



*Kyoto University,
Graduate School of Economics
Research Project Center Discussion Paper Series*

**Mark-up Pricing, Sectoral Dynamics, and the Traverse
Process in a Two-Sector Kaleckian Economy**

Shinya Fujita

Discussion Paper No. E-15-005

*Research Project Center
Graduate School of Economics
Kyoto University
Yoshida-Hommachi, Sakyo-ku
Kyoto City, 606-8501, Japan*

August 2015

Mark-up Pricing, Sectoral Dynamics, and the Traverse Process in a Two-sector Kaleckian Economy

Shinya Fujita[†]

Abstract

Kaleckian models, which study the relation between functional income distribution and demand formation, have focused on how macro-level distribution affects macro-level performance. In the real economy, however, labour–management negotiations are held at the industry level and thus the relation between sectoral distribution and sectoral/macroeconomic performance should be considered. This study presents a two-sector Kaleckian model with intermediate inputs and investigates how a distributive change in one sector affects sectoral/macroeconomic capacity utilization and capital accumulation. The results of the presented comparative static analysis and traverse analysis demonstrate that one sector's change in the mark-up rate shifts each sector's rate of capacity utilization in the opposite direction, while the impact of one sector's change in the mark-up rate on performance differs by sector. The analyses also demonstrate that the effect of a change in the mark-up rate on capital accumulation depends on the firm's animal spirits.

Keywords: Two-sector model, Mark-up pricing, Traverse analysis

JEL Classification: E12, E22, O41

[†] Graduate School of Economics, Nagoya University. E-mail: fujita@soec.nagoya-u.ac.jp

1 Introduction

How a change in functional income distribution affects demand formation has been widely studied by using one-sector/one-commodity Kaleckian models.¹ An economy is called a ‘wage-led regime’ when distributive policy in favour of labour such as decreases in the mark-up rate and the profit share stimulates aggregate demand, employment, and growth. By contrast, an economy is called a ‘profit-led regime’ when pro-labour income distribution negatively affects economic performance. Thus far, the conditions under which each regime is established have been theoretically investigated,² with studies showing that the properties of investment and consumption functions determine which regime characterizes an economy (Blecker, 2002; Lavoie and Stockhammer, 2013). For instance, if investment is not sensitive to a firm’s profitability and the propensity to consume out of wages is high, a fall in the profit share hardly decreases investment but does increase consumption, which raises aggregate demand and leads to a wage-led demand regime.

Most Kaleckian models, which study the relation between income distribution and demand formation, are based on the aggregate variables in the macroeconomy. In other words, they focus on the relation between macro-level distribution and macro-level performance.³ In many OECD countries, however, labour–management negotiations including wage bargaining are held at the industry or firm level and thus their results vary by industry (Calmfors et al., 1988; Soskice, 1990; Lodovici, 2000). For instance, in Germany, industry-level labour unions negotiate with firms to improve working conditions, whereas firm-level unions bargain with firms in the United States and East Asia. Indeed, in Japan, the labour union of a large company plays a leading role in the negotiation process. Moreover, since each industry has specific market structure, each industry tends to have its own mark-up rate that becomes the determinant factor for distribution. Furthermore, the rates of capacity utilization and capital accumulation vary by industry owing to diverse demand levels. Accordingly, how industrial income distribution and market structure affect sectoral performance as well as macroeconomic performance should be considered.

In this study, we use a two-sector Kaleckian model composed of an investment goods sector and a consumption goods sector.⁴ Dutt (1987) and Lavoie and Ramírez-Gastón (1997) use a two-sector model to investigate how a change in the sectoral mark-up rate influences economic performance. Dutt (1987) considers macroeconomic investment, which is an increasing function of the macroeconomic rate of profit and the sectoral rate of capacity utilization, and shows that a rise in the mark-up rate in the consumption goods sector reduces the rate of capital accumulation. Further, the author highlights that the effect of a rise in the mark-up rate in the investment goods sector on capital accumulation is ambiguous. This model, however, considers only short-run dynamics; it abstracts from the dynamics of capital stocks. Lavoie and Ramírez-Gastón (1997), using a two-sector model with target-return pricing, show that increases in the mark-up rates in the investment goods and

consumption goods sectors negatively affect both sectors' rates of capacity accumulation and the macroeconomic rate of capital accumulation. This result crucially depends on their particular assumptions that a firm's profitability never affects investment and there are no intermediate inputs, both of which are accepted in our model.

Other interesting two-sector models have also been proposed.⁵ Dutt (1988, 1990), adopting a sectoral investment function that depends positively on the sectoral rates of profit and capacity utilization, demonstrates that in a Kaleckian monopoly economy the sectoral rate of profit never converges to the equal rate of profit, even in the long run. Taylor (1989) supposes that one sector produces goods purchased from wages, while another produces investment goods as well as goods purchased from profits, and considers how a demand composition change affects capital accumulation. By contrast, in Franke (2000) the investment goods sector produces intermediate input goods as well as investment goods. In addition, Franke (2000) introduces the optimal use of capital and the financial sector in the price adjustment economy to conduct the stability analysis.

Based on the above studies, we construct a two-sector model with intermediate inputs and investigate, by using comparative static and traverse analysis, how a change in the sectoral mark-up rate affects industry-/macro-level capacity utilization and capital accumulation. Our model does not consider the effect of the profit share, as in one-sector/one-commodity models, but rather that of the mark-up rate because in our model, a change in one sector's profit share is caused by not only its mark-up rate change but also another sector's mark-up rate change. Thus, we consider the sectoral mark-up rate rather than the profit share since the former is more independent than the latter. Furthermore, the mark-up rate offers richer policy implications than the profit share because it changes according to public industrial policy as well as inter-firm distribution policy.

First, we show that a rise in the mark-up rate in either sector produces three types of demand regimes: that in which both sectors' rates of capacity utilization increase, that in which both sectors' rates of capacity utilization decrease, and that in which the rate of capacity utilization in the investment (consumption) goods sector increases (decreases). Second, we reveal that the impact of one sector's change in the mark-up rate on economic performance differs from another sector's impact. Third, we demonstrate that the effect of a change in the mark-up rate on capital accumulation depends on the firm's animal spirits.

The remainder of the paper is organized as follows. Section 2 presents a two-sector model with intermediate inputs. Section 3 assumes that capital stocks do not accumulate and investigates the short-run effect of a change in the mark-up rate on the rate of capacity utilization. Section 4 assumes that capital stocks accumulate and investigates the long-run effect of a change in the mark-up rate on capital accumulation and capacity utilization in the traverse process. By using numerical simulations, section 5 removes the distinction between the short and long run and confirms how a change in the

mark-up rate influences the equilibrium and transitional dynamics. Section 6 concludes.

2 Model

2.1 Basic setup

We consider a closed economy with no government sector. The economy is composed of an investment goods sector (sector 1) and a consumption goods sector (sector 2). Each sector is assumed to have a Leontief-type fixed coefficient production function and produces each good by using fixed capital stocks, intermediate input goods, and labour. Once fixed capital stocks are installed, they cannot be moved among sectors. On the contrary, labour is movable among sectors, which implies that the equal rate of nominal wage holds. In addition, there are no labour supply constraints. Moreover, we assume that in both sectors oligopolistic firms control each market and adopt mark-up pricing. Both sectors have excess capacity, and the supply of output can be immediately adapted to demand. Value added is distributed to workers as wages and to capitalists as profits. Workers spend all their wage income on consumption goods, whereas capitalists save all their profit income.⁶ Neither sector's investment behaviour necessarily coincides because each is an independent economic agent. Finally, we ignore technological progress and the depreciation of fixed capital stocks.

In the economy, we assume that the prices in each industry are marked upon prime costs as follows:⁷

$$p_1 = (1 + \mu_1)(p_2 a_{21} + w b_1), \quad (1)$$

$$p_2 = (1 + \mu_2)(p_1 a_{12} + w b_2), \quad (2)$$

where p_i denotes the price of good i , μ_i the mark-up rate in sector i , w the equal rate of nominal wage, a_{ij} the coefficient of intermediate input good i in sector j , and b_i the labour input coefficient in sector i .⁸ μ_i , a_{ij} , and b_i are assumed to be positive constants. In the following, $i = 1$ (2) represents the investment (consumption) goods sector.

The mark-up rate represents the monopoly power in the market as well as the relative bargaining power of firm. The higher the monopoly power or stronger the bargaining power of the firm, the higher the mark-up rate is (Kalecki, 1971; Sen and Dutt, 1995). Thus, the level and transition of the mark-up rate vary by industry. Moreover, equations (1) and (2) indicate that the price of one good interrelates with that of another because we consider intermediate inputs. However, to avoid excessive calculations, we abstract from the intermediate input of good i in sector i , meaning $a_{11} = a_{22} = 0$.

Next, we consider the quantity system. Demand for investment goods is represented by

$$p_1 D_1 = p_1 a_{12} X_2 + p_1 (I_1 + I_2), \quad (3)$$

where D_i denotes real aggregate demand, X_i real output, and I_i real investment. The first term

on the right-hand side (RHS) in equation (3) shows intermediate demand for investment goods in sector 2, while the second term shows final demand for investment goods in both sectors. We assume that investment is independent of capitalists' saving (Keynes, 1930; Kalecki, 1971).

Demand for consumption goods is represented by

$$p_2 D_2 = p_2 a_{21} X_1 + p_2 C, \quad (4)$$

where C denotes real consumption. The first term on the RHS in equation (4) shows intermediate demand for consumption goods in sector 1, while the second term shows final demand for consumption goods. We assume that workers spend all their wage income on consumption goods, whereas capitalists save all their profit income, which implies that macroeconomic consumption is equal to workers' wage income.

$$p_2 C = w(b_1 X_1 + b_2 X_2). \quad (5)$$

These price and quantity equations are summarized in Table 1. In most two-sector models, Kaleckian two sectors are not Sraffian sectors that produce basic goods (Sraffa, 1960). In other words, they assume $a_{12} = a_{21} = 0$.

