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**Abstract**

The paper formulates a macrodynamic model of interaction between a Post-Keynesian investment function with endogenous capacity utilization and pro-cyclical markup over wage costs in a demand-constrained closed developing economy. Given the specific context of a developing economy under neoliberalism, the workers are not in a position to collectively bargain, and the policymakers are not in a position to conduct fiscal policy. We explore the extent to which a combination of pro-cyclical mark-up dynamics and counter-cyclical interest rate rules can stabilize the potentially unstable investment dynamics. We also examine the effectiveness of monetary policy in the form of interest rate rules in stabilizing output and income distribution. We show that in this situation, monetary policy has both an economic as well as a political role, of maintaining economic and social stability.

*Keywords:* Steindl, mark-up dynamics, interest rate rules.

*JEL classification:* B51; E12; E32; E43; G01

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## 1 Introduction

In this paper, we attempt to analyze the interaction between a Post-Keynesian investment function with endogenous capacity utilization and pro-cyclical markup over wage costs in a demand-constrained closed economy. The specific context that we attempt to model is a developing country under the influence of neoliberalism. This context motivates us to make two restrictions to the standard model: firstly, the workers have very little bargaining power; and secondly, the policy-makers are not in a position to conduct fiscal policy. We examine the effectiveness of monetary policy in the form of interest rate rules to stabilize the economy in this context.

Conflict between various sections of society over distribution of income has engaged substantial attention in Post-Keynesian and other heterodox macroeconomics discourse. This conflict might arise either between different social classes or within a social class. Goodwin (1967) proposed one of the earliest formal models of such a conflict between workers and capitalists, resulting in growth cycles. Much of contemporary Post-Keynesian formulation of conflicting claims, however, owes its origin to Kalecki (1971, chapter 14) and Rowthorn (1977). An important feature of this formulation is presence of market power with either side of this conflict. Workers in this formulation have market power by collectively bargaining as a trade union, while capitalists have market power from imperfect competition in an oligopolistic environment. Each side attempts to maintain its own target share of income – the former by collectively bargaining for a level of money wage that keeps the real wage at a pre-determined level desired by workers (usually based on some notion of 'fair' or historic share); and the latter by setting prices that keeps markup over real wage at the level desired by capitalists. Inflation results in case of an inconsistency between the targets set by the two social classes. In this case, rival claims on income from those negotiated by workers through collective bargaining and those pursued by capitalists through oligopolistic pricing falls short of the total income (see, for instance, Cripps 1977, Rowthorn 1977). Outcome of this bilateral bargaining, as Dalziel (1990) demonstrated, would depend on relative bargaining power of the workers and the capitalists. A detailed discussion of this literature might be found in Lavoie (2014, chapter 8). Maital & Benjamini (1980) provides a game-theoretic representation of the same argument.

More recently, the above model of conflicting claims has been integrated into contemporary neo-Kaleckian model of growth and distribution (see, for instance, Dutt 1992, Cassetti 2002). This class of models, following the arguments given by Steindl (1952, part II, chapter 10), includes endogenous capacity utilization as one of the factors affecting investment and growth in both short as well as the long-run. Since conflict, either between or within social classes over income distribution, is the main cause of inflation in this setup, Post-Keynesians argue that any attempt by the state or the policymaker (including the monetary authorities) to control inflation will only be successful when it is able to resolve this conflict. In other words, role of the state in this framework is to achieve a social consensus on distribution of income among various social classes as well as within them.

This emphasis among Post-Keynesians on the role of state to achieve social consensus on distribution of income should be evident from the rather large critical Post-Keynesian literature which has emerged recently on use of Taylor-type interest rate rules to target inflation (Fontana & Palacio-Vera 2002, Arestis & Sawyer 2004, Arestis, Baddeley & McCombie 2005, Arestis & Sawyer 2008). These rules were suggested by Taylor (1993) and (as pointed out by Clarida & Gertler 1997, Clarida, Galí & Gertler 1998, Judd & Rudebusch 1998, Clarida, Galí & Gertler 2000, Woodford 2002) adopted by many central banks, especially in developed countries. Post-Keynesian critiques, however, have pointed out that the success of these policies crucially depend on achieving a social consensus on distribution of income (See, for instance, Setterfield 2006, Lavoie 2014). Discussion on Post-Keynesian alternatives to standard inflation targeting models might be found in Rochon (2007), Rochon & Setterfield (2007), Wray (2007), Nishi (2015).

There is, however, another kind of conflict, represented by a rivalry among oligopolist capitalists, which is generally not a part of the standard Post-Keynesian or neo-Kaleckian model but was verbally described by Steindl (1952). Steindl (1952) argued that rivalry within oligopolist capitalists intensifies close to full capacity utilization, as price-cuts become increasingly ineffective due to a reduction in excess capacity. This makes the mark-up dynamics pro-cyclical. A formal model consistent with Steindl's (1952) verbal description was offered by Cassetti (2002) and Flaschel & Skott (2006). We attempt to offer a slightly modified version of such pro-cyclical mark-up dynamics in the following sections. In the absence of any standard term, we refer to this as 'Steindlian mark-up dynamics'.

Our primary departure from the standard Post-Keynesian literature, however, is in the way class conflict between capitalist and workers is modeled. An important feature of the standard Post-Keynesian or neo-Kaleckian framework discussed above is that it assumes that the oligopolistic capitalists and workers (organized as unions) participate from a similar position of strength in the process of nominal wage bargaining. This point will be clear, for instance, from the discussion of various hypothetical situations discussed by Dalziel (1990). The cases where either of the sides do not have market power gives rise to markedly different outcomes. In particular, when the workers do not have market power, "firms are able to achieve any market claim they desire by exercising market power to their advantage."(Dalziel 1990, page 429). The actual experience of three decades of neoliberalism in most countries seems to be at odds with the above description. One of the stylized facts which has characterized the world economy since 1980s is a substantial fall in labor share of income to historic low rates, after maintaining stable share since the beginning of this century (ILO & OECD 2015, page 2, footnote 1). For instance, the average adjusted labor share in G20 economies declined by 0.3 percentage points per year between 1980 and late 2000s, with share of labor declining in 26 out of 30 advanced countries within this period. Similarly, Karabarbaounis & Neiman (2014) reports a downward trend in labor share in 42 of 59 countries with 15 years of data between 1975 and 2012. Charpe (2011) reported an even sharper decline in wage share for emerging and developing countries: wage share declined by around 20 percentage points since 1994 in Asia, around 15 percentage points since 1990 in Africa (with around 30 percentage points since 2000 in North Africa), and around 10 percentage points since 1993 in Latin America. Similar figures were reported by Stockhammer (2013). This fall in the labor share of income has been accompanied with a rise in share of profits, especially corporate profits (see, for instance, Piketty & Goldhammer 2014, page 200-1, table 6.1 & 6.2 for figures of Britain and France respectively). Further, this fall in labor share of income has been accompanied with a growth in real GDP per worker which exceeded the figures in previous decades, and a rise in labor productivity. It seems somewhat difficult to explain such a large and consistent fall in labor share of income without attributing this to a failure of effective collective bargaining by workers.

