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Income inequality in terms of a Gini coefficient: A Kaleckian perspective

Shinya FUJITA†

Abstract: This study presents a theoretical framework that connects functional income distribution and personal income distribution from the Kaleckian perspective and investigates the effects of changes in mark-up rate and of monetary policy on income inequality in terms of the Gini coefficient. The results demonstrate that a rise in the mark-up rate with weak bargaining power of workers raises the Gini coefficient irrespective of a profit-led or wage-led demand regime. The analyses also demonstrate that a decline in the interest rate with monetary easing negatively affects the Gini coefficient if and only if the bargaining power of workers is sufficiently strong.

Keyword: personal income distribution, Gini coefficient, functional income distribution, demand regime, Kaleckian model, monetary policy
JEL classification: D31, E11, E25, E52

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1. Introduction

Income distribution is gathering attention again after Piketty (2014). Post-Keynesians have traditionally provided many suggestions for functional income distribution, especially between capitalists who own capital and workers who do not. It has clarified the effects of factors such as labour market institutions and financialization on the distribution between capitalists and workers (Stockhammer, 2004; Mohun, 2006; Dallery, 2009; Dünhaupt, 2017; Kohler et al., 2019). Moreover, following the tradition of Keynes, post-Keynesians have tackled the question of how to reduce unemployment caused by the lack of effective demand. There is a clear disparity between the employed and the unemployed; the problem of unemployment is thus also closely linked to inequality, and how many people will be hired from the pool of the unemployed is a matter of economic growth. Kaleckian models consider the relationship between functional income distribution and effective demand, and show which combination of functional income distribution and demand/growth regimes will increase growth and reduce unemployment (Rowthorn, 1981; Dutt, 1994; Bhaduri and Marglin, 1990; Taylor, 2004; Lavoie and Stockhammer, 2013; Onaran and Obst, 2016).

Functional income distribution has a significant impact on personal income distribution (Glyn, 2009; Schlenker and Schmid, 2015; Wolff, 2015; Bengtsson and Waldenström, 2018). However, in reality, workers own capital and receive a part of the profits as financial income, which implies that inequality in functional income distribution does not directly lead to inequality in personal income distribution.[1] Moreover, as described above, it is necessary to focus on inequality between the employed and the unemployed by using a growth model. Thus, this study clarifies the factors of income inequality at the personal level by using a Kaleckian model to comprehensively capture the relationship between functional distribution and growth. Using this model, we consider inequality not only between capitalists and workers who own some capital, but also between workers and the unemployed.

In line with the post-Keynesian tradition, some models investigate personal income distribution.[2] Molero-Shimarro (2017) used a Bhaduri–Marglin–type model to investigate the relationship between functional income distribution and personal income distribution. The model shows that a decrease in the

wage share under a profit-led regime improves inequality via a reduction in unemployment, while an increase in the wage share under a wage-led regime contracts inequality by not only suppressing the high-income group but also getting the poor out of unemployment. However, the model of Molero-Shimarro (2017) is too simple. For instance, the effect of a change in the wage share on workers' income, including both wages and profits, is abstracted when workers are assumed to own capital. Palley (2017) presents a Bhaduri–Marglin model with two classes, capitalist-managers and workers, and investigates the factors promoting income inequality. In the model, although both capitalist-managers and workers acquire profits as well as wages, workers are distinguished from capitalist-managers by their small share of capital ownership, by gaining a larger share of wage income, and by their relatively low propensity to save. Palley shows that increases in the workers' share of capital and workers' share of wage income have an impact of reducing income inequality between the two classes. However, in this model, workers' capital share is given. Since capital/asset inequality is one of the main factors for income inequality (Piketty, 2014; Alvaredo et al., 2018), it is necessary to consider how workers' capital share is endogenously determined. Using a Bhaduri–Marglin model, Ederer and Rehm (2020a) investigate the mechanism of wealth distribution between capitalists and workers. Their model assumes that capitalists acquire a proportion of wages, whereas workers save and hold assets. In many EU countries, since the workers' propensity to save is larger than zero, workers own a constant proportion of wealth in the long run, which conflicts with the view of Piketty (2014) that income inequality will continue to expand due to asset occupancy. Dutt (2016) uses a model with the highest income group (the 'top') and other income groups (the 'rest'), and investigates the effect of financialization, such as rising dividend payout ratio on growth and distribution. In the model, the top is characterised by some assumptions: their labour supply is proportionate to capital stocks, that their wages are a constant multiple of the wages of the rest, and that they acquire brokerage fees as financiers and dividends from firms. In the model, various scenarios about growth and distribution can be obtained by using two types of closing models, the Marxian one of constant output–capital ratio and the post-Keynesian one of endogenous output–capital

ratio. Ryoo (2018) presents the long-run Kaldorian model as an alternative to Piketty's neoclassical explanation of inequality. His model assumes that both capitalists and workers gain financial income, such as dividends and interest. Ryoo (2018) indicates a scenario in which financialization factors such as decreasing retention ratio and rising stock buybacks lead to a decrease in savings and thus an increase in the profit share, which are adjustment variables for investment and savings, which in turn causes income inequality between capitalists and workers. The model thus fully considers financial variables but ignores the demand/growth regime.

