (12.1) \]
\[ S_2 \equiv S_{2,1} + S_{2,2} \equiv I_{s,1} + I_{s,2} \quad (12.2) \]

where \( N_s \) is the supply of labour.

From the assumption of target-return pricing, standard sales \( S^s \) corresponding to the standard (or normal) degree of capacity utilization of each sector \( u^s \) must provide enough

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8 In his study through interviews with entrepreneurs, Lanzillotti finds that ‘About one-half of the companies explicitly indicated that their pricing policies were based mainly upon the objective of realizing a particular rate of return on investment … and the margins added to standard costs are designed to produce the target profit rate on investment, assuming standard volume to be the long-run average rate of plant utilization’ (Lanzillotti, 1958, p. 923).

9 Clifton (1977, p. 143) and Steedman (1992, pp. 131-132) criticizes simple markup pricing by claiming that it does not or cannot take into account the mutual dependence of markups among industries, for instance, in Dutt’s (1988) model. The present model constitutes an implicit answer to their critique. In addition, target-return pricing allows us to introduce an adjustment mechanism towards fully adjusted positions, as adopted by Lavoie (1995; 1996a; 2003).
profits to fulfill the firms’ target rate of return \( r^i \). Full-capacity output \( S_{fc,i} \) and the standard sales are defined respectively as

\[
S_{fc,i} = K_{i(-1)}/\sigma_i \quad --- (13)
\]

\[
S_i^* = u_i^* S_{fc,i} \quad --- (14)
\]

where \( \sigma \) is the capital to full-capacity output ratio which is exogenously given by the technology in the present model.

Equating the two equations that define total profits targeted by firms in sector \( i \),

\[
F_{T,i}^* = \theta_i w_i^* \alpha^* S_i^* = r_i^* p_{2(-1)}^* K_{n(-1)}^{*}, \quad 10
\]

the costing margin of each sector is derived

\[
\theta_1 = \sigma_i \alpha_i r_i^* u_i^*/\left[\alpha_i u_i^*(u_i^* - \sigma_i r_i^*)\right] \quad --- (15.1)
\]

\[
\theta_2 = \sigma_2 r_2^*/(u_2^* - \sigma_2 r_2^*) \quad --- (15.2)
\]

The condition ensuring positive costing margins (and hence positive prices) is \( u_i^* > r_i^* \sigma_2 \) for each sector.\(^{11}\) Note that a costing margin (and hence pricing) in the consumption sector depends on pricing in the investment sector. An increase in the price of investment goods leads to a higher costing margin in the consumption sector, because firms in the latter sector would try to offset losses due to the increased purchasing price of investment goods by raising their cost margin, for a given target rate of return.

Now let us consider the inflation process. While neo-classical economists view inflation as a monetary phenomenon, most post-Keynesians describe inflation as a result of conflicting claims of different economic classes over income distribution.\(^{12}\) According to the latter, prices relative to wage rates are influenced by the bargaining power of trade unions which restrains firms from passing along wage rate increases to prices. In other

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10 For the sake of simplicity, we use total profits prior to the payment of interest, while Duménil and Lévy (2002, p. 421) suggest the use of profits before interest payments for individual firms but the use of profits after interest payments for industries.

11 This condition will necessarily be fulfilled when the total output in the investment sector is greater than the share of entrepreneurs in that sector, i.e., since \( S_{i} > r_i^* K_{z} \), the condition \( u_i^* > r_i^* \sigma_2 \) will be fulfilled by equations (13) and (14).

12 According to Kalecki (1962), the quantity theory can be associated only with the state of hyperinflation where additional money is rapidly converted into goods. He however argues that hyperinflation is an exceptional case (also there is no necessary causal link from money supply to inflation), whereas in the normal state a change in the quantity of money has very small, indirect effects on prices.
words, in equations (9.1) and (9.2), markups are determined not only by the monopolistic power in an industry, but also by the strength of trade unions (Kalecki, 1971, pp. 160-162). In line with Marglin (1984, p. 133), Dutt (1994, p. 96) and Lavoie (2002, p. 179), we assume that the evolution of nominal wage rates $g_w$ is associated with differences between the economy-wide actual and the target rate of profit sought by labour $r^t_w$, and with the rate of expected inflation $\pi^e$, as follows:\footnote{The target real wage (or the target wage share) of trade unions can be expressed in terms of a targeted profit share or a targeted markup. From equations (9.1) and (9.2), a profit share is $m = \theta / (1 + \theta)$ and a markup is $\theta = (1/\alpha - \omega) / \omega$, where $\omega$ is the real wage rate. Also, with equations (15.1) and (15.2), the targeted real wage rate can be described in terms of the target rate of return.}

$$w = (1 + g_w)w_{(-1)} \quad (16)$$

$$g_w = \mu_1(r_{(-1)} - r^t_{w(-1)}) + \mu_2 \pi^e \quad (17)$$

$$\pi^e = \pi_{(-1)} \quad (18)$$

$$\pi = \Delta p_1 / p_{1(-1)} \quad (19)$$

where $0 < \mu_1, \mu_2 < 1$ are reaction coefficients to the discrepancy between actual and targeted rates and an indexation coefficient to expected inflation respectively, both being exogenously given.\footnote{In the present model, it is assumed that a change in labour productivity does not have an impact on the determination of the nominal wage rate, but affects the real wage rate via a change in prices due to changing unit costs.}

$$r = (r_1K_1 + r_2K_2) / (K_1 + K_2)$$

is the economy-wide actual rate of profit and $\pi$ is the rate of inflation measured by the price of consumption goods.\footnote{In Turnovsky (1977, p. 90), where wage increases are associated with a higher profit rate.}

The targeted profit rate of trade unions is related to the state of the labour market and the business cycle. The higher is the economic activity, the stronger are the income claims of trade unions, and vice versa. In particular, we assume that the target rate of profit
sought by trade unions is a decreasing function of the rate of change of economy-wide employment $g_{nd}$ such that

$$r^*_w = \bar{r}^*_w - \varepsilon g_{nd(-1)} \quad --- (20)$$

$$g_{nd} = \Delta N_d / N_{d(-1)} \quad --- (21)$$

where $\bar{r}^*_w > 0$ is an autonomous term given exogenously, reflecting historical, institutional, and political aspects, and $\varepsilon > 0$ is a reaction coefficient.19

We also assume that the target rate of return sought by firms is an increasing function of the rate of capacity utilization, which is an indicator of the state of the goods market. It could be justified by the fact that ‘more buoyant demand conditions’ lead to higher utilization rates and induce firms attempt to increase markups (Dutt, 1994, p. 98; Lavoie, 1992, p. 410; Skott, 1989, p. 141).20 We also make an additional assumption: the target rates of return sought by firms are the same in both sectors and those are simultaneously changed in the same proportion ($r^*_1 = r^*_2$).21 Hence, the target rate of return sought by firms is described as

$$r^*_f = \bar{r}^*_f + \tau (-1) \quad --- (22)$$

19 Most post-Keynesians assume that the targeted growth rate of wages is a function of an employment (or unemployment) rate (for instance, Cassetti, 2002; Dutt, 1992; 1994; Rowthorn, 1977; Skott, 1989, p. 141). Some argue that it depends on an unemployment level (for instance, Setterfield and Lovejoy, 2005) or an unemployment gap (Isaac, 1991). However, Screpanti (1996; 2000) insists that wage claims are related to the change in the rate of employment, rather than the rate of unemployment or its level, because of employed workers’ self-interested behavior, information problems and political factors. As Blanchard and Summers (1987) point out, in fact employed workers (insiders) could crucially affect the determination of the (real) wage rate although there in part exists pressure from the reserve army of labour (outsiders). Hence insiders’ concern might be ‘the probability of a worker being fired’, that is, the change in the rate of employment. Meanwhile, Lavoie (1992, p. 406) assumes that the targeted growth rate of wages is a function of the rate of change of the employment rate.