There does exist a substantial literature which, in fact, seems to confirm our above suspicion. Machin (1997), for instance, reported a marked fall in participation of labor market institutions in Britain, accompanied by a series of anti-worker legislative measures which is responsible for both a decline in share of labor income in GDP as well as a rise in wage inequality. Substantial deunionization was also reported for US during the period of neoliberalism, among others, by DiNardo, Fortin & Lemieux (1996) and Acemoglu, Aghion & Violante (2001) for US, by Disney, Gosling & Machin (1996) for Britain and by Ünal Töngür & Elveren (2014) for OECD countries. DiNardo et al. (1996), Machin (1997) and Ünal Töngür & Elveren (2014) also looked into the association of deunionization with rise in income inequality. Vidal (2013) argued that deunionization was, in fact, part of larger changes in the system of production and accumulation referred to as 'post-fordism', and accompanied with increase in outsourcing, informalization and increase in flexibility of labor during this period. Stockhammer (2013), on the other hand, attributes an important role to increase in financialization for weakening of bargaining power of workers and fall in share of wages.

For many developing countries, however, the degree of unionization of labor was ineffectively low to begin with, even before neoliberalism set in. In addition, many of these developing countries have been at the receiving end of global supply chain through subcontracting and outsourcing, where competition has further eroded the bargaining power of workers. Hensman (2011), for instance, discusses the state of unionization in India both before and after neoliberalism, and how a large proportion of informal labor has weakened the bargaining power of workers. Unni & Rani (2008), on the other hand, describes how India created a very flexible labor system with the onset of neoliberalism, and how this has affected labor systems elsewhere, weakening labor not just in India but also in those economies with which India developed linkages. Similar evidence might be found commonly in many developing countries. It would be evident that this is a different world from the one described by the standard Post-Keynesian models of conflicting claims. In this world, competition and conflict exists between capitalists; however, the real wages might be squeezed to accommodate capitalist claims on income distribution, if required down to even levels below living wage. This is the world which we attempt to model in the following sections.

With the above objective, we propose a simple Post-Keynesian model of a closed developing economy in the following sections, where unlike the standard model, workers have no bargaining power. There is, however, competition among capitalists which affect the mark-up dynamics. In the absence of conflicting claims, inflation is not a major concern.[1] Hence, as a simplifying assumption we ignore prices in our model. While this might be an unrealistic assumption, we contend that given the balance of class power in our model, an explicit inclusion of prices might not substantially alter the qualitative outcomes of our model. Hence, the model that we offer in the following sections might be looked upon as an abstraction and not a description of an actual economy, but which nevertheless captures some of the processes underlying distribution dynamics and policy formulation in a capitalist economy.

Given the above setup, the state or the policymaker, therefore, has a slightly different role than that of resolving conflicting claims as in the standard model. Given that workers do not have any bargaining power, the state or the policymaker now needs to step in to ensure that the real wages of the workers are not squeezed below the level of living or socially sustainable wage. Any real wage below this level might be a threat to social stability and order. In other words, we make a departure from the standard concern with conflict-inflation in the Post-Keynesian literature and focus on a larger political role of maintaining social stability. We also need to note that state under neoliberalism is typically

[1]We should, however, note that possibilities of inflation still exists even without workers' bargaining power, as was shown by Dalziel (1990). This possibility would arise when the initial claims made by workers and capitalists exceed the total output. However, in the absence of workers' bargaining power, a small inflation will quickly bring the real wages down to the level consistent with the claim made by capitalists, without the inflation spiralling out of control. In other words, inflation is unlikely to be a major concern in such an economy, unless there is a major supply shock. This largely conforms with our real world observation that many of these developing countries with low levels of unionization are characterized by low levels of inflation.

constrained to undertake fiscal policy, making monetary policy the primary policy instrument. We attempt to explore the role that monetary policy, in the form of an interest rate rule, plays in the context of a post Keynesian growth model with class conflict. We seek to see whether such a combination of two negative feedbacks – 'Steindlian' mark-up dynamics and a monetary policy rule – can provide endogenous bounds to an otherwise unstable multiplier-accelerator system. We also attempt to explore the long-run behavior of the resultant dynamics.

We begin by setting up the model in section 2, discuss the comparative dynamics in section 4, and make a few concluding remarks in section 5.

# 2 The Model

## 2.1 Goods Market

We consider a simple continuous time Kaleckian model of a closed economy without government.[2] The economy consists of workers earning wages ($W$), and capitalists earning profits ($P$) from enterprises. The national income, $Y$, is measured by income method as the sum of wages and profits, i.e. $Y(t) = W(t) + P(t)$. The total income is distributed between wages and profits as an outcome of class struggle between workers and capitalists. Let the share of profits in period $t$, $\psi(t) = P(t)/Y(t)$, i.e. wages, $W(t) = [1 - \psi(t)]Y(t)$. Following the standard assumptions in the literature, all wages and a fraction $1 - s_p$ of profits are consumed, where $s_p$ is the propensity to save out of profits by the capitalists, i.e. consumption,

$$C(t) = W(t) + (1 - s_p)[P(t)] \tag{1}$$

The aggregate demand is composed of the total expenditure on consumption and investment, i.e. $AD(t) = C(t) + I(t)$, where $I(t)$ is the investment (or the rate of change of capital stock).

Let the potential output or the rate of capacity of production in the economy, $Y^\star$, be defined as the maximum output that can possibly be produced, given the existing constraints of factors and a given technology. Assuming the availability of capital as the binding constraint on production, we have $Y^\star(t) = \beta K(t)$, where $\beta$ is the output-capital ratio determined by the existing technology. The actual level of output or the national income, $Y$, can now be represented as $Y(t) = \min(AD(t), Y^\star(t))$. In other words, for all $AD \leq Y^\star$, aggregate demand acts as the main constraint on the level of production and the output is determined by the aggregate demand.

[2]See, for instance, the basic framework found in Kalecki (1971, chapt. 7) or Lavoie (2014, chapt. 5.3.6).

At the goods market equilibrium, the level of output measured by the income method equals the aggregate demand, i.e. $Y(t) = AD(t)$ so that $W(t) + P(t) = C(t) + I(t)$. Substituting the value of $C$ from (1), we have

$$Y(t) = \frac{1}{s_p \psi(t)} I(t) \tag{2}$$

Let the rate of capacity utilization be defined as the ratio of actual to potential output, i.e.

$$u(t) = \frac{Y(t)}{Y^{\star}(t)} \tag{3}$$

We define the rate of investment,

$$g(t) \equiv \frac{I(t)}{K(t)} \tag{4}$$

From the definition of $u$, $Y^{\star}$ and $g$, and the goods market equilibrium condition given in (2), we have

$$g(t) = s_p \psi(t) \beta u(t) \tag{5}$$

with a feasibility condition $0 \leq u \leq 1 \Leftrightarrow 0 \leq g \leq g_{\max}$, where $g_{\max} \equiv s_p \psi(t) \beta$ represents the rate of investment corresponding to full capacity utilization.