In contrast to the above studies, we examine the effect of changes in the mark-up rate in pricing and that of monetary policy on inequality in personal income distribution. This study makes the following contributions: First, by using the Kaleckian model with firms' debt accumulation (Lavoie, 1995; Hein, 2007; Sasaki and Fujita, 2012; Nishi, 2015), we consider that a rise in the mark-up rate, instead of a decline in the wage share, has an impact on income distribution, which in turn affects demand and growth, and thus the Gini coefficient, by changing the number of the unemployed. The mechanism of improving inequality by reducing unemployment has rarely been addressed in previous studies. Expressing income inequality using the Gini coefficient is key to this study. If we do not use the Gini coefficient, we ignore inequality between the middle- and low-income groups (i.e. disparity between the employees and the unemployed). In fact, as we will see in the next section, a rise in the Gini coefficient in some countries comes from the low-income group. Second, we assume four agents: capitalists who own capital, indirect (managerial) workers who own a part of capital, direct (productive) workers without capital, and the unemployed. Changes in the mark-up rate and of monetary policy affect the Gini coefficient by changing each income share and population share. Third, we show that an increase in the mark-up rate positively affects the Gini coefficient. An increased mark-up rate does not lead to improving inequality under any demand regime, which differs from the result of Molero-Shimarro (2017). Finally, this study analyses the impact of lower interest rates on inequality due to central bank's monetary easing.[3] Specifically, we show that a decrease in the interest rate is effective for improving inequality if and only if the mark-up rate is sufficiently small,

which is consistent with the empirical result of Furceri et al. (2018).

The remainder of this paper is organised as follows. Section 2 explains the current income inequality situation in some developed countries. Section 3 presents the model. Section 4 draws a Lorenz curve based on the propositions obtained from the model and visualises the effects of changes in the mark-up rate and of monetary policy on the Gini coefficient. In addition, we discuss some factors that increase the Gini coefficient in a real economy. Section 5 concludes.

2. Current status of income inequality

This section briefly confirms how income inequality in terms of the Gini coefficient expands in developed countries. The countries we consider in this section are France, Germany, Italy, Sweden, Japan, and the United States. According to research in comparative political economy and Règulation approach, capitalist countries are institutionally diverse, and institutional variety has a crucial impact on economic performance, including growth, unemployment, and inequality (Hall and Soskice, 2001; Amable, 2003; Pontusson, 2005; Schneider and Paunescu, 2012; Hein, Meloni, and Tridico, 2020). We select six countries that are considered to have different institutional structures and performance.[4] In addition, regarding the Gini coefficient, we used two common databases. The Luxembourg Income Study (LIS) is the most commonly used in international comparisons of income inequality, but of the six countries considered here, it only provides complete data for the United States and Germany. Another database is Solt's (2019) Standardized World Income Inequality Database (SWIID). This database standardises various international statistics on income inequality based on LIS method, and the data are complete by country.

Table 1 shows the Gini coefficient of pre-redistribution (pre-tax and pre-transfer) income and post-redistribution (post-tax and post-transfer) income. Basically, there is no significant difference between the two databases, so we will discuss inequality based on SWIID below. The Gini coefficient of pre-redistribution income is rising in all countries, and that of post-redistribution income is also on the rise as a result. However, there are shades of difference in each country. Post-redistribution income inequality in France and Italy has

not widened significantly compared to other countries: In France, the Gini coefficient of pre-redistribution income increased by only 0.014 points from the 1990s to the 2010s, which is in contrast to an increase of 0.058 points in Germany, 0.038 points in Sweden, and 0.032 points in the United States.