20 Dutt (1990, pp. 65-67; 1994, p. 98; 1995, pp. 148-149) argues that the sign of $\tau$ is either positive or negative. In fact, the impact of a change in utilization rates on markups would depend not only on the state of the goods market, but also on the degree of monopoly in an industry. During periods of depression with high excess capacity, monopoly firms might try to increase markups in order to compensate for high overhead or fixed costs (Kalecki, 1954, p. 17-18), but firms in a more competitive environment might try to decrease markups fearing market invasion by their competitors (Rowthorn, 1977, p. 219). We here assume that $\tau$ has a positive sign so that the pressure of aggregate demand increases leads to a higher target rate of return.

21 This assumption ensures convergence towards long-run positions; otherwise, the present model will diverge due to the different rates of change in the price levels of both sectors, and due to the spiral of prices and wages.
where \( \bar{r}_f^* > 0 \) is an autonomous term given exogenously, \( \tau > 0 \) a reaction coefficient, and \( u = (p_1S_1 + p_2S_2) / (p_1S_{c,1} + p_2S_{c,2}) \) the economy-wide actual rate of capacity utilization.

Since the present model assumes that the share of profit depends on class conflict over aggregate income, the actual target rate of return is determined by the weighted sum of the target rates of return sought by trade unions and firms such that
\[
    r_s = \psi r_f^* + (1 - \psi) r_w^* \quad (23)
\]
where \( 0 \leq \psi \leq 1 \) describes the relative (social) bargaining position of trade unions and firms which is exogenously given. Equation (23) implies that real wage rates and wage shares depend not only on economic conditions, but also on class struggle forces.\(^{22}\)

From equations (9.1) and (9.2), the actual total profits before interest payments are given by
\[
    F_{T,j} = m_i p_i S_i \quad (24)
\]
where \( m = \theta / (1 + \theta) \) is the gross profit margin, which is also called the ‘degree of monopoly’ in Kalecki’s terminology. The actual rate of capacity utilization \( u_i \) is defined as
\[
    u_i \equiv S_i / S_{c,i} \quad (25)
\]

Using \( F_{T,j} = \theta_i w_i \alpha_i S_i \) and equations (15.1) and (15.2), we obtain the realized rate of profit \( r_i \) measured at the price level of an investment good in the previous period,
\[
    r_i = F_{T,j} / (p_{2(c-1)}K_{i(c-1)}) = r_i^* (u_i / u_i^*) \quad (26)
\]
With target-return pricing, the actual rate of profit changes proportionally with the actual rate of capacity utilization (so do the ratio of the actual to the target rate of profit with the ratio of the actual to the standard rate of utilization), for a given target rate of return and standard rate of capacity utilization. Here, if \( (u_i / u_2) = (r_i^s / r_f^s)(u_i^s / u_2^s) \), then actual rates of profit are equalized in both sectors, and if \( r_i = r_i^s \), then the actual rate of capacity utilization

\(^{22}\) Kalecki (1971, p. 161) also emphasizes that an increase in prices due to rising wages would be restrained by competition in an industry.
is equal to the standard rate.\textsuperscript{23} In the present model, however, a uniform rate of profit could be obtained only by a fluke, since mechanisms achieving those are not introduced here.\textsuperscript{24}

Demand for current investment is expressed as

\[ I_{d,i} = \Delta K_i = g_i K_{i(i-1)} \quad \quad (27) \]

where \( g \) is the rate of capital accumulation which is determined endogenously in the present model. Adopting the Lavoie and Godley’s (2001-2002) investment function, we assume that the rate of accumulation depends on five variables: the rate of cash flow \( r_{cf} \), the debt ratio (or leverage ratio) \( l \), Tobin’s \( q \) ratio (or the valuation ratio in Kaldor’s terminology), the actual rate of capacity utilization \( u \) and the technical progress rate \( g_T \).\textsuperscript{25} Assuming that the rate of accumulation is presented as a linear function of these variables, the investment function is described as

\[ g_i = \gamma_{i0} + \gamma_{i1} r_{cf,j(i-1)} - \gamma_{i2} l_{i(i-1)} + \gamma_{i3} (q_{i(i-1)} - 1) + \gamma_{i4} u_{i(i-1)} + \gamma_{i5} g_{T,j(i-1)} \quad \quad (28) \]

\[ r_{cf,i} \equiv (F_{U,i} + F_{D,i})/(p_{2(i-1)} K_{i(i-1)}) \quad \quad (29) \]

\[ l_i \equiv L_{d,i} /(p_{2} K_i) \quad \quad (30) \]

\[ q_i \equiv (L_{s,i} + e_{s,i} p_{s,i})/(p_{2} K_i) \quad \quad (31) \]

where \( \gamma \)s are coefficients: in particular, \( \gamma_{i0} \) reflects animal spirits of entrepreneurs on

\textsuperscript{23} In the same way, if \( u_i = u_i^* \), then the actual rate of profit is equal to the target rate of return. However, in his one-sector model with conflicting claims, Lavoie (2002; 2003) shows that even when these adjustment mechanisms are incorporated, the actual and the target rates would not converge towards each other in the long run.

\textsuperscript{24} For its proof in a two-sector model with target return pricing, see Lavoie and Ramírez-Gastón (1997). Most of neo-Marxians/Sraffians such as Semmler, Duménil and Lévy, and Park assert that profit rates among industries tend to be equalized in the long run, since competition among capitalists leads necessarily to the mobility of (financial) capital from a sector with a low profit rate to one with a high rate even in an oligopolistic economy. However, monopoly power theorists such as Kalecki, Steindl, Sweezy and Dutt argue that with increasing concentration and centralization in modern capitalism, monopoly firms possess power to control prices (markups), and reinforce barriers to the mobility of capital so that those result in a ‘hierarchy of profit rates’. Therefore, the intersectoral differences of profit rates might prevail in modern monopoly capitalism. For an analysis incorporating long-run adjustment mechanisms in a two-sector Kaleckian model, see Kim (2006).

\textsuperscript{25} From this definition, the \( q \) ratio can be presented as \( q_i \equiv l_i + (e_{s,i} p_{s,i})/(p_{2} K_i) \), and hence in our model, a change in the debt ratio has two opposite effects on investment, i.e., a direct negative impact from itself and an indirect positive impact via the \( q \) ratio. Its total effect depends on parameters in the investment equation.
investment (Amadeo, 1986b, p. 151), including expectations of firms about future demand growth (Lavoie, 1995, p. 807). Note that \( r_{t(-1)}^{l_{t(-1)}} \) has a negative sign, which means that as debt ratios are increasing, the ‘crumbling credit-worthiness’ of firms leads to a fall in their investment expenditures.\(^{27}\)

We next consider endogenous technical progress. As shown in equation (28), technical progress would have a positive impact on the rate of accumulation because firms would try to increase investment in order to take advantages of ‘technical novelties’ (Kalecki, 1971, p. 151) and because new products might increase the propensity to consume (Dutt, 2003, p. 92).\(^{28}\) Technical progress can take place through two ways: one is capital-saving technical progress and the second is labour-saving technical progress. According to stylized factors suggested by Kaldor (1961, p. 178-179), however, capital-output ratios are stable and have ‘no clear long-term trends, either rising or falling, if differences of the degree of utilization of capacity are allowed for’, while there is the continuous growth of labour productivity at a steady trend rate. In other words, there exists a tendency of capital deepening (increases in capital intensity) over long periods, with increasing labour-output ratios and constant capital-output ratios. Following Kaldor’s argument, we assume that technical progress takes place only through increases in labour productivity.

