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Abstract

This study examines the effect of using the neo-Kaleckian model to target inflation. Here, we assume the following: a model with monopolistic competition, a symmetric economy, the inflation conflict theory, the target profit share of firms depends on the number of firms, and free entry. Using the neo-Kaleckian model, we find the Taylor principle destabilizes the system, which means that an inelastic nominal interest monetary policy is a plausible way to ensure stability. In addition, we find that the Taylor principle is not compatible with the standard neo-Kaleckian results, including the effects of independent demand and income distribution in favour of workers.

Key words: neo-Kaleckian model; Taylor principle; free entry. E24, E31

1 Introduction

This study investigates the relationship between a monetary policy that targets inflation and the stability of an economy, as well as the effects of various economic policies on the long-run growth rate of an economy. Here, we use the inflation-conflict theory with free entry, and find that the Taylor principle plays an important role in both the stability condition and various economic policies that aim to increase the growth rate of an economy.

As is well known, the neo-Kaleckian model assumes imperfect competition and treats capacity utilization and growth rate as endogenous variables (Rowthorn, 1982; Dutt, 1984;

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Taylor, 1985).[1] The neo-Kaleckian model offers a number of benefits, including a wage-led growth regime and stagnationism, which contrast with the results of neoclassical economics. As a result, the neo-Kaleckian model has definite and strong political economy implications in that it provides a theoretical foundation for obtaining a higher growth rate by shifting the income distribution in favour of workers.

Furthermore, while many studies discuss the factors that affect the overall stability condition, the neo-Kaleckian models are based on the Keynesian stability condition. For example, Bhaduri (2008) and Dutt (1992) discuss the effect of profit squeeze caused by an imperfect labour market, and show the unstable case under a wage-led growth regime. Hein (2006) shows the financialization effect, and finds that the stability condition depends on the effect of the real interest rate on firms' investment and renters' consumption. Rowthorn (1977) and Cassetti (2002) construct models of the inflation conflict theory in which the markup ratio depends on the target markup ratios set by firms and labour. Both studies show that the stability condition depends on numerous parameters. Other studies show that path dependence causes instability through changes in the endogenous normal profit rate, normal capacity utilization rate (Lavoie, 1995), and animal spirits (Dutt, 1997). In Lavoie (2010), the markup ratio is endogenous, and is determined by both the goods market effect and the labour market effect. [2] Lavoie (2010) confirms that the stability condition depends on

[1] A constant degree of monopoly is a common assumption in the neo-Kaleckian model. In addition, following Kalecki (1971), we determine the markup ratio using the degree of industrial concentration and the relative bargaining power of firms and workers.

[2] Many studies consider how changes in the markup ratio affect the growth rate and capacity utilization of

the aforementioned effects, but also depends on the combination of the Keynesian stability condition and the regime (i.e. stagnation regime or exhilaration regime). In addition, Ohno (2013) discusses the effect of free entry in the neo-Kaleckian model to incorporate an endogenous market structure, and finds that a wage-led growth regime (WG) is unstable, while a profit-led growth regime (PG) is stable with the Horizontalist view. [3] As shown above, many works discuss the unstable neo-Kaleckian model.

Various monetary policies, including inflation-targeting as a monetary policy[4] are discussed in terms of the neo-Kaleckian model. [5] [6] As Dumenil and Levy (1999) and Rochon and Setterfield (2012) point out, the monetary policy may be important to stability. Hein and Stockhammer (2011) show that the stabilizing effect of the inflation-targeting monetary policy depends on how the redistribution between firms and renters affects capacity utilization in the short term. However, Hein (2006) also shows the economy is unstable in the long

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firms. For example, Dutt (1984) shows how the growth rate has a positive effect on the markup ratio, while Sawyer (1995) and Flaschel and Skott (2006) allow the markup ratio to depend on the capacity utilization rate.

[3]The model is stable under both the stagnation regime and PG in Ohno (2013), although the Lavoie (2010) model is unstable when excess demand leads to a decrease in the markup ratio.

[4]Many countries, including the United Kingdom, adopt this policy, for which a theoretical foundation is provided by the New Consensus Model (see Taylor, 2000; Woodford, 2001; Gali, 2008).

[5]The Horizontalist view assumes that the interest rate is an exogenous variable for the assimilation process, whereas the quantities of credit and money are determined endogenously by economic activity (Moore, 1988). According to this view, the central bank controls the base interest rate. Commercial banks set the market interest rate by marking up the base rate, and then supply the credit demand of consumers and investors they consider creditworthy at this interest rate. The central bank accommodates the commercial banks by providing them with the necessary cash. On the other hand, the Structuralist view assumes the interest rate depends on economic activity. Here, a greater amount of economic activity means a higher interest rate. In addition, Smithin (2004) suggests that the real interest rate should be set to zero, or as close to zero as possible. Lavoie (2006) and Seccareccia (1998) are in favour of setting the real interest rate equal to the productivity growth rate.

[6]Some post-Keynesian works show the inflation-targeting monetary policy has a stabilizing effect when the Taylor principle is satisfied (Setterfield, 2006; Issac, 2008; Proano et al., 2011).

term when the markup ratio depends on the interest rate. Therefore, an inflation-targeting monetary policy does not always have a stabilizing effect in the neo-Kaleckian model.

In this study, we examine the potential stabilizing role of targeting inflation in the neo-Kaleckian model, with free entry (Ohno, 2013). Here, the model has the same relationship between the real interest rate and profit share as in Hein (2011).[7] [8] Based on Ohno (2013) and an inflation-targeting policy, we assume that the target profit share set by firms is a function of the number of firms, and the nominal interest rate is a function of the inflation rate. Using this model, we find that the Taylor principle has a destabilizing effect on the stability condition.[9] Therefore, both the WG and part of the PG are unstable when the Taylor principle is satisfied. On the other hand, the PG and part of the WG are stable when the Taylor principle is not satisfied. Therefore, a nominal interest rate that is less sensitive to the inflation rate is a plausible way to widen the stable area.

Then, we obtained the following results in addition to those already described. An shift that increases the income distribution in favour of workers causes an increase (a decrease) in the growth rate under the PG and when the sensitivity of the nominal interest rate to the inflation rate is larger (smaller) than 1. On the other hand, the growth rate increases

[7]The relationship between the markup ratio and the interest rate in Hein (2006) is the same as in Ohno (2013), who considers free entry. Therefore, one of the motivations for this study is to discuss an alternative monetary policy to promote stability, in line with Hein (2006).

[8]Ohno (2013) finds that WG is conditionally stable, assuming a Structuralist view.