(Table 1 here)

2.2 Price system

Equations (1) and (2) provide the following relative price and real wage rate:

$$p \equiv \frac{p_1}{p_2} = \frac{(1 + \mu_1)[b_1 + (1 + \mu_2)a_{21}b_2]}{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]}, \quad (6)$$

$$\omega \equiv \frac{w}{p_2} = \frac{1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21}}{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]}, \quad (7)$$

where p denotes the ratio of the investment goods price and consumption goods price (i.e. the relative price) and ω the nominal wage rate divided by the consumption goods price (i.e. the real wage rate). The positive real wage rate requires $1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21} > 0$. Thus, we make the following assumption.

Assumption 1. Intermediate input coefficients are sufficiently small, and accordingly $1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21} > 0$ holds.

We obtain the following proposition regarding the relative price and real wage rate.

Proposition 1. A rise in the mark-up rate in sector 1 raises the relative price and reduces the real wage rate. Moreover, a rise in the mark-up rate in sector 2 reduces both the relative price and the real wage rate.

Proof. See Appendix A, which is available on request.

By using equations (6) and (7), we represent the profit share in each sector, m_1 and m_2 , as follows:

$$m_1 = 1 - \frac{\omega b_1}{p - a_{21}} = \frac{\mu_1 [b_1 + (1 + \mu_2) a_{21} b_2]}{(1 + \mu_1) [1 - (1 + \mu_2) a_{12} a_{21}] b_1 + \mu_1 (1 + \mu_2) a_{21} b_2}, \quad (8)$$

$$m_2 = 1 - \frac{\omega b_2}{1 - p a_{12}} = \frac{\mu_2 [b_2 + (1 + \mu_1) a_{12} b_1]}{(1 + \mu_2) [1 - (1 + \mu_1) a_{12} a_{21}] b_2 + \mu_2 (1 + \mu_1) a_{12} b_1}. \quad (9)$$

From Assumption 1, $1 - (1 + \mu_2) a_{12} a_{21} > 0$ and $1 - (1 + \mu_1) a_{12} a_{21} > 0$, which implies that the denominator on the RHS in equations (8) and (9) is positive. Moreover, the numerator on the RHS is smaller than the denominator in equations (8) and (9). Thus, the profit share in each sector is positive and smaller than unity. We thus obtain the following proposition regarding the profit share.

Proposition 2. A rise in the mark-up rate in either sector increases both sectors' profit shares.

Proof. See Appendix B, which is available on request.

Because traditional Kaleckian models assume $a_{12} = a_{21} = 0$, a rise in the mark-up rate in one sector does not affect the profit share in another. On the contrary, in our model, a rise in the mark-up rate in one sector increases another sector's profit share as well as that of its own sector. Proposition 2 implies that if a rise in the bargaining power of workers in one sector leads to a decrease in the mark-up rate in that sector, redistribution in favour of workers occurs even in another sector.

2.3 Quantity system

Our model assumes that nominal investment normalized by the capital stocks in each sector is an increasing function of both the profit share and the rate of capacity utilization (Bhaduri and Marglin, 1990):

$$g_1 \equiv \frac{I_1}{K_1} = \alpha_1 + \beta_1 m_1 + \gamma_1 u_1, \quad (10)$$

$$g_2 \equiv \frac{I_2}{K_2} = \alpha_2 + \beta_2 m_2 + \gamma_2 u_2, \quad (11)$$

where g_i denotes the rate of capital accumulation, K_i fixed capital stocks, and $u_i (\equiv X_i / K_i)$ the rate of capacity utilization.⁹ In addition, α_i represents the firm's animal spirits, β_i the coefficient of investment to the profit share, and γ_i the coefficient of investment to capacity

utilization. α_i , β_i , and γ_i are assumed to be positive constants.

Contrary to previous studies such as Dutt (1987, 1988), Lavoie and Ramírez-Gastón (1997), and Franke (2000), we emphasize that one sector is independent of another and that the demand regime is diverse. Thus, we consider the sectoral investment function and negative impact of profitability on investment demand.

Substituting equations (10) and (11) into (3) yields

$$\frac{D_1}{K_1} = \alpha_1 + \beta_1 m_1 + \gamma_1 u_1 + [\alpha_2 + \beta_2 m_2 + (\gamma_2 + a_{12})u_2] / k, \quad (12)$$

where $k(\equiv K_1 / K_2)$ denotes the sectoral ratio of capital stocks.

Since excess demand (supply) leads to a rise (decline) in capacity utilization, the dynamics of the rate of capacity utilization in sector 1 are

$$\dot{u}_1 = \theta_1 \left(\frac{D_1}{K_1} - u_1 \right) = \theta_1 \{ (\gamma_1 - 1)u_1 + (\gamma_2 + a_{12})u_2 / k + (\alpha_2 + \beta_2 m_2) / k + \alpha_1 + \beta_1 m_1 \}, \quad (13)$$

where $\theta_i (> 0)$ denotes the adjustment speed of the investment goods market. Hereafter, the dot over the variable represents its time derivative.

Equation (5) is rewritten as

$$\frac{C}{K_2} = (p - a_{21})(1 - m_1)ku_1 + (1 - pa_{12})(1 - m_2)u_2. \quad (14)$$

From equations (4) and (14), we obtain

$$\frac{D_2}{K_2} = (p - a_{21})(1 - m_1)ku_1 + (1 - pa_{12})(1 - m_2)u_2 + a_{21}ku_1. \quad (15)$$

As in the investment goods market, we assume that quantity adjustment works in the consumption goods market; thus, the dynamics of the rate of capacity utilization in sector 2 are

$$\dot{u}_2 = \theta_2 \left(\frac{D_2}{K_2} - u_2 \right) = \theta_2 \{ [p(1 - m_1) + a_{21}m_1]ku_1 - [pa_{12}(1 - m_2) + m_2]u_2 \}. \quad (16)$$

Finally, taking the logarithmic derivative with respect to the time of the sectoral ratio of capital stocks yields

$$\dot{k} = (g_1 - g_2)k = (\gamma_1 u_1 - \gamma_2 u_2 + \alpha_1 - \alpha_2 + \beta_1 m_1 - \beta_2 m_2)k. \quad (17)$$

This leads to a dynamical system composed of equations (13), (16), and (17) with endogenous variables u_1 , u_2 , and k .

3 Short-run dynamics

3.1 Stability analysis

Quantity adjustment in the market is practiced more rapidly than capital accumulation. Accordingly, this section investigates only the dynamics of the rate of capacity utilization while leaving capital

stocks unchanged.

We define as the short-run equilibrium the situation where $\dot{u}_1 = \dot{u}_2 = 0$ holds with constant k , that is, demand meets supply in both markets. In the short-run equilibrium, we obtain the rate of capacity utilization as follows:

$$u_1 = \frac{[pa_{12}(1-m_2) + m_2][\alpha_1 + \beta_1 m_1 + (\alpha_2 + \beta_2 m_2)/k]}{[pa_{12}(1-m_1) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + a_{21}m_1]}, \quad (18)$$

$$u_2 = \frac{[p(1-m_1) + m_1 a_{21}][(\alpha_1 + \beta_1 m_1)k + \alpha_2 + \beta_2 m_2]}{[pa_{12}(1-m_1) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + a_{21}m_1]}, \quad (19)$$

where p , m_1 , and m_2 are given by equations (6), (8), and (9).

By using equations (13) and (16), we obtain the trace and determinant of Jacobian matrix \mathbf{J} :

$$\text{trace}\mathbf{J} = -\theta_1(1-\gamma_1) - \theta_2[pa_{12}(1-m_2) + m_2], \quad (20)$$

$$\det\mathbf{J} = \theta_1\theta_2 \{ [pa_{12}(1-m_2) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + a_{21}m_1] \}. \quad (21)$$

Since the coefficient of investment with respect to capacity utilization is considered to be sufficiently small, it is appropriate to assume $1-\gamma_1 > 0$, which leads to $\text{trace}\mathbf{J} < 0$. In addition, if γ_2 and a_{12} are sufficiently small, we obtain $\det\mathbf{J} > 0$. Thus, we make the following assumption.

Assumption 2. The parameters γ_i and a_{12} are sufficiently small, and hence

$$[pa_{12}(1-m_2) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + m_1 a_{21}] > 0 \text{ holds.}$$

The negative trace and positive determinant of the Jacobian matrix mean that the short-run equilibrium is locally stable. Moreover, the positive determinant of the matrix is equivalent to a positive rate of capacity utilization.

3.2 Rise in the mark-up rate in sector 1

Equations (18) and (19) imply that a mark-up rate affects the rate of capacity utilization through the relative price and profit share. Figure 1 helps to illustrate how the mark-up rate affects capacity utilization.

(Figure 1 here)

By using equation (13), we obtain the $\dot{u}_1 = 0$ curve in the short-run equilibrium.

$$u_1|_{\dot{u}_1=0} = \frac{\alpha_1 + \beta_1 m_1 + (\alpha_2 + \beta_2 m_2)/k + (\gamma_2 + a_{12})u_2/k}{1-\gamma_1}. \quad (22)$$

In Figure 1, equation (22) has a straight line with a positive intercept and slope. From equation (16), we obtain the $\dot{u}_2 = 0$ curve in the short-run equilibrium:

$$u_1|_{\dot{u}_2=0} = \frac{pa_{12}(1-m_2) + m_2}{[p(1-m_1) + a_{21}m_1]k} u_2. \quad (23)$$

Equation (23) has a straight line with a positive slope and passes the origin. Figure 1 expresses equations (22) and (23) as solid lines. Additionally, Assumption 2 implies that the $\dot{u}_2 = 0$ curve is steeper than the $\dot{u}_1 = 0$ curve. The intersection of these curves, e_u , shows the equilibrium in both markets, and the rates of capacity utilization on e_u are expressed by equations (18) and (19).