We introduce a Kaldorian technical progress function in which the growth of

\[ \gamma_{t} = \bar{r}_{t} - \gamma_{t\mu_{t(-1)}} . \]

\(^{26}\) We can also write

\[ \gamma_{t} = \bar{r}_{t} - \gamma_{t\mu_{t(-1)}} . \]

\(^{27}\) Therefore, it can also be interpreted as a case of credit rationing by banks: ‘In a growth model they [credit constraints] will imply a restricted amount of capital accumulation by entrepreneurs, and hence credit restraint is incorporated within the investment function, with the latter being sensitive to debt ratios or the weight of debt payments for instance’ (Lavoie, 2001, p. 8). In this case, as Lavoie pointed out, the credit constraints will appear at the stage of initial finance, not at the stage of final finance. Therefore, problems of credit constraints cannot arise at the end of the accounting period. In addition, the \( q \) ratio might impose borrowing constraints. Since the low \( q \) ratio may imply low market values of firms (low total values of equities), it lowers the collateral values and hence the credit-worthiness of firms.

\(^{28}\) Dutt also argues that technical progress would change markups because it brings about changes in the degree of monopoly. In the present model, long-term labour productivity is the same in both sectors, and thus as shown equations in (15.1) and (15.2), there is no direct impact on costing margins. However, since a change in technical progress will affect long-term employment growth rates and utilization rates, it has an indirect impact on costing margins through conflicting claims. In this sense, therefore, ‘increases in productivity are, at the same time, cause and effect of the long-run increase in wages relative not only to the prices of machines but to all or almost prices’ (Sylos-Labini, 1983-4, p. 169).
productivity is positively associated with economic growth (Kaldor, 1957; 1961; 1989), which is called the ‘Verdoorn’s Law’.\textsuperscript{29} Hence, there exists a positive, cumulative feedback relation between technical progress and capital accumulation (‘cumulative causation’). This positive relation stems from various reasons such as micro/macro economies of scale, the ‘embodiment effect’, the ‘vintage effect’ and ‘learning-by-doing’ (León-Ledesma and Thirlwall, 2002, p. 445).\textsuperscript{30} In addition, we can consider another factor to influence technical progress. Facing the higher claims of labour over national income, firms would try to reduce employment per output by stimulating productive innovation further in order to compensate for increasing real wage rates (You, 1994, pp. 124-125; Cassetti, 2003, p. 461).\textsuperscript{31} Therefore, a higher increasing wage rate would contribute to faster labour-saving technical progress.\textsuperscript{32} Hence, the technical progress function can be described as

\[ T_i = (1 + g_{T,i})T_{i(-1)} \quad (32) \]

\[ g_{T,i} = g_{T,i} + \phi_1 g_{w,i(-1)} + \phi_2 g_{i,i(-1)} \quad (33) \]

where \( T \) is labour productivity \((\alpha = 1/T)\). In equation (33), \( g_T > 0 \) represents the autonomous growth rate of labour productivity, \( \phi_1 > 0 \) is a reaction coefficient to the increasing wage rates, and \( \phi_2 > 0 \) captures Verdoorn’s Law.\textsuperscript{33}

Dividends distributed to households are determined by entrepreneurs, based on total capital stocks, that is, ‘improved knowledge is, largely if not entirely, infused into the economy through the introduction of new equipment ... [and hence] the rate of technical improvement will depend on the rate of capital accumulation’ (Kaldor, 1961, p. 207). In contrast to Verdoorn’s Law, a Schumpetarian model may suggest that technical progress is negatively associated with economic growth, because a lower profit rate (and hence a lower growth rate) will impose pressure on firms to innovate or because under economic depression, the exit of inefficient firms will lead to an increase of the average growth rate of productivity (Dutt, 1994, p. 99).

\textsuperscript{29} Here, it must be noted that technology evolves through the rate of increase of capital rather than the level of capital stocks, that is, ‘improved knowledge is, largely if not entirely, infused into the economy through the introduction of new equipment ... [and hence] the rate of technical improvement will depend on the rate of capital accumulation’ (Kaldor, 1961, p. 207).

\textsuperscript{30} The embodiment effect says that some technical progress is embodied in capital, and the vintage effect implies that newly installed capital is more productive than the older one.

\textsuperscript{31} A higher (real) wage rate might also have substitution effects in favor of machines. In the present model, this effect happens only in relation to the positive effect of technical progress on investment, as specified in equation (28).

\textsuperscript{32} Thus, technical progress is linked with income distribution in the present model.

\textsuperscript{33} The technical progress function presented in Sylos-Labini (1983-4, p. 175) involves both the growth rate of output and the amount of investment. He argues that the growth rate of output and past investment have positive effects but current investment has negative effects because new installed plants might have a ‘disturbance effect’ on the ordinary operations. Thus, current investment has a ‘demand effect’ that increases employment, while past investment has a ‘productivity effect’ that decreases employment (Sylos-Labini, 1984, p. 99).
profits minus interest payments of the previous period, such that
\[ F_{D,i} = (1 - s_{f,i}) (F_{T,i(-1)} - r_{i(-2)} L_{s,i(-2)}) \]  --- (34)
where \( s_f \) is firms’ propensity to save out of net profits.

Finally, we assume a uniform rate of return on equities in both sectors. Since financial capital moves across the different sectors in pursuit of higher returns (without uncertainty), the rate of return on the equities of both sectors would be equalized at least in the long run.\(^{34}\) We here suppose that the growth rate of equities in the investment sector depends on the differential of rates of return on equities, while the growth rate of equities in the consumption sector is exogenously determined, such that
\[ e_{s,i} = (1 + g_{e,r}) e_{s,i(-1)} \]  --- (35)
\[ g_{e,r} = \bar{g}_e \]  --- (36.1)
\[ g_{e,2} = g_{e,2(-1)} + \delta (r_{e,2(-1)} - r_{e,1(-1)}) \]  --- (36.2)
where \( \bar{g}_e \) is the autonomous growth rate of equities given exogenously and \( \delta > 0 \) is a reaction coefficient.

2.2 Households
We suppose that households determine their consumption expenditure \( C_d \) on the basis of their expected wage incomes \( W^e \), expected financial incomes \( F^e \) and wealth of the previous period,\(^{35}\)
\[ C_d = a_1 W^e + a_2 F^e + a_3 V_{(-1)} \]  --- (37)
\[ W^e = (1 + g_{y(-1)}) (W_{s,1(-1)} + W_{s,2(-1)}) \]  --- (38)
\[ F^e = (1 + g_{y(-1)}) (F_{D,1(-1)} + F_{D,2(-1)} + r_{m(-2)} M_{d(-2)}) \]  --- (39)

\(^{34}\) Park (2001-2002, p. 319) argues that in the long-run equilibrium the rate of return on equities should be equal to the rate of profit as a result of the free mobility of (financial) capital. Following his argument, equations (36.1) and (36.2) could be replaced with \( g_{e,r} = g_{e,1(-1)} + \delta (r_{e,1(-1)} - r_{e,1(-1)}) \) --- (36)’. However, since in the present model a uniform rate of profit is not achieved, incorporating equation (36)’ will result in different rates of return on equities of both sectors. Dutt (1988, p. 153) insists that although the tendency for a uniform rate of return on equities might be more plausible, it would not lead necessarily to uniform profit rates.

