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International Competition and Distributive Class Conflict in an Open Economy Kaleckian Model

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Abstract

This paper constructs an open economy Kaleckian model in which the international competition affects the bargaining process between firms and workers, and investigates the effect of such bargaining on macroeconomy. If the real exchange rate has little impact on the trade balance, the economy is stable, whereas if it has a larger impact on the trade balance, the economy is unstable. Moreover, we show that the effect of a change in the bargaining power on aggregate demand depends not only on the demand regimes but also on which agent bears the burden arising from the international price competition.

Keywords: Kaleckian model, Open economy, International price competition, Wage bargaining

JEL Classification: E12; F43; J50

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1. Introduction

Thus far, a number of Kaleckian models have been developed, and the relation between income distribution and aggregate demand has been investigated.[1] From those models, we derived a familiar result that there are two types of demand regime, stagnationist (wage-led) and exhilarationist (profit-led), according to the parameter constellation of investment and saving functions.[2] The stagnationist regime indicates an economy in which a rise in the profit share (a fall in the wage share) decreases aggregate demand and the exhilarationist regime indicates an economy in which a rise in the profit share increases aggregate demand.

Most of the Kaleckian models that investigate the relation between income distribution and aggregate demand assume a closed economy and abstract from international trade. The real economy is nevertheless an open economy, and accordingly there are complications in applying analytical results based on the assumption of a closed economy to the real world. It is necessary to construct an open economy model and derive effective implications for the real economy.

Needless to say, some of the Kaleckian models take into account an open economy case.[3] A pioneering work that introduces international price competition into the Kaleckian model is Blecker (1989). By adding net export into demand components, he shows that an increase in the wage share can lower international price competitiveness and has a negative impact on investment, which implies that the stagnationist regime is hard to obtain. Another novel idea of Blecker (1989) is the assumption that firms restrain their prices in terms of international price competition, whereas normal Kaleckian models assume that firms determine their price as they like. This modification implies that international competition strictly affects income distribution in the domestic country.

Blecker (1989) nevertheless assumes that the measure of international price competition (i.e., the ratio of domestic unit labor cost to import prices) is exogenously given and hence

[1] For the so-called Kaleckian model, see Rowthorn (1981) and Lavoie (1992). As for the empirical studies on the relation between income distribution and aggregate demand based on the Kaleckian framework, see Stockhammer and Onaran (2004), Barbosa-Filho and Taylor (2006), Naastepad and Storm (2007), Hein and Vogel (2008), Stockhammer, Onaran, and Ederer (2009), and Stockhammer, Hein, and Grafl (2011).

[2] For a theoretical explanation of the demand regime, see Blecker (2002).

[3] Cordero (2002) constructs an open economy Kaleckian model that integrates the theory of conflicting-claims inflation. This model assumes, however, that price is determined in the international goods market and formalizes only workers' bargaining process. La Marca (2010), using an open economy version of the stock-flow consistent model, considers the dynamics of the rate of capacity utilization, profit share, and trade balance. Von Arnim (2011) constructs an open economy Kaleckian model and considers the effect of the wage policy on growth and distribution by using Monte Carlo simulation.

does not explicitly consider the process in which international competition influences income distribution. We therefore need to endogenize income distribution to improve the open economy model.

A representative way to endogenize the process of income distribution in a Kaleckian model is to use the theory of conflicting-claims inflation developed by Rowthorn (1977).[4] This theory assumes that both firms and workers have their own target value of each distributive share and then negotiate over the price and the nominal wage in response to the gap between the actual share and their own target.

The Cassetti (2002) model is one that takes into account the open economy case using the theory of conflicting-claims inflation. He considers the situation in which inflation of domestic products due to class conflict changes the real exchange rate, and this change affects the growth rate of the economy through exports and imports. His model is important in that it simultaneously introduces international price competition and the determination of income distribution.

Cassetti's (2002) model nevertheless leaves room for further investigation. When extending a Kaleckian model with conflict-inflation to an open economy model, he uses equations that determine the wage and price dynamics in closed economy without any modifications. In other words, he assumes that in the face of international price competition in the international goods market, firms and workers never consider the competition, which is unrealistic. To investigate income distribution under an open economy, we must consider the effect of international price competition on the conflict between firms and workers.

A study that considers this aspect is Missaglia (2007). He assumes that the price equation of firms depends on the real exchange rate; when the terms of trade deteriorate, firms restrain their prices. Missaglia's (2007) approach is still unsatisfactory because he does not consider the effect of international price competition on the wage bargaining of workers. The same problem holds for Blecker (1998), which is an extension of Blecker (1989).

With the ongoing globalization of the real world, workers cannot demand a wage increase without considering international competition as well as firms. Increasing wages recklessly in open economy causes a decrease in the price competitiveness of the domestic industry and a decline in market share on the international market, which in turn causes a fall in domestic

[4] For closed economy Kaleckian models with the theory of conflicting-claims inflation, see Cassetti (2003) and Dutt (1987).

labor demand and leads to the loss of workers. In addition, if international capital flow is allowed, firms facing losses due to international price competition transfer their production base to foreign countries to seek cheaper labor. Accordingly, the pressure on domestic workers will intensify. It is therefore reasonable to suppose that workers who engage in wage bargaining pay attention to the relative price of domestic and foreign products.[5]

When both firms and workers consider international price competition, the effect of price pressure on income distribution has two meanings. Whether the wage share or the profit share increases when international competition intensifies depends on how much firms and workers share the burden arising from price restraint.

The Blecker (2011) model accordingly assumes that international price competition affects both firms and workers. In this model, the target profit share of firms depends on the real exchange rate, and moreover, the rate of change in the nominal wage that is determined by wage bargaining depends on the real exchange rate. In his approach, however, the target profit share of workers is assumed to be constant. It is because the price of imports is indexed to the nominal wage and not because the international price competition affects the target of workers that changes in the real exchange rate affect the nominal wage. As stated above, however, it is possible that under severe international competition, labor unions revise the target downward. It is therefore necessary to build a conflict model that considers this possibility.

In addition, the Blecker (2011) model separates the determination of output (capacity utilization), the determination of income distribution and the real exchange rate are separated. In other words, the goods market has nothing to do with the profit share and the real exchange rate that are determined in the labor market; there is a feedback from the labor market to the goods market, but not from the goods market to the labor market.

In the present paper, we therefore present a Kaleckian model in which international price competition affects both firms' decision and workers' decisions. In addition, there is bilateral feedback from the labor market to the goods market and from the goods market to the labor market. Using this model, we investigate the stability of the steady state equilibrium and the effect of international price competition on the equilibrium values. From our analysis, we obtain the following new results.

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[5] For a model that assumes the effect of international price competition on the wage bargaining of workers, see Blecker (1996). He also introduces a real world example that supports this assumption: the labor union of Xerox Corporation accepts a sharp wage cut to prevent workers from moving abroad in the face of international price competition.

First, with regard to the stability of the equilibrium, as long as the effect of the real exchange rate on trade balance is sufficiently small, the equilibrium is likely to be stable irrespective of which regime is realized in the equilibrium, the stagnationist regime or the exhilarationist regime. By contrast, if the real exchange rate effect is large, then the equilibrium is likely to be unstable, and depending on conditions, cyclical fluctuations can occur.

Second, in regard to the comparative statics analysis, if we focus on the bargaining powers of firms and workers, we obtain the following results. Even if the domestic economy is characterized as an exhilarationist regime, unlike in a closed economy, a rise in the bargaining power of firms can depress domestic business. Moreover, even if the domestic economy is characterized as a stagnationist regime, unlike in a closed economy, a rise in the bargaining power of workers can depress domestic business.

The remainder of the paper is organized as follows. Section 2 presents our model. Section 3 investigates the dynamics of the model. Section 4 conducts comparative statics analysis. Section 5 is the conclusion.

2. Model

Consider a small open economy in which workers and capitalists coexist. Workers consume all their wages and capitalists save a fraction s of their profits. Workers and capitalists consume both domestic and foreign goods. The goods market is imperfectly competitive, and hence, firms set prices according to a mark-up pricing rule. Moreover, firms have an investment function independent of savings. Investment is conducted by only domestic goods.