(Table 1 here)

Which income group is the main cause of the increase in the Gini coefficient? Table 1 also shows the pre-tax income share of the bottom 50 percent from the World Inequality Database (WID), and the incidence of low pay (i.e. percentage of full-time workers earning less than two-thirds of full-time median wages) from the OECD. We find that the pre-tax income share of the bottom 50 percent in France remained constant from the 1990s to the 2010s. This seems to have prevented an excessive increase in the Gini coefficient of pre-redistribution income. By contrast, in Germany, Sweden, and the United States, the pre-tax income share of the bottom 50 percent has dropped significantly. Moreover, regarding the incidence of low-pay, only Germany showed an upward trend. From these facts, we find that in Germany, the expansion of the low-wage worker group widened pre-redistribution income inequality, and as a result, the Gini coefficient in post-redistribution income increased (Baccaro and Pontusson, 2017). For the United States and Sweden, it is often pointed out that regressive tax reform has become the main cause of widening inequality (Saez and Sucman, 2019; Gustafsson and Jansson, 2008). However, we should not overlook the fact that pre-redistribution income of the lower groups is declining in these countries, if not to as extreme an extent as in Germany.

As mentioned above, when we discuss income inequality, it is not enough to consider inequality between the highest income group and others. We have to focus not only on the inequality between intermediate-income workers and low-income workers but also on the disparity between low-income workers and the unemployed. The Gini coefficient is a useful indicator in that it can cover the income inequality of all these economic agents.[5] In the following sections, we build a framework that can capture changes in the Gini coefficient.

3. Model

3.1 Basic settings

The economy is assumed to be closed, without a government. This section contains the following types of agents: firms (capitalists), indirect workers, and direct workers. It is assumed that firms carry out various activities, such as pricing, production, investment, etc., but that all the profits obtained there are paid to the owner of the capital. For simplicity we assume wealth to take the form of physical capital.[6] Owing to being the main owners of capital, capitalists are the main recipients of profits.[7] Indirect (managerial) workers are indirectly involved in production, such as via business management within firms, and their employment does not change with respect to short-term fluctuations in output. In addition, indirect workers are assumed to have higher position within the firms and obtain a wage premium thereby. They are relatively richer and save a part of their income, which, in turn, is borrowed by firms. This implies that indirect workers acquire interests that accrue from their capital. Direct (productive) workers are directly involved in the production of goods, and their employment is adjusted for short-term fluctuations in output. This type of worker is characterised by unstable employment and relatively low wages. As a result, direct workers do not save and do not own capital.

Moreover, a single good can be used for both production and consumption. Firms produce this good by using fixed capital stocks and two types of labour: indirect and direct labour. We assume non-substitutability between capital and the two types of labour, which differ from the neo-classical supposition of Piketty (2014, 2015). Value added is distributed to two types of workers as wages and to firms as profits; then, firms distribute profits as dividends to capitalists and pay interest to indirect workers due to their capital. In addition, we assume that oligopolistic firms adopt cost-plus pricing, which also has excess capacity, and that the supply of output can be immediately adapted to demand. Technological progress is not considered; both the potential output–capital ratio and the output–labour ratio are assumed to be constant. Finally, we abstract capital depreciation.

First, we consider costs. We represent the number of total workers as N, the number of direct workers, which is variable according to output, as N_v, and the number of indirect workers, which is fixed according to output, as N_f.[8] Thus, we obtain $N = N_v + N_f$. The employment of direct workers depends on

the real output, Y, and thus, their labour productivity is expressed by $a_v = Y/N_v(>0)$. The amount of indirect workers depends on the full capacity output, $\bar{Y}$, and accordingly, their productivity is expressed by $a_f = \bar{Y}/N_f(>0)$. We represent the nominal wage of direct workers as w and that of indirect workers as w_f; the latter is larger than the former because of the wage premium. For simplicity, we assume that the nominal wage of indirect workers is $\sigma(>1)$ times that of direct workers, that is, $w_f = \sigma w$.[9]

We assume that firms' costs consist only of wages, and accordingly, total costs are equal to $wN_v + w_f N_f$. Thus, we express the unit cost as $(wN_v + w_f N_f)/Y$. Moreover, by denoting the capacity utilisation rate as $u(\equiv Y/\bar{Y})$, the unit cost can be rewritten as follows:

$$\text{Unit cost} = \frac{w\left(1+\frac{\sigma f}{u}\right)}{a_v}, f \equiv \frac{a_v}{a_f}. \quad (1)$$