Next, we set up an investment function. A substantial literature, following the arguments given by Steindl (1952, part II, chapter X), includes the rate of capacity utilization as one of the factors affecting investment. Within this broad category of investment functions with the rate of capacity utilization as an argument, however, there has emerged two distinct traditions in the literature regarding the manner in which the rate of capacity utilization is included in the investment function. The class of investment functions usually referred to as 'Post-Keynesian', 'neo-Kaleckian' or 'Steindlian' involves postulating a simple monotonic relationship between rate of investment and the rate of capacity utilization (see, for instance, Bhaduri & Marglin 1990, Dutt 2006*a*, Dutt 2006*b*, Bhaduri 2008, Setterfield 2009), whereas the class of investment functions referred to as 'Classical', 'Harrodian', or 'Marxian' involves postulating investment as a function of deviation of actual rate of capacity utilization from its exogenously specified normal rate (see, for instance, Duménil & Lévy 1999, Flaschel & Skott 2006, Shaikh 2009). While both classes of investment functions yield similar short-run conclusions, the long-run implications differ. The dependence of investment to the rate of capacity utilization is maintained in long-run steady state in the former class of investment functions, while in the latter, this dependence disappears in long-run.[3] We adopt the former approach and hence, suggest

[3]Lavoie, Rodríguez & Seccareccia (2004) offers a reconciliation to this debate by suggesting an alternative interpretation of the 'Post-Keynesian' investment function, where the normal rate of capacity utilization is determined endogenously, depending on the actual rate of capacity utilization. For more on this debate, see Commendatore (2006), Hein, Lavoie & van Treeck (2011), Skott (2010) and the critique of Duménil & Lévy's (1999) model by Lavoie & Kriesler (2007).

an investment function which does not explicitly include an exogenously specified normal rate of capacity utilization. Let $g^\star$, the desired rate of investment, depend directly and linearly on the rate of capacity utilization, i.e. $g^\star(t) = \bar{\gamma} + \gamma(t)\, u(t)$. Substituting from (5), we have

$$g^\star(t) = \bar{\gamma} + \frac{\gamma(t)\, g(t)}{s_p \beta \psi(t)} \tag{6}$$

where $\gamma$ is the 'accelerator' or the sensitivity of the desired rate of investment, $g^\star$ to the rate of capacity utilization, $u$, and is endogenously determined by financial factors. $\bar{\gamma}$, on the other hand, due to reasons given by Duménil & Lévy (1999, page 686), comprises the exogenous component of investment (sometimes referred to as 'animal spirits' in the literature.

## 2.2 Financial Determinants of Investment

We now turn our attention to the financial determinants of the rate of investment. To begin with, we suggest that the flexible accelerator, $\gamma$, depends inversely on the rate of interest. This could be because

(a) an increase in the rate of interest increases the the cost of servicing debt for firms financing a part of their investment through debt;

(b) an increase in the rate of interest increases the opportunity cost of investing in physical capital; and

(c) an increase in the rate of interest, by increasing the likelihood of an adverse selection of risky projects might lead to an increase in credit rationing and red-lining, leading to abandonment of projects which might have been feasible at a lower rate of interest.

With an inverse linear dependence of the flexible accelerator on the rate of interest,[4] we have

$$\gamma(t) = \bar{\mu} - \alpha r(t) \tag{7}$$

Substituting from (7) into (6), we have

$$g^\star(t) = \bar{\gamma} + \frac{\bar{\mu} - \alpha r(t)}{s_p \beta \psi(t)} g(t) \tag{8}$$

Let the rate of investment be continuously adjusted so as to meet a fraction, $h$, with $h \in [0, \infty)$, of the gap between the actual and the desired rate of investment, i.e.

$$\frac{\dot{g}(t)}{g(t)} = h\left(g^\star(t) - g(t)\right) \tag{9}$$

[4]We might point out here that an alternative way of incorporating the financial factors might be to directly incorporate them into the investment function instead of using the flexible accelerator. While this might simplify the relationship, in our view it also introduces unnecessary rigidities into our model in the form of imposed linearities in the accelerator relationship without an economic basis. However, we contend that the two approaches differ only in the non-linear part, and the linear approximation of the two approaches will coincide.

where $h$ represents the speed of adjustment of the actual investment to the desired level by the investors. Substituting the value of $g^{\star}(t)$ from (8) into (9), we have the following equation of motion to represent the dynamics of the rate of investment:

$$\dot{g}(t) = \left[\bar{\gamma} + \frac{\bar{\mu} g(t)}{s_p \beta \psi(t)} - \frac{\alpha g(t) r(t)}{s_p \beta \psi(t)} - g(t)\right] h g(t) \tag{10}$$

We should point out here that we are making a modelling choice to represent the percentage change in the investment rate (rather than just the change in investment rate itself) as a function of the gap between the actual and the desired rate of investment. This is in lines with the arguments made by Kalecki (1962) in favor of allowing the possibility of a steady state with zero growth rate of investment, which was later reiterated by Patnaik (1997, chapter 2). We also note that the choice of investment function above makes the growth regime wage-led and stagnationist. In other words, in the tradition of Kaleckian models, given a higher savings propensity out of profits, a shift in income distribution in favor of profits will have a negative impact on aggregate demand and investment.[5]

## 2.3 Class Conflict and Mark-up Dynamics

Next, we introduce Steindlian mark-up dynamics. Following Steindl's (1952) descriptive account, modeled among others by Flaschel & Skott (2006) and Cassetti (2002), we turn our attention to distributional dynamics in an oligopolistic market environment where the firms practice mark-up pricing.

First, we recall from our earlier discussion that our model refers to a world where the workers have no bargaining power as far as wages are concerned, and the capitalists are free to set the share of profits at their desired level. In other words, the capitalists are in a position to squeeze the share of wages to a level consistent with their claims to income distribution. As we pointed out earlier, this might be accompanied with a small one time inflation to bring the real wage in line with capitalist claims. However, the inflation will not spiral out of control in the absence of counter claim by workers to income distribution, unless there is an adverse supply shock. We ignore this inflation or change in prices for the time being in order to simplify our model.

There is, however, a conflict among oligopolist capitalists over a share of the market. Close to normal level of capacity utilization, a decline in excess capacity reduces the effectiveness of price-cuts by limiting the options for individual firms to increase output and capture a larger share of the market. This leads to an increase in tendency towards cartelization, raising markups and the share of

[5] A more detailed discussion on wage-led and profit-led regimes might be found in Blecker (2002).

profits in national income. This argument might be modeled in a straightforward way by introducing a law of motion for the share of profits, $\psi$, as follows:

$$\dot{\psi}(t) = \kappa(\psi^{\star}(t) - \psi(t)) \tag{11}$$

where $\psi^{\star}$ represents the share of profits desired by the firms. If the actual share of profits, $\psi$, falls short of its desired rate, the firms increase the mark-up, leading to a rise in $\psi$. $\kappa$ represents the speed at which firms adjust the share of profits in response to a gap between its actual and desired rate, with $\kappa \in [0, \infty)$.