[9]According to the New Consensus Model, the Taylor principle assures the determinacy of a system. The Taylor principle proposes that the central bank stabilizes the macroeconomic system by adjusting its interest rate by more than one-for-one with the inflation rate. The reasoning is as follows. Excess demand leads to an increase in the inflation rate, and this leads to an increase in the real interest rate. An increase in the real interest rate decreases the effective demand in the goods market. Therefore, the model is stable.

under the WG and when the sensitivity of the nominal interest rate to the inflation rate is smaller than 1. Then, an increase in independent demand causes an increase (a decrease) in the growth rate when the sensitivity of the nominal interest rate to the inflation rate is smaller (larger) than 1. The standard neo-Kaleckian model requires a shift in the income distribution in favour of workers (firms) and an increase in independent demand for a higher growth rate under the WG (PG). However, in this study, we show that these results need the sensitivity of the nominal interest rate to the inflation rate to be smaller than 1. In other words, the Taylor principle is not satisfied. Thus, we must pay close attention to the relationship between free entry and the monetary policy in the neo-Kaleckian model.

The remainder of this paper is organized as follows. Section 2 presents a neo-Kaleckian model with free entry, using the inflation-conflict theory. Section 3 discusses the long-run stability condition, and Section 4 discusses the economic policies that are able to achieve a higher growth rate. Then, Section 5 concludes the paper.

2 The model

For our neo-Kaleckian model with free entry in the long run, we make the following assumptions. We assume a monopolistically competitive economy with a continuum of firms from 0 to m. Each firm produces differentiated products that can be consumed and invested. Since each firm believes that an increase in the number of firms leads to an increase in the degree of competition in the goods market, each firm decreases its target markup ratio. Therefore, the target markup ratio depends on the number of firms. As is usually the case with Keynesian models, firms operate at less than full capacity and adjust output as required, based on demand. We assume that the supply of labour is given exogenously, and that employment is less than the full employment level. In our closed economy, there are two social classes, namely capitalists, who own the firms, and workers. The workers consume their entire wages. The capitalists save a constant fraction of their profits and consume the rest. All consumers, including workers and capitalists, buy every good for consumption and investment on equal terms. The goods are produced with two homogenous factors of production, namely labour and capital. Here, capital is physically the same as the good produced. We divide time into a short run and long run. The short run is defined as the time over which the number of firms, m, is fixed and capacity utilization is decided by a demand constraint (to satisfy the goods market equilibrium clearing condition). We define the long run such that the number of firms is endogenous and determined by the zero-profit condition. The economy can be described as follows.[10]

There are m sectors in the economy. Each firm has the following production function. The output of each firm per unit of capital, y_i, is given by

$$y_i = a_i n_i, \tag{1}$$

where n_i is the labour-capital ratio of each firm and a_i is the productivity of the labour

[10]For simplicity, we do not consider assumptions concerning savings from wages, taxes, or foreign trade.

employed by each firm. We then introduce the following definitions, where Y_i, N_i, and K_i represent the output, employment, and capital stock of each firm, respectively:

$$u_i = \frac{Y_i}{Y_i^*}, \quad n_i = \frac{N_i}{K_i}, \quad K_i = Y_i^*.$$

The first equation defines the rate of capacity utilization of each firm, with Y_i^* representing each firm's full capacity output. The second equation defines the labour-capital ratio, and the third equation defines the capital to full output ratio, which we assume depends on technology. We further assume that the firms hold excess capital. If there is a maximum output that capital can produce, determined by the maximum capital-output ratio of 1 (as specified by the third equation), the economy must obey the restriction $Y_i < K_i$. Using these definitions and (1), we obtain:

$$n_i = \frac{u_i}{a_i}. \tag{2}$$

We now define the markup ratio as follows:

$$\tau_i = \frac{a_i p_i}{w_i} - 1, \tag{3}$$

where w_i is the nominal wage per product, p_i is the price of each good, and τ_i is the markup ratio.

The nominal cost of each product is $\frac{w_i}{a_i}$, the wage share is $\frac{1}{1+\tau}$, and the value of each firm is the same, even though the nominal wage rate and labour productivity in each firm may be different. Therefore, the profit share is $\pi_i = \left(1 - \frac{1}{1+\tau}\right)$, and the profit rate is

$r_i = \left(1 - \frac{1}{1+\tau}\right) u_i$. Using (3) and the definition of profit share, we obtain the following the dynamic profit share equation:

$$\dot{\pi} = (1 - \pi) \left(\frac{\dot{p}}{p} - \frac{\dot{w}}{w} \right). \tag{4}$$

We also expect wages, prices, and markups to change in response to conditions that affect the workers' bargaining power and firms' pricing decisions. To explain changes in wages, prices, and distributive shares, Post-Keynesian economists have developed the conflicting claims approach to inflation and income distribution (Rowthorn, 1977). According to this framework, workers and firms are assumed to have targets for wages and profits, respectively. Firms set prices in pursuit of their target markup, but their price-setting power is subject to various constraints (e.g. domestic or foreign competition). The claims of workers and firms are said to conflict if what each group wants would result in the other group raising either nominal wages or prices in an effort to achieve their own target income levels.

To maintain our focus on domestic competition, we only consider how the number of firms influences wage and price settings. Thus, for simplicity, we do not consider the important effect of the feedback of aggregate demand and employment on wages and prices. As a first step, we assume that workers and firms set nominal wages and prices according to the following simple 'reaction functions':

$$\frac{\dot{w}}{w} = \theta_w(\pi - \pi_w), \qquad \theta_w > 0 \tag{5}$$

$$\frac{\dot{p}}{p} = \theta_f(\pi_f - \pi), \qquad \theta_f > 0, \tag{6}$$

where π is the profit share, π_w is the target profit share of workers, and π_f is the target profit share of firms. Each firm decreases the price of its goods to lower its profit share when the target profit share is smaller than the actual profit share. [11]

We assume that the target profit share of firms is determined by the degree of monopoly in the goods market. In line with Blanchard and Giavazzi (2003), we assume that an increase in the number of firms (products) could decrease the degree of monopoly in the goods market (i.e. increase competition), and lead to a decrease in the target profit share of firms. Therefore, the target profit share of firms is

$$\pi_f = \pi_f(m), \quad \frac{\partial \pi_f(m)}{\partial m} < 0. \tag{7}$$

We assume that $\pi_f(m)$ indicates the level of competition between firms in the goods market. We assume that $\pi_f(m)$ remains constant in the short run because the number of firms is fixed, but that it varies according to the number of firms in the long run. This means that more firms means a more competitive goods market, and a lower markup ratio. As a result, each firm believes that this could lead to a decrease in revenue, and so it decreases its markup ratio to curb the decline.[12]

[11] As shown in Dutt and Sen (1997), the target price is determined by profit maximization under monopolistic competition in the neo-Kaleckian model. To maximize its profit, each firm decreases the price when the actual price is higher than his target price. Since π_f is also derived from the profit maximization of each firm under a constant nominal wage rate, each firm decreases the price of its goods for a lower profit share when the target profit share is smaller than the actual profit share.