The effect of a rise in the mark-up rate in sector 1 on the $\dot{u}_1 = 0$ curve is represented by

$$\left. \frac{\partial u_1}{\partial \mu_1} \right|_{\dot{u}_1=0} = \frac{\beta_1(\partial m_1 / \partial \mu_1) + \beta_2(\partial m_2 / \partial \mu_1) / k}{1 - \gamma_1} > 0. \quad (24)$$

Proposition 2 shows that the $\dot{u}_1 = 0$ curve shifts upwards when the mark-up rate in sector 1 increases. In Figure 1, this shifted curve is represented by the dashed line. Moreover, the larger β_1 , β_2 , and γ_1 , the larger the $\dot{u}_1 = 0$ curve shifts upwards with an increasing mark-up rate. A rise in the mark-up rate reduces capacity utilization if investment responds largely to the profit share (Blecker, 2002; Sasaki, 2010).

Next, the effect of a rise in the mark-up rate in sector 1 on the $\dot{u}_2 = 0$ curve is represented by

$$\begin{aligned} \left. \frac{\partial u_1}{\partial \mu_1} \right|_{\dot{u}_2=0} &= \frac{\partial m_1}{\partial \mu_1} \sigma [pa_{12}(1 - m_2) + m_2](p - a_{21}) + \frac{\partial m_2}{\partial \mu_1} \sigma [p(1 - m_1) + a_{21}m_1](1 - pa_{12}) \\ &\quad - \frac{\partial p}{\partial \mu_1} \sigma [(1 - m_1)m_2 - a_{12}a_{21}(1 - m_2)m_1] \end{aligned}, \quad (25)$$

where

$$\begin{aligned} \sigma &= \frac{u_2}{[p(1 - m_1) + a_{21}m_1]^2} > 0, \\ p - a_{21} &= \frac{(1 + \mu_1)b_1[1 - (1 + \mu_2)a_{12}a_{21}] + \mu_1(1 + \mu_2)a_{21}b_2}{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]} > 0, \\ 1 - pa_{12} &= \frac{(1 + \mu_2)b_2[1 - (1 + \mu_1)a_{12}a_{21}] + \mu_2(1 + \mu_1)a_{12}b_1}{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]} > 0. \end{aligned}$$

The first and second terms on the RHS in equation (25) are positive, which implies that a rise in the mark-up rate rotates the $\dot{u}_2 = 0$ curve anticlockwise by increasing the profit share, which reduces the consumption of workers and rate of capacity utilization, a familiar story in the Kaleckian context. We call this effect the ‘negative effect of the profit share’. In addition, the third term shows how a rise in the mark-up rate affects the $\dot{u}_2 = 0$ curve by raising the relative price. From Proposition 1 and Assumption 1, it is natural to suppose that the third term becomes negative. This means that a rise in the mark-up rate in sector 1 rotates $\dot{u}_2 = 0$ clockwise. The story is explained as follows. A rise in the mark-up rate in sector 1 raises the price of investment goods rather than that of consumption goods, which implies that the intermediate inputs of the consumption goods in sector 1 become relatively low. As a result, value added in sector 1 increases and consumption expenditure

grows. We call this effect the ‘positive effect of the relative price’. As we see from the third term, this effect weakens if the profit share in sector 1 is extremely high, as an increment in value added is distributed mainly to capitalists and hence consumption expenditure grows little.

By combining the ‘negative effect of the profit share’ and ‘positive effect of the relative price’, the $\dot{u}_2 = 0$ curve can theoretically rotate anticlockwise or clockwise. However, in plausible settings, it tends to rotate anticlockwise. Figure 1 represents the case where the $\dot{u}_2 = 0$ curve rotates anticlockwise slightly as the dashed line of Case (a), where the curve rotates moderately as the dashed line of Case (b), and where the curve rotates largely as the dashed line of Case (c).

The relation between the mark-up rate in sector 1 and capacity utilization can be summarized as the following three patterns.¹⁰ In the first pattern, as in Case (a), the equilibrium shifts from e_u to e_u^a and the rates of capacity utilization in both sectors increase. Two conditions yield this situation. First, if any of β_1 , β_2 , and γ_1 in the investment function are sufficiently large, the $\dot{u}_1 = 0$ curve shifts largely with an increasing mark-up rate. Second, if the ‘positive effect of the relative price’ is sufficiently strong, the anticlockwise rotation of the $\dot{u}_2 = 0$ curve is suppressed. When these conditions are satisfied, a rise in the mark-up rate increases both sectors’ rates of capacity utilization.

In the second pattern, as in Case (c), the equilibrium shifts from e_u to e_u^c , and the rates of capacity utilization in both sectors decrease. This situation is obtained if β_1 , β_2 , and γ_1 are sufficiently small or the ‘positive effect of the relative price’ is sufficiently weak. If these conditions are met, a rise in the mark-up rate in sector 1 decreases both sectors’ rates of capacity utilization.

In the third pattern, as in Case (b), when the mark-up rate in sector 1 increases, the equilibrium shifts from e_u to e_u^b and the rate of capacity utilization in sector 1 (sector 2) increases (decreases).

3.3 Rise in the mark-up rate in sector 2

Next, the effects of a rise in the mark-up rate in sector 2 on the $\dot{u}_1 = 0$ and $\dot{u}_2 = 0$ curves are represented by

$$\left. \frac{\partial u_1}{\partial \mu_2} \right|_{\dot{u}_1=0} = \frac{\beta_1(\partial m_1 / \partial \mu_2) + \beta_2(\partial m_2 / \partial \mu_2) / k}{1 - \gamma_1} > 0, \quad (26)$$

$$\begin{aligned} \left. \frac{\partial u_1}{\partial \mu_2} \right|_{\dot{u}_2=0} &= \frac{\partial m_1}{\partial \mu_2} \sigma [pa_{12}(1 - m_2) + m_2](p - a_{21}) + \frac{\partial m_2}{\partial \mu_2} \sigma [p(1 - m_1) + a_{21}m_1](1 - pa_{12}) \\ &\quad - \frac{\partial p}{\partial \mu_2} \sigma [(1 - m_1)m_2 - a_{12}a_{21}(1 - m_2)m_1] \end{aligned} \quad (27)$$

Regarding equation (26), we find from Proposition 2 that the $\dot{u}_1 = 0$ curve shifts upwards when the mark-up rate in sector 2 increases. Moreover, the third term on the RHS in equation (27) is likely to be positive from Assumption 1 and Proposition 1. Hence, a rise in the mark-up rate in sector 2

negatively affects capacity utilization, resulting in the ‘negative effect of the relative price’.¹¹ A rise in the mark-up rate in sector 2 strengthens the anticlockwise rotation of the $u_2 = 0$ curve more than a rise in the mark-up rate in sector 1 because, *ceteris paribus*, the former leads to the ‘negative effect of the relative price’.

As for sector 1, three patterns summarize how a rise in the mark-up rate in sector 2 affects capacity utilization: both sectors’ rates of capacity utilization increase, both sectors’ rates of capacity utilization decrease, and the rate of capacity utilization in sector 1 (sector 2) increases (decreases). Moreover, as for sector 1, whether a rise in the mark-up rate in sector 2 increases the rate of capacity utilization depends mainly on the parameters in the investment function. That is, if any of β_1 , β_2 , and γ_1 are sufficiently large, both sectors’ rates of capacity utilization increase with a rising mark-up rate, and vice versa. Moreover, if those parameters are intermediate, each sector’s rate of capacity utilization moves in the opposite direction.

The ‘negative effect of the relative price’ means that a rise in the mark-up rate in sector 2 tends to affect capacity utilization negatively in contrast to that in sector 1. For instance, a rise in the mark-up rate in sector 2 may increase (decrease) the rate of capacity utilization in sector 1 (sector 2) under the parameter settings where a rise in the mark-up rate in sector 1 increases both sectors’ rates of capacity utilization. Again, the mark-up rate rise in sector 2 may reduce both sectors’ rates of capacity utilization under the parameter settings where a mark-up rate rise in sector 1 decreases (increases) capacity utilization in sector 2 (sector 1).

In summary, when a rise in the mark-up rate in one sector increases (decreases) the short-run equilibrium rates of capacity utilization in both sectors, the economy is called a profit-led (wage-led) demand regime. Moreover, when a rise in the mark-up rate in one sector increases the short-run equilibrium rate of capacity utilization in the investment goods sector but decreases that in the consumption goods sector, the economy is called a hybrid demand regime.

The diverse conditions under which these three types of regime appear are summarized in Table 2. However, the mechanism that a larger coefficient of the investment parameters yields a profit-led regime is common for both sectors. In addition, a rise in the mark-up rate only in sector 2 tends to yield a wage-led regime.

(Table 2 here)

A reason for a hybrid demand regime is explained as follows. If we consider intermediate inputs, a rise in the mark-up rate in one sector increases both sectors’ profit shares. Since both sectors adopt a common investment function of the Bhaduri and Marglin-type, not only the sector in which its mark-up rate rises but also another sector in which its mark-up rate does not rise increase investment demand, and thus output in sector 1 increases. By contrast, since both sectors’ profit shares increase, workers’ consumption expenditure in both sectors decreases, which reduces output in sector 2.

Hence, each sector's rate of capacity utilization moves in a separate direction.

Finally, by substituting equations (18) and (19) into equations (10) and (11), we obtain each sector's rate of capital accumulation in the short run:

$$g_1 = \alpha_1 + \beta_1 m_1 + \gamma_1 \frac{[pa_{12}(1-m_2) + m_2][\alpha_1 + \beta_1 m_1 + (\alpha_2 + \beta_2 m_2)/k]}{[pa_{12}(1-m_1) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + m_1 a_{21}]}, \quad (28)$$

$$g_2 = \alpha_2 + \beta_2 m_2 + \gamma_2 \frac{[p(1-m_1) + m_1 a_{21}][(\alpha_1 + \beta_1 m_1)k + \alpha_2 + \beta_2 m_2]}{[pa_{12}(1-m_1) + m_2](1-\gamma_1) - (\gamma_2 + a_{12})[p(1-m_1) + m_1 a_{21}]}. \quad (29)$$

Similar to the rate of capacity utilization, the short-run equilibrium rate of capital accumulation is profit-led if any of β_1 , β_2 , and γ_1 are sufficiently large, meaning that the second and third terms on the RHS in equations (28) and (29) dominate. In a profit-led demand regime, the rate of capital accumulation always becomes profit-led. Moreover, even in the hybrid or wage-led demand regime, a rise in the mark-up rate tends to increase the rate of capital accumulation because of the positive effect of profitability on investment demand. However, each sector's rate of capital utilization converges to the same level in the long run when capital stocks change.