The desired level of the share of profits, $\psi^{\star}$, on the other hand, depends on the rate of capacity utilization. A higher rate of capacity utilization, $u$, as argued by Steindl (1952), Cassetti (2002) and Flaschel & Skott (2006), would provide an incentive to the firms to raise their mark-up over costs, leading to a rise in the share of profits in national income, $\psi$. In a simple linear formulation, this might be represented as follows:

$$\psi^{\star}(t) = a + bu(t) \tag{12}$$

where $a$ is the minimum level of $\psi$, the share of profits, and $b$ is the sensitivity of $\psi$ with respect to $u$, with $a, b > 0$ and $a + b < 1$, so that $u \in [0, 1] \Leftrightarrow \psi \in (0, 1)$.[6] Substituting from (12) into (11), we have

$$\dot{\psi}(t) = \kappa(a + bu(t) - \psi(t)) \tag{13}$$

Substituting from (5) into (13), we have

$$\dot{\psi}(t) = \kappa\left(a + \frac{bg(t)}{s_p\beta\psi(t)} - \psi(t)\right) \tag{14}$$

### 2.4 A Simple Dynamical System

Equations (10) and (14) together describes our dynamical system, reproduced below for clarity:

$$\boxed{\begin{aligned} \dot{g}(t) &= \left[\bar{\gamma} + \frac{\bar{\mu}g(t)}{s_p\beta\psi(t)} - \frac{\alpha g(t)\, r}{s_p\beta\psi(t)} - g(t)\right] hg(t) \\ \dot{\psi}(t) &= \kappa\left(a + \frac{bg(t)}{s_p\beta\psi(t)} - \psi(t)\right) \end{aligned}} \tag{15}$$

We note from this discussion that the dynamical system represented by (15) has three steady states. Typically only one of these steady states is likely to be economically meaningful, i.e. lies in the interior of real positive orthant. We also find that the economically meaningful steady state is locally stable for wide range of parameters, as long as the exogenous component of investment, $\bar{\gamma}$ (or 'animal

[6] $[a, b]$ and $(a, b)$ represent the closed and the open interval respectively.

spirits') is sufficiently large. In other words, as long as the indicator of animal spirits, represented by $\bar{\gamma}$ is sufficiently large, any trajectory starting from an initial point in the neighborhood of the economically meaningful non-trivial steady state will eventually converge to it.

We can illustrate the strong convergence possibilities of this system with the help of a numerical example. If the parameters have values as follows:

$$s_p = 0.2, \quad \alpha = 0.8, \quad \beta = 0.3, \quad \bar{\mu} = 0.02, \quad a = 0.2, \quad b = 0.7, \quad \bar{\gamma} = 0.05,$$
$$r = 0.03, \quad \kappa = 0.9, \quad h = 0.9$$

then $(0.0463, 0.8420)$, representing a rate of investment of 4.63% and an equilibrium steady state share of profit of 84.2%[7] is the only economically meaningful steady state. Further, by an application of Routh-Hurwitz condition, we note that this economically meaningful steady state is locally stable, so that solutions starting from initial points close to this steady state are likely to converge.

We illustrate this convergence by numerically obtaining the solutions starting from initial point $(0.05, 0.6)$. The convergence of the trajectories to the non-trivial steady state would be evident from the phase portrait of the above numerical example, shown in $g$-$\psi$ space below in figure 1:

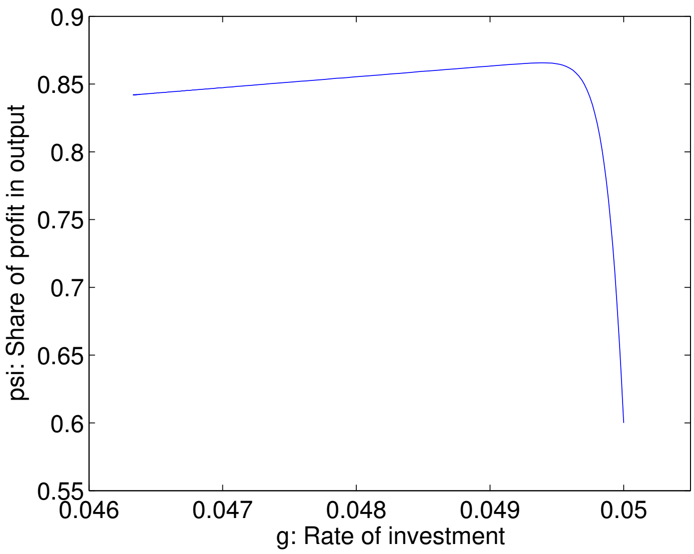


Figure 1: Phase diagram of numerical solution to (15) with initial point at $(0.05, 0.6)$

[7]The other two, namely $(0, 0.2000)$ and $(0.0552, -0.7086)$ are economically not meaningful. Hence, we ignore these.

We also show the time-series of the rate of investment and the share of profits below in figure 2. Very quick convergence to the steady state is evident here as well.

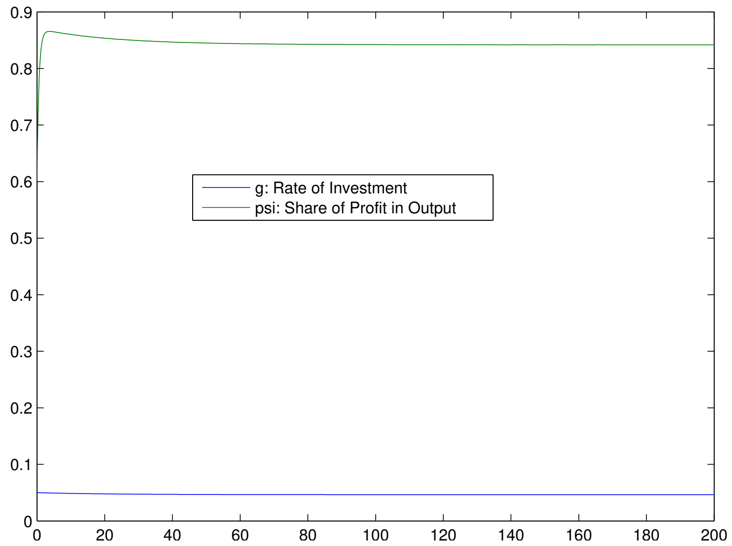


Figure 2: Time series of numerical solution to (15) with initial point at $(0.05, 0.6)$

We might note here that the share of profits in the above numerical example is 84.2%, which seems to be a bit higher than what we typically observe in most real-life economies. However, this should not come as a surprise, given the lack of collective bargaining by workers as well as lack of intervention by the state. We are going to argue in the following sections that this is going to be one of the primary reasons for state intervention in our current model.