[12] Dutt and Sen (1997) show the relationship between the number of firms and the markup ratio in the neo-Kaleckian model using the monopolistic competition framework. Sen and Dutt (1995) consider how the number of firms affects the degree of monopoly using a New Keynesian framework. However, they do not analyze the effect of free entry, because their analyses focus on the short run, and therefore assume that both the markup ratio and number of firms remain constant.

Then, the price reaction function becomes

$$\frac{\dot{p}}{p} = \theta_f(\pi_f(m) - \pi), \tag{8}$$

and the dynamic profit share equation can be shown as

$$\dot{\pi} = (1 - \pi)(\theta_f(\pi_f(m) - \pi) - \theta_w(\pi - \pi_w)). \tag{9}$$

Next, we consider the investment function of each firm. Since we aim to discuss the relationship between the stability condition and the growth regime, we consider a general investment function, following Bhaduri and Marglin (1990). This investment function—as set by firms—depends on the rate of capacity utilization and profit share, and can be expressed in linear form as

$$\frac{I_i}{K_i} = g_1 + g_\pi \pi + g_2 u_i - g_3 r, \qquad g_1 > 0, \quad g_2 > 0, \quad g_3 > 0, \quad g_\pi > 0, \tag{10}$$

where g_1 represents independent demand, including the animal spirits of each firm and government expenditure. Whenever u_i increases, firm i reacts by increasing investment. On the other hand, when the profit share decreases, the firm decreases its investment.[13]

We define the saving function for each firm, S_i, as follows:

$$\frac{S_i}{K_i} = s\pi u_i. \tag{11}$$

[13]There is a debate over the long-run response of investment to variations in the utilization rate in the neo-Kaleckian model between Hein et al. (2011) and Skott (2012). However, one purpose of this study is to show the fragility of the Taylor principle when the neo-Kaleckian model only induces the free-entry effect. Therefore, we employ a standard investment function. One possible area for future research would be to endogenize the desired utilization rate in the long run.

We also assume that workers do not save, but that capitalists do save a fraction of their gross profit, s.

Finally, we consider the free-entry condition. We assume that many firms have the potential to enter the market, and that the net profit of each firm determines its entry or exit in the long run. If a firm's gross profit is greater than the entry barrier, the firm's net profit will be positive, in which case, it may enter the market. When this occurs, the firms' target profit share, $\pi_f(m)$, falls. In contrast, if a firm's gross profit is less than the entry barrier, the firm may exit the market, leading to an increase in the remaining firms' target profit share.

We assume the real entry barrier, D_i, is proportional to the capital stock: $D_i = (d+r)K_i$. Here, D_i involves both the interest rate and the entry barrier, d. In turn, we believe that d involves both the normal profit rate and the depreciation rate of the capital stock. Therefore, the dynamic equation for the number of firms is as follows:

$$\frac{\dot{m}}{m} = g_m \left(\pi u_i - d - r\right), \qquad g_m > 0. \tag{12}$$

In addition, we consider the effect of the monetary policy on the model. Following Taylor (2008), we present the Taylor rule in terms of the inflation rate:[14]

$$R = \rho + \beta_1 \frac{\dot{p}}{p}, \tag{13}$$

where R is the nominal interest rate. This can also be rewritten in real terms by considering

[14] We omit the effect of the rate of capacity utilization on the nominal interest rate, but extend the model to include this effect in Appendix A.

that $r = R - \frac{\dot{p}}{p}$. As such, the above equation becomes

$$r = \rho + \beta_1 \frac{\dot{p}}{p} - \frac{\dot{p}}{p}. \tag{14}$$

Therefore, using (6), (12), and (14), the dynamic equation for the growth rate of the number of firms now becomes:

$$\frac{\dot{m}}{m} = g_m \left(\pi u - d_1 - (\beta_1 - 1)\theta_f(\pi_f(m) - \pi) \right), \tag{15}$$

where $d_1 = d + \rho$. If the net profit of each firm is zero, there will be no entry or exit from the market, and the number of firms and their target profit share will be constant.

3 Short-run and long-run models

In this section, we consider the model in the short run and long run.

3.1 Short run

We determine the labour input of firms in the short run to fulfil the goods market-clearing condition. We assume that all the firms are symmetrical, meaning that all firms produce the same amount with the same technology: $Y_i = Y$, $u_i = u$, $K_i = K$, $I_i = I$, $a_i = a$, $b_i = b$, and $S_i = S$. We further assume that all consumers, including workers and capitalists, buy every good from the market for consumption and investment, on equal terms. Therefore, we obtain the following equation:

$$\frac{S}{K} = \frac{I}{K} = g, \tag{16}$$

where g is the growth rate.

Substituting (10) and (11) into the above equation, and rearranging, we obtain

$$g_1 + g_\pi \pi + g_2 u - g_3 r = s\pi u. \tag{17}$$

This is the goods market equilibrium condition.[15] Here, we show the effect of a decrease in π on capacity utilization and the short-run growth rate.[16] The value of $\frac{\partial u}{\partial \pi}$ is negative when evaluated in the short-run equilibrium condition, although the sign is ambiguous; $g_\pi \pi - g_2 u$ is negative (positive), when the model uses the WG (PG). [17]

3.2 Long run

So far, we have assumed an exogenous number of firms. However, in the long run, we allow for m to change over time. Therefore, we now consider the dynamic equation for the growth rate of the number of firms, (15), and the dynamic equation of the profit share, (9). Note that the inflation and interest rates are endogenous variable parameters.

Next, we examine the long-run equilibrium stability condition related to the dynamic

[15] The short-run stability condition is as follows:

$$\Delta = s\pi - g_2 > 0. \tag{18}$$

For stability in the goods market, the induced increase in investment, given a rise in u, must be less than the induced increase in savings. We assume $\Delta > 0$.

[16]

$$\frac{\partial u}{\partial \pi} = \frac{g_\pi - su}{\Delta} < 0.$$
$$\frac{\partial g}{\partial \pi} = \frac{s}{\Delta}\left(g_\pi \pi - g_2 u\right).$$

[17] In the short-run equilibrium, we find stagnationism (capacity utilization inversely related to profit share) and the WG (capital accumulation rate inversely related to profit share) in the neo-Kaleckian model. Note that these results depend on the assumption of a positive utilization effect, g_2, in the investment function.

equations (15) and (9).

Proposition 1. If $\beta_1 > 1$, the PG is conditionally unstable and the WG is unstable. If $\beta_1 < 1$, the PG is stable and the WG is conditionally stable. If $\beta_1 = 1$, the PG is stable and the WG is unstable.

Proof: See Appendix B.1.

Let us now examine the relationship between the stability condition and β_1 under the PG. The reasoning is as follows. When $\pi u > d$, new firms enter the market, and the target profit share of each firm decreases in proportion to the increase in the number of firms. This leads to a decrease in the inflation rate in addition to the decrease in the firms' profit share. This decrease in profit share leads to excess demand in the goods market, which in turn leads to an increase in u. As the relationship between the growth rate and profit share is positive under the PG, πu is smaller when the goods market equilibrium condition is satisfied. On the other hand, a lower inflation rate leads to an increase in the real interest rate when $\beta_1 \leqq 1$. Therefore, since the gap between πu and d narrows under $\beta_1 < 1$, the neo-Kaleckian model with free entry is stable under the PG and when $\beta_1 < 1$.