Firms are assumed to adopt normal cost pricing; here, normal cost pricing indicates that the price is marked by normal costs (i.e. total costs divided by normal output). This pricing is popular among large-scale corporations because, in reality, firms tend to use normal output rather than real output for cost calculation (Lee, 1998; Coutts and Norman, 2013). We represent as Y_s normal output, that is, output produced by the constant normal rate of capacity utilisation $u_s(\equiv Y_s/\bar{Y})$. Then, firms set the price by multiplying the mark-up rate $\mu(>0)$ on total costs per normal output:

$$p = (1+\mu)\frac{w(1+\sigma f/u_s)}{a_v}. \quad (2)$$

The higher the monopoly power or the stronger the bargaining power of the firm, the higher the mark-up rate (Kalecki, 1971; Sen and Dutt, 1995). From equation (2), we obtain the real wage of direct workers in the case of normal cost pricing:

$$\frac{w}{p} = \frac{a_v}{\Delta}, \ \Delta \equiv (1+\mu)\left(1+\frac{\sigma f}{u_s}\right) > 1. \quad (3)$$

The real wage of indirect workers is σ times that of direct workers. Note that the real wages of both worker types are constant, because we assume constant productivity.

The income of direct workers, Π_{vw}, per capital stock, K, is composed only of

their labour income. Using equation (3), we obtain:

$$\frac{\Pi_{vw}}{pK} = \frac{wN_v}{pK} = \frac{u}{\Delta}. \quad (4)$$

In the following, we assume $\bar{Y}/K = 1$ for simplicity. Note that Π_{vw}/pK moves pro-cyclically because the amount of direct workers is proportional to the output.

Income of indirect workers, Π_{fw}, per capital stock is composed of labour income and financial income:

$$\frac{\Pi_{fw}}{pK} = \frac{w_f N_f + iL}{pK} = \frac{\sigma f}{\Delta} + i\lambda, \quad (5)$$

where L represents indirect workers' capital borrowed by firms and $i(>0)$ represents the constant interest rate, which is controlled by the central bank. In addition, the endogenous variable $\lambda(\equiv L/pK)$ represents the debt–capital ratio of firms, that is, the capital share of indirect workers. The first term on the right-hand side (RHS) in equation (5) is constant because the number of indirect workers does not change according to the output, whereas the second term endogenously changes according to the capital share of indirect workers.

We define the wage share π as the total labour income divided by the value added as follows:

$$\pi \equiv \frac{wN_v + w_f N_f}{pY} = \frac{1 + \frac{\sigma f}{u}}{\Delta}. \quad (6)$$

Unlike most studies, in our model wage share is an endogenous variable and moves counter-cyclically, because of labour hording.

Income of capitalists, Π_c, per capital stock is the difference between value added and total labour income:

$$\frac{\Pi_c}{pK} = \frac{pY - \Pi_{vw} - \Pi_{fw}}{pK} = \left(\frac{\Delta - 1}{\Delta}\right)u - \frac{\sigma f}{\Delta} - i\lambda. \quad (7)$$

As equation (7) shows, Π_c/pK changes pro-cyclically and moves opposite to the capital share of indirect workers.

Next, we turn to savings and investments. We assume that indirect workers save a constant fraction, s_w, of their income, and capitalists save a constant fraction, s_c, of their income. Total savings, S, in real terms, comprises both indirect workers' savings and capitalists' savings. Using equations (5) and (7), the aggregate saving function is obtained as follows:

$$\frac{S}{K} = s_c\left(\frac{\Delta - 1}{\Delta}\right)u - (s_c - s_w)\left(\frac{\sigma f}{\Delta} + i\lambda\right), s_c \in (0,1), s_w \in (0,1). \quad (8)$$

The Kaleckian models feature many variants of the desired investment function. Charles (2008) assumes that investment is an increasing function of retained profits. Hein (2006) uses a normal Kaleckian-type investment function that positively relates the investment per unit of capital to the profit rate and the rate of capacity utilisation. Our model simply assumes that real investment, I, per unit of capital responds positively to firms' profits:

$$\frac{I}{K} = \alpha + \beta\left[\left(\frac{\Delta - 1}{\Delta}\right)u - \frac{\sigma f}{\Delta} - i\lambda\right], \alpha > 0, \beta > 0. \quad (9)$$

3.2 Solving endogenous variables

The disequilibrium between investment and savings is instantaneously adjusted through changes in capacity utilisation. The equilibrium rate of capacity utilisation is obtained from equations (8) and (9):

$$u = \frac{\alpha\Delta - (s_w + \beta - s_c)(\sigma f + \Delta i\lambda)}{(s_c - \beta)(\Delta - 1)}. \quad (10)$$

This equilibrium is stable if the investment is sufficiently insensitive to variations in capacity utilisation, that is, if $s_c - \beta > 0$.