# 3 Role of the State and Policy

## 3.1 Monetary Policy and Interest Rate Rule

Next, we turn to the monetary policy by the Central Bank. Last few decades have seen monetary authorities of many countries around the world shifting to some form of an interest rate rule targeting inflation, in the lines suggested by Taylor (1993) and more generally referred to as the 'New Consensus in Macroeconomics' or NCM (cf. Clarida & Gertler 1997, Clarida et al. 1998, Judd & Rudebusch 1998, Clarida et al. 2000, Woodford 2002). However, as pointed out in section 1, this form of interest rate rule targeting inflation has come under severe criticism in the Post-Keynesian literature (see, for instance, Fontana & Palacio-Vera 2002, Arestis & Sawyer 2004, Arestis et al. 2005, Arestis & Sawyer 2008), especially in the context of the transmission mechanism of these rules. Post-

Keynesian critiques[8] have pointed out that the main cause of inflation in an economy is not excess supply of money or an excess demand for goods, as it is usually assumed in mainstream economic ideas which are behind NCM. On the contrary, in the Post-Keynesian view inflation is an outcome of conflicting claims to income from various sections of the society or different social classes. The conflicting claims occur because of a disagreement between various social classes over distribution of income. Since the main transmission mechanism for NCM is through demand contraction, Post-Keynesians disagree with this transmission channel. According to Post-Keynesians, therefore, in order to control inflation the monetary authorities need to resolve class conflict between various social classes and bring them into an agreement over distribution of income. Viewed in this way, one might, therefore, argue that the monetary authorities not only have an economic but also a political task before them when they attempt to control inflation.

In the context of our current model, however, we feel that we need to re-interpret the role of monetary authorities. We note, from our discussion in previous sections, the distinct nature of class conflict in the model described by (15). In particular, the workers do not have any bargaining power. The capitalists are able to squeeze real wages to the level consistent with their claims to income distribution. As mentioned above, absence of counter claim from workers would prevent a situation of spiralling inflation. So conflict inflation is not a problem in our model economy.

There are, however, two alternative sources of conflict dynamics in our model, which we elaborate below:

1. Firstly, competition among oligopolist capitalists over share of market. As we pointed out above in section 2.3, at low levels of capacity utilization, it is relatively easier for firms to capture each others' markets through price-cuts. However, as one approaches near full capacity, a reduction in excess capacity makes price cuts relatively less effective, increasing the tendency towards cartelization, increasing the share of profits in output.

2. Secondly, even though workers do not have a direct bargaining power in the form of ability to collectively bargain with their employers over money wage, they might exercise their collective strength with the state to demand certain minimum living standards. Collective bargaining with the state can take place in various ways, for instance, by collectively voting out incumbent governments in elections, or through various kinds of social unrest or threat to law and order which might interfere with smooth functioning of the economy or the capitalist accumulation process.[9]

[8] See, for instance, a summary of this literature in Lavoie (2014, chapter 8).

[9] Indian economy is a good example. Very low levels of unionization and a very large unor-

We might note here that the competition among capitalists was also discussed, among others, by Ohno (2014). The market structure in our model, however, is distinct from the one provided by Ohno (2014). The market structure in Ohno (2014) is characterized by imperfect competition, and hence the main threat of competition comes from free entry. The market structure in our model, on the other hand, is oligopolistic, and the main threat of competition comes from price cuts. Further, our model is also unlike much of the literature (e.g. Isaac (2009) and Proaño, Flaschel, Krolzig & Diallo (2011)) since it lacks conflict inflation. The main role of monetary policy is not to target inflation but to manage output and income distribution. The latter also has important implication for maintaining social stability.

In other words, the policymaker (Central Bank in this case) is being called upon to resolve a slightly different problem than the one found in conflicting claims model: to protect a certain minimum living standard for the workers by preventing the capitalists from making a claim to the income distribution which is socially not sustainable. Given that share of profits directly responds to increase in capacity utilization and reduction in excess capacity, the Central Bank can keep a check on income distribution by ensuring some optimal level of excess capacity. The monetary policy, therefore, consists of using the interest rate as an instrument to target a specific level of capacity utilization. Also, due to reasons specified earlier, namely the assumption of a developing economy with standard neoliberal restrictions on fiscal policy, a rule-based monetary policy targeting capacity utilization becomes the primary policy tool in our model. The Central Bank, in other words, follows an interest rate rule that targets the level of capacity utilization and adjusts the rate of interest as a response to the gap between the target and the actual level of capacity utilization. If the level of capacity utilization desired by the Central Bank is represented by $u^\star$ (with $u^\star \in ]0,1[$), then the interest rate rule is given by

$$\begin{aligned} \frac{\dot{r}(t)}{r(t)} &= l\,(u - u^\star) \\ \Rightarrow \dot{r}(t) &= l\left\{\frac{g(t)}{s_p \beta \psi(t)} - u^\star\right\} r(t) \end{aligned} \tag{16}$$

where $l \in [0, \infty)$ is the speed of adjustment of the rate of interest by the Central Bank. We contend that our rule, represented by (16) might be considered as a contribution to the larger literature on Post-Keynesian alternatives (see, for

ganized and informal workforce makes it very difficult for most workers, with the exception of government employees, to protect their real wage during inflation. However, relative to some other economies, inflation is politically sensitive. Even a moderately high inflation leads to major social unrest, and often results in electoral defeat of incumbent governments. The governments, therefore, are forced to worry and intervene, if required, in case of even a moderately high and short phases of inflation.

instance, Rochon 2007, Rochon & Setterfield 2007, Wray 2007, Lavoie 2014, Nishi 2015) to NCM interest rate rules.

### 3.2 Complete Dynamical System

Equations (10), (14) and (16) together completely describes our dynamical system, reproduced below for clarity:

$$\boxed{\begin{aligned} \dot{g}(t) &= \left[\bar{\gamma} + \frac{\bar{\mu} g(t)}{s_p \beta \psi(t)} - \frac{\alpha g(t) r(t)}{s_p \beta \psi(t)} - g(t)\right] h g(t) \\ \dot{\psi}(t) &= \kappa \left(a + \frac{b g(t)}{s_p \beta \psi(t)} - \psi(t)\right) \\ \dot{r}(t) &= l \left\{\frac{g(t)}{s_p \beta \psi(t)} - u^{\star}\right\} r(t) \end{aligned}} \tag{17}$$

We note that the dynamical system represented by (17) has only one non-trivial, economically meaningful steady state that lies in the interior of real positive orthant. This is given by:

$$\bar{E} : \left(\bar{g}, \bar{\psi}, \bar{r}\right) = \left(s_p \beta \left(a + b u^{\star}\right) u^{\star}, a + b u^{\star}, \frac{1}{\alpha}\left\{\frac{\bar{\gamma}}{u^{\star}} + \bar{\mu} - s_p \beta \left(a + b u^{\star}\right)\right\}\right) \tag{18}$$

Before proceeding any further, we should note that the monetary authorities play an important role in determination of the steady state in the above system. By targeting a specific level of capacity utilization, $u^{\star}$, the monetary authorities choose both the steady state rate of investment, $\bar{g}$, as well as the income distribution in steady state, $\bar{\psi}$.