4 Long-run dynamics

4.1 Stability analysis

This section considers the long-run dynamics of the sectoral ratio of capital stocks. We obtain the long-run dynamical equation by substituting equations (28) and (29) into equation (17). We define as the long-run equilibrium the situation where $\dot{k} = 0$ holds. In the long-run equilibrium, we find from equation (17) that a balanced growth path (BGP), that is, $g_1 = g_2$, appears. Moreover, $dg_1/dk < 0$ and $dg_2/dk > 0$ from equations (28) and (29), and accordingly the following equation holds:

$$\frac{dk}{dk} = \frac{dg_1}{dk} - \frac{dg_2}{dk} < 0. \quad (30)$$

Thus, we obtain the following proposition.

Proposition 3. The long-run equilibrium is locally stable. Moreover, when the mark-up rate in one sector rises, each sector's rate of capital accumulation temporally diverges from the rate on the old BGP and reaches a different level. However, they finally converge to the same rate on the new BGP.

4.2 A traverse from the old to the new equilibrium

Next, we investigate the long-run traverse process, which is the transitional process from the old to the new equilibrium.¹² In Figure 2, which shows the long-run traverse process of the main variables, the third quadrant is the reverse of that in Figure 1. Each sector's rate of capacity utilization is

determined on the intersection point of the $\dot{u}_1 = 0$ (equation (22)) and $\dot{u}_2 = 0$ curves (equation (23)). The fourth (second) quadrant represents the investment function in sector 1 (sector 2) (see equations (10) and (11)). The first quadrant shows the relation between both sectors' rate of capital accumulation. In the long-run equilibrium, the BGP appears, which implies that the long-run equilibrium rate of capital accumulation exists on the 45-degree line.

(Figure 2 here)

First, the economy is assumed to be on the initial equilibrium e_g in the first quadrant (e_u in the third quadrant), namely the old BGP. At the current point in time, the relations between the variables are represented by the solid lines in all quadrants. If, for example, the parameters in the investment function are sufficiently large, a rise in the mark-up rate in either sector increases both sectors' rates of capacity utilization and the economy exhibits a profit-led demand regime. In the second and third quadrants, equations (22) and (23), which shifted after the mark-up rate rise, are represented by the dashed line, and the equilibrium temporally moves from e_u to e'_u . A mark-up rate rise in either sector, by contrast, increases both sectors' profit shares, which leads equation (10) in the fourth quadrant (equation (11) in the second quadrant) to the dashed lines. Each sector's new rate of capacity utilization on e'_u determines the sectoral rate of capital accumulation, which then appears on the 45-degree line in the first quadrant. Figure 2 shows that the rate of capital accumulation in sector 1 is higher than that in sector 2. In this situation, the sectoral ratio of capital stocks begins to increase. Until each sector's rate of capital accumulation finally converges to the same rate, k continues to increase, which reduces (raises) the rate of capacity utilization in sector 1 (sector 2). These movements are represented by the arrows in the first quadrant. In addition, with increasing k , equations (22) and (23) shift upwards in the third quadrant (dot-dashed line). Finally, a new equilibrium e''_g in the first quadrant (e''_u in the third quadrant) appears.

Figure 2 also shows that a rise in the mark-up rate in one sector always raises the long-run rate of capital accumulation if the short-run equilibrium exhibits a profit-led demand regime. On the contrary, the effect of a rise in the mark-up rate in one sector on capacity utilization is ambiguous. This is because shifts in the $\dot{u}_1 = 0$ and $\dot{u}_2 = 0$ curves depend on the motion of k , which is constrained by many parameters.

In a profit-led demand regime, a rise in the mark-up rates in either sector increases the rate of capital accumulation. However, we may not obtain such a result in other regimes. Figure 3 shows the traverse process of the variables in the hybrid demand regime. When the mark-up rate in either sector increases, the equilibrium in the third quadrant shifts from e_u to e'_u . Moreover, the investment function in sector 1 (sector 2) shifts right (upward) in the fourth (second) quadrant. In Figure 3, the rate of capital accumulation in sector 1 (sector 2) for e'_u is represented by g'_1 (g'_2). In the hybrid demand regime, g'_1 (g'_2) is likely to be larger (smaller) than that for e_g .¹³

Furthermore, with an increasing sectoral ratio of capital stocks, the former rate decreases, whereas the latter increases, and thus whether a new equilibrium, which guarantees the BGP, is larger than initial equilibrium e_g depends on the motion of both sectors' rates of capital accumulation.

(Figure 3 here)

How do both sectors' rates of capital accumulation move until they arrive at the new equilibrium? Equation (28) shows that the larger $\alpha_2 + \beta_2 m_2$, the more quickly g_1 decreases with increasing k . Similarly, equation (29) shows that the larger $\alpha_1 + \beta_1 m_1$, the more quickly g_2 increases with increasing k . Accordingly, if the animal spirits in sector 1 (sector 2) are sufficiently large (small), the rate of capital accumulation in sector 2 (sector 1), which was temporally reduced (raised) by a mark-up rate rise, rapidly increases (slackly decreases). According to the combination of such motions in g_1 and g_2 , the new equilibrium e_g'' in the first quadrant (e_u'' in the third quadrant) holds and thus the rate of capital accumulation on the BGP increases.

Further, if the animal spirits in sector 1 (sector 2) are small (large), a rise in the mark-up rate in one sector reduces the rate of capital accumulation on the BGP because a rise in the mark-up rate in the hybrid demand regime positively (negatively) affects capital accumulation in sector 1 (sector 2) by increasing investment (decreasing consumption), which implies that capital stocks accumulate in sector 1 rather than in sector 2. Then, if the animal spirits in sector 1 are smaller than those in sector 2, capital stocks accumulate in the sector where unwillingness to invest prevails, and accordingly macroeconomic capital accumulation stagnates.

Finally, Figure 4 shows the traverse process of the variables in a wage-led demand regime. With a rise in the mark-up rate in one sector, the equilibrium in the third quadrant shifts from e_u to e_u' and the investment function in sector 1 (sector 2) shifts right (upward) in the fourth (second) quadrant. This shift in the investment function is assumed to be small in line with the condition that yields a wage-led demand regime (β_i in the investment function is sufficiently small). In Figure 4, the rate of capital accumulation in sector 1 for e_u' is higher than that in sector 2. However, both sectors' rates of capital accumulation are smaller than the rate of capital accumulation for e_g . Thus, Proposition 1 shows that the rate of capital accumulation for the new equilibrium e_g'' is lower than that for the initial equilibrium e_g .¹⁴

(Figure 4 here)

5 Numerical simulations

5.1 Parameter settings

In this section, by using numerical simulations, we examine how a change in the mark-up rate affects both the equilibrium values and the traverse process. First, although we have thus far examined the short-run and long-run dynamics separately for simplicity, this section considers the

dynamics of capacity utilization and sectoral ratio of capital stocks simultaneously. We confirm that the results presented in the previous sections are robust when the three variables change at the same time. Second, the numerical simulations show that our investigation in the previous sections is sufficiently realistic. Under plausible parameter settings, we confirm that each sector's rate of capacity utilization does not necessarily move in the same direction. Further, the impact of the mark-up rate in sector 1 on the equilibrium differs from that in sector 2 even if the same condition is fulfilled, while the effect of the mark-up rate on capital accumulation depends on the firm's animal spirits.

We set the following patterns for the benchmark parameters:

●Pattern (1)

$$\mu_1 = 0.2, \mu_2 = 0.2, a_{12} = 1/15, a_{21} = 1/15, b_1 = 0.1, b_2 = 0.1, \alpha_1 = 1/15, \beta_1 = 0.3, \gamma_1 = 0.01, \alpha_2 = 1/15, \beta_2 = 0.3, \gamma_2 = 0.01, \theta_1 = 1, \theta_2 = 1$$

●Pattern (2)

$$\mu_1 = 0.2, \mu_2 = 0.2, a_{12} = 1/15, a_{21} = 1/15, b_1 = 0.1, b_2 = 0.1, \alpha_1 = 1/15, \beta_1 = 0.15, \gamma_1 = 0.05, \alpha_2 = 1/15, \beta_2 = 0.15, \gamma_2 = 0.05, \theta_1 = 1, \theta_2 = 1$$

In these patterns, the initial values of the endogenous variables are set as $u_1[0] = 0.5$, $u_2[0] = 0.5$, and $k[0] = 0.4$. We assume that each sector has symmetrical structural parameters for the sake of simplicity, although these parameters differ by sector in the real economy. We reconsider the case where the animal spirits differ by sector in section 5.3.

The investment function parameters differ between these patterns. Pattern (1) has larger β_i . This means that a rise in the mark-up rate in sector 1 increases both sectors' rates of capacity utilization in the short run (i.e. a profit-led demand regime holds). However, under the same parameters of Pattern (1), a rise in the mark-up rate in sector 2 increases the rate of capacity utilization in sector 1 but decreases that in sector 2 (i.e. a hybrid demand regime holds). In Pattern (2), leaving capital stocks constant, a rise in the mark-up rate in sector 1 increases the rate of capacity utilization in sector 1 but decreases that in sector 2. In addition, a rise in the mark-up rate in sector 2 decreases both rates of capacity utilization (i.e. a wage-led demand regime holds).