However, if $\beta_1 > 1$, the model will be conditionally unstable under the PG. The reasoning in this case is as follows. The real interest rate decreases when $\beta_1 > 1$, owing to a lower inflation rate. If the decrease in the profit rate is smaller than the decrease in d, the gap between πu and d increases. Thus, even under the PG, the model is conditionally unstable when $\beta_1 > 1$.

Next, we consider the relationship between the stability condition and β_1 under the WG. When $\pi u > d$, new firms enter the market, and firms' target profit share decreases in proportion to the increase in the number of firms. This leads to a decrease in the inflation rate in addition to the decrease in the firms' profit share. The decrease in the profit share leads to excess demand in the goods market and an increase in u. As the relationship between the growth rate and profit share is negative, πu becomes larger when the goods market equilibrium condition is satisfied. On the other hand, the real interest rate decreases (is constant) when $\beta_1 > 1$ ($\beta_1 = 1$) owing to a lower inflation rate. So, the gap between πu and d widens, and the model becomes unstable. However, since the real interest rate would increase when $\beta_1 < 1$, owing to a lower inflation rate, if the increase in profit rate is smaller than the increase in d, the gap between πu and d narrows. Thus, even under the WG, the model may be stable when $\beta_1 < 1$. Note that these results depend on the value of β_1 being less than 1.

As shown in this section, the stability condition depends on both the growth regime and β_1. If $\beta_1 > 1$, the WG and part of the PG are unstable. If $\beta_1 = 1$, the PG is stable and the WG is unstable. On the other hand, if $\beta_1 < 1$, part of the WG is unstable. Therefore, a sufficiently aggressive monetary policy rule ($\beta_1 > 1$) in terms of the Taylor principle destabilizes the system, and having a nominal interest rate that is less sensitive to the inflation rate is a plausible way to widen the stable area.

3.3 Graphical illustrations of the dynamics

Figures 1 to 8 illustrate the transition dynamics in the various cases. In the figures, $\dot{\pi} = 0$ is labelled as 'IC' and $\dot{m} = 0$ is labelled as 'FE'. The IC curve is always sloping downward, but the FE curve can slope either upward or downward:

$$\frac{d\pi}{dm}|_{FE} = \frac{(\beta_1 - 1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f \pi_f'(m)}{(\beta_1 - 1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f + \frac{g_\pi \pi - g_2 u}{\Delta_b}}. \tag{19}$$

Here, in case (a) the FE curve slopes upward; in case (b) the FE curve slopes downward and is flatter than the IC curve; in case (c) the FE curve slopes downward and is steeper than the IC curve; and in case (d), the FE curve is horizontal. The stability of the steady-state equilibrium point at which the two curves intersect (where $\dot{\pi} = \dot{m} = 0$) depends on β_1 in each of the four possible configurations.

In addition, $\frac{\partial \dot{m}}{\partial m}$ depends on β_1. Since $\frac{\partial \dot{m}}{\partial m} < 0$ under $\beta_1 < 1$, on the right-hand side of FE, m decreases, shifts to the left, and converges to FE. On the other hand, if $\beta_1 > 1$, on the right-hand side of FE, m increases, shifts to the right, and diverges from FE. Therefore, there are eight possible configurations of these curves, as shown in Figures 1 to 8. Figures 1, 2, 6, and 7 illustrate the stable cases, and Figures 3, 4, 5, and 8 illustrate the unstable cases.

[Insert Figure 1]

[Insert Figure 2]

[Insert Figure 3]

[Insert Figure 4]

[Insert Figure 5]

[Insert Figure 6]

[Insert Figure 7]

[Insert Figure 8]

From (19), the effect of β_1 on the slope of FE depends on the growth regime $(g_\pi \pi - g_2 u)$.

$$\frac{\partial \frac{d\pi}{dm}|_{FE}}{\partial \beta_1} = \frac{\theta_f \left(1 + \frac{g_3 \pi}{\Delta_b}\right) \pi'_f(m) \frac{g_\pi \pi - g_2 u}{\Delta_b}}{\left((\beta_1 - 1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right) \theta_f + \frac{g_\pi \pi - g_2 u}{\Delta_b}\right)^2}. \tag{20}$$

Equation (20) is positive (negative) if $g_\pi \pi - g_2 u$ is negative (positive). Furthermore,

$$\frac{d\pi}{dm} = \frac{\theta_f \pi'_f(m) \left(1 + \frac{g_3 \pi}{\Delta_b}\right)}{\theta_f \left(1 + \frac{g_3 \pi}{\Delta_b}\right) - \frac{g_\pi \pi - g_2 u}{\Delta_b}} \qquad when \quad \beta_1 = 0. \tag{21}$$

Therefore, as β_1 increases, the slope of FE decreases in a clockwise direction, and finally slopes downward under the PG. On the other hand, as β_1 increases, the slope of FE rises in an anti-clockwise direction, and finally slopes upward under the WG.

Let us first consider the case of the PG. In the case of the PG, the slope of the FE is positive (or negative) when $\beta_1 = 0$. [18] As β_1 increases, the positive slope of FE decreases

[18] If β_1 is small under $\beta_1 < 1$, the slope is negative. This case is illustrated in Figure 2.

in a clockwise direction. This case is illustrated in Figure 1. When β_1 is 1, the slope of FE becomes horizontal as shown in Figure 7. After β_1 exceeds 1, the slope of FE becomes negative. If β_1 is small under $\beta_1 > 1$, the slope will also be small, and the model becomes stable. This case is illustrated in Figure 6. If β_1 is large, the slope will also be large, and the model becomes unstable. This case is illustrated in Figure 5.

On the other hand, in the case of the WG, the slope of the FE curve is negative under $\beta_1 < 1$. If β_1 is 0, the slope of FE will be large in terms of its absolute value, and the model becomes stable. This case is illustrated in Figure 2. As β_1 increases, the slope of FE increases in an anti-clockwise direction. If β_1 is large under $\beta_1 < 1$, the slope is small in terms of its absolute value, and the model becomes unstable. This case is illustrated in Figure 3. Next, we consider the case of $\beta_1 = 1$. When $\beta_1 = 1$, the slope of FE is horizontal. This case is illustrated in Figure 8. When β_1 exceeds 1, the slope of FE is positive. This case is illustrated in Figure 4. Both cases are unstable. Therefore, as β_1 increases, the stability conditions become less satisfied.

4 Structural change

In this section, we show the effect of a decrease in the entry barrier, d_1, a decrease in π_w, and an increase in g_1 on capacity utilization and the growth rate in the long run when the stability condition is satisfied. Here, we compare the long-run equilibrium in the following stable cases: $0 < \beta_1 < 1$ under the WG, and both $0 < \beta_1 < 1$ and $1 \geqq \beta_1$ under the PG.