2.1 Dynamics of the capacity utilization

Suppose that firms operate with a fixed coefficient production function. The ratio of the potential output Y^F to the capital stock K is assumed to be constant. We can then write the rate of capacity utilization as $u = Y/K$, where Y denotes the actual output.[6] From this, we have $r = \pi u$, where r and π denote the profit rate and the profit share, respectively.

Following Marglin and Bhaduri (1990), we assume that the firms' investment function is increasing in both the rate of capacity utilization and profit share:

[6] The rate of capacity utilization is defined as Y/Y^F. Since we have $Y/Y^F = (Y/K)/(K/Y^F)$, we can use Y/K as the rate of capacity utilization as long as K/Y^F is technologically fixed and constant.

$$g_d = g_d(u,\pi), \quad g_{du} > 0, \quad g_{d\pi} > 0, \tag{1}$$

where g_{du} denotes the partial derivative with respect to the rate of capacity utilization and $g_{d\pi}$ the partial derivative with respect to the profit share.

Let us specify consumption demand. Total domestic consumption demand consists of demand for domestic goods and foreign goods. First, we assume that total nominal consumption of domestic goods is a constant fraction α of total nominal consumption expenditure.

$$p(C_w^D + C_c^D) = \alpha[wE + (1-s)rpK], \tag{2}$$

where p denotes the price of domestic goods, C_w^D workers' real consumption of domestic goods, C_c^D capitalists' real consumption of domestic goods, w the nominal wage, and E employment. Next, we assume that total nominal consumption of foreign goods (i.e., total nominal imports) is a constant fraction $1-\alpha$ of total nominal consumption expenditure.

$$ep^*(C_w^M + C_c^M) = (1-\alpha)[wE + (1-s)rpK], \tag{3}$$

where e denotes the nominal exchange rate in terms of home currency, p^* the price of foreign goods that is exogenously given, C_w^M workers' real consumption of foreign goods, and C_c^M capitalists' real consumption of foreign goods.

Following Cassetti (2002), we assume that the expenditure coefficient for domestic goods is a function of the real exchange rate $\varepsilon = ep^* / p$.

$$\alpha = \alpha(\varepsilon), \quad 0 < \alpha(\cdot) < 1, \tag{4}$$

where p^* denotes the price of foreign goods. How the expenditure coefficient changes when the real exchange rate changes depends on the elasticity of substitution ρ between domestic goods and foreign goods. If ρ is less than unity, then α is a decreasing function of ε. On the other hand, if ρ is more than unity, then α is an increasing function of ε.

We specify demand for exports. Nominal exports equal real exports multiplied by the price of domestic goods. We assume that real exports are increasing in both the real exchange rate and foreign real incomes Y^*.

$$p \cdot EX = p \cdot EX(\varepsilon, Y^*) = p \cdot ex(\varepsilon) \cdot Y^*, \quad ex' > 0 \tag{5}$$

For simplicity, we assume that real exports are linear in foreign real incomes.

The goods market clearing condition leads to

$$\begin{aligned} pY &= pC + pI + pEX - ep^*M \\ &= (pC^D + ep^*C^M) + pI + pEX - ep^*M , \\ &= pC^D + pI + pEX \end{aligned} \tag{6}$$

where C denotes total consumption made up of the consumption of domestic goods C^D and that of foreign goods C^M, and M denotes imports. Dividing both sides of equation (6) by pK and substituting equations (2), (3), (4), and (5) in the resultant expression, we obtain

$$g_d = [1 - \alpha(\varepsilon)]u + \alpha(\varepsilon)su\pi - ex(\varepsilon)\frac{Y^*}{K} . \tag{7}$$

If we denote the right-hand side of equation (7) as g, the excess demand of the goods market is given by $g_d - g$. Here, for simplicity, we assume that Y^* / K is constant and unity.[7]

We assume that in the goods market, quantity adjustment prevails.

$$\dot{u} = \phi(g_d - g), \quad \phi > 0 , \tag{8}$$

where ϕ denotes the speed of adjustment of the goods market. Equation (8) shows that excess demand leads to a rise in the rate of capacity utilization, while excess supply leads to a decline in the rate of capacity utilization. Substituting equation (1) and the right-hand side of equation (7) in equation (8), we obtain the dynamics of the rate of capacity utilization.

$$\dot{u} = \phi\{g_d(u,\pi) - [1 - \alpha(\varepsilon)]u - \alpha(\varepsilon)su\pi + ex(\varepsilon)\}. \tag{9}$$

2.2 Dynamics of the profit share

Differentiating the definition of the profit share $\pi = 1 - [w/(pa)]$ with respect to time, we obtain

$$\frac{\dot{\pi}}{1-\pi} = \hat{p} - \hat{w} + \hat{a} , \tag{10}$$

where $\hat{x} = \dot{x} / x$ denotes the rate of change in a variable x and a the level of labor productivity. In this subsection, we specify each term in the right-hand side of equation (10).

We specify changes in the domestic price and the nominal wage by using Rowthorn's (1977) conflicting-claims theory of inflation. First, suppose that firms set their price to close the gap between their target profit share π_f and the actual profit share. Second, suppose that the growth rate of the nominal wage that workers manage to negotiate depends on the gap

[7] We assume that the economy is in the short run or medium run wherein capital stock remains constant. Hence, this assumption is reasonable.

between their target profit share π_w and the actual profit share.

$$\hat{p} = \theta_f(\pi_f - \pi), \quad \pi_f = \pi_f(\varepsilon), \quad \pi'_f > 0, \quad \theta_f > 0, \quad 0 < \pi_f < 1, \tag{11}$$

$$\hat{w} = \theta_w(\pi - \pi_w), \quad \pi_w = \pi_w(\varepsilon, u), \quad \pi_{w\varepsilon} < 0, \quad \pi_{wu} < 0, \quad \theta_w > 0, \quad 0 < \pi_w < 1. \tag{12}$$

Here, we assume that $\pi_f > \pi_w$. Firms attempt to set their targets as high as possible whereas workers attempt to set their targets as low as possible. This assumption is therefore reasonable. We can interpret θ_f and θ_w as the bargaining power of firms and that of workers, respectively. We assume that $\theta_f + \theta_w = 1$ and define $\theta_f = \theta$ ($0 < \theta < 1$), because bargaining power is a relative concept. We can consider an increase in the unionization rate as a factor for raising the bargaining power of workers (i.e., a decrease in θ), and an increase in the market power of oligopolistic firms as a factor for raising the bargaining power of firms (i.e., an increase in θ).

In our model, the two target profit shares are determined endogenously.

First, we assume that the target profit share of firms is an increasing function of the real exchange rate. This means that domestic firms set their price by considering international price competition with foreign firms. When the price competitiveness of domestic firms lowers, domestic firms cut their target profit share and hence their price to defend their market share in the international goods market.

Second, we assume that the target profit share of workers is decreasing in both the real exchange rate and the rate of capacity utilization. A decrease in the price of the domestic goods has a negative effect on employment and workers thus set their target profit share considering the price decrease. When the real exchange rate decreases and price competitiveness worsens, workers therefore compromise to lower the target profit share. Let us identify an increase in the rate of capacity utilization with an increase in the rate of employment. When the rate of employment increases, workers' attitude in bargaining becomes strong, leading them to seek a higher target wage share, that is, a lower target profit share. This is known as the "reserve army effect."

The growth rate of labor productivity is determined endogenously. Here, we assume that labor productivity growth is an increasing function of the rate of capacity utilization.

$$\hat{a} = g_a(u), \quad g'_a > 0 \tag{13}$$

This specification is similar to the "reserve-army creation effect" described in Sasaki (2011, 2012), where the growth rate of labor productivity is an increasing function of the rate of employment. If the rate of employment is positively related with the rate of capacity utilization, that is, if Okun's law holds, we can use capacity utilization in place of the employment rate (Tavani, Flaschel, and Taylor, 2011). As the rate of employment (capacity utilization) increases and the labor market tightens, the bargaining power of workers increases, which exerts an upward pressure on wages, leading capitalists to adopt labor-saving technical changes. In other words, capitalists intentionally create unemployment (Bhaduri, 2006; Dutt, 2006; Flaschel and Skott, 2006; Sasaki, 2010, 2011).