5.2 Transitional dynamics

First, we consider Pattern (1). Figure 5 shows the dynamics of the main variables when we raise the mark-up rate in sector 1 or 2.

(Figure 5 here)

In Figures 5 and 6, the top left panels show the transitional dynamics of the rate of capacity utilization, in which the black and blue lines indicate the rate in sectors 1 and 2, respectively. The top right panels show the dynamics of the aggregate/macroeconomic rate of capacity utilization.¹⁵ The

bottom left panels show the dynamics of the rate of capital accumulation. When a mark-up rate increases, each sector's rate of capital accumulation temporally moves in a different way, but they finally converge to the same rate on the new BGP. We plot only the rate of capital accumulation in sector 1 for illustrative simplicity. The bottom right panels show the dynamics of the sectoral ratio of capital stocks. Here, the solid lines indicate the benchmark cases ($\mu_1 = 0.2$ and $\mu_2 = 0.2$) of Pattern (1) (Pattern (2) in Figure 6), the dashed lines indicate the cases where the mark-up rate in sector 1 increases ($\mu_1 = 0.21$), and the dot-dashed lines indicate the cases where the mark-up rate in sector 2 increases ($\mu_2 = 0.21$).

In the top left panel of Figure 5, a rise in the mark-up rate in sector 1 shifts the rate of capacity utilization in sector 1 downwards, and that in sector 2 upwards. Recall that a rise in the mark-up rate in sector 1 yields a profit-led demand regime with a constant sectoral ratio of capital stocks. When there is no distinction between the short and long run, however, a rise in the mark-up rate in sector 1 increases the sectoral ratio of capital stocks (see the bottom right panel), which in turn moves each sector's rate of capacity utilization in the opposite direction. The inconsistent movement of the sectoral rate of capacity utilization implies that at least one of the sectoral rates of capacity utilization always conflicts with the macro-level rate, irrespective of how we aggregate the sectoral rates; as the top right panel shows, the macroeconomic rate of capacity utilization rises slightly, whereas the rate of capacity utilization in sector 1 decreases. In addition, the bottom left panel illustrates that the rate of capacity utilization increases with a mark-up rate rise in sector 1.

Contrary to the mark-up rate in sector 1, the top left panel shows that a rise in the mark-up rate in sector 2 shifts the rate of capacity utilization in sector 1 upwards, and that in sector 2 downwards. The top right panel indicates that the macroeconomic rate of capacity utilization decreases in contrast to the mark-up rate in sector 1. Finally, the bottom left panel shows that the rate of capital accumulation increases when the mark-up rate in sector 2 increases.

Next, we turn to Pattern (2). In the short run, a rise in the mark-up rate in sector 1 stimulates (stagnates) capacity utilization in sector 1 (sector 2). However, as Figure 6 shows, a rise in the sectoral ratio of capital stocks shifts the rate of capacity utilization in sector 1 downwards, and that in sector 2 shifts upwards. Moreover, the bottom left panels show that a mark-up rate rise in sector 1 raises the rate of capital accumulation. By contrast, a rise in the mark-up rate in sector 2 reduces the macroeconomic capital accumulation. Hence, we find that the effect of a change in the mark-up rate in sector 1 on capital accumulation differs from that in sector 2.

(Figure 6 here)

5.3 Animal spirits

In this section, we build on the findings in section 4.2 by using the following numerical example. We

set the special benchmark parameters as follows (this setting is as same as that of Pattern (2) except for β_i):

●Pattern (3)

$$\mu_1 = 0.2, \mu_2 = 0.2, a_{12} = 1/15, a_{21} = 1/15, b_1 = 0.1, b_2 = 0.1, \alpha_1 = 1/15, \beta_1 = 0.1, \gamma_1 = 0.05, \alpha_2 = 1/15, \beta_2 = 0.1, \gamma_2 = 0.05, \theta_1 = 1, \theta_2 = 1$$

Figure 8 shows the transitional dynamics of the rate of capital accumulation (in sector 1) in Pattern (3). The solid black line indicates the dynamics of capital accumulation, the rate of which converges to $g = 0.12074$. Then, leaving the other parameters unchanged, when we raise the mark-up rate in sector 1 from $\mu_1 = 0.2$ to $\mu_1 = 0.23$, the capital accumulation rate shifts upwards ($g = 0.12101$), as the solid red line indicates.

(Figure 7 here)

Next, consider the gap in the sectoral animal spirits by decreasing it in sector 1 to $\alpha_1 = 0.9/15$ and increasing in sector 2 to $\alpha_2 = 1.1/15$. If we raise the mark-up rate in sector 1 from $\mu_1 = 0.2$ to $\mu_1 = 0.23$, the rate of capital accumulation shifts from the black dotted line to the red dotted line; the rate of capital accumulation decreases from $g = 0.12704$ to $g = 0.12698$. Thus, the sectoral animal spirits play a crucial role in determining the effect of the mark-up rate on capital accumulation.

6 Conclusion

Most previous Kaleckian research has studied macro-level functional income distribution and macroeconomic performance. However, in the real economies, both labour–management negotiation and market structure vary by industry, and accordingly how sectoral income distribution/degree of monopoly affects sectoral as well as macroeconomic performance should be considered. For the presented industry-level analysis, we constructed a two-sector model composed of an investment goods sector and a consumption goods sector and investigated how a sectoral mark-up rate change affects sector-/macro-level rates of capacity utilization and capital accumulation.

First, we demonstrated that a rise in the mark-up rate in either sector increases both sectors' profit shares. Based on this result, we showed that three types of demand regimes exist in the short run (profit-led, wage-led, hybrid). In the hybrid demand regime, each sector's rate of capacity utilization moves in the opposite direction, even in the long run, which implies that the macro-level rate of capacity utilization always conflicts with that of one sector. This is the fallacy of composition between industry-level and macro-level performance, suggesting that desirable macroeconomic policy is not always beneficial for an individual industry.

Second, we showed that the impact of one sector's change in the mark-up rate on economic performance differs from another sector's impact. In the short run, cutting the mark-up rate in the

consumption goods sector tends to raise capacity utilization compared with that in the investment goods sector. Furthermore, the numerical simulations showed that under the same conditions, a rise in the mark-up rate in the consumption (investment) goods sector stagnates (stimulates) capital accumulation. These results imply that while sector-specific policy is necessary to improve performance, macroeconomic policy (e.g. modifying the market structures or income distributions of all sectors simultaneously) is not.

Finally, we revealed that the firm's animal spirits play a crucial role in determining how a mark-up rate change influences the long-run rate of capital accumulation. Recall here that a decrease in the mark-up rate in either sector leads to redistribution in favour of workers. The wage-led strategy that links pro-labour distribution to stimulating the economy requires higher animal spirits in the consumption goods sector. Accordingly, for the wage-led strategy to succeed, policy must promote animal spirits in the consumption goods sector, such as by reducing industrial capital investment tax and supporting the creation of new goods.

Appendix (Available on request)

A. Proof of Proposition 1

By using equations (6) and (7), we obtain

$$\begin{aligned}\frac{\partial p}{\partial \mu_1} &= \frac{[b_1 + (1 + \mu_2)a_{21}b_2]b_2}{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]^2} > 0. \\ \frac{\partial p}{\partial \mu_2} &= -\frac{(1 + \mu_1)[b_2 + (1 + \mu_1)a_{12}b_1]b_1}{\{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]\}^2} < 0. \\ \frac{\partial \omega}{\partial \mu_1} &= -\frac{(1 + \mu_2)[b_1 + (1 + \mu_2)a_{21}b_2]a_{12}}{\{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]\}^2} < 0. \\ \frac{\partial \omega}{\partial \mu_2} &= -\frac{(1 + \mu_1)[b_1 + (1 + \mu_2)a_{21}b_2]a_{12} + [1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21}]b_2}{\{(1 + \mu_2)[b_2 + (1 + \mu_1)a_{12}b_1]\}^2} < 0.\end{aligned}$$

B. Proof of Proposition 2

From equations (8) and (9), we obtain

$$\begin{aligned}\frac{\partial m_1}{\partial \mu_1} &= \frac{[b_1 + (1 + \mu_2)a_{21}b_2][1 - (1 + \mu_2)a_{12}a_{21}]b_1}{\{(1 + \mu_1)[1 - (1 + \mu_2)a_{12}a_{21}]b_1 + \mu_1(1 + \mu_2)a_{21}b_2\}^2} > 0. \\ \frac{\partial m_1}{\partial \mu_2} &= \frac{\mu_1 a_{21} b_1 b_2 [1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21}] + \mu_1(1 + \mu_1)a_{12}a_{21}b_1 [b_1 + (1 + \mu_2)a_{21}b_2]}{\{(1 + \mu_1)[1 - (1 + \mu_2)a_{12}a_{21}]b_1 + \mu_1(1 + \mu_2)a_{21}b_2\}^2} > 0. \\ \frac{\partial m_2}{\partial \mu_1} &= \frac{\mu_2 a_{12} b_1 b_2 [1 - (1 + \mu_1)(1 + \mu_2)a_{12}a_{21}] + \mu_2(1 + \mu_2)a_{12}a_{21}b_2 [b_2 + (1 + \mu_1)a_{12}b_1]}{\{(1 + \mu_2)[1 - (1 + \mu_1)a_{12}a_{21}]b_2 + \mu_2(1 + \mu_1)a_{12}b_1\}^2} > 0. \\ \frac{\partial m_2}{\partial \mu_2} &= \frac{[b_2 + (1 + \mu_1)a_{21}b_2][1 - (1 + \mu_1)a_{12}a_{21}]b_2}{\{(1 + \mu_2)[1 - (1 + \mu_1)a_{12}a_{21}]b_2 + \mu_2(1 + \mu_1)a_{12}b_1\}^2} > 0.\end{aligned}$$