As all firms are symmetric, we obtain the following zero-profit condition:

$$\pi u = d_1 - (1-\beta_1)\frac{\dot{p}}{p}. \tag{22}$$

The profit share of firms is determined as follows

$$\pi = \frac{\theta_f \pi_f(m) + \theta_w \pi_w}{\theta_f + \theta_w}. \tag{23}$$

An increase in the target share of workers and a decrease in the number of firms lead to an increase in firms' real profit share. In addition, the steady inflation rate is as follows:

$$\frac{\dot{w}}{w} = \frac{\dot{p}}{p} = \frac{\theta_f \theta_w (\pi_f(m) - \pi_w)}{\theta_f + \theta_w}. \tag{24}$$

We find that an increase in the number of firms and the target profit share of workers decreases the inflation rate.

Using these equations and (17), we can summarize the following two equations for the unknowns of u and m in the long run.

$$\begin{aligned} s\frac{\theta_f \pi_f(m) + \theta_w \pi_w}{\theta_f + \theta_w}u = {} & g_1 + g_\pi \frac{\theta_f \pi_f(m) + \theta_w \pi_w}{\theta_f + \theta_w} + g_2 u \\ & - g_3\left(\rho + (\beta - 1)\frac{\theta_f \theta_w (\pi_f(m) - \pi_w)}{\theta_f + \theta_w}\right), \end{aligned} \tag{25}$$

$$\frac{\theta_f \pi_f(m) + \theta_w \pi_w}{\theta_f + \theta_w}u = d_1 - (1-\beta_1)\left(\frac{\theta_f \theta_w (\pi_f(m) - \pi_w)}{\theta_f + \theta_w} - \hat{p}^*\right). \tag{26}$$

Equation (25) is the goods market equilibrium condition and (26) is the zero-profit condition.

Proposition 2. A decrease in d_1 causes an increase in m, and a decrease in the profit share. The effect on g depends on the growth regime, increasing under the WG and decreasing under the PG.

Proof: See Appendix B.2.

A decrease in d_1 has no effect in the short run. However, in the long run, a decrease in d_1 leads to a net profit such that new firms enter the market, and firms' target profit share decreases owing to a more competitive economy. Then, the inflation rate decreases and the total entry barrier becomes smaller than the initial level, although a lower inflation rate leads to an increase (a decrease) in the interest rate under $\beta_1 < 1$ ($\beta_1 > 1$). As a result, the profit share of firms decreases. Thus, a lower d_1 leads to an increase in capacity utilization. However, the effect on g depends on the growth regime, increasing under the WG and decreasing under the PG. Therefore, a decrease in d_1, that is, the deregulation of the goods market, is recommended for a higher growth rate under the PG. On the other hand, an increase in d_1, that is, the regulation of the goods market, is recommended for a higher growth rate under the WG. Note that these results depend on the growth regime and are independent of the value of β_1.

Proposition 3. A decrease in π_w causes a decrease in m, an increase (a decrease) in π, and an increase (a decrease) in i under $\beta_1 > 1$ ($\beta_1 < 1$). This leads to an increase in the growth rate when $\beta_1 > 1$ under the PG and when $\beta_1 < 1$ under the WG. On the other hand, the growth rate decreases when $\beta_1 < 1$ under the PG.

Proof: See Appendix B.3.

In the short run, a decrease in π_w leads to an increase in the capacity utilization in each firm, but the effect on the growth rate and profit rates depend on some other parameters.

Let us first consider the WG. To satisfy the stability condition, it is necessary that $\beta_1 < 1$. Since a decrease in π_w increases the short-run gross profit rate, new firms enter the market, which leads to an increase in m and a decrease in $\pi_f(m)$. Therefore, both a short-run decrease in π_w and a decrease in $\pi_f(m)$ would lead to a decrease in firms' profit share. In addition, since the inflation rate decreases as a result of a decrease in $\pi_f(m)$, the real interest rate increases when $\beta_1 < 1$. As a result, the profit share of each firm decreases, the growth rate and capacity utilization in each firm increase, and the long-run effects are larger than the short-run effects.

Next, we consider the PG. First, we discuss the cases in which $\beta_1 < 1$ and $\beta_1 \geqq 1$ hold. Since a decrease in π_w leads to a decrease in the short-run gross profit rate, some firms may exit the market, leading to a decrease in m and an increase in $\pi_f(m)$. Therefore, the effect of a decrease in π_w in the short run gradually disappears with an increase in $\pi_f(m)$, which leads to an increase in the profit share and a decrease in the growth rate and capacity utilization rate.

When $\beta_1 = 1$, since the interest rate is constant, the entry barrier is also constant.

Therefore, the growth rate and the level of capacity utilization in each firm will return to the initial levels. These results are as the same as in Ohno (2013). However, the inflation rate increases owing to a less competitive economy, and the real interest rate decreases when $\beta_1 < 1$. As the entry barrier decreases when the real interest rate decreases, we find that m increases, the profit share decreases, and the growth rate decreases, as described in Proposition 2.

On the other hand, when $\beta_1 > 1$, the real interest rate increases owing to the higher inflation rate. Since the real interest rate increases, some firms may exit the market, and the profit share of each firm increases, leading to a decrease in the capacity utilization rate and an increase in the growth rate.

Therefore, the effect of π_w on the growth rate depends on the growth regime and on β_1. For a higher growth rate, a decrease in π_w is needed when $\beta_1 > 1$ under a profit-led growth regime or when $\beta_1 < 1$ under the WG. On the other hand, an increase in π_w is needed when $\beta_1 < 1$ under the PG. In addition, when $\beta_1 < 1$, we find that the effect of π_w on the growth rate is larger under the WG than under the PG.

Neo-classical policy makers usually consider that the economy is under the PG, and so use the Taylor principle and a lower wage rate to increase the growth rate. Under these conditions, we find that these combinations have a negative effect at a higher growth rate. Therefore, policy makers tend to make misguided policies. Therefore, the Taylor principle is not compatible with a decrease in the target wage share to achieve an increase in the growth rate under the PG. This result contrasts with the results of neoclassical economics and the standard neo-Kaleckian model.

Proposition 4. An increase in g_1 causes an increase in m, and a decrease in the profit share. The growth rate depends on β_1, increasing (decreasing) when $\beta_1 < 1$ ($\beta_1 > 1$), and remaining constant when $\beta_1 = 1$.

Proof: See Appendix B.4.

An increase in g_1 leads to an increase in capacity utilization, the growth rate, and the profit rate in the short run. As a result, new firms enter the market, leading to a decrease in both the profit share of firms and the inflation rate.

We first consider the WG when $\beta_1 < 1$. A decrease in the profit share of each firms leads to a further increase in the growth rate, profit rate, and capacity utilization rate. Therefore, the growth and capacity utilization rates increase.