The local stability properties of the non-trivial economically meaningful steady state, $\bar{E}$, is discussed in appendix A. We find from the discussion that there are strong possibilities of the dynamics converging to the non-trivial economically meaningful steady state. In other words, starting from any arbitrary initial point, there are strong possibilities that the dynamics of our model would push the trajectories to converge to $\bar{E}$ for large ranges of reasonable and realistic values of various parameters. This might be clear from a numerical example. For the sake of illustration, if the parameters have values as follows:

$$s_p = 0.2, \quad \alpha = 0.8, \quad \beta = 0.3, \quad \bar{\mu} = 0.02, \quad a = 0.2, \quad b = 0.3 \quad \bar{\gamma} = 0.05$$

and if the monetary authorities are targeting a capacity utilization of 80%, i.e. $u^{\star} = 0.8$, then all the above stability conditions are satisfied with any positive values of the rates of adjustment, $h$, $\kappa$ and $l$. In other words, we demonstrate that under reasonable configuration of parameters, there exist very strong possibilities for the dynamics to converge to the economically meaningful non-trivial steady state, which in this case is given by $(0.0365, 0.7600, 0.0461)$, i.e. an investment rate of 3.65%, a share of profits of 76% and a rate of interest of 4.6%. We demonstrate one such trajectory converging to the steady state below. For the sake of illustration, we use the following rates of adjustment:

$$h = 0.9, \quad \kappa = 0.9, l = 0.9$$

and numerically compute the solution to (17) with initial point at $(0.05, 0.5, 0.05)$.

The following phase diagram in figure 3 illustrates this convergence to the steady state of the above trajectory in $g$-$\psi$-$r$ phase-space.

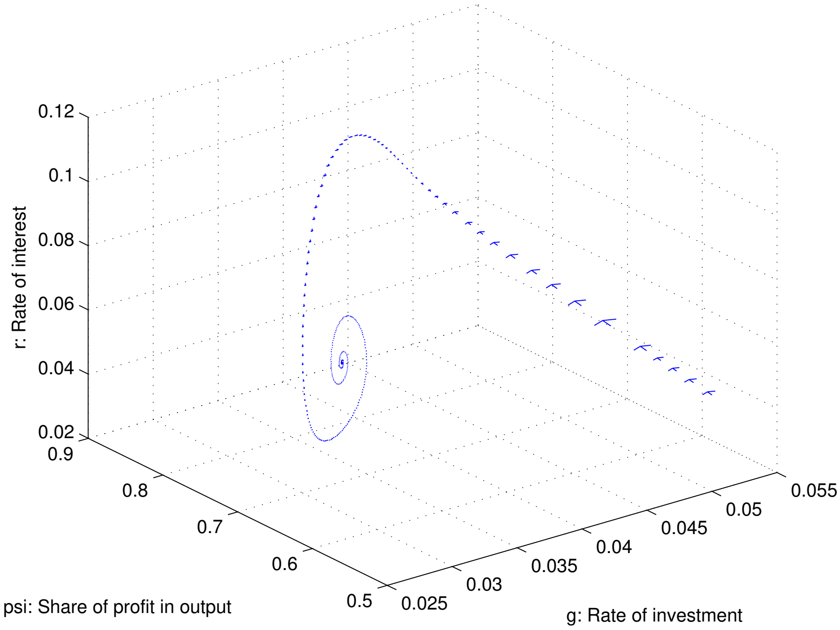


Figure 3: Phase diagram of numerical solution with initial point at $(0.05, 0.5, 0.05)$

We can also plot the time-series of the rate of investment, the share of profits and the rate of interest along the trajectory in the following time-series diagram in figure 4. As would be evident from the time-series, all the three variables, $g$, $r$ and $\psi$ very quickly converges to the steady state in about a few hundred iterations.

We end this discussion of the dynamics of our system with two passing remarks. Firstly, we note that due to interaction of two positive feedbacks, the multiplier and accelerator, the accumulation dynamics by themselves, are inherently unstable. This is a standard fact in the rather large literature on multiplier-accelerator models[10] We notice that Steindlian markup dynamics, by providing

[10]See, for instance, Hicks (1950) for an early example.

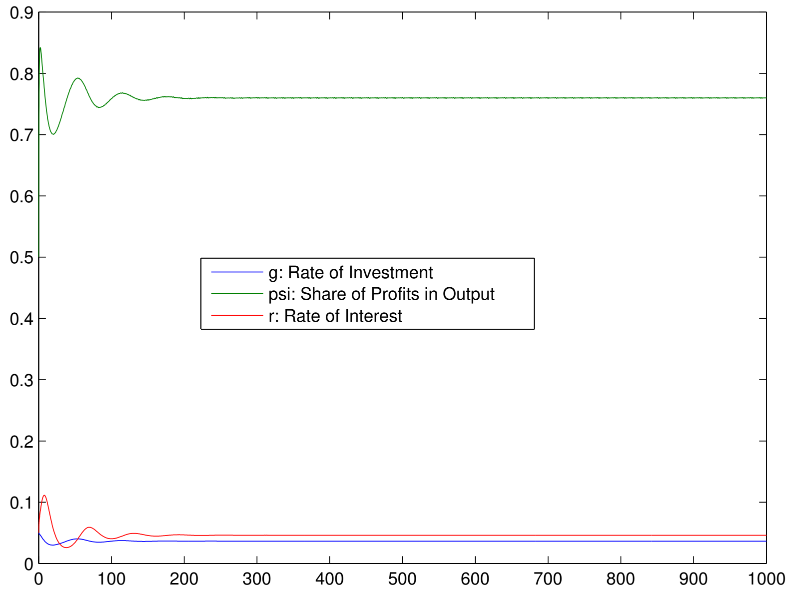


Figure 4: Time series of numerical solution with initial point at $(0.05, 0.6, 0.05)$

a negative feedback, imparts a stabilizing impact on this class of models. This is particularly evident in case of (15), where the markup dynamics alone plays a stabilizing role in dampening the potentially explosive multiplier-accelerator interaction. In the presence of interest rate rule in (17), this provides additional negative feedback. In addition, as we note from the two numerical examples with similar parameter specifications, the negative feedback from interest rate rule also results in a reduction in share of profits, $\psi$ in the economically meaningful steady state, and hence plays a role in providing social stability as well. Secondly, we would like to draw the attention of readers to the fact that, in a model of interaction between Post-Keynesian investment function with flexible accelerator and interest rate rules targeting capacity utilization, Datta (2011) showed cycles in the form of closed orbits. The possibilities of finding cycles, however, are greatly diminished in the presence of Steindlian mark-up dynamics. In this sense, we might argue that the mark-up dynamics provide a stabilizing impact to our model. Such an argument, however, might be made with two points of caution. Firstly, we should note that our result is at least partially driven by the specific form of investment function we have considered, which lacks an exhilarationist term.[11] An exhilarationist term, no doubt, would have added a positive feedback to our model, and hence would have imparted a destabilizing impact.[12] Secondly, inclusion of workers' bargaining power might have induced additional positive feedback to out model, and provided a destabilizing impact.