\(^{35}\) It implies that changes in unexpected income affect consumption with time lags, and the differences between realized and expected incomes lead, in exactly the same amount, to changes in the money stock held by households. Therefore, actual money balances are a residual (Lavoie and Godley, 2001-2002, p. 291).
where \( a_i \) is the propensity to consume and \( g_y \) is the growth rate of nominal households income. The superscript \( e \) represents expected values. Here, we assume \( 0 < a_2 < a_1 < 1 \), that is, a class-based saving behavior such that wages are mostly consumed while financial income is largely devoted to saving.

Functions representing portfolio choices of households have been developed in Godley (1999, pp. 406-407) and Godley and Lavoie (2005). According to them, we assume that the targeted amount of each asset being held by households is represented by expected wealth and expected household income, since the portfolio plans would be made in the initial stage of a period. The three asset demand functions are

\[
M^e_d / V^e = \lambda_{10} + \lambda_{11}r_m - \lambda_{12}r_{e, l(-1)} - \lambda_{13}r_{e, 2(-1)} + \lambda_{14}(Y^e_{hr} / V^e) \tag{41}
\]

\[
p^e_{e,1}e_{d,1} / V^e = \lambda_{20} - \lambda_{21}r_m + \lambda_{22}r_{e, l(-1)} - \lambda_{23}r_{e, 2(-1)} - \lambda_{24}(Y^e_{hr} / V^e) \tag{42}
\]

\[
p^e_{e,2}e_{d,2} / V^e = \lambda_{30} - \lambda_{31}r_m - \lambda_{32}r_{e, l(-1)} + \lambda_{33}r_{e, 2(-1)} - \lambda_{34}(Y^e_{hr} / V^e) \tag{43}
\]

where \( \lambda_s \) are coefficients. The rate of return on equities \( r_e \), households’ expectations on current income \( Y^e_{hr} \), the expected level of wealth \( V^e \) and the expected capital gains \( CG^e \) are described respectively as

\[
r_{e,i} \equiv (F_{D,i} + CG_i) / (p_{e,(i(-1))} e_{d,(i(-1))}) \tag{43}
\]

\[
Y^e_{hr} = (1 + g_{y(-1)})Y^e_{hr(-1)} \tag{44}
\]

\[
V^e \equiv Y^e_{hr} - C_d + (CG^e_1 + CG^e_2) + V_{(-1)} \tag{45}
\]

\[
CG^e_i = (1 + g_{y(-1)})CG_{i(-1)} \tag{46}
\]

By the adding-up constraint, which implies ‘a system-wide consistency requirement’,\(^{36}\) the
expected money demand for transactions is given as

\[ M^e_d = V^e - (p^e_{c,1}e^e_{d,1} + p^e_{c,2}e^e_{d,2}) \]

### 2.3 Market equilibrium and closures

To close the present model, we need several equilibrium equations. First, we assume that the elasticity of labour supply is infinite. Hence, supplied labour is always determined by the demand for labour in both sectors

\[ N_{s,d} = N_{d,i} \quad (47) \]

Second, we assume that with the presence of excess capacity in the present model, the supply of both consumption and investment goods is adjusted to the fluctuations of demand within each period

\[ C_s = C_d \quad (48) \]

\[ I_s = I_d \quad (49) \]

Third, we assume that in line with post-Keynesian endogenous money theory, banks accommodate demand for loans to all credit-worthy firms. Hence, there always exists equality between loan demand and supply,

\[ L_{s,d} = L_{d,i} \quad (50) \]

Finally, we assume that there exists a price market-clearing mechanism in the equity markets. In particular, we presume that all new equities issued by firms will be held by household in the equity market whereas the prices of equities are determined by the portfolio decision of households, so that

\[ e_{d,i} = e_{s,i} \quad (51) \]

\[ p_{e,i} = p^e_{e,i} / e_{d,i} \quad (52) \]

---

37 In the present model, we do not need an additional equation to equalize money supply and demand, because the equality must necessarily be ensured as a redundant equation. For a detailed discussion, see Lavoie (2001) and Lavoie and Godley (2001-2002, pp. 294-5).

38 These additional assumptions also allow each row in the transaction matrix to sum to zero.

39 This adjustment of equity prices allows the targeted portfolio choice to be obtained in the steady-state (because \( V = V \) and \( y_e^r = y_e \)).
III. EXPERIMENTS
In this section, we examine which traverses and long-run positions the model exhibits, following a change in the propensity to consume, the costing margin and the nominal wage rate, the growth rate of equities, the capital to capacity ratio and the interest rate.\textsuperscript{40} In particular, our experiments confirm that the ‘paradox of thrift’ and the ‘paradox of costs’ still hold, with the chosen parameters. Those also show that income distribution and monetary policy could play a crucial role in the magnitude of impacts due to external shocks. Note that in the figures showing the results of the experiments, horizontal lines are normalized to unity for the initial periods, implying an initial steady state at the chosen parameters.\textsuperscript{41}

3.1 Changes in the propensity to consume
First, we examine changes in the propensity to consume. With the chosen parameters, an increase in the propensity to consume out of wage income leads to higher rates of capital accumulation with higher rates of utilization and higher rates of profit in both sectors in the short period as well as in the long run. These results demonstrate the ‘paradox of thrift’, which describes that a lower propensity to save leads to faster growth (consumption-led growth).\textsuperscript{42}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure1.png}
\caption{Here}
\end{figure}

As shown in <Figure 1a>, in the initial period, the increase in consumption demand leads immediately to a rise in the rate of capacity utilization and to a higher profit rate in the consumption sector. A higher rate of capacity utilization in this sector leads to a positive reaction of investment with a time lag. In turn the rate of capacity utilization in the

\textsuperscript{40} In the present model, we do not explicitly specify regimes such as those found by Lavoie and Godley (2001-2002) where two stable regimes are distinguished and analyzed: a ‘normal’ regime with the smaller value given to the parameter of Tobin’s $q$ in the investment function relative to that of the rate of utilization, and a ‘puzzling’ regime as the opposite case. Distinguishing such regimes, however, is much more ambitious and complicated in the two-sector model represented here, because economic activity and investment decision depends on the complex interaction of economic performance of both sectors. To avoid this difficulty, we deal mainly with a case in which investment decisions are more sensitive to the rate of capacity utilization than to the $q$ ratio.

\textsuperscript{41} For the chosen exogenous variables and parameters, see Appendix.

\textsuperscript{42} Also, an increase in the propensity to consume out of financial income or out of a change in household wealth leads essentially to the same results.
investment sector starts to increase and so does the rate of accumulation of that sector.\textsuperscript{43} These processes are further stimulated by the pro-cyclical effect of technical progress (‘cumulative causation’). The higher cash flow and the low debt ratio also contribute to a higher rate of accumulation. As realized rates of profit increase, in Figure 1b cash flows go up and the debt ratio decreases in both sectors. Those positive effects overwhelm the negative effect of the lessened $q$ ratio, and bring about a faster rate of accumulation.\textsuperscript{44}

However, the high rate of accumulation in the initial period will not be continuously sustained and it will slow down over time because of inflationary pressure. In the economic boom, a high utilization rate allows firms to increase the target rate of return, and a high employment rate induces workers to have stronger claims over aggregate income. Figure 1c shows that inflationary forces override deflationary pressures due to increased technical progress, and raise price levels at a faster rate. High inflation slows down increases in real wage rates, which in turn leads to a drop in aggregate demand in Figure 1d. With reduced aggregate demand, utilization rates and accumulation rates go down and so do the rate of inflation, until the economy arrives at a new long-term position. In the conflicting-claim model, therefore, a higher propensity to consume results in a higher long-term rate of accumulation than in the previous steady state, but lower than the one obtained in a model without conflicting claims, where the initial higher rate of accumulation tends to be kept over time.