References

- Araujo, R.A. and Teixeira, J.R. 2015. A multi-sector version of the post-Keynesian growth model, *Estudos Economicos*, vol. 42, no. 3, 127–52
- Bhaduri, A. and Marglin, S.A. 1990. Unemployment and the real wage: the economic basis for contesting political ideologies, *Cambridge Journal of Economics*, vol. 14, no. 4, 375–93
- Blecker, R.A. 2002. Distribution, demand and growth in neo-Kaleckian macro-models, in Setterfield, A. (ed.): *The Economics of Demand-led Growth: Challenging the Supply-side Vision of the Long Run*, Cheltenham, Edward Elgar
- Bowles, S. and Boyer, R. 1995. Wages, aggregate demand and employment in an open economy: an empirical investigation, in Epstein, G. and Gintis, H. E. (eds.): *Macroeconomic Policy after Conservative Era: Studies in Investment, Saving and Finance*, Cambridge, Cambridge University Press
- Calmfors, L., Driffill, J., Honkapohja, S. and Giavazzi, F. 1988. Bargaining structure, corporatism and macroeconomic performance, *Economic Policy*, vol. 3, no. 6, 13–61
- Coutts, K. and Norman, N. 2013. Post-Keynesian approaches to industrial pricing: a survey and critique, in Harcourt, G. C. and Kriesler, P. (eds.): *The Oxford Handbook of Post-Keynesian Economics Volume 1: Theory and Origins*, Oxford, Oxford University Press
- Dixon, R. and Toporowski, J. 2013. Kaleckian economics, in Harcourt, G. C. and Kriesler, P. (eds.): *The Oxford Handbook of Post-Keynesian Economics Volume 1: Theory and Origins*, Oxford, Oxford University Press
- Duménil, G. and Lévy, D. 1999. Being Keynesian in the short term and classical in the long term: the traverse to classical long-term equilibrium, *The Manchester School*, vol. 67, no. 6, 684–716
- Dutt, A.K. 1987. Competition, monopoly power and the uniform rates of profit, *Review of Radical Political Economics*, vol. 19, no. 4, 55–72
- Dutt, A.K. 1988. Convergence and equilibrium in two sector models of growth, distribution and prices, *Journal of Economics*, vol. 48, no. 2, 135–58
- Dutt, A.K. 1990. *Growth, Distribution, and Uneven Development*, Cambridge, Cambridge University Press
- Franke, R. 2000. Optimal utilization of capital and a financial sector in a classical gravitation process, *Metroeconomica*, vol. 51, no. 1, 40–60
- Kalecki, M. 1971. *Selected Essays on the Dynamics of the Capitalist Economy*, Cambridge, Cambridge University Press
- Keynes, J.M. 1930. *A Treatise on Money, Volume 1: The Pure Theory of Money*, Harcourt, Brace and Company
- Lavoie, M. 1992. *Foundations of Post-Keynesian Economic Analysis*, Cheltenham, Edward Elgar

- Lavoie, M. and Ramírez-Gastón, P. 1997. The traverse in a two-sector Kaleckian model of growth with target return pricing, *The Manchester School*, vol. 55, no. 2, 145–69.
- Lavoie, M. and Stockhammer, E. 2013. Wage-led growth: concept, theories and policies, in Lavoie, M. and Stockhammer, E. (eds.): *Wage-led Growth: An Equitable Strategy for Economic Recovery*, London, Palgrave Macmillan
- Lavoie, M. 2014. *Post-Keynesian Economics: New Foundations*, Cheltenham, Edward Elgar
- Lee, F. S. 1998. *Post Keynesian Price Theory*, Cambridge, Cambridge University Press
- Lodovici, M.S. 2000. The dynamics of labor market reform in European countries, in Esping-Andersen, G. and Regini, M. (eds.): *Why Deregulate Labor Market?* Oxford, Oxford University Press
- Nishi, H. 2014. Income distribution and economic growth in a multi-sectoral Kaleckian model, *Research Project Center Discussion Paper, Graduate School of Economics, Kyoto University*, No. E-14-011
- Rowthorn, R.E. 1981. Demand, real wages and economic growth, *Thames Papers in Political Economy*, Autumn
- Sasaki, H. 2010. Endogenous technological change, income distribution, and unemployment with inter-class conflict, *Structural Change and Economic Dynamics*, vol. 21, no. 2, 123–34
- Sen, A. and Dutt, A.K. 1995. Bargaining power, imperfect competition and the markup: optimizing microfoundations, *Economic Letters*, vol. 48, no. 1, 15–20
- Soskice, D. 1990. Wage determination: the changing role of institutions in advanced industrialized countries, *Oxford Review of Economic Policy*, vol. 6, no. 4, 36–61
- Sraffa, P. 1960 *Production of Commodities by Means of Commodities: Prelude to a Critique of Economic Theory*, Cambridge, Cambridge University Press
- Stockhammer, E. and Onaran, O. 2004 Accumulation, distribution and employment: a structural VAR approach to a Kaleckian macro model, *Structural Change and Economic Dynamics*, vol. 15, no. 4, 421–47
- Storm, S. and Naastepad, C.W.M. 2012. *Macroeconomics Beyond the NAIRU*, Cambridge, MA, Harvard University Press
- Taylor, L. 1989. Demand composition, income distribution and growth, in Feiwel, G. R. (ed.): *Joan Robinson and Modern Economic Theory*, New York, New York University Press
- Taylor, L. 2004. *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*, Cambridge, MA, Harvard University Press