[11] For a contrast, for instance, one might refer to Flaschel & Skott (2006), which has similar mark-up dynamics; however, the investment function contains an exhilarationist term.

[12] Lavoie (2014, chapter 6) contains a detailed discussion of the implications of including an exhilarationist term, including several objections.

# 4 Comparative Statics

We first note that the unique non-trivial economically meaningful steady state for (17) can be obtained sequentially. The rate of capacity utilization targeted by the Central Bank, $u^\star$ directly determines the income distribution in the steady state, $\bar{\psi}$. The equilibrium share of profits, $\bar{\psi}$, together with $u^\star$ determines the steady state rate of investment, $\bar{g}$. In other words, the state plays a major role in this economy in both economic and political sphere, by influencing both growth and distribution.

Next, we attempt a comparative dynamic analysis to determine the sensitivity of the steady state with respect to some of the parameters. The strong convergence possibilities noted in section 3.2 allows us to perform this exercise with greater confidence. We begin by noting that the non-trivial steady state is completely insensitive to the three rate of adjustment parameters, viz. $h$, $\kappa$ and $l$. This is expected, as all the above three processes of adjustment take place in the short-run and does not affect the long-run steady state. Let us now examine the steady state values of the three variables, $\bar{g}$, $\bar{\psi}$ and $\bar{r}$ separately.

## 4.1 Rate of investment

We recall from (18) that the steady state rate of investment, $\bar{g}$ is given by

$$\bar{g} = s_p \beta \left(a + bu^\star\right) u^\star \tag{19}$$

We perform a sensitivity analysis of the steady state rate of investment with respect to various parameters. Partially differentiating the steady state rate of investment, $\bar{g}$ with respect to the propensity to save out of profits, $s_p$, we have

$$\frac{\partial \bar{g}}{\partial s_p} = \left(a + bu^\star\right) \beta u^\star > 0 \tag{20}$$

i.e. the steady state rate of investment depends directly on the propensity to save out of profits. Given that the steady state share of profits, $\bar{\psi} = a + bu^\star$, the total propensity to save out of income is given by $s_p \bar{\psi} = s_p \left(a + bu^\star\right)$. We find that the steady state rate of investment depends directly on the propensity to save out of income. In other words, the paradox of thrift holds in the long-run.

We should recall here that there is a long debate between Harrodians or neo-Marxians on one hand and Post-Keynesians on the other on the long-run sensitivity of the rate of investment to capacity utilization. The former approach is to include an exogenously given rate of growth of output or capacity utilization (known variously as the 'normal rate', the 'natural rate' or the 'non-accelerating inflation rate') either in the investment function or the Phillips curve. The economy grows along this exogenously specified rate in the long-run, i.e. paradox of thrift does not hold. The latter, on the other hand, argue that such a 'normal' or 'natural' rate either does not exist, or is endogenously determined from the short-run growth rates. The paradox of thrift holds in this class of models even in the long-run.

In the background of this debate, some of the above comparative dynamic results might come across as unexpected. We started out with a fairly standard Post-Keynesian relationship between investment and capacity utilization, without any exogenously given rate of investment or capacity utilization. The steady state rate of investment, however, depends directly on the total savings propensity out of income (given by $s_p\bar{\psi} = s_p\left(a + bu^{\star}\right)$), i.e. the paradox of thrift does not hold in the long-run. In this sense the model shows some similarity with the Harrodian or neo-Marxian models.

On a closer examination, however, our model shows an important point of departure from the Harrodian or neo-Marxian class of models. Partially differentiating the steady state rate of investment, $\bar{g}$, with respect to the rate of capacity utilization targeted by the central bank, $u^{\star}$, we have

$$\frac{\partial \bar{g}}{\partial u^{\star}} = s_p\beta\left(a + 2bu^{\star}\right) > 0 \tag{21}$$

i.e. the steady state rate of investment depends directly on the rate of capacity utilization targeted by the central bank, $u^{\star}$. Note that $u^{\star}$ is policy determined, and represents the target rate of capacity utilization by the central bank. In this sense, the rate of capacity utilization at the steady state in our model is neither at the full employment level, as in Harrod (1939), nor at the exogenously given 'natural' or 'normal' rate to which the private investors try to adjust their actual rate of investment. A corollary from this would follow, that unlike the mainstream Keynesian or the Harrodian models, the monetary authorities are in a position to influence the long-run steady state rate of growth. In other words, monetary policy is effective not just in the short-run, but even in long-run. This conclusion is in line with the larger Post-Keynesian literature. However, we should add a cautious note here that such an ability to influence the steady state will be limited only to the case where the non-trivial steady state, $\bar{E}$, is locally stable.

Further, by partially differentiating the steady state rate of investment, $\bar{g}$ with respect to the output capital ratio determined by technology, $\beta$, we have

$$\frac{\partial \bar{g}}{\partial \beta} = s_p\left(a + bu^{\star}\right)u^{\star} > 0 \tag{22}$$

i.e. the steady state rate of investment depends directly on output-capital ratio determined by the existing technology.

Finally, partially differentiating $\bar{g}$ with respect to the relative bargaining power of the capitalists vis-à-vis workers (represented by $a$ and $b$):

$$\frac{\partial \bar{g}}{\partial a} = s_p \beta u^\star > 0 \tag{23a}$$

$$\frac{\partial \bar{g}}{\partial b} = s_p \beta u^{\star 2} > 0 \tag{23b}$$

i.e. the steady state rate of growth depends directly on the relative bargaining power of the capitalists vis-à-vis workers. Alternately, we can also say that the steady state rate of growth depends directly on the sensitivity of the profit share to capacity utilization (represented by $a$ and $b$). This is in line with the results discussed above on the direct dependence of the steady state rate of investment on the savings propensity out of income. A higher sensitivity of $\psi$ to $u$ will allow allocation of larger mark-ups for any particular rate of capacity utilization, leading to higher savings and higher rate of investment.

### 4.2 Income distribution

We recall from (18) that $\bar{\psi} = a + bu^\star$, i.e.

$$\frac{\partial \bar{\psi}}{\partial a} > 0 \tag{24a}$$

$$\frac{\partial \bar{\psi}}{\partial b} > 0 \tag{24b}$$

$$\frac{\partial \bar{\psi}}{\partial u^\star} > 0 \tag{24c}$$

i.e. the income distribution in the steady state depends directly on the sensitivity of the profit share to capacity utilization as well as the rate of capacity utilization targeted by the central bank. The political role of a central bank in our model should be evident from this. The central bank, by targeting a specific level of capacity utilization (or, excess capacity) determines the level of competition among the oligopolist capitalists. This, in turn, determines the level of mark-up and the distribution of income.