On the equity market, as shown in Figure 1e, the initial decrease in saving out of wage income reduces the demand for equities in both sectors and hence the rates of increase in equity prices. In turn, lower capital gains from holding equity diminish the rates of return on equities of both sectors in the short period. However, a higher rate of accumulation and higher real wage income push up equity prices with higher demand for equities, and hence those raise rates of return on equities to higher levels than in the previous steady state level.

\textsuperscript{43} The impact of a change in the propensity of consume on the investment sector is slower and smaller than that in the consumption sector because the former occurs via the latter. Thus, it leads to higher capital stocks in the consumption sector relative to the investment sector over time.

\textsuperscript{44} As mentioned in the previous section, the effect of $q$ ratio tends to be offset by that of the debt ratio if there is no significant increase in equity prices compared with an inflation rate.
3.2 Changes in the bargaining position

Now we consider what happens when labour unions have stronger bargaining power. As shown in equations (15.1) and (15.2), if other variables are constant, a lower target rate of return decreases costing margins and hence the prices of goods, while increasing the share of wages out of aggregate income and raising real wage rates. In a canonical Kaleckian growth model, a higher real wage spurs aggregate demand, and thus it leads to a higher rate of capacity utilization and a faster rate of accumulation in the long run. It eventually brings about a higher long-term rate of profit, which is called the ‘paradox of costs’ (Lavoie, 1992, p. 313; Rowthorn, 1981, p. 18).

< Figure 2 > Here

First, let us examine a case in which $\psi$ in equation (23) decreases because of the strengthened bargaining power of labour unions, that is, the target rate of return in the price function falls off. In this case, as shown in <Figure 2a>, the present model confirms the paradox of costs: the reduced target rate of return leads to a faster rate of accumulation and a higher rate of profit, with an increased wage share, in the long run.

<Figure 2b> show that, in the initial periods, a decrease in the realized target rate of return brings about a lower rate of price inflation. A lower inflation rate leads not only to higher real wages, but also to the increased real wealth of households. The higher real revenues and wealth of households boost consumption demand. In turn, it induces a higher rate of capacity utilization and a positive effect on the rates of accumulation in both sectors. As the economy grows at a faster rate, the rate of inflation begins to increase over time. Recalling equation (26), the long-term actual rate of profit depends on the target rate of return and the ratio of the actual to the standard rate of capacity utilization. In the initial period, the rate of profit falls in both sectors because of a lower target rate of return, but it rises as the rate of capacity utilization goes up. Eventually, the rate of profit is realized at a higher level than that in the initial steady state.

The other determinants of investment are the rate of cash flows, the debt ratio and the $q$ ratio. In the initial period, the $q$ ratio climbs because of two positive forces. On the one hand, lower retained earnings lead to lower internal finance to investment and the
higher debt ratio, and hence it contributes to increase the $q$ ratio. On the other hand, a rise in the real wage of households induces higher demand for equities. It in turn pushes up the rate of increase in equity prices and thus raises the $q$ ratio. Meanwhile, a lower initial rate of profit lessens the rate of cash flows. In Figure 2c these short-term tendencies of ratios are reversed in the long term as the economy expands, and those contribute to escalating the rate of accumulation in both sectors, offsetting the effects of the $q$ ratio and the debt ratio.

Next, let us examine a case in which only $\mu_i$ in equation (17) rises with no change in $\psi$ in equation (23): that is, labour unions achieve an agreement for a higher wage rate in the wage negotiation with entrepreneurs, but firms have enough power to pass along increased wages into prices in the same proportion. In a model without conflicting claims, nominal wage rate changes have only short-term effects on economic activity, but no long-term real effects. In the conflicting-claim model, however, a change in nominal wage rates will bring about long-term real effects and the economy will converge towards a new long-term position. At the time of the shock, an increase in nominal wage rates induces a higher wage share out of aggregate income and higher real wage rates. However, since increased wage rates immediately cause higher inflation in Figure 2d, it reduces the real financial income and the real wealth of households. A decrease in disposable income causes a fall in consumption demand, and hence, as shown Figure 2e, it results in the lower rates of accumulation in both sectors, with the lower rates of capacity utilization. The new economic situation will affect wage bargaining between workers and firms. A change in relative bargaining positions prevents the economy from returning to the initial steady state, and it results in a lower rate of economic growth than the initial rate: i.e., stagflation with a higher rate of inflation and a lower rate of growth. This result also implies that growth phases are 'path-dependent' and real balance effects do not ensure a return to the initial 'equilibrium' position. In conclusion, what has a positive effect on economic activity is not an increase in nominal wages in itself, but the strong bargaining position of labour unions to refrain the profit share (through the target rate of return in the present model).

Finally, let us consider how income redistribution influences the magnitude of the impact of an increase in the propensity to consume on the rate of accumulation as in section
3.1. <Figure 2f> depicts that the impact varies as bargaining positions change. When trade unions do not have bargaining power against firms, that is, when the target rate of return in the price function is determined only by capitalists \( (\psi = 1 \text{ in equation (23)}) \), the impact on the rate of accumulation is wiped out by inflation pressure.\(^{45} \) However, the positive impact is augmented as the bargaining power of workers rises. The stronger the bargaining power of trade unions, the larger the positive impact on economic activity.

3.3 Change in technical progress

In the present model, an increase in labour productivity affects economic growth through three channels. First, higher technical progress has direct, positive impact on the rate of accumulation as shown in equation (28). Second, higher labour productivity reduces prices and raises real wage rates. Increased real revenues and wealth contribute to boosting consumption demand and the rate of accumulation. Finally, a rise in labour productivity results in a decrease in the number of employed labour per output. With decreased employment, lower total wages make economic growth sluggish. Therefore, the net effect of technical progress on economic activity will depend on the relative magnitude of two positive effects and a negative effect.\(^{46} \)

< Figure 3 > Here

Let us assume that the autonomous growth rate of labour productivity in equation (33) goes up in the same proportion in both sectors. With the chosen parameters, <Figure 3a> shows that labour-saving technical progress leads to a faster rate of accumulation and a higher rate of profit. An increase in labour productivity reduces the price inflation rate and hence pushes up real wage rates. The increased real revenues and real wealth of households raise demand for consumption goods and the rate of capacity utilization. It stimulates the rate of accumulation with the direct impact of innovation. Furthermore, the ‘cumulative causation’ spurs economic growth over time.

\(^{45} \) When the reaction coefficient of the \( q \) ratio in an investment function is relatively large, even the weak bargaining position of workers could lower the rate of economic growth, which may be called a ‘puzzling regime’ as in Lavoie and Godley (2001-2002).

\(^{46} \) Note that two positive effects tend to enlarge employment. Thus, the net impact of technical progress on employment rates is obscure, and it will depend on reaction coefficients and parameters (Lavoie, 1992, pp. 316-327).
In <Figure 3b>, the share of wage out of aggregate income deteriorates as a result of innovation, although the rate of real wage reaches a higher level. It is due to a higher realized target rate of return in the price function. Increased demand pressure induces firms to raise their target rate of return. Also, in the initial period, a decrease in the growth rate of employment weakens the bargaining positions of trade unions and contributes to realizing a higher target rate of return. During the traverse towards new long-term positions, the lower initial growth rate of employment starts to climb back as the economy grows at a faster rate, and it nearly recovers the long-term rate of the previous steady state.47 <Figure 3b> also shows that labour-saving technical progress allows the faster overall rate of accumulation to surpass the growth rate of employment, and hence it accelerates capital deepening. These results might explain the phenomenon of the “new economy” experienced in the United States in the 1990s: the high rate of growth, the high rate of real wages, the high rate of profit, the low rate of inflation and the low wage share.