Next, we consider the case under the PG. The effect of an increase in g_1 in the short run gradually disappears with a decrease in π, and the growth and capacity utilization rates return to their initial levels. In addition, a decrease in π leads to a decrease in the inflation rate, and the real interest rate increases (decreases) when $\beta_1 < 1$ ($\beta_1 > 1$), although it is constant when $\beta_1 = 1$. Therefore, an increase in g_1 leads to an increase in the number of firms, a decrease in the profit share, a decrease in the capacity utilization rate, and an increase (a decrease) in the growth rate when $\beta_1 < 1$ ($\beta_1 > 1$). When $\beta_1 = 1$, the growth rate returns to its initial level. Therefore, an increase (a decrease) in g_1 is needed for a higher growth rate when $\beta_1 < 0, (\beta_1 > 1)$. In addition, when $\beta_1 < 1$, we find that the effect of g_1 on the growth rate is larger under the WG than under the PG.

Firm's animal spirits and government expenditure are both included in g_1. We believe that an increase in government expenditure has a negative effect on the growth rate when $\beta_1 > 1$ under the PG. This contrasts with post-Keynesian economics theory that considers an increase in government expenditure an effective way to achieve economic growth. On the other hand, we also evaluate the fiscal austerity of the neo-liberal regime when $\beta_1 > 1$ under the PG.

5 Conclusion

As Ohno (2013) suggests, an endogenous market structure in the neo-Kaleckian model is an important perspective when reviewing the significance of the neo-Kaleckian model in modern economics. Here, we discuss how the sensitivity of the nominal interest rate to the inflation rate affects the neo-Kaleckian model with free entry, and show the effect on the stability condition and the growth rate.

First, we find that an increase in β_1 has a negative effect on the stability condition. If $\beta_1 > 1$, the model is conditionally stable, even under the PG. On the other hand, if $\beta_1 < 1$, the model is conditionally stable, even under the WG. Therefore, a sufficiently aggressive monetary policy rule ($\beta_1 > 1$) in terms of the Taylor principle will destabilize the system, and having a nominal interest rate that is less sensitive to the inflation rate is a plausible way to widen the stable area. In addition, we find that $\beta_1 < 1$ can bring about various structural changes in the growth rate.

We propose the following economic policies for policy makers, depending on both the monetary policy and the growth regime. When $\beta_1 > 1 (\beta_1 < 1)$ under the PG, a decrease (an increase) in the target profit share by workers, a decrease (an increase) in d_1, and a decrease (an increase) in g_1 can achieve a higher growth rate. When $\beta_1 < 1$ under the WG, a decrease in the target profit share by workers, an increase in d_1, and an increase in g_1 can bring about a higher growth rate. The standard neo-Kaleckian model requires a positive shift in the income distribution in favour of workers (firms) and an increase in independent demand to bring about a higher growth rate under the WG (PG). However, this study shows that these results also need the sensitivity of nominal interest rate to the inflation rate to be smaller than 1. In other words, the Taylor principle is not satisfied. Therefore, the monetary policy and growth regime are important elements when deciding on an economic policy to achieve a higher growth rate in the neo-Kaleckian model with free entry.

Appendix A

Here, we consider how the Taylor rule affects the stability condition in terms of the rate of utilization. Following Woodford (2001), the Taylor rule is presented as follows:

$$R = \rho + \beta_1 \frac{\dot{p}}{p} + \beta_2 u, \tag{27}$$

where β_2 is the sensitivity of the nominal interest rate to a change in the capacity utilization. This dynamic equation of the growth rate of the number of firms can be rewritten in real terms, as follows:

$$\frac{\dot{m}}{m} = g_m \left(\pi u - d_1 - \beta_1(\theta_f(\pi_f(m) - \pi)) + \theta_f(\pi_f(m) - \pi) - \beta_2 u \right). \tag{28}$$

The dynamic equation of the profit share is the same as (9).

Proposition 5. The value of β_2 has a positive effect on the stability condition.

The associated stability conditions are $(trace) < 0$ and $(det) > 0$.

$$\frac{\partial \dot{\pi}}{\partial \pi} = -(1-\pi)(\theta_f + \theta_w) < 0 \tag{29}$$

$$\frac{\partial \dot{\pi}}{\partial m} = (1-\pi)\theta_f \pi_f'(m) < 0 \tag{30}$$

$$\frac{\partial \frac{\dot{m}}{m}}{\partial \pi} = (\beta_1 - 1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f + \frac{g_\pi \pi - g_2 u - \beta_2 g_\pi + \beta_2 s u}{\Delta_b} \tag{31}$$

$$\frac{\partial \frac{\dot{m}}{m}}{\partial m} = (1 - \beta_1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f \pi_f'(m) \tag{32}$$

$$(trace) = -(1-\pi)(\theta_f + \theta_w) + (1-\beta_1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f \pi_f'(m) < 0. \tag{33}$$

Since β_2 has no effect on $(trace)$, $(trace)$ is the same as (41). On the other hand,

$$(det) = (1-\pi)\theta_f \pi_f'(m) \left((\beta_1 - 1)\left(1 + \frac{g_3\pi}{\Delta_b}\right)\theta_w - \frac{g_\pi \pi - g_2 u - \beta_2 g_\pi + \beta_2 s u}{\Delta_b} \right) > 0. \quad (34)$$

Therefore, the following equation should be satisfied to ensure stability:

$$\beta_1 < 1 + \frac{g_\pi \pi - g_2 u}{\theta_w (\Delta_b + g_3 \pi)} + \beta_2 \frac{su - g_\pi}{\theta_w (\Delta_b + g_3 \pi)}. \quad (35)$$

According to the above condition, we find

$$\frac{\partial(det)}{\partial \beta_2} = (1-\pi)\theta_f \pi_f'(m)\beta_2 \frac{g_\pi - su}{\Delta_b} > 0. \quad (36)$$

The effect of β_2 on (det) is positive because $\frac{su - g_\pi}{\Delta_b}$ is positive. Therefore, β_2 has a positive effect on the stability condition.

Q.E.D

Thus, we find that β_2 has a positive effect on the stability condition. If $\beta_2 > 0$, the WG is also stable, even when $\beta_1 > 1$. This is shown in Figure 9, where the configuration of coefficients β_1 and β_2 is associated with both the stable equilibrium and the unstable equilibrium. A comparison with Figure 10 (Woodford (2001) or Gali (2008)) would show a completely different area of stability.

[Insert Figure 9]

[Insert Figure 10]

Appendix B.1.