Substituting equations (11), (12), and (13) in equation (10), we obtain the dynamics of the profit share.

$$\frac{\dot{\pi}}{1-\pi} = \theta[\pi_f(\varepsilon) - \pi] - (1-\theta)[\pi - \pi_w(\varepsilon, u)] + g_a(u) . \quad (14)$$

2.3 Dynamics of the real exchange rate

We specify the dynamics of the real exchange rate. The rate of change in the real exchange is given as

$$\hat{\varepsilon} = \hat{e} + \hat{p}^* - \hat{p} . \quad (15)$$

Following Blecker and Seguino (2002) and Blecker (2011), we introduce a crawling peg system in regard to the nominal exchange rate:

$$\hat{e} = \lambda(\bar{\varepsilon} - \varepsilon), \quad \bar{\varepsilon} > 0, \quad \lambda > 0 , \quad (16)$$

where λ denotes the speed of adjustment. The currency authority has a target level of the real exchange rate $\bar{\varepsilon}$ and adjusts the nominal exchange rate according to the gap between the target and the actual levels.

Substituting equations (11) and (16) in equation (15), we obtain the following equation of the dynamics of the real exchange rate:

$$\hat{\varepsilon} = \lambda(\bar{\varepsilon} - \varepsilon) + \hat{p}^* - \theta[\pi_f(\varepsilon) - \pi] . \quad (17)$$

3. Dynamics of the model

From the above analysis, the dynamics of the rate of capacity utilization, profit share, and real exchange rate are given as

$$\dot{u} = \phi\{g_d(u,\pi) - [1-\alpha(\varepsilon)]u - \alpha(\varepsilon)su\pi + ex(\varepsilon)\}, \tag{18}$$

$$\dot{\pi} = (1-\pi)\{\theta[\pi_f(\varepsilon) - \pi] - (1-\theta)[\pi - \pi_w(\varepsilon,u)] + g_a(u)\}, \tag{19}$$

$$\dot{\varepsilon} = \varepsilon\{\lambda(\bar{\varepsilon} - \varepsilon) + \hat{p}^* - \theta[\pi_f(\varepsilon) - \pi]\}. \tag{20}$$

The steady state is a situation where $\dot{u} = \dot{\pi} = \dot{\varepsilon} = 0$. We let the steady state values be denoted as u^*, π^*, and ε^*. In the following analysis, we assume that there exist steady state values such that $0 < u^* < 1$, $0 < \pi^* < 1$, and $\varepsilon^* > 0$. As the numerical simulations in Appendix B show, such a steady state actually exists though this result depends on functional specifications.

The elements of the Jacobian matrix $\mathbf{J}$ that corresponds to the system of the differential equations are given by as follows:

$$J_{11} \equiv \frac{\partial \dot{u}}{\partial u} = \phi\{g_{du} - [1-\alpha(\varepsilon)] - \alpha(\varepsilon)s\pi\}, \tag{21}$$

$$J_{12} \equiv \frac{\partial \dot{u}}{\partial \pi} = \phi[g_{d\pi} - \alpha(\varepsilon)su], \tag{22}$$

$$J_{13} \equiv \frac{\partial \dot{u}}{\partial \varepsilon} = \phi\{\alpha'(\varepsilon)u(1-s\pi) + ex'(\varepsilon)\}, \tag{23}$$

$$J_{21} \equiv \frac{\partial \dot{\pi}}{\partial u} = (1-\pi)[(1-\theta)\pi_{wu} + g_a'(u)] = (1-\pi)\Omega, \quad \text{where} \quad \Omega \equiv (1-\theta)\pi_{wu} + g_a'(u), \tag{24}$$

$$J_{22} \equiv \frac{\partial \dot{\pi}}{\partial \pi} = -(1-\pi) < 0, \tag{25}$$

$$J_{23} \equiv \frac{\partial \dot{\pi}}{\partial \varepsilon} = (1-\pi)[\theta\pi_{f\varepsilon} + (1-\theta)\pi_{w\varepsilon}], \tag{26}$$

$$J_{31} \equiv \frac{\partial \dot{\varepsilon}}{\partial u} = 0, \tag{27}$$

$$J_{32} \equiv \frac{\partial \dot{\varepsilon}}{\partial \pi} = \theta\varepsilon > 0, \tag{28}$$

$$J_{33} \equiv \frac{\partial \dot{\varepsilon}}{\partial \varepsilon} = -\varepsilon(\lambda + \theta\pi_{f\varepsilon}) < 0. \tag{29}$$

All the elements are evaluated at the steady state values. In what follows, we explain elements whose signs are ambiguous.

To conduct the analysis further, we introduce the following assumption.

Assumption 1. The condition $g_{du} - [1-\alpha(\varepsilon)] - \alpha(\varepsilon)s\pi < 0$ holds.

This condition is an open economy version of the Keynesian stability condition in which we assume that the quantity adjustment in the goods market is stable. We then have $J_{11} < 0$.

Next, we introduce the following definition.

Definition 1. We define $g_{d\pi} - \alpha(\varepsilon)su < 0$ as the stagnationist regime and $g_{d\pi} - \alpha(\varepsilon)su > 0$ as the exhilarationist regime.

The element J_{12} shows the effect of an increase in the profit share on the rate of capacity utilization. If the sign is negative, the economy is in the stagnationist regime, and if the sign is positive, the economy is in the exhilarationist regime.

The element J_{13} shows the effect of an increase in the real exchange rate on the trade balance (normalized by capital stock) $TB = ex(\varepsilon) - [1-\alpha(\varepsilon)](1-s\pi)u$. If ρ is more than unity, we have $\alpha'(\varepsilon) > 0$, which leads to $J_{13} > 0$. This corresponds to $\partial TB / \partial \varepsilon > 0$, which means that the Marshall-Lerner condition (ML condition, hereafter) is satisfied. If ρ is less than unity, we have $\alpha'(\varepsilon) < 0$, which leads to $J_{13} < 0$, depending on conditions. In this case, the ML condition is not satisfied.

The element J_{21} shows the effect of an increase in the rate of capacity utilization on the profit share. If the reserve army effect exceeds the reserve army creation effect, we have $\Omega < 0$, leading to $J_{21} < 0$. This corresponds to the case where the profit share is counter-cyclical to the rate of capacity utilization. On the contrary, if the reserve army creation effect exceeds the reserve army effect, we have $\Omega > 0$, leading to $J_{21} > 0$. This corresponds to the case where the profit share is pro-cyclical to the rate of capacity utilization.

The element J_{23} shows the effect of an increase in the real exchange rate on the profit share. If firms are more responsive than workers, that is, if the absolute value of $\pi_{f\varepsilon}$ is greater than that of $\pi_{w\varepsilon}$, then $J_{23} > 0$. In contrast, if workers are more responsive than firms, that is, if the absolute value of $\pi_{w\varepsilon}$ is greater than that of $\pi_{f\varepsilon}$, then $J_{23} < 0$. If firms are responsive, firms bear the burden arising from international price competition more than workers, but if workers are responsive, workers bear the burden arising from international price competition more than firms.

The characteristic equation that corresponds to the Jacobian matrix $\mathbf{J}$ is given as

$$q^3 + a_1 q^2 + a_2 q + a_3 = 0, \tag{30}$$

where q denotes a characteristic root. The coefficients of equation (30) are given by

$$a_1 = -\mathrm{tr}\mathbf{J} = -(J_{11} + J_{22} + J_{33}) > 0, \tag{31}$$

$$a_2 = (J_{22}J_{33} - J_{23}J_{32}) + (J_{11}J_{33}) + (J_{11}J_{22} - J_{12}J_{21}), \tag{32}$$

$$a_3 = -\det\mathbf{J} = -J_{11}(J_{22}J_{33} - J_{23}J_{32}) + J_{21}(J_{12}J_{33} - J_{13}J_{32}), \tag{33}$$

where $\mathrm{tr}\mathbf{J}$ denotes the trace of $\mathbf{J}$ and $\det\mathbf{J}$ the determinant of $\mathbf{J}$.