Now we consider capital-saving technical progress in which the amount of fixed capital per unit of output decreases. In a canonical Kaleckian model, a decrease in the capital to (full-capacity) output ratio results in a lower rate of growth and a lower actual rate of capacity utilization when the economy is operating below full capacity (Lavoie, 1992, p. 316; Rowthorn 1981, pp. 27-8). As shown in <Figure 3c>, the outcomes obtained in the present model are consistent with the results of a canonical Kaleckian model.48 In the initial period, the lower ratio of capital to full-capacity output leads to a sharp drop in the rate of capacity utilization and the rate of accumulation. At the same time, however, since it reduces the costing margins of firms and the rate of price inflation, the positive effect of higher real wage rates give a boost to the rate of accumulation, but it never achieves back its previous steady state level.

3.4 Changes in the interest rate

47 If the reaction coefficient of investment to technical progress rises with higher labour productivity, a higher long-term growth rate of employment could be achieved and be compatible with the above results, that is, with a higher rate of economic growth, a higher rate of profit, a higher profit share and a lower rate of inflation.

48 However, note that the stronger reaction of investment to the $q$ ratio could lead to a faster rate of accumulation with a lower rate of capacity utilization and a lower rate of profit in both sectors, which could be called a ‘puzzle regime’ as in Lavoie and Godley (2001-2002).
An increase in the interest rate has two opposite effects on the rate of accumulation: on the one hand, a higher interest rate has a negative effect on investment because of increased debt commitments, and on the other hand, the higher interest income of households has a positive effect on consumption demand and the rate of capacity utilization. Hence, the net effect of a change in interest rates on economic activity will depend on the propensity to consume out of interest income in the consumption function and the firms’ reaction to a change in interest rates in the investment function.\footnote{As shown in Lavoie and Godley (2001-2002), the net effect might also depend on the values of the parameters of the $q$ ratio and the rate of capacity utilization in the investment equation. Meanwhile, when there is a (significantly) higher value of the parameter of the debt ratio in the investment equation, their model could show that the higher interest rate leads to puzzling results even in a normal regime.} In the present model, since we assume a sufficiently high propensity to save out of interest income, as shown in Figure 4a, a rise in the interest rate on loans and deposits leads to lower rates of capacity utilization, slower rates of accumulation, and hence lower rates of profit in both sectors.\footnote{A slower rate of accumulation might be compatible with a higher rate of capacity utilization and a higher rate of profit in the new long-term position, if the propensity to consume out of financial income is the same as that out of wage income (that is, the former is significantly high), as in Lavoie and Godley (2001-2002).}

<Figure 4> Here

The large fall in rates of accumulation in the initial period is alleviated over time. In Figure 4b, economic depression due to higher interest rates induces a lower rate of inflation and hence higher real wages. Since the slow price inflation rates also raise the real wealth of households, it has a positive impact on economic growth although the economy could not recover the level of the previous steady state.

On the equity market, because increased debt commitments reduce retained earnings of firms, as shown in Figure 4c, the rates of return in both sectors fall below the previous steady state, and this in turn reduces the demand for equities by households. With a slower rate of increase in equity prices, the equity-to-wealth ratios in both sectors eventually decrease and the money-to-wealth ratio increases in the new steady state.

Next, we examine how inflation targeting by the monetary authorities affects economic activity. According to the New Consensus in monetary macroeconomics, nowadays the key monetary instrument is the short-term nominal interest rate, not the
money supply (Romer, 2000; Taylor, 2000). In line with the New Consensus, we assume that inflation targeting is conducted by an instrument rule, that is, by the adjustment of a nominal interest rate through a reaction function: \( r_i = r_{l,a} + \pi_{(-1)} + \xi(\pi_{(-1)} - \pi^T) \), where \( r_{l,a} \) is the ten-period moving average of real interest rates, \( \pi^T \) the targeted rate of inflation, and \( \xi \) a rule parameter. Suppose that a monetary authority adopts this instrument rule when the propensity to consume increases as in section 3.1, and the target rate of inflation is set as the actual rate before the shock. As shown in Figure 4d, inflation targeting brings about a slower rate of accumulation because of the increasing debt burden of firms, in contrast to that obtained without adopting inflation targeting. It implies that the ‘paradox of thrift’ could be removed by monetary policy and the economy might be depressed by inflation targeting, even when there exists a positive shock. Furthermore, it might make an economy more volatile, rather than stabilize it, if the monetary authority rapidly reacts to the deviation of the current rate of inflation from the target rate.

3.5 Changes in the growth rate of equities

In the previous section, we assumed that firms finance their investment through retained earnings, new equity issues and loans from banks, but no bond issues. An increase in the growth rate of equities has two opposite effects on investment. A higher growth rate of equities leads to a lower debt ratio and hence it has a positive effect on the rate of accumulation. On the other hand, an increase in the growth rate of equities reduces the rate

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51 This argument is in part based on endogenous money supply and exogenous interest rates, which post Keynesians have insisted for decades. However, in the long-run analysis, the New Consensus is exactly compatible with a Neoclassical Synthesis: the supply-led determination of natural rates and no long-run trade-off between inflation and unemployment. For a post-Keynesian critique of the New Consensus, see Kriesler and Lavoie (2005), Lavoie and Seccareccia (2004), Palacio-Vera (2005) and articles in the Journal of Post Keynesian Economics, 2002 summer, among others.

52 In general, the Taylor rule or its modified form is considered as a monetary policy rule by monetary authorities. This rule can be written as \( r_i = r^* + \pi + \xi(\pi - \pi^T) + \zeta(y - \bar{y}) \), where \( r^* \) is an equilibrium (or normal) real interest rate, \( y \) real GDP, \( \bar{y} \) estimated potential real GDP, and \( (y - \bar{y}) \) is an output gap (Taylor, 1993). As shown in previous experiments, however, since in the present model there exists the ‘path-dependency’ of economic activity, the targeted rate of inflation could not be achieved by the rule because potential output levels (or the potential growth rates of output) are not independent of actual output. Our experiment shows that this rule also would reduce long-run growth without achieving the targeted inflation rate.
of increase in equity prices, and hence decreases the consumption demand of households due to smaller capital gains or possible capital losses.

<Figure 5> Here

Let us consider a case in which only firms in the consumption sector increase the growth rate of equity issues. As shown in <Figure 5b>, the additional equity issues immediately reduce the growth rate of equity prices and thus the real rate of return on equities. This results in a fall in the financial income obtained by households, and in turn the lower income slows down consumption demand and the rate of capacity utilization with a lag. Meanwhile, the increased equity finance on investment causes the lower debt ratio, and it decreases the $q$ ratio with a lower growth rate of equity prices. Since negative effects of a lower rate of capacity utilization and of the lower $q$ ratio on investment overwhelm the positive effect of the lower debt ratio, the rate of accumulation and the rate of profit decrease towards the new steady state in <Figure 5a>.

The larger issue of new equities in the consumption sector also lowers the growth rate of equity prices and hence the real rate of return on equities in the investment sector with time lags. This is because in equation (36.2) the difference of the nominal rates of return between the two sectors leads to an increase in the growth rate of equity issues in the investment sector. A fall in the rate of profit contributes to further decreases in the real rate of return on equities in both sectors. Finally, during the traverse towards the new long-term position, in <Figure 5c>, the money-to-wealth ratio increases, while the equity-to-wealth ratios in both sectors decrease in the long period.