The associated stability conditions are $(trace) < 0$ and $(det) > 0$. Since

$$\frac{\partial \dot{\pi}}{\partial \pi} = -(1-\pi)(\theta_f + \theta_w) < 0, \tag{37}$$

$$\frac{\partial \dot{\pi}}{\partial m} = (1-\pi)\theta_f \pi_f'(m) < 0, \tag{38}$$

$$\frac{\partial \frac{\dot{m}}{m}}{\partial \pi} = g_m \left((\beta_1 - 1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f + \frac{g_\pi \pi - g_2 u}{\Delta_b} \right), \tag{39}$$

$$\frac{\partial \frac{\dot{m}}{m}}{\partial m} = g_m (1-\beta_1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f \pi_f'(m), \tag{40}$$

the following equation will satisfy $(trace) < 0$:

$$(trace) = -(1-\pi)(\theta_f + \theta_w) + (1-\beta_1)\left(1 + \frac{g_3 \pi}{\Delta_b}\right)\theta_f \pi_f'(m) < 0. \tag{41}$$

If $\beta_1 < 1$, or if β_1 is small, but greater than 1, $(trace)$ is negative.

In addition, the following equation will satisfy $(det) > 0$:

$$(det) = (1-\pi)\theta_f \pi_f'(m) \left((\beta_1 - 1)\theta_w \left(1 + \frac{g_3 \pi}{\Delta_b}\right) - \frac{g_\pi \pi - g_2 u}{\Delta_b} \right) > 0. \tag{42}$$

Therefore,

$$(\beta_1 - 1)\theta_w \left(1 + \frac{g_3 \pi}{\Delta_b}\right) - \frac{g_\pi \pi - g_2 u}{\Delta_b} < 0 \tag{43}$$

will satisfy $(det) > 0$. The value of $\frac{g_\pi \pi - g_2 u}{\Delta_b}$ depends on the growth regime in the short run. If the value is positive (negative), the regime will be the PG (WG). For this to hold, the following conditions should be satisfied: $\beta_1 < 1$, or β_1 is small, but greater than 1.

Therefore, to satisfy both $(det) > 0$ and $(trace) < 0$, β_1 should be small. As a result, the PG and part of the WG are stable when $\beta_1 < 1$, the PG is stable when $\beta_1 = 1$, and part of the PG is stable when $\beta_1 > 1$.

Q.E.D

Appendix B.2.

$$\begin{aligned}
\frac{\partial u}{\partial d_1} &= \frac{\theta_f \pi_f(m)}{\theta_f + \theta_w} \frac{g_\pi - su - g_3(\beta - 1)\theta_w}{\Delta_l} > 0, \\
\frac{\partial m}{\partial d_1} &= \frac{s\pi - g_2}{\Delta_l} < 0, \\
\frac{\partial \pi}{\partial d_1} &= \frac{\pi_f'(m)}{\Delta_l} \frac{\theta_f}{\theta_f + \theta_m}(s\pi - g_2) > 0, \\
\frac{\partial g}{\partial d_1} &= \frac{s\theta_f}{\theta_f + \theta_w} \frac{\pi_f'(m)}{\Delta_l}(g_\pi \pi - g_2 u - g_3(\beta - 1)\theta_w \pi), \\
\Delta_l &= \frac{\theta_f \pi_f'(m)}{\theta_f + \theta_w}\left((s\pi - g_2)(u - \theta_w(\beta_1 - 1)) - (su - g_\pi + g_3(\beta - 1)\theta_w)\pi\right) < 0.
\end{aligned}$$

Appendix B.3.

$$\begin{aligned}
\frac{\partial u}{\partial \pi_w} &= -\frac{\theta_f \theta_w \pi_f'(m)}{(\theta_f + \theta_m)\Delta_l}(g_\pi - su - g_3 u)(\beta_1 - 1), \\
\frac{\partial m}{\partial \pi_w} &= \frac{\theta_w}{(\theta_f + \theta_w)\Delta_l}(g_2 u - g_\pi \pi - (\beta_1 - 1)\theta_f(s\pi - g_2)), \\
\frac{\partial \pi}{\partial \pi_w} &= -\frac{\pi_f'(m)}{\Delta_l} \frac{\theta_w \theta_f}{\theta_f + \theta_w}(s\pi - g_2 + g_3\pi)(\beta_1 - 1), \\
\frac{\partial g}{\partial \pi_w} &= \frac{\theta_w \theta_f}{\theta_f + \theta_w} \frac{\pi_f'(m)}{\Delta_l} s(\beta_1 - 1)(g_2 u - g_\pi \pi).
\end{aligned}$$

Appendix B.4.

$$
\begin{aligned}
\frac{\partial u}{\partial g_1} &= \frac{\theta_f \pi_f'(m)}{\theta_f + \theta_w} \frac{u - \theta_w(\beta_1 - 1)}{\Delta_l} > 0. \\
\frac{\partial m}{\partial g_1} &= -\frac{\pi}{\Delta_l} > 0. \\
\frac{\partial \pi}{\partial g_1} &= -\frac{\pi_f'(m)}{\Delta_l} \frac{\theta_f}{\theta_f + \theta_w} \pi < 0. \\
\frac{\partial g}{\partial g_1} &= \frac{-\theta_f \theta_w}{\theta_f + \theta_w} \frac{\pi_f'(m)}{\Delta_l} s\pi \left(\beta_1 - 1\right).
\end{aligned}
$$

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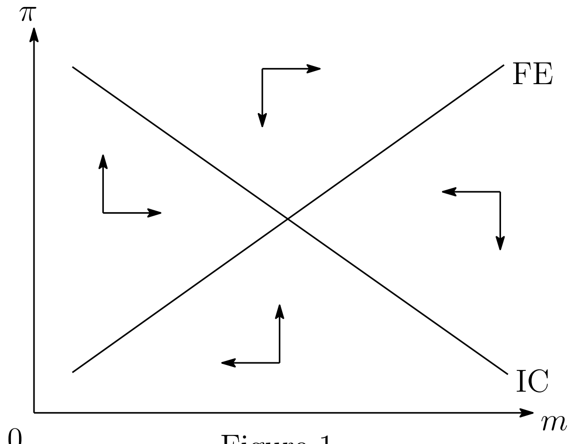
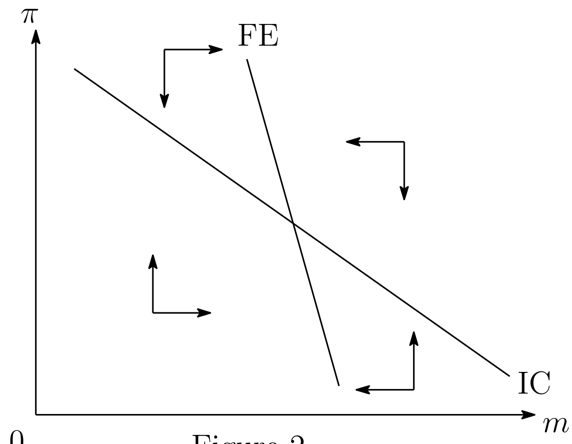