The necessary and sufficient conditions for the local stability of the steady state equilibrium are given by $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$. We investigate whether or not these conditions are satisfied. In this case, because of the property of our model, the coefficients of the characteristic equation are linear functions of the adjustment speed of ϕ and hence, $a_1a_2 - a_3$ is a quadratic function of ϕ, where[8]

$$a_1 = \Delta_1\phi + \Delta_2, \tag{34}$$

$$a_2 = \Delta_3\phi + \Delta_4, \tag{35}$$

$$a_3 = \Delta_5\phi, \tag{36}$$

$$a_1a_2 - a_3 = f(\phi) \equiv (\Delta_1\Delta_3)\phi^2 + (\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5)\phi + \Delta_2\Delta_4. \tag{37}$$

In the following analysis, we explain the coefficients Δ_1, Δ_2, Δ_3, Δ_4, and Δ_5.

To begin with, the signs of Δ_1, Δ_2, and Δ_4 are immediately obtained as

$$\Delta_1 = [1 - \alpha(\varepsilon)] + \alpha(\varepsilon)s\pi - g_{du} > 0, \tag{38}$$

$$\Delta_2 = (1 - \pi) + \varepsilon(\lambda + \theta\pi_{f\varepsilon}) > 0, \tag{39}$$

$$\Delta_4 = \varepsilon(1 - \pi)[\lambda + \theta(1 - \theta)(\pi_{f\varepsilon} - \pi_{w\varepsilon})] > 0. \tag{40}$$

$\Delta_1 > 0$ is obtained from Assumption 1, and $\Delta_4 > 0$ is obtained from both $\pi_{f\varepsilon} > 0$ and $\pi_{w\varepsilon} < 0$.

Next, the coefficient Δ_3 leads to

$$\Delta_3 = \{[1 - \alpha(\varepsilon)] + \alpha(\varepsilon)s\pi - g_{du}\}[(1 - \pi) + \varepsilon(\lambda + \theta\pi_{f\varepsilon})] - (1 - \pi)[g_{d\pi} - \alpha(\varepsilon)su]\Omega. \tag{41}$$

[8] We use the fact that the speed of adjustment of the goods market ϕ affects the dynamic process of the model but not the steady state values.

From this, if both $g_{d\pi} - \alpha(\varepsilon)su < 0$ and $\Omega > 0$ hold, then $\Delta_3 > 0$, and if $g_{d\pi} - \alpha(\varepsilon)su > 0$ and $\Omega < 0$ hold, then $\Delta_3 > 0$. Under other combinations, however, the sign of Δ_3 is ambiguous. We therefore assume these two combinations in the following analysis.

Assumption 2. Both $g_{d\pi} - \alpha(\varepsilon)su < 0$ and $\Omega > 0$ hold.
Assumption 3. Both $g_{d\pi} - \alpha(\varepsilon)su > 0$ and $\Omega < 0$ hold.

Assumption 2 corresponds to the case where the economy is in the stagnationist regime and the reserve army creation effect exceeds the reserve army effect. Then, we have both $J_{12} < 0$ and $J_{21} > 0$. Assumption 3 corresponds to the case where the economy is in the exhilarationist regime and the reserve army effect exceeds the reserve army creation effect. We then have $J_{12} > 0$ and $J_{21} < 0$.

The coefficient Δ_5 leads to

$$\begin{aligned}\Delta_5 = &\ \varepsilon(1-\pi)\{[1 - g_{du} - \alpha(\varepsilon)(1 - s\pi)][\lambda + \theta(1-\theta)(\pi_{f\varepsilon} - \pi_{w\varepsilon})] \\ &- \Omega\{[g_{d\pi} - \alpha(\varepsilon)su](\lambda + \theta\pi_{f\varepsilon}) + \theta[\alpha'(\varepsilon)u(1 - s\pi) + ex'(\varepsilon)]\}\}\end{aligned}. \tag{42}$$

The first line of the right-hand side of equation (42) is always positive. Let us focus on the second line.

First, when Assumption 2 holds and the ML condition is satisfied, the sign of the second line depends on the absolute size of the following term:

$$-\theta\Omega[\alpha'(\varepsilon)u(1 - s\pi) + ex'(\varepsilon)]. \tag{43}$$

If equation (43) is small, we have $\Delta_5 > 0$, leading to $a_3 > 0$. This effect is small when $\alpha'(\varepsilon) > 0$ is small and $ex'(\varepsilon) > 0$ is small, that is, when the expenditure coefficient for domestic goods is not so responsive to the real exchange rate and when export demand is not so responsive to the real exchange rate. In other words, when the trade balance is not so responsive to the real exchange rate, then $\partial TB / \partial \varepsilon > 0$ is small. By contrast, if Assumption 2 holds and the ML condition is not satisfied, $\Delta_5 > 0$ necessarily holds.

Second, when Assumption 3 holds and the ML condition is satisfied, $\Delta_5 > 0$ necessarily holds. By contrast, when Assumption 3 holds and the ML condition is not satisfied, we have $\Delta_5 > 0$ as long as the absolute value of $\partial TB / \partial \varepsilon < 0$ is small, which is to say, close to zero.

Finally, we investigate the sign of $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5$. If the sign is positive, we always have $a_1 a_2 - a_3 > 0$. On the other hand, if the sign is negative and its absolute value is large, we have $a_1 a_2 - a_3 < 0$.

$$\begin{aligned} &\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 \\ &= [(1-\pi) + \varepsilon(\lambda + \theta\pi_{f\varepsilon})]^2 (1 - \alpha + \alpha s\pi - g_{du}) \\ &\quad - (1-\pi)\Omega\{(1-\pi)(g_{d\pi} - \alpha su) - \theta\varepsilon[\alpha'(\varepsilon)u(1 - s\pi) + ex'(\varepsilon)]\} \end{aligned} . \qquad (44)$$

The first line of the right-hand side of equation (44) is always positive. Let us focus on the second line.

When Assumption 2 holds and the ML condition is satisfied, the second line of equation (44) is always positive and hence, we have $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$, leading to $a_1 a_2 - a_3 > 0$. By contrast, when Assumption 2 holds and the ML condition is not satisfied, we have $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$ as long as the absolute value of $\partial TB / \partial\varepsilon < 0$ is small, which is to say, close to zero.

When Assumption 3 holds and the ML condition is satisfied, we have $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$ if $\partial TB / \partial\varepsilon > 0$ is small because the second line is positive. By contrast, when Assumption 3 holds and the ML condition is not satisfied, $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$ necessarily holds.

From these analyses, we obtain the following proposition:

Proposition 1. Suppose that the effect of the real exchange rate on the trade balance is small, that is, the absolute value of $\partial TB / \partial\varepsilon$ is small. Then, irrespective of whether or not the ML condition is satisfied, the combination of either the stagnationist regime and $\Omega > 0$ or the exhilarationist regime and $\Omega < 0$ makes the steady state equilibrium stable.

Proof. See Appendix A.1.

As Appendix C shows, in a closed economy, the combination of the stagnationist regime and $\Omega > 0$ or the exhilarationist regime and $\Omega < 0$ is a stability condition. In the open economy, if the effect of the real exchange rate on the trade balance is small, these combinations are also the stability conditions.

We also obtain the two further propositions:

Proposition 2. Suppose that the effect of the real exchange rate on the trade balance is large, that is, the absolute value of $\partial TB/\partial\varepsilon$ is large. Then, if the ML condition is satisfied, the combination of the stagnationist regime and $\Omega > 0$ makes the steady state equilibrium unstable. On the other hand, if the ML condition is not satisfied, under the combination of the stagnationist regime and $\Omega > 0$, limit cycles occur when the speed of adjustment of the goods market lies within some range.

Proof. See Appendix A.2.

Proposition 3. Suppose that the effect of the real exchange rate on the trade balance is large, that is, the absolute value of $\partial TB/\partial\varepsilon$ is large. Then, if the ML condition is satisfied, under the combination of the exhilarationist regime and $\Omega < 0$, limit cycles occur when the speed of adjustment of the goods market lies within some range. On the other hand, if the ML condition is not satisfied, the combination of the exhilarationist regime and $\Omega < 0$ makes the steady state equilibrium unstable.

Proof. See Appendix A.3.