VI. CONCLUDING REMARKS

In the present paper, we tried to generalize a Kaleckian two-sector model in a stock-flow consistent framework, applying target-return pricing, conflicting-claims inflation and endogenous labour-saving technical progress. Through the experiments of simulations, we found the following interesting results.

First, the ‘paradox of thrift’ and the ‘paradox of costs’ would still hold in the present model, but the impact would be smaller than that in a model without conflicting-
claims inflation and endogenous labour-saving technical progress because of inflation pressure. A positive external shock leads to a higher rate of inflation and it mitigates the increasing rate of real wage and real wealth. With reduced real income and wealth, increases in the rate of economic growth become blunt.

Second, the initial status of income distribution and monetary policy could play a crucial role to determine the magnitude of the impact of external shocks, and even those could make paradoxes vanish. The weaker bargaining power of trade unions could result in the smaller positive impact on economic activity, and the inflation targeting of monetary authorities could induce depression because of the increased debt burdens of firms even when there is a positive shock on the economy.

Third, labour-saving technical progress might explain the phenomenon of the ‘new economy’ within a framework which is an alternative to Neoclassical models. An increase in labour productivity leads to higher real wages and faster economic growth with a lower rate of inflation. This pro-cyclical process is further stimulated by ‘cumulative causation’. However, the present model shows that capital-saving technical progress would bring about economic depression because of reduced real wages. Finally, increased equity finance on investment could make economic growth sluggish because it would decrease households’ capital gains.

In conclusion, the present model reinforces a post-Keynesian growth theory where aggregate demand is the most important determinant of long-term positions as well as short-term positions. Our experiments show that economic growth is demand-led, rather than supply-led, and it is characterized by the ‘path-dependency’.
References


Rowthorn, R.E. (1981), ‘Demand, Real Wages and Growth’, *Thames Papers in Political*


Zezza, G. and C. Dos Santos (2004), ‘The Role of Monetary Policy in Post-Keynesian
Table 1: Balance sheets

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Firm 1 (Consumption good)</th>
<th>Firm 2 (Capital good)</th>
<th>Banks</th>
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<tr>
<td>Money</td>
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<td></td>
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</tr>
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<td>Equities</td>
<td>+(eₙ₁pₑ₁+eₙ₂pₑ₂)</td>
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<td>-eₙ₂pₑ₂</td>
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<tr>
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<td>Loans</td>
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<td>0</td>
</tr>
<tr>
<td>∑</td>
<td>+V</td>
<td>p₂K₁(Łₙ₁+eₙ₁pₑ₁)</td>
<td>p₂K₂(Łₙ₁+eₙ₂pₑ₂)</td>
<td></td>
<td>+p₂(Κ₁+Κ₂)</td>
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Table 2: Transaction matrix

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<td>Capital (3)</td>
<td>Current (4)</td>
<td>Capital (5)</td>
<td>Current (6)</td>
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<tr>
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<td>+p_2 I_{s,1}</td>
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</tr>
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<td>Firm 1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm 2</td>
<td></td>
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</tr>
<tr>
<td>Wages</td>
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<td>-W_{d,1}</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>Firm 2</td>
<td></td>
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<td></td>
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<tr>
<td>Net profits</td>
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<td>+F_{U,1}</td>
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</tr>
<tr>
<td>Firm 2</td>
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<td>-(F_{U,2}+F_{D,2})</td>
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</tr>
<tr>
<td>Firm 2</td>
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<td>+r_1 L_{s,2}</td>
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<tr>
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<td>( \Delta ) in loans</td>
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<tr>
<td>Firm 1</td>
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<td>Firm 2</td>
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<tr>
<td>( \Delta ) in money</td>
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</tr>
<tr>
<td>Firm 1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Firm 2</td>
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Figure 1. Higher Propensity to Consume

(a) 

(b) 

(c) 

(d) 

(e)
Figure 2. Stronger Bargaining Position of Labour

(a)  (b)

(c)  (d)

(e)  (f)
Figure 3. Higher Technical Progress

(a)  
(b)  
(c)
Figure 4. Higher Interest Rate

(a)      (b)

(c)      (d)
Figure 5. Higher Growth Rate of Equities

(a) 

(b) 

(c)

\[ \frac{M}{V} = \phi_1 * e_1 / V \]
Appendix.

For simulations, we used the version 4.1 of E-Views and gave the initial values of endogenous variables where the consistent balance sheet and the transaction matrix were held over all periods. Our experiments confirmed that a hidden equation $M_s = M_d$ was held in all simulations over periods (but in some cases a very small difference between two stocks was observed, which might come from errors cumulatively caused by decimal differences over periods).

The economic system represented in this paper has a total of 80 equations (endogenous variables), 15 exogenous variables ($a_i$, $r_i$, $\sigma_i$, $u_i^s$, $\bar{r}_w^s$, $\bar{r}_j^s$, $s_{f,i}$, $s_{g,e}$), and 33 parameters.

(1) Model equations

Social Accounting Matrices

Nominal regular income of households: $Y_{hr} \equiv (W_{s,1} + W_{s,2}) + (F_{D,1} + F_{D,2}) + r_{m(-1)}M_{d(-1)}$ - (1)

Money stock held by households: $\Delta M_d \equiv \Delta V - (\Delta e_{d,1}p_{e,1} + \Delta e_{d,2}p_{e,2}) - (CG_1 + CG_2)$ - (2)

Capital gains on equities: $CG_i \equiv \Delta p_{e,1}e_{d,1(-1)}$ - (3)  
Change in wealth: $\Delta V \equiv Y_{hr} - C_d + (CG_1 + CG_2)$ - (4)

Retained earnings: $F_{t,1} \equiv F_{t,1} - F_{D,1} - r_{i(-1)}L_{d,1(-1)}$ - (5)

Change in demand for loans: $\Delta L_{d,1} \equiv p_2I_{d,1} - F_{U,1} - \Delta e_{s,1}p_{e,1}$ - (6)

Supply of money: $M_s = L_{s,1} + L_{s,2}$ - (7)

Rate of interest on money deposits: $r_m = r_l$ - (8)

Firms’ Behavioural Equations

Prices of goods: $p_i = (1 + \theta_i)w_i\alpha_i$ - (9)  
Demand for labour: $N_{d,i} \equiv \alpha_iS_i$ - (10)

Nominal labor wage: $W_{s,j} \equiv wN_{s,j}$ - (11)

Actual real output: $S_i \equiv C_i/p_i$ - (12.1)  
$S_2 \equiv S_{21} + S_{22} \equiv I_{s,1} + I_{s,2}$ - (12.2)

Full-capacity output: $S_{fc,i} \equiv K_{i(-1)}/\sigma_{i(-1)}$ - (13)

Standard sales: $S^t_{fc,i} \equiv u^t_{s}S_{fc,i}$ - (14)

Costing margins: $\theta_1 = r^*_2\sigma_2u^*_2/\alpha_iu^*_i(u^*_2 - r^*_2\sigma_2)$ - (15.1)  
$\theta_2 = r^*_2\sigma_2/u^*_2 - r^*_2\sigma_2$ - (15.2)

Nominal wage rate: $w = (1 + g_w)w_{(-1)}$ - (16)
Growth rate of nominal wage rates: 
\[ g_w = \mu_1 (r_{t-1} - r_{m(t-1)}) + \mu_2 \pi^e \]  - (17)

Expected Inflation: 
\[ \pi^e = \pi_{(t-1)} \]  - (18)

Inflation: 
\[ \pi = \Delta p^1 / p^1_{(t-1)} \]  - (19)

Target rate of profit sought by a trade union: 
\[ r^s_{t-1} = \pi^s_{t-1} - \pi g_{md(t-1)} \]  - (20)