Figure 1



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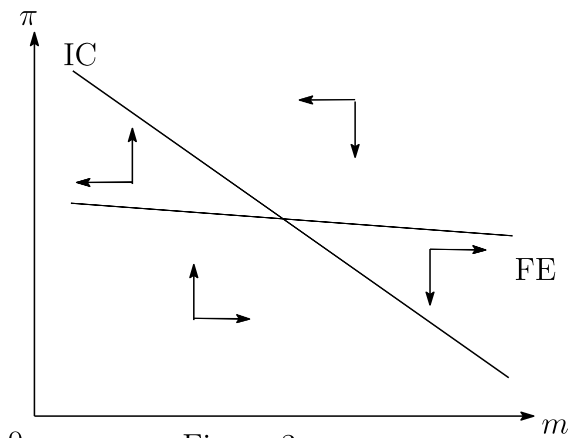

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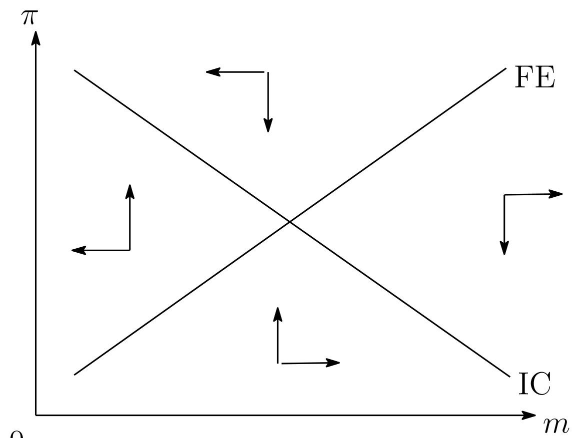

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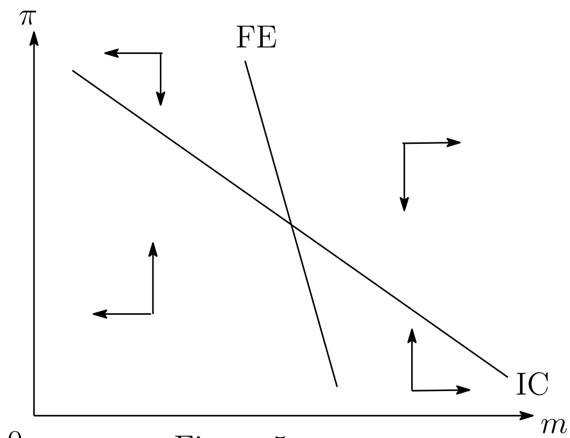

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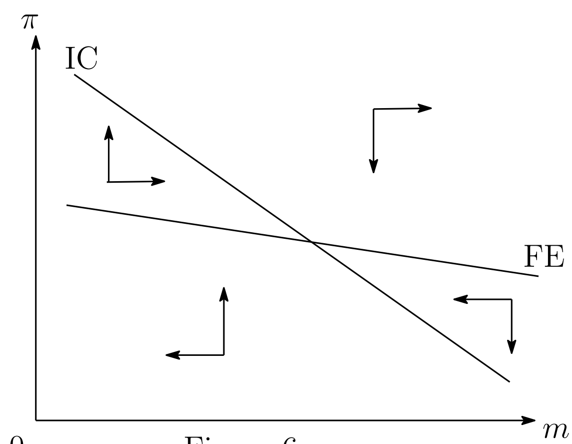

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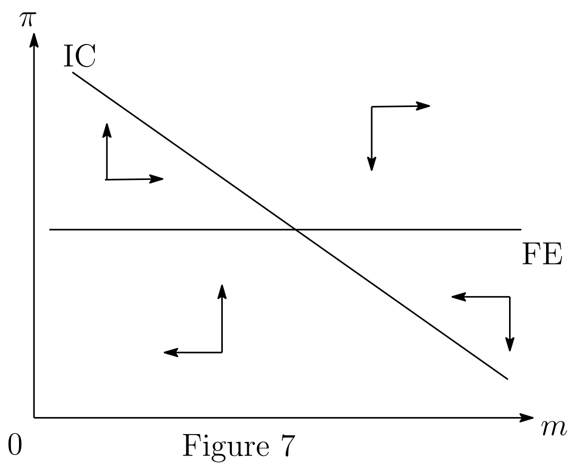

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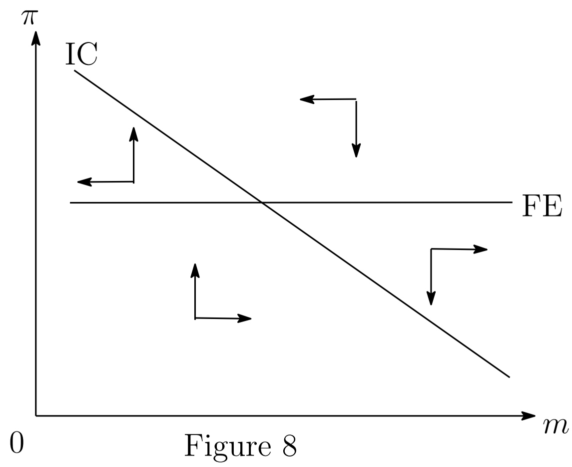

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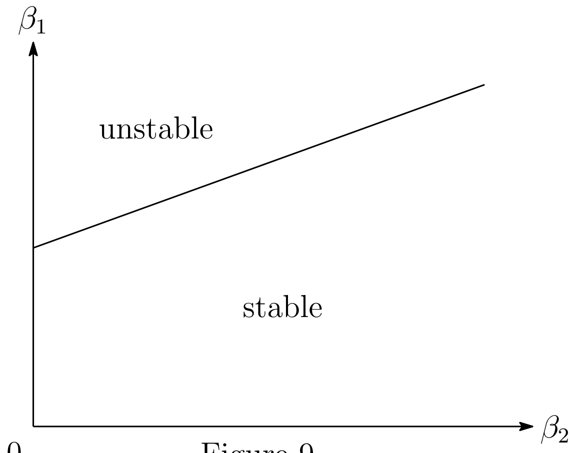

Figure 9

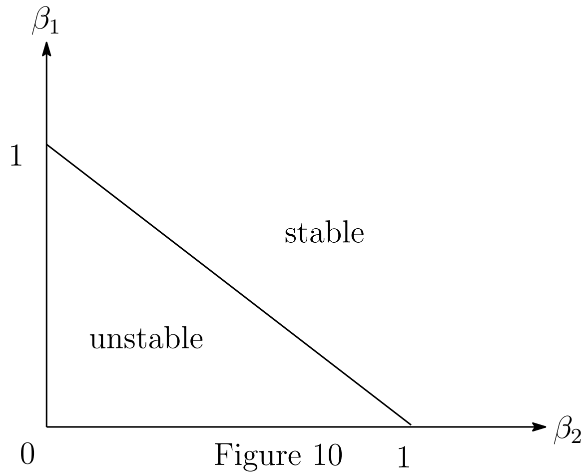

Figure 10