We now explain why there occur limit cycles when the speed of adjustment of the goods market is medium. First, when ϕ is sufficiently close to zero, the rate of capacity utilization is not adjusted and the analysis of the dynamic system therefore amounts to the analysis of the subsystem that consists of the profit share and the real exchange rate. After some calculations, we find that the dynamics of the subsystem are stable. Second, when ϕ is sufficiently large, the rate of capacity utilization is adjusted immediately and the effect of the rate of capacity utilization on the dynamical system therefore does not last. In this case, too, the analysis of the dynamic system amounts to the analysis of the subsystem that consists of the profit share and the real exchange rate. When ϕ takes an intermediate value, the rate of capacity utilization changes with lags. The rate of capacity utilization therefore has a lasting effect on the dynamical system and, accordingly, cyclical fluctuations occur.

Propositions 1, 2, and 3 are summarized in Figure 1.

[Figure 1 around here]

4. Comparative statics analysis

This section examines the effect of changes in the saving rate of capitalists, the bargaining power of firms, and the target value of the real exchange rate on the steady state values of the rate of capital utilization, profit share, and the real exchange rate.[9] Here, we only consider the stable steady state: Assumption 1 holds, either Assumption 2 ($J_{12} < 0$ and $J_{21} > 0$) or Assumption 3 ($J_{12} > 0$ and $J_{21} < 0$) holds, and the trade balance does not respond much to the real exchange rate (i.e., the absolute value of $\partial TB / \partial \varepsilon$ is sufficiently small). In addition, we suppose here that the ML condition is always satisfied, that is, $\partial TB / \partial \varepsilon > 0$ holds.[10]

4.1 Saving rate of capitalists

We represent the effect of a change in the saving rate of capitalists on the rate of capacity utilization as follows:

$$\frac{du}{ds} = \frac{\alpha\varepsilon(1-\pi)\pi u\left[\lambda + \theta(1-\theta)(\pi_{f\varepsilon} - \pi_{w\varepsilon})\right]}{\det \mathbf{J}} < 0. \tag{45}$$

Note here that the stable steady state always requires $\det \mathbf{J} < 0$. Equation (45) thus means that the paradox of thrift holds even in an open economy version of the Kaleckian model: an increase in the saving rate of capitalists reduces the rate of capacity utilization.

The effects of a change in the saving rate of capitalists on the profit share and the real exchange rate are given by

$$\frac{d\pi}{ds} = \frac{-\alpha\pi u J_{21} J_{33}}{\det \mathbf{J}}. \tag{46}$$

$$\frac{d\varepsilon}{ds} = \frac{\alpha\pi u J_{21} J_{32}}{\det \mathbf{J}}. \tag{47}$$

As described above, an increase in the saving rate of capitalists decreases the rate of capacity utilization. When the reserve army creation effect exceeds the reserve army effect ($J_{21} > 0$), a decline in the rate of capacity utilization reduces labor productivity growth and thus the profit share ($d\pi / ds < 0$). Furthermore, a fall in the profit share decreases the real exchange rate ($d\varepsilon / ds < 0$) because a loss of profitability urges capitalists to raise the price of domestic goods.

[9] The current analysis abstracts from the effect of the price of foreign goods on the steady state values. This is because, for the home country, a rise in the target value of the real exchange rate is equivalent to a rise in the price of foreign goods in the sense that they both produce the same results.

[10] The results of the comparative statics analysis in the case where the ML condition does not hold is more complicated than those in which the condition holds. We therefore do not investigate the former case.

On the other hand, if the reserve army effect is stronger than the reserve army creation effect ($J_{21} < 0$), a rise in the saving rate of capitalists leads to a rise in the profit share ($d\pi / ds > 0$). This is because a fall in the rate of capacity utilization decelerates nominal wage growth. An increase in profitability, moreover, leaves room for lowering the price of domestic goods. Consequently, an increase in the saving rate of capitalists raises the real exchange rate ($d\varepsilon / ds > 0$).

4.2 Bargaining power of firms

The next task is to investigate the effects of the bargaining power of firms on the steady state values. Because it is difficult to derive purely analytical results from our model, we here confine ourselves to pointing out that the propositions obtained in a closed version of a Kaleckian model may not be applied to an open economy case.

We represent an effect of an increase in the firms' bargaining power on the rate of capacity utilization as follows:

$$\frac{du}{d\theta} = \frac{-(\pi_f - \pi_w)J_{13}J_{32} + (\pi_f - \pi_w)J_{12}J_{33} - (\pi_f - \pi)J_{13}J_{22} + (\pi_f - \pi)J_{12}J_{23}}{\det \mathbf{J}}. \tag{48}$$

In a closed economy, a rise in the bargaining power of firms has a strictly positive impact on the rate of capacity utilization under the exhilarationist regime.[11] In an open economy, however, this may not occur.

Assume that the economy exhibits the exhilarationist regime ($J_{12} > 0$). The first and second terms on the right-hand side of equation (48) are thus positive, whereas the third and fourth terms are negative in the case where $\pi_f - \pi > 0$ and $J_{23} > 0$ are satisfied.[12] If the latter effects are larger than the former, a rise in the bargaining power of firms reduces the rate of capacity utilization even under the exhilarationist regime. The story behind such a situation is explained as follows. An increase in the firms' bargaining power puts upward pressure on the price of domestic goods under $\pi_f - \pi > 0$, which in turn leads to a decline in the real exchange rate. A direct effect of a decrease in the real exchange rate is that it worsens the trade balance and the rate of capacity utilization (the third term); its indirect effect is that it reduces

[11] See Appendix C.

[12] Our model endogenizes the growth rate of labor productivity. If the reserve army creation effect is sufficiently strong, labor productivity grows rapidly and the profit share accordingly reaches a high level. In this case, $\pi_f - \pi < 0$ is likely to be obtained in the steady state. On the contrary, if the reserve army effect is sufficiently large, $\pi_f - \pi > 0$ is likely to be obtained because the reserve army effect squeezes the profit share.

the profit share and thus shrinks domestic demand under the exhilarationist regime if firms bear the burden arising from international price competition more than workers (the fourth term).

The fourth term also shows negative sign if $\pi_f - \pi < 0$ and $J_{23} < 0$ are satisfied. An increase in the firms' bargaining power lowers the price of domestic goods under $\pi_f - \pi < 0$ and raises the real exchange rate. If workers who face a rising real exchange rate demand higher nominal wage growth, the profit share decreases and domestic demand contracts under the exhilarationist regime. This indicates that strengthening the bargaining power of firms under the exhilarationist regime does not necessarily raise the rate of capacity utilization.

A well-known implication of equation (48) is that the stagnationist regime may not allow firms to weaken their bargaining power.[13] The first term in the right-hand side of equation (48) implies that a decrease in the firms' bargaining power reduces its profitability and forces them to push up the price of domestic goods; a rise in the price of domestic goods, in turn, decreases the rate of capacity utilization by deteriorating terms of trade. This gives reason to justify strengthening the bargaining power of firms that confront international price competition, even under the stagnationist regime.

The impact of a change in the firms' bargaining power on the profit share is given as

$$\frac{d\pi}{d\theta} = \frac{-(\pi_f - \pi_w)J_{11}J_{33} + (\pi_f - \pi)J_{13}J_{21} - (\pi_f - \pi)J_{11}J_{23}}{\det \mathbf{J}}. \tag{49}$$

It is likely that an increase in the bargaining power of firms raises the profit share, but the result is not so simple in an open economy framework. For instance, if $\pi_f - \pi > 0$, $J_{21} > 0$, and $J_{23} > 0$ are satisfied, both the second and third terms in the right-hand side of equation (49) show a negative sign, which implies that there exists a possibility of increasing bargaining power of firms to reduce the profit share. Strengthening its bargaining power raises the price of domestic goods under $\pi_f - \pi > 0$ and decreases the real exchange rate. A decline in the real exchange rate,, in turn, leads to decreases in the rate of capacity utilization and profit share if the reserved army creation effect is sufficiently large (the second term). It also causes a decrease in the profit share if firms bear the burden arising from international price competition more than workers (the third term).