Figures and Tables

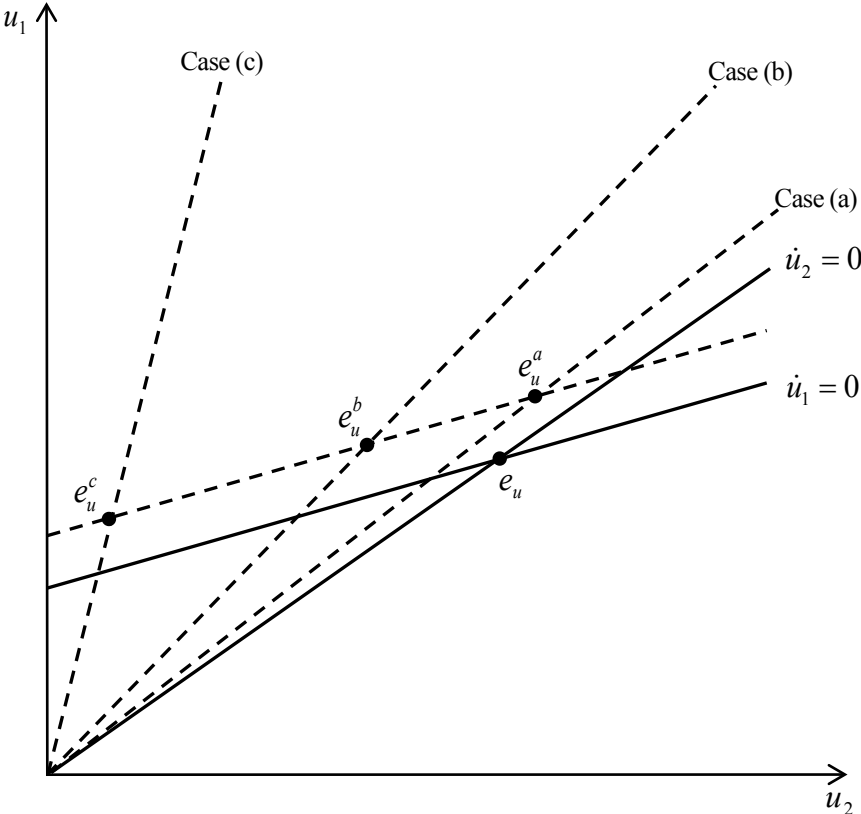


Figure 1: Short-run equilibrium and the effect of a rise in the mark-up rate

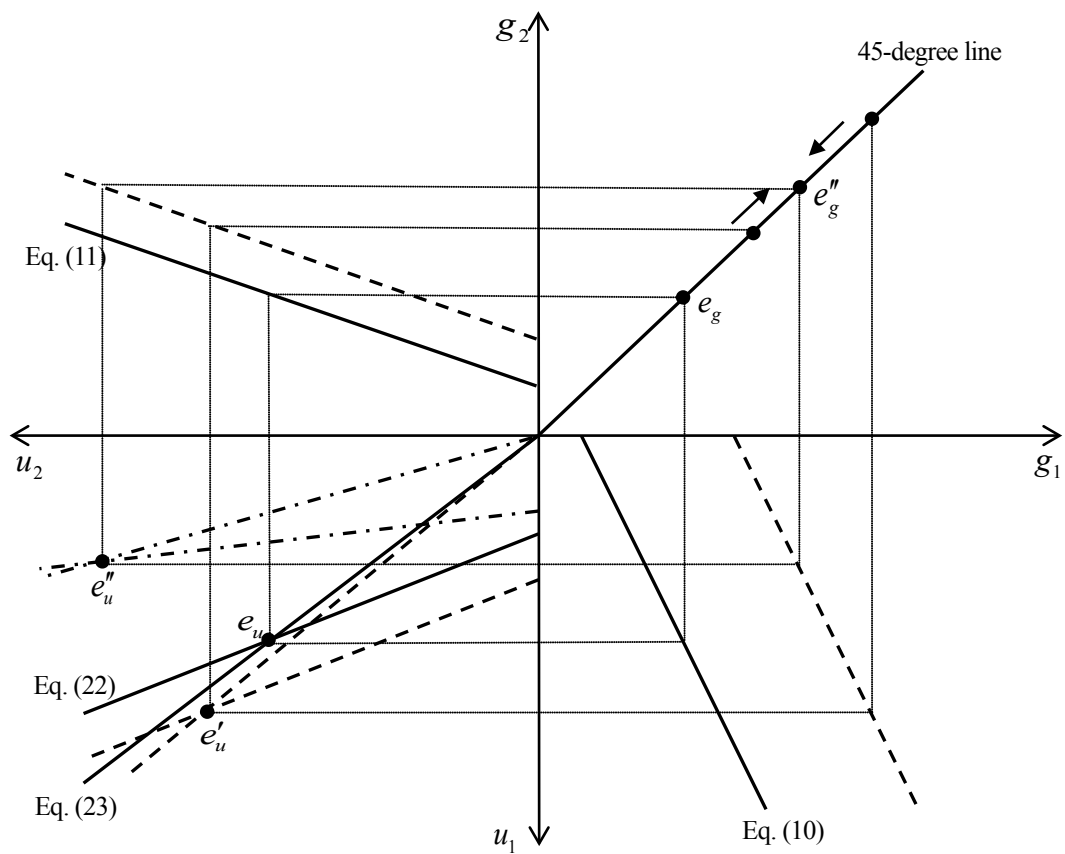


Figure 2: A traverse process in the profit-led demand regime

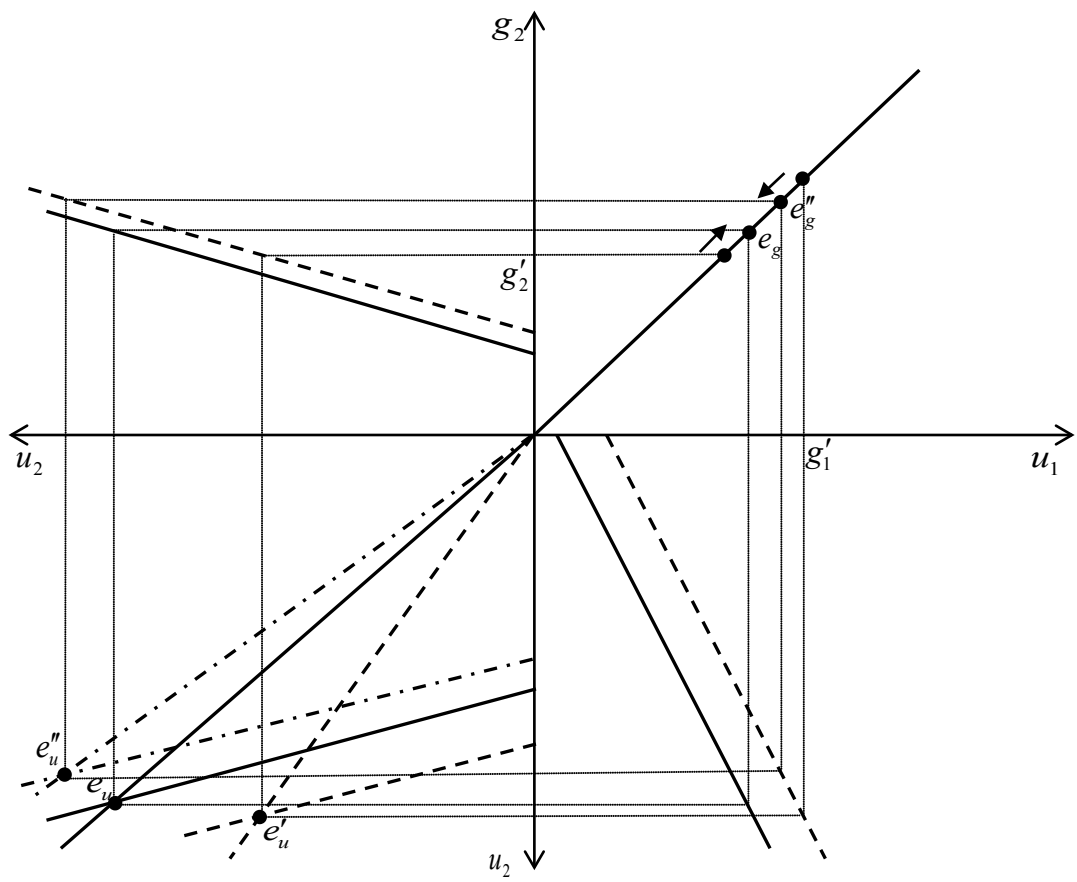


Figure 3: A traverse process in the hybrid demand regime

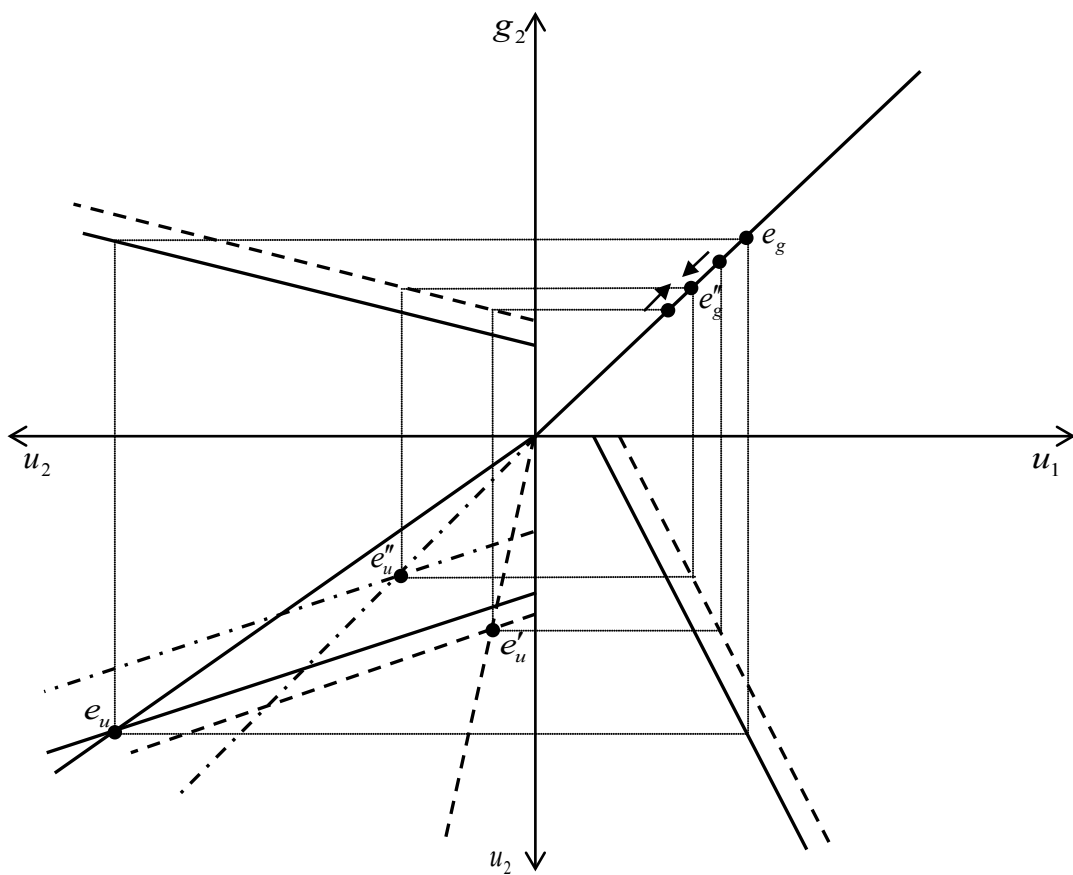


Figure 4: A traverse process in the wage-led demand regime

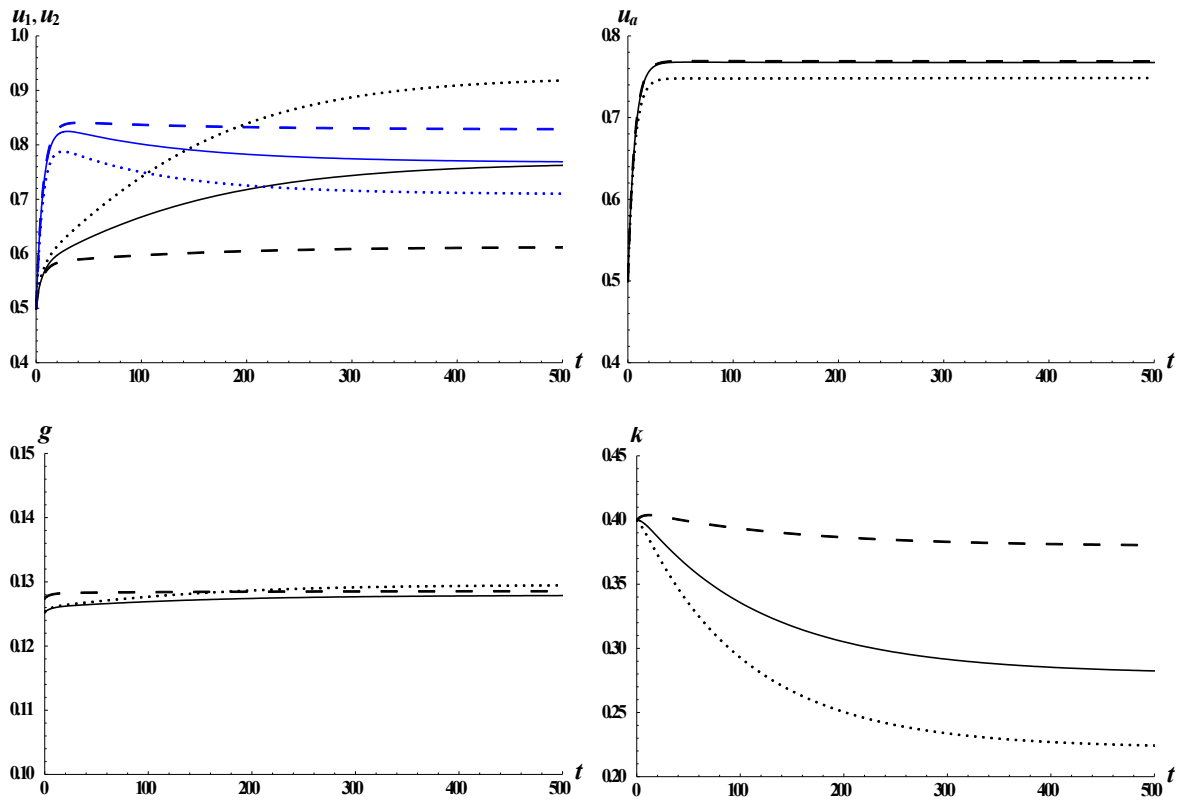


Figure 5: Pattern (1)