Rate of Change in employment: 
\[ g_{nd} = \Delta N_d / N_{d(t-1)} \]  - (21)

Target rate of return sought by firms: 
\[ r_f^s = \pi^s_f + \pi u_{(t-1)} \]  - (22)

Actual target rate of return: 
\[ r_s = \psi (r_f^s + (1-\psi)r_w^s) \]  - (23)

Total profits: 
\[ F_{T,i} = m_i p_i S_i \]  - (24)

Rate of capacity utilization: 
\[ u_i = S_i / S_{f,i} \]  - (25)

Rate of profit: 
\[ r_f = F_{T,i} / (p_{(t-1)} K_{i(t-1)}) \]  - (26)

Investment: 
\[ I_{d,i} = \Delta K_i = g_{i} K_{i(t-1)} \]  - (27)

Rate of capital accumulation: 
\[ g_i = \gamma_i + \gamma_{ii} r_{f(i-1)} + \gamma_{ii} r_{i(i-1)} I_{i(i-1)} + \gamma_{ii} (q_{i(i-1)} - 1) + \gamma_{ii} u_{i(i-1)} + \gamma_{ii} g_{T,i(i-1)} \]  - (28)

Rate of cash flow: 
\[ r_{cf,i} = F_{U,i} / (p_{(t-1)} K_{i(t-1)}) \]  - (29)

Debt ratio: 
\[ l_i = L_{d,i} / (p_2 K_i) \]  - (30)

Tobin’s q ratio: 
\[ q_i = (L_{s,i} + p_{e,i} e_{s,i}) / (p_2 K_i) \]  - (31)

Labour productivity: 
\[ T_i = (1 + g_{T,i}) T_{i(t-1)} \]  - (32)

Technical progress: 
\[ g_{T,i} = g_{T,i} + \phi_{i} g_{m(i-1)} + \phi_{i} g_{m(i-1)} \]  - (33)

Dividends distributed to households: 
\[ F_{D,i} = (1-s_{f,i})(F_{T,i(i-1)} - r_{l(i-1)} L_{s,i(i-2)}) \]  - (34)

Total equities: 
\[ e_{s,i} = (1 + g_{e,i}) e_{s(i-1)} \]  - (35)

Rate of growth of equities: 
\[ g_{e,1} = g_{e,1(i-1)} + \delta (r_{e,2(i-1)} - r_{e,1(i-1)}) \]  - (36.1)

\[ g_{e,2} = g_{e,2(i-1)} + \delta (r_{e,2(i-1)} - r_{e,1(i-1)}) \]  - (36.2)

**Households’ Behavioural Equations**

Consumption expenditure: 
\[ C_d = a_1 W^e + a_2 FI^e + a_3 V^{(-1)} \]  - (37)

Expected wage income: 
\[ W^e = (1 + g_{y(-1)})(W_{x,1(i-1)} + W_{x,2(i-1)}) \]  - (38)

Expected financial income: 
\[ FI^e = (1 + g_{y(-1)})(F_{D,1(i-1)} + F_{D,2(i-1)} + m_{(t-1)} M_{d(t-2)}) \]  - (39)

Growth rate of regular income: 
\[ g_y = \Delta Y_{hr} / Y_{hr(-1)} \]  - (40)

Portfolio choices of households:
\[ M_d^e / V^e = \lambda_{10} + \lambda_{12} r^e_m - \lambda_{12} r^e_{1(i-1)} - \lambda_{13} r^e_{2(i-1)} + \lambda_{14} (Y^e_{hr} / V^e) \]
\[ p_{e,i}^e / V^e = \lambda_{20} - \lambda_{21} r^e_m + \lambda_{22} r^e_{1(i-1)} - \lambda_{23} r^e_{2(i-1)} - \lambda_{24} (Y^e_{hr} / V^e) \]  - (41)
\[ p_{e,i} e_{d,i} / V^e = \lambda_{30} - \lambda_{31} r_m - \lambda_{32} r_{e,i(-1)} + \lambda_{33} r_{e,2(-1)} - \lambda_{34} (Y_{hr}^e / Y^e) \] - (42)

Rate of return on equities: \( r_{e,i} \equiv (F_{D,i} + CG_i) / (p_{e,i(-1)} e_{d,i(-1)}) \) - (43)

Expected regular income of households: \( Y_{hr}^e = (1 + g_{y(i-1)}) Y_{hr(-1)} \) - (44)

Expected households’ wealth: \( V^e \equiv Y_{hr}^e - C_d + (CG^e_i + CG^e_z) + V_{(-1)} \) - (45)

Expected capital gains: \( CG^e_i = (1 + g_{ii(-1)}) CG^e_i_{(-1)} \) - (46)

Equilibrium Equations

Labour market: \( N_{s,i} = N_{d,i} \) - (47)
Consumption good market: \( C_s = C_d \) - (48)
Investment good market: \( I_{s,i} = I_{d,i} \) - (49)
Labour market: \( L_{s,i} = L_{d,i} \) - (50)
Equity market: \( e_{d,i} = e_{e,i} \) - (51)
\[ p_{e,i} = p^e_{e,i} e_{d,i} / e_{d,i} \] - (52)

(2) Exogenous variables and parameters

Exogenous variables

Propensity to consume: \( a_1 = 0.85 \) (0.87 for its experiment), \( a_2 = 0.1 \), \( a_3 = 0.004 \)
Firms’ propensity to save out of net profits: \( s_{f1} = 0.6 \), \( s_{f2} = 0.6 \)
Growth rate of equities: \( \bar{g}_e = 0.01 \) (0.013 for its experiment)
Rate of interest on loans: \( r_l = 0.0275 \) (0.0285 for its experiment)
Ratio of capital-output: \( \sigma_1 = 4 \) (3.8 for its experiment), \( \sigma_2 = 6.9 \) (6.6 for its experiment)
Standard rate of capacity utilization: \( u^e_1 = 0.85 \), \( u^e_2 = 0.85 \)
Autonomous term of target rate of return: \( \bar{r}^e_w = 0.04 \), \( \bar{r}_f^e = 0.05 \)
Autonomous growth rate of labour productivity:
\[ \bar{\bar{g}}_{T,1} = 0.01 \) (0.011 for its experiment), \( \bar{\bar{g}}_{T,2} = 0.01 \) (0.011 for its experiment)

Parameter Values

Investment function:
\[ \gamma_{10} = 0.025, \gamma_{11} = 0.39, \gamma_{12} = 0.32, \gamma_{13} = 0.017, \gamma_{14} = 0.040, \gamma_{15} = 0.1 \]
\[ \gamma_{20} = 0.025, \gamma_{21} = 0.45, \gamma_{22} = 0.40, \gamma_{23} = 0.020, \gamma_{24} = 0.045, \gamma_{25} = 0.1 \]
Households’ portfolio choices function:
\[ \lambda_{20} = 0.3, \lambda_{21} = 0.01, \lambda_{22} = 0.11, \lambda_{23} = 0.1, \lambda_{24} = 0.01 \]
\[ \lambda_{30} = 0.3, \lambda_{31} = 0.01, \lambda_{32} = 0.1, \lambda_{33} = 0.11, \lambda_{34} = 0.01 \]
Equity growth rate function: \( \delta = 0.1 \)
Nominal wage growth rate function: $\mu_1 = 0.7$, $\mu_2 = 0.9$
Target rate of return function: $\varepsilon = 0.1$, $\tau = 0.03$
Actual target rate of return function: $\psi = 0.8$ (0.75 for its experiment)
Technical progress function: $\varphi_{i1} = 0.01$ $\varphi_{i2} = 0.1$
Central Bank’s reaction function: $\zeta = 0.04$