Furthermore, in the case of $\pi_f - \pi < 0$, $J_{21} < 0$, and $J_{23} < 0$, both second and third terms in the right-hand side of equation (49) show a negative sign. Strengthening the bargaining

[13] This point is stressed by Blecker (2011) and Cassetti (2012). They show that cutting down a mark-up rate of domestic goods as well as decreasing nominal wage causes higher growth under the stagnationist regime.

power of firms reduces the price of domestic goods under $\pi_f - \pi < 0$ and increases the real exchange rate. A rise in the real exchange rate, in turn, leads to a rise in the rate of capacity utilization but reduces the profit share if the reserved army effect is sufficiently large (the second term). It also suppresses the profit share if workers request higher nominal wage growth (the third term).

We represent the effect of a change in the firms' bargaining power on the real exchange rate as follows:

$$\frac{d\varepsilon}{d\theta} = \frac{(\pi_f - \pi)(J_{11}J_{22} - J_{12}J_{21}) + (\pi_f - \pi_w)J_{11}J_{32}}{\det \mathbf{J}}. \quad (50)$$

Under either Assumption 2 or Assumption 3, the sign of the first term in the right-hand side of equation (50) is negative in the case where $\pi_f - \pi > 0$ holds, whereas the sign of the second term is positive. The result is therefore ambiguous. If $\pi_f - \pi < 0$ holds, however, the first term becomes positive as well as the second term so that increasing the firms' bargaining power has a positive impact on the real exchange rate and thus improves the terms of trade.

4.3 Target value of the real exchange rate

Governments often intend to raise the real exchange rate to improve the trade balance and output. To begin with, we consider the effect of an increase in the target value of the exchange rate on its steady state value:

$$\frac{d\varepsilon}{d\bar{\varepsilon}} = \frac{-\lambda(J_{11}J_{22} - J_{12}J_{21})}{\det \mathbf{J}} > 0. \quad (51)$$

Because $d\varepsilon / d\bar{\varepsilon} > 0$ is obtained from $J_{11}J_{22} - J_{12}J_{21} > 0$, raising the target value of the real exchange rate increases its steady state value.

Next, we investigate whether the attempt to depreciate the exchange rate (i.e., raising the target value of the real exchange rate) succeeds in stimulating output.

$$\frac{du}{d\bar{\varepsilon}} = \frac{\lambda J_{13}J_{22} - \lambda J_{12}J_{23}}{\det \mathbf{J}}. \quad (52)$$

The sign of the first term in the right-hand side of equation (52) is positive, whereas the sign of the second term is ambiguous. The depreciation policy therefore may not work. The story behind the failure of that policy is explained as follows.

Assume that the economy exhibits the exhilarationist regime and workers are more responsive to the change of the real exchange rate than firms. Under these assumptions, the sign of the second term in the right-hand side of equation (52) is negative. A rise in the real exchange rate caused by the depreciation policy triggers workers to demand higher nominal wage, which causes a decline in the profit share and stagnation of domestic demand. The depreciation policy stimulates foreign demand as long as the ML condition is met, but it reduces domestic demand. The total effect is therefore ambiguous. To succeed in the depreciation policy under the exhilarationist regime, it is necessary for workers to bear the burden arising from international price competition.

Next, we assume that the stagnationist regime is realized and firms are more responsive to the change of the real exchange rate than workers. In this case, currency depreciation may not work because the sign of second terms in the right-hand side of equation (52) is negative. A rise in the real exchange rate increases the profit share by increasing the price of domestic goods, which in turn causes a decline in domestic demand. Under the stagnationist regime, the nominal wage must therefore rise higher than the price of domestic goods to stimulate aggregate demand by means of the depreciation policy.

Finally, we represent the effect of a change in the real exchange rate on the profit share as follows:

$$\frac{d\pi}{d\bar{\varepsilon}} = \frac{-\lambda J_{13} J_{21} + \lambda J_{11} J_{23}}{\det \mathbf{J}}. \quad (53)$$

If the reserve army creation effect is stronger than the reserve army effect, the depreciation policy raises the rate of capacity utilization by improving the trade balance, and increases the profit share (i.e., the sign of the first term in the right-hand sided of equation (53) is positive). On the other hand, if the reserve army effect is stronger than the reserve army creation effect, the policy decreases the profit share (i.e., the sign of the first term is negative).

In addition, when firms are more responsive to the change of the real exchange rate than workers, the depreciation policy raises the price of domestic goods and increases the profit share (i.e., the sign of the second term is positive). When workers are more responsive, however, this policy reduces the profit share through higher nominal wage growth (i.e., the sign of the second term is positive).

4.4 Summary

Table 1 shows the results of comparative statics analysis in the case where the stagnationist regime is realized and the reserve army creation effect is larger than the reserve army effect, while Table 2 shows the results of the case in which the exhilarationist regime is realized and the reserve army effect is larger than the reserve army creation effect.

Let us review the key points obtained from our analysis. First, the paradox of thrift holds even in the open economy Kaleckian model. Second, the effect of an increase in the bargaining power of firms on the rate of capacity utilization hinges on which demand regime is realized and which agent, firms or workers, bear the burden arising from the international price competition. Depending on the combination of these two factors, there exist various scenarios that might unfold under international competition. Third, to succeed in the depreciation policy, it is necessary for the government to consider both the demand regime in the domestic economy and how to bear the burden of international price competition.

[Tables 1 and 2 around here]

5 Conclusions

This paper has presented an open economy Kaleckian model, considering the process in which international price competition affects wage bargaining between firms and workers and the effect of such bargaining on the stability and steady state values. In particular, we intend to make it clear that some of the propositions obtained from a closed economy Kaleckian model do not hold in an open economy model. Our results are summarized as follows.

Stability analysis. (1) The stability conditions in the closed economy case (i.e., the combination of either the stagnationist regime and a larger reserve army creation effect or the exhilarationist regime and a larger reserve army effect) are accepted in the open economy case where a change in the real exchange rate has little impact on the trade balance. (2) By contrast, if a change in the real exchange rate has a larger impact on the trade balance, the steady state becomes unstable. (3) Moreover, if the ML condition is satisfied under the combination of the exhilarationist regime and a larger reserve army effect, limit cycles occur as long as the speed of adjustment of the goods market lies within some range.

Comparative statics analysis. (4) The paradox of thrift is true even in the open economy setting. (5) Strengthening the firms' bargaining power may depress the economy that exhibits the exhilarationist regime but may not reduce the rate of capacity utilization under the stagnationist regime. We therefore conclude that not only the demand regimes but also the agent, whether firms or workers, that bears the burden arising from the international price competition determines the effect of the bargaining power on the aggregate demand. (6)

Furthermore, the success of the depreciation policy depends on how to spread the burden of international price competition between firms and workers as well as demand regime.

Appendix A: Proofs of propositions

A.1 Proof of proposition 1

Irrespective of the sign of $\partial TB/\partial\varepsilon$, if the absolute value of $\partial TB/\partial\varepsilon$ is small, we have $\Delta_5 > 0$ and $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$. From this, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$. All the necessary and sufficient conditions are therefore satisfied.

A.2 Proof of proposition 2

First part: If $\partial TB/\partial\varepsilon > 0$ is large, we have $\Delta_5 < 0$ and $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$. Then, we have $a_1 > 0$, $a_2 > 0$, $a_3 < 0$, and $a_1a_2 - a_3 > 0$, which means that one condition is not satisfied. The steady state equilibrium is therefore unstable.

Second part: If the absolute value of $\partial TB/\partial\varepsilon < 0$ is large, we have $\Delta_5 > 0$ and $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 < 0$. If the absolute value of $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 < 0$ is large, it is possible that the sign of $f(\phi) = (\Delta_1\Delta_3)\phi^2 + (\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5)\phi + \Delta_2\Delta_4$ alternates. The quadratic function $f(\phi)$ is convex downwards and its intercept is positive. If the discriminant of $f(\phi) = 0$ is positive, the equation $f(\phi) = 0$ has two positive real roots: for $\phi \in (0, \phi_1)$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$; for $\phi \in (\phi_1, \phi_2)$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 < 0$; and for $\phi > \phi_2$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$. There thus occurs the Hopf bifurcation at $\phi = \phi_1$ and $\phi = \phi_2$. Indeed, at $\phi = \phi_1$ and $\phi = \phi_2$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_1a_2 - a_3 = 0$, and $\partial(a_1a_2 - a_3)/\partial\phi\big|_{\phi=\phi_1 \text{ or } \phi_2} \neq 0$, which mean that all the conditions for the Hopf bifurcation are satisfied. There therefore exists a continuous family of non-constant, periodic solutions of the system around $\phi = \phi_1$ and $\phi = \phi_2$.