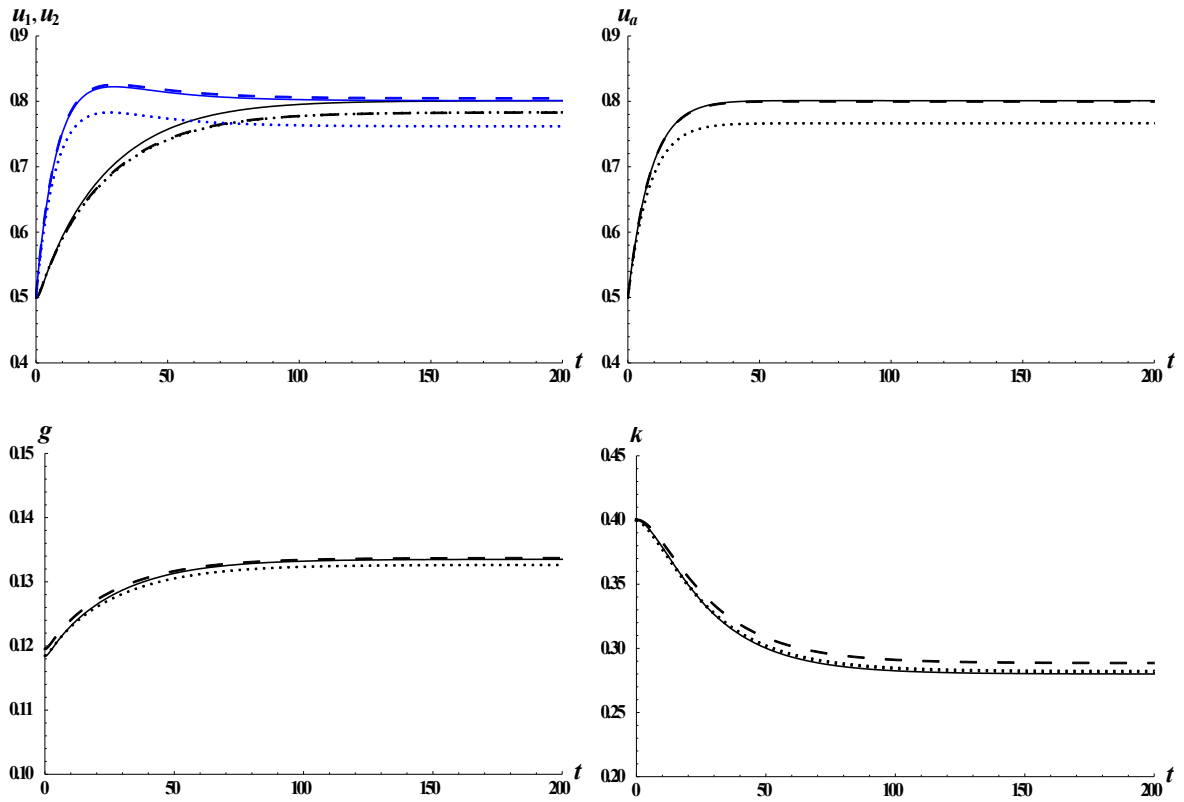


Figure 6: Pattern (2)

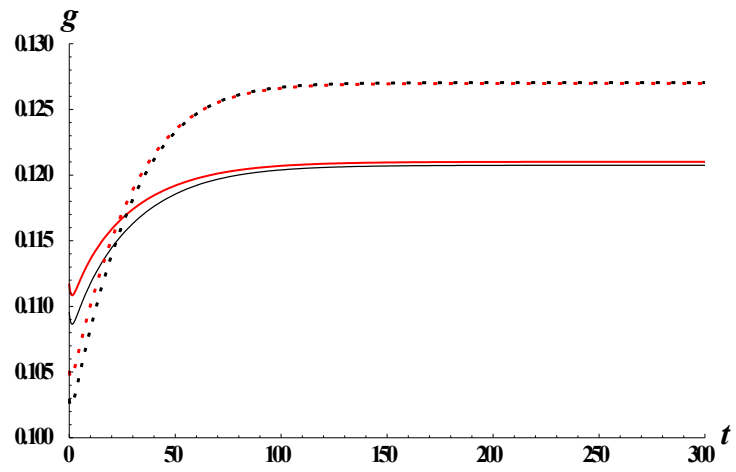


Figure 7: Pattern (3)

		Intermediate demand		Final demand		Output
		Sector 1	Sector 2	Consumption	Investment	
Intermediate input	Sector 1	0	$p_1 a_{12} X_2$	0	$p_1 (I_1 + I_2)$	$p_1 X_1$
	Sector 2	$p_2 a_{21} X_1$	0	$p_2 C$	0	$p_2 X_2$
Value added	Wages	$w b_1 X_1$	$w b_2 X_2$			
	Profits	$\mu_1 (p_2 a_{21} + w b_1) X_1$	$\mu_2 (p_1 a_{12} + w b_2) X_2$			
Output		$p_1 X_1$	$p_2 X_2$			

Table 1: Hypothetical two-sector transaction table

	Impact on capacity utilization	Demand regime	Conditions	
Mark-up rate change		Rises in u_1 and u_2	Profit-led	β_1 , β_2 , and γ_1 are large and the positive effect of the relative price is strong (m_1 is small)
	A rise in μ_1	A rise in u_1 and a fall in u_2	Hybrid	Intermediate parameters
		Falls in u_1 and u_2	Wage-led	β_1 , β_2 , and γ_1 are small and the positive effect of the relative price is weak (m_1 is large)
		Rises in u_1 and u_2	Profit-led	β_1 , β_2 , and γ_1 are large
	A rise in μ_2	A rise in u_1 and a fall in u_2	Hybrid	Intermediate parameters
		Falls in u_1 and u_2	Wage-led	β_1 , β_2 , and γ_1 are small

Table 2: Definitions of demand regimes in the short-run equilibrium

Notes

1 For more details on Kaleckian models, see Rowthorn (1981), Taylor (2004), and Lavoie (2014).

2 In addition, based on theoretical research, many empirical studies have examined whether the economy exhibits a wage-led or profit-led regime. For example, see Bowles and Boyer (1995), Stockhammer and Onaran (2004), and Storm and Naastepad (2012).

3 While macro-level income distribution may be interpreted as the representative firm's distribution, such an interpretation is problematic because it disregards the heterogeneity of goods and industry.

4 We cannot divide easily the real industries into two sectors because some industries produce both goods. However, it is still meaningful to consider which kind of goods each sector mainly produces. From a Kaleckian viewpoint, we must consider the stream from income to demand (i.e. from wages to consumption or from profits to investment; Dixon and Toporowski, 2013).

5 By using the multi-sectoral framework instead of the two sector model, Araujo and Teixeira (2015) demonstrate that each sector has a different growth regime, while Nishi (2014) reveals that the sectoral composition of saving and investment play a crucial role in determining the growth regime. However, they do not consider sectoral diversity in pricing, income distribution, or the input-output structure.

6 Even if capitalists were assumed to consume a constant proportion of profits, our results change little.

7 See Lavoie (1992), Lee (1998), and Coutts and Norman (2013) on post-Keynesian price theory. For the sake of simplicity, we assume the most familiar pricing rule.

8 The labour input coefficient is equal to labour divided by output.

9 We assume that the ratio of potential output to the capital stock in each sector is constant. Accordingly, the ratio of output to capital stock is a proxy of the capacity utilization rate.

10 When the 'positive effect of the relative price' is larger than the 'negative effect of the profit share', and thus a rise in the mark-up rate in sector 1 rotates the $\dot{u}_2 = 0$ curve clockwise, the rates of capacity utilization in both sectors necessarily increase. However, this case is unrealistic.

11 A rise in the mark-up rate in sector 2 makes the intermediate inputs of the investment goods in sector 2 relatively low and raises that sector's value added in nominal terms. However, it simultaneously increases the price of consumption goods, which does not raise consumption expenditure in real terms. A rise in the mark-up rate in sector 2, on the contrary, makes the intermediate inputs of the consumption goods in sector 1 relatively high and reduces value added in sector 1. As a result, a relative price change caused by increasing the mark-up rate in

sector 2 tends to affect capacity utilization negatively.

12 We assume that one sector's mark-up rate does not change when another's does. Constructing a more complicated model in which the mark-up rate endogenously changes according to the market situation is beyond the scope of this study.

13 A rise in the mark-up rate does not necessarily reduce the rate of capital accumulation in sector 2 below the initial rate in the hybrid demand regime. The larger effect of investment profitability might mean that a rise in the mark-up rate shifts equation (11) much in the second quadrant. Thus, the rate of capital accumulation in sector 2 becomes higher than the initial rate. However, such a case seems to be rare because the hybrid demand regime needs the effect of investment profitability to be moderate.

14 With a rise in the mark-up rate, equations (10) and (11) may shift much in each quadrant and accordingly the rate of capital accumulation may rise above the initial rate for e_g . However, such a case is exceptional owing to the conditions of a wage-led demand regime.

15 For simplicity, we obtain the macroeconomic rate of capacity utilization by attaching the weight of sectoral capital stocks on the sectoral rate of capacity utilization:

$$u_a = \frac{K_1}{K_1 + K_2} u_1 + \frac{K_2}{K_1 + K_2} u_2 = \frac{k}{1+k} u_1 + \frac{1}{1+k} u_2.$$

Duménil and Lévy (1999) define the macroeconomic rate of capacity utilization as the aggregate output divided by the aggregate capital stocks in nominal terms:

$$u_a = \frac{p_1 X_1 + p_2 X_2}{p_1 (K_1 + K_2)} = \frac{p(ku_1 + u_2)}{p(1+k)}.$$

However, this rate is biased by a relative price change.