### 4.3 Rate of interest

We recall from (18) that $\bar{r} = 1/\alpha \left\{\bar{\gamma}/u^\star + \bar{\mu} - s_p \beta \left(a + bu^\star\right)\right\}$, so

$$\frac{\partial \bar{r}}{\partial u^\star} = -\frac{1}{\alpha}\left(\frac{\bar{\gamma}}{u^{\star 2}} + s_p \beta b\right) < 0$$

i.e. targeting a higher rate of capacity utilization would require setting a lower rate of interest in the steady state. Further,

$$\frac{\partial \bar{r}}{\partial s_p} = -\frac{\beta}{\alpha}\left(a + bu^\star\right) < 0$$

$$\frac{\partial \bar{r}}{\partial \beta} = -\frac{s_p}{\alpha}\left(a + bu^\star\right) < 0$$

In other words, a higher propensity to save out of profits or a higher output-capital ratio would require a less contractionary monetary policy from the central bank to stabilize the economy at any given rate of capacity utilization. We further note that

$$\frac{\partial \bar{r}}{\partial a} = -\frac{s_p \beta}{\alpha} < 0 \tag{25}$$

i.e. if the capitalists target higher share of profit for each level of capacity utilization, then this would reduce the degree of negative feedback required from the central bank in the form of contractionary monetary policy.

# 5 Concluding Remarks

The main conclusions we can draw from our discussion in the preceding sections can be summarized as follows:

1. A combination of 'Steindlian' mark-up dynamics and a counter-cyclical monetary policy in the form of an interest rate rule is able to stabilize the otherwise unstable multiplier-accelerator dynamics of the rate of investment. The resultant dynamics has a strong tendency to converge to the steady state, especially under reasonable parameter configurations.

2. The state plays an important economic as well as political role in this set-up. This is highlighted by the fact that in the steady state, both the rate of investment as well as income distribution (represented by $\bar{g}$ and $\bar{\psi}$ respectively) are directly determined by the rate of capacity utilization targeted by the central bank. The political dimension of monetary policy is important, as in the absence of effective collective bargaining by workers, income distribution might get too adverse for the workers, affecting social stability. This, in turn, might affect the general process of capitalist accumulation. Monetary policy, in this sense, plays an important role in maintaining social stability and ensuring continuation of capitalist accumulation.

3. In our study, we use a Post-Keynesian investment function, i.e. an investment function without an exogenously given 'normal' rate of capacity utilization. The monetary authorities, however, target a specific rate of capacity utilization, given by their policy objectives, using an interest rate rule. Given this formulation, we find that in an apparent similarity with 'Harrodian' class of models, our model attains long-run equilibrium at the rate of capacity utilization desired by the monetary authorities. This has usual 'Harrodian' implications, like the paradox of thrift not operating in the long-run. However, unlike the Harrodian models, the steady state rate of capacity utilization here is not exogenously given but determined by the monetary authorities, allowing them to determine the long-run rate of growth of an economy. In other words, there is a role for policy even in long-run, in line with the larger Post-Keynesian literature.

4. Finally, we should point out that the model presented in the previous sections represents a benchmark model, where the wage dynamics resulting from workers bargaining with the capitalists are not considered. We argue that a number of developments around the world in last three decades or so have made this simplification not as far from reality as it would seem, not only in developing economies (as we have argued in this model), but increasingly in developed countries as well. Similarly, we ignore price dynamics in our model, which might be a reasonable assumption in economies with low inflation (especially with absence of conflict inflation). Nevertheless, for a more comprehensive analysis of the role of monetary policy in influencing distribution dynamics, we need a more explicit discussion of wage as well as price dynamics. We leave these issues as areas of future investigation.

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# Appendix A Local Stability of Non-Trivial Steady State $\bar{E}$

Linearizing (17) around the economically meaningful non-trivial steady state, $\bar{E}$, from the first-order terms of its Taylor expansion evaluated at $\bar{E}$, we compute the following Jacobian matrix evaluated at $\bar{E}$, $J|_{\bar{E}} =$

$$\begin{bmatrix} -h\bar{\gamma} & \beta h s_p u^\star \left(\bar{\gamma} - \beta b s_p u^{\star 2} - \beta a s_p u^\star - \bar{\mu} h u^\star + \bar{\mu} u^\star\right) & -\alpha\beta h s_p u^{\star 2}\left(a + bu^\star\right) \\ \frac{\kappa b}{\beta s_p (a+bu^\star)} & -\frac{\kappa\left(2bu^\star + a\right)}{a+bu^\star} & 0 \\ \frac{l\left(\bar{\gamma} - \beta b s_p u^{\star 2} - \beta a s_p u^\star + \bar{\mu} u^\star\right)}{\alpha\beta s_p u^\star (a+bu^\star)} & -\frac{l\left(\bar{\gamma} - \beta b s_p u^{\star 2} - \beta a s_p u^\star + \bar{\mu} u^\star\right)}{\alpha(a+bu^\star)} & 0 \end{bmatrix} \tag{26}$$

Next, we calculate the characteristic equation to the jacobian matrix given in (26) and test for the conditions for local stability from Routh-Hurwitz condition. Following Flaschel (2009, page 385, theorem A.5) for the characteristic equation represented by $\lambda^3 + a_1\lambda^2 + a_2\lambda + a_3 = 0$, all the eigenvalues have negative real parts if and only if the set of inequalities $a_1 > 0$, $a_3 > 0$ and $a_1 a_2 - a_3 > 0$ is satisfied. We test for these inequalities and obtain the following:

1. $a_1 = \dfrac{(bhu^\star + ah)\,\bar{\gamma} + 2\kappa b u^\star + \kappa a}{a + bu^\star} > 0$
2. $a_3 = \left[\bar{\gamma}\kappa + \bar{\mu}\kappa u^\star - s_p \beta\kappa u^\star\left(a + bu^\star\right)\right] hlu^\star \;> 0$ for $s_p < \dfrac{\bar{\gamma} + \bar{\mu} u^\star}{\left(a + bu^\star\right)\beta u^\star}$.
3. The expression, $a_1 a_2 - a_3$ is a polynomial, which is linear in $l$. It is possible to solve the inequality, $a_1 a_2 - a_3 > 0$ for $l$ so that one can obtain a range for $l$ under which the dynamics will converge to the non-trivial steady state.

In other words, the above analysis shows that there are strong possibilities of dynamics converging to the non-trivial steady state.[13]

[13] While there exists a possibility, analytically speaking, of the non-trivial steady state undergoing a Hopf bifurcation for some configuration of parameters, from a series of numerical examples and simulation we are of the opinion that such a possibility is highly unlikely under any realistic or reasonable configuration of parameters.