A.3 Proof of proposition 3

First part: If $\partial TB/\partial\varepsilon > 0$ is large, we have $\Delta_4 > 0$ and $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 < 0$. When the absolute value of $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 < 0$ is large, it is possible that the sign of $f(\phi) = (\Delta_1\Delta_3)\phi^2 + (\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5)\phi + \Delta_2\Delta_4$ alternates. The quadratic function $f(\phi)$ is convex downwards and its intercept is positive. If the discriminant of $f(\phi) = 0$ is positive, the equation $f(\phi) = 0$ has two positive real roots: for $\phi \in (0, \phi_1)$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$; for $\phi \in (\phi_1, \phi_2)$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 < 0$; and for $\phi > \phi_2$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, and $a_1a_2 - a_3 > 0$. There thus occurs the Hopf bifurcation at $\phi = \phi_1$ and $\phi = \phi_2$. Indeed, at $\phi = \phi_1$ and $\phi = \phi_2$, we have $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_1 a_2 - a_3 = 0$, and $\partial(a_1 a_2 - a_3)/\partial\phi\big|_{\phi=\phi_1 \text{ or } \phi_2} \neq 0$, which means that all the conditions for the Hopf bifurcation are satisfied. There therefore exists a continuous family of non-constant, periodic solutions of the system around $\phi = \phi_1$ and $\phi = \phi_2$.

Second part: If the absolute value of $\partial TB/\partial\varepsilon < 0$ is large, we have $\Delta_5 < 0$ and $\Delta_1\Delta_4 + \Delta_2\Delta_3 - \Delta_5 > 0$. We then have $a_1 > 0$, $a_2 > 0$, $a_3 < 0$, and $a_1 a_2 - a_3 > 0$, which means that one condition is not satisfied. The steady state equilibrium is therefore unstable.

Appendix B: Numerical simulations

Using numerical simulations, we show that the Hopf bifurcation actually occurs. For this purpose, we have to specify functional forms.

Investment function: $g_d = \gamma_0 u^{\gamma_1} \pi^{\gamma_2}$, $\gamma_0 > 0, 0 < \gamma_1 < 1, \gamma_2 > 0$. (B1)

Here, following Blecker (2002) and Sasaki (2010), we use the Cobb-Douglas investment function. Roughly speaking, the parametric restriction $0 < \gamma_2 < 1$ corresponds to the stagnationist regime while $\gamma_2 > 1$ corresponds to the exhilarationist regime.

Firms' target profit share: $\pi_f = \alpha_0 + \alpha_1\varepsilon$, $0 < \alpha_0 < 1, \alpha_1 > 0$, (B2)

Workers' target profit share: $\pi_w = \beta_0 - \beta_1 u - \beta_2\varepsilon$, $0 < \beta_0 < 1, \beta_1 > 0, \beta_2 > 0$, (B3)

Labor productivity growth: $g_a = \eta u$, $\eta > 0$, (B4)

Expenditure coefficient: $\alpha(\varepsilon) = B_0 \varepsilon^{\rho - 1}$, $B_0 > 0, 0 < \rho < +\infty$ ρ, the elasticity of substitution, (B5)

Export demand function: $ex(\varepsilon) = A_0 \varepsilon^{\psi}$, $A_0 > 0, 0 < \psi < +\infty$ ψ, the price elasticity of export demand. (B6)

In what follows, we present a numerical example that corresponds to the case where $\Omega < 0$, the economy is in the exhilarationist regime, and $\partial TB/\partial\varepsilon > 0$ is large. First, we set the parameters as follows:

$s = 0.7$, $\gamma_0 = 0.2$, $\gamma_1 = 0.2$, $\gamma_2 = 1.7$, $\alpha_0 = 0.3$, $\alpha_2 = 0.01$, $\beta_0 = 0.3$, $\beta_1 = 0.2$,

$\beta_2 = 0.01$, $A_0 = 0.4$, $\psi = 1500$, $\theta = 0.3$, $\eta = 0.01$, $\lambda = 1$, $\bar{\varepsilon} = 1$, $p^* = 0.01$, $B_0 = 0.3$, $\rho = 150$.

In this numerical example, the open economy version of the Keynesian stability condition holds, workers are more responsive than firms, the two endogenously determined target profit shares are more than zero and less than unity, the inequality $\pi_f > \pi_w$ holds, and the endogenously determined expenditure share is $0 < \alpha(\varepsilon^*) < 1$.

We set initial conditions to $u(0) = 0.15$, $m(0) = 0.25$, and $\varepsilon(0) = 0.98$. As figure B1 shows, there exist two Hopf bifurcation points.

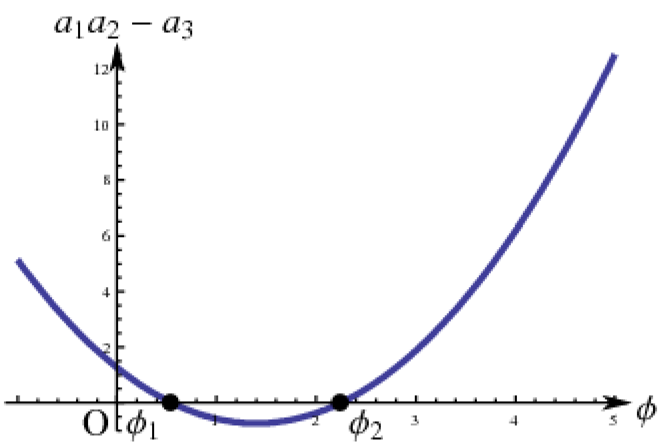

Figure B1: Existence of two Hopf bifurcation points

Using $\phi = 1$ as the speed of adjustment of the goods market, we obtain the following figures with regard to the time series of the endogenous variables (figures B2-B5).

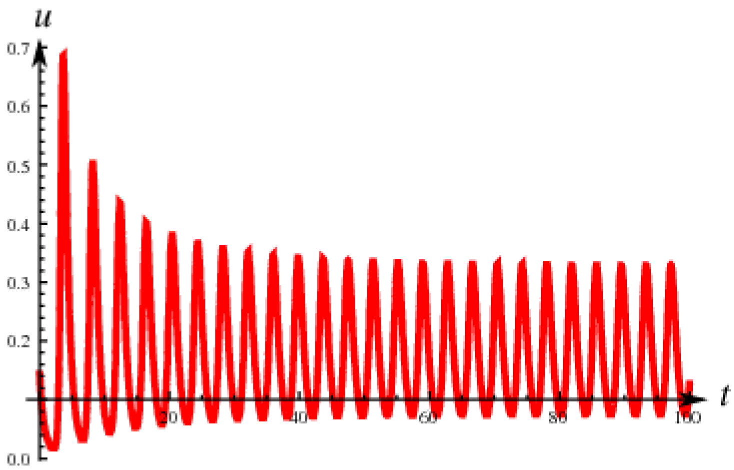

Figure B2: Dynamics of the capacity utilization

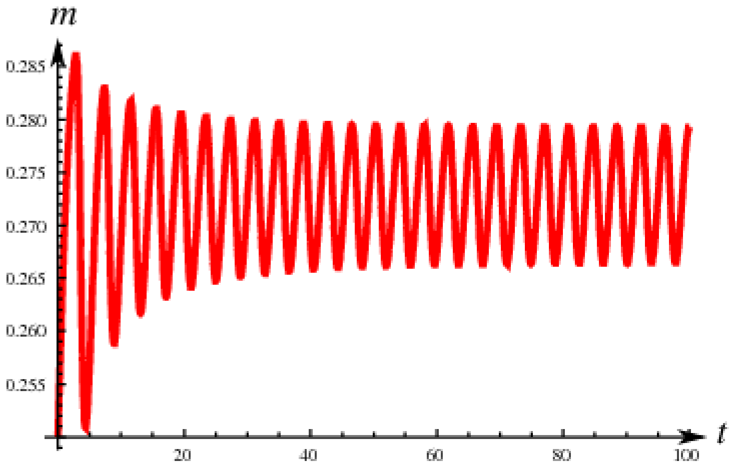

Figure B3: Dynamics of the profit share

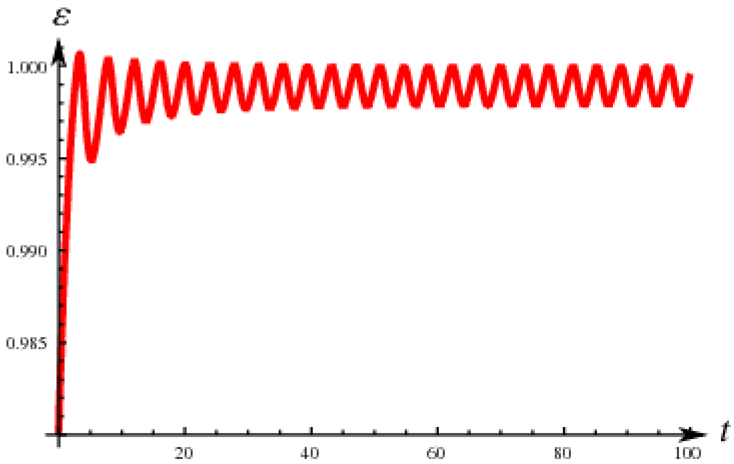

Figure B4: Dynamics of the real exchange rate

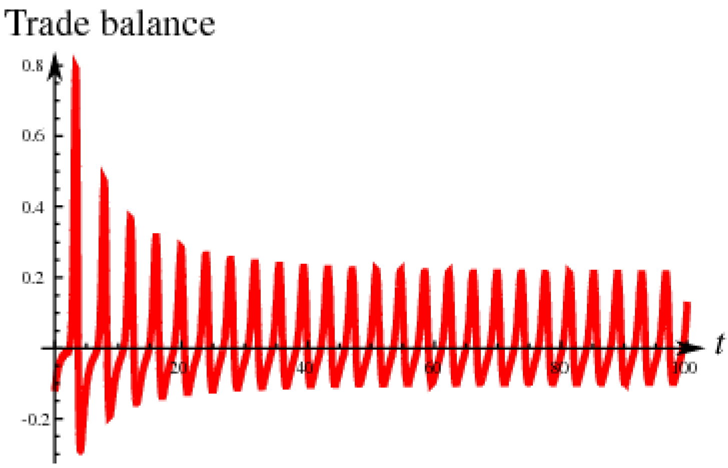

Figure B5: Dynamics of the trade balance

Appendix C: Closed economy model

We briefly explain the closed economy model, which is a model that removes import and export demand as well as the effect of the real exchange rate from the open economy model. In this case, the dynamics of the rate of capacity utilization and the profit share are as follows:

$$\dot{u} = \phi\{g_d(u,\pi) - su\pi\}, \tag{C1}$$

$$\dot{\pi} = (1-\pi)\{\theta(\pi_f - \pi) - (1-\theta)[\pi - \pi_w(u)] + g_a(u)\}. \tag{C2}$$

The steady state equilibrium is given by $\dot{u} = \dot{\pi} = 0$.

The elements of the Jacobian matrix are given by

$$J_{11} = \phi(g_{du} - s\pi), \tag{C3}$$

$$J_{12} = \phi(g_{d\pi} - su), \tag{C4}$$

$$J_{21} = (1-\pi)[(1-\theta)\pi'_w(u) + g'_a(u)] = (1-\pi)\Omega, \tag{C5}$$

$$J_{22} = -(1-\pi) < 0. \tag{C6}$$

All the elements are evaluated at the steady sate equilibrium values.

Similar to the open economy model, we use the following three assumptions.

Assumption 1'. $g_{du} - s\pi < 0$.

Assumption 2'. $g_{d\pi} - su < 0$ and $\Omega > 0$.

Assumption 3'. $g_{d\pi} - su > 0$ and $\Omega < 0$.

From assumption 1', we have $\mathrm{tr}\mathbf{J} < 0$. The determinant is given by

$$\det J = \phi(1-\pi)[(s\pi - g_{du}) - (g_{d\pi} - su)\Omega]. \tag{C7}$$

Under assumption 2', we have $\det\mathbf{J} > 0$. In addition, under assumption 3', we have $\det\mathbf{J} > 0$. If assumptions 1' and 2' hold simultaneously or if assumptions 1' and 3' hold simultaneously, we have both $\mathrm{tr}\mathbf{J} < 0$ and $\det\mathbf{J} > 0$, which thus satisfies the necessary and sufficient conditions for the local stability of the equilibrium.

We investigate the effect of an increase in θ (i.e., the bargaining power of firms) on the equilibrium rate of capacity utilization. Totally differentiating the equilibrium conditions, we obtain

$$\frac{du^*}{d\theta} = \frac{\phi(1-\pi)(\pi_f - \pi_w)(g_{d\pi} - su)}{\det\mathbf{J}}. \tag{C8}$$

As in the open economy model, we assume that $\pi_f > \pi_w$. We have that $\det\mathbf{J} > 0$, from the stability condition. Then, if $g_{d\pi} - su > 0$, we have $du^*/d\theta > 0$, and if $g_{d\pi} - su < 0$, we have

$du^* / d\theta < 0$. Consequently, if the economy is in the exhilarationist regime, an increase in the bargaining power of firms increases the rate of capacity utilization, whereas if the economy is in the stagnationist regime, and an increase in the bargaining power of firms decreases the rate of capacity utilization.

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Figure and Tables

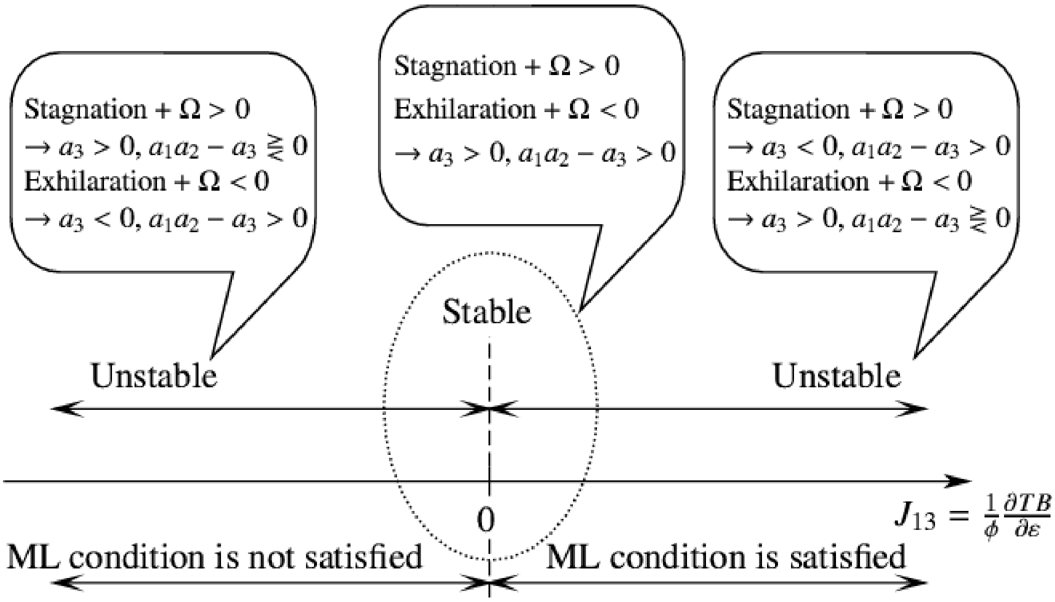

Figure 1: Diagram of stability analysis

Table 1: Results for comparative statics analysis under assumption 2

	u	π	ε
s	−-	−	−
θ	+ or −	+ or −	+ or −
$\bar{\varepsilon}$	+ or −	+ or −	+

Table 2: Results for comparative statics analysis under assumption 3

	u	π	ε
s	−	+	+
θ	+ or −	+ or −	+ or −
$\bar{\varepsilon}$	+ or −	+ or −	+