The rate of capacity utilisation is debt-led if $s_w + \beta - s_c < 0$. This is because increases in the capital share of indirect workers (i.e. debt–capital ratio) and the interest rate in turn raise the consumption demand of indirect workers by raising financial income. In contrast, if $s_w + \beta - s_c > 0$, the rate of capacity utilisation is debt-burdened because decreases in the capital share of indirect workers and interest rate stimulate investment demand. Thus, depending on each agent's propensity to save the coefficient of investment to profits, various scenarios occur. This study focuses on monetary easing, in which the central bank is expected to stimulate effective demand by guiding the interest rate to a lower level. This implies that the economy exhibits a debt-burdened situation, where a fall in the interest rate increases the capacity utilisation rate. Thus, we present the following assumption:

Assumption 1. The Keynesian stability condition, $s_c - \beta > 0$, is always satisfied, whereas $s_w + \beta - s_c > 0$ always holds, so that the economy exhibits

debt burden.

The growth rate of the capital share of indirect workers is given by

$$\dot{\lambda} \equiv F(\lambda) = \frac{s_w \beta i}{s_c - \beta}\lambda^2 + \left[s_w i + \frac{-s_c \alpha \Delta + s_w \beta \sigma f}{(s_c - \beta)\Delta}\right]\lambda + \frac{s_w \sigma f}{\Delta}, \quad (11)$$

where dots over variables denote time derivatives.[10] Equilibrium is defined as $\dot{\lambda} = 0$. By solving $F(\lambda) = 0$, we obtain multiple equilibria $(\lambda_1^*, \lambda_2^*)$. The low equilibrium value, which is represented by λ_1^*, is locally stable, whereas the high value, λ_2^*, is locally unstable.[11]

This study focuses on the mark-up rate and interest rate as distributive parameters that affect the stable equilibrium value λ_1^*. First, we consider the effect of a change in the mark-up rate on the equilibrium values. Note that a change in the mark-up rate is synonymous with a change in Δ because $d\Delta/d\mu > 0$. By simple calculation, we obtain $d\lambda_1^*/d\Delta < 0$,[12] which means that an increase in the mark-up rate always reduces the debt–capital ratio. On the other hand, as the following equation shows, the effect of a change in the mark-up rate on the rate of capacity utilisation is ambiguous:

$$\frac{du}{\partial \Delta} = \frac{-\alpha + \left(\overbrace{s_w + \beta - s_c}^{+}\right)\left[\sigma f + i\lambda_1^* - \Delta(\Delta - 1)i\left(\overbrace{\frac{d\lambda_1^*}{d\Delta}}^{-}\right)\right]}{(\Delta - 1)^2}. \quad (12)$$

If α is sufficiently small (large) or i is sufficiently large (small) that the numerator of the RHS in equation (12) is positive (negative), we obtain $du/d\Delta > 0$ $(du/d\Delta < 0)$, which means that an increase in the mark-up rate raises (reduces) the rate of capacity utilisation. Here, we define the demand regime as follows.

Definition. We call the economy a profit-led demand regime when $du/d\Delta > 0$ holds. In contrast, we call the economy a wage-led demand regime when $du/d\Delta < 0$ holds.

Regarding the effect of a change in the mark-up rate on the rate of capital accumulation, we obtain the following equation:

$$\frac{d(I/K)}{d\Delta} = \beta\left(\frac{1}{\Delta^2}u + \frac{\Delta - 1}{\Delta}\frac{du}{d\Delta} + \frac{\sigma f}{\Delta^2} - i\frac{\widetilde{d\bar{\lambda}_1^*}}{d\Delta}\right). \quad (13)$$

If the economy exhibits a profit-led demand regime, we have $d(I/K)/d\Delta > 0$, and thus, increasing the mark-up rate accelerates capital accumulation. However, in the case of the wage-led demand regime, we obtain either $d(I/K)/d\Delta > 0$ or $d(I/K)/d\Delta < 0$. Summarising the results leads to the following proposition.

Proposition 1. *An increase in the mark-up rate reduces the equilibrium rate of the capital share of indirect workers, irrespective of the demand regime. In addition, if α is sufficiently small (large) or the interest rate is sufficiently large (small), a rise in the mark-up rate increases (decreases) the equilibrium rate of capacity utilisation. Moreover, when the economy is a profit-led demand regime, an increase in the mark-up rate always increases the rate of capital accumulation.*

Next, as for the interest rate, we obtain $d\lambda_1^*/di > 0$, which means that a fall in the interest rate always reduces the capital share of indirect workers. In addition, as long as assumption 1 is satisfied, equation (10) shows that a decrease in the interest rate with a decreasing capital share of indirect workers raises the rate of capacity utilisation. Moreover, in general, the saving propensity of capitalists is higher than that of indirect workers, and thus $s_c - s_w > 0$ holds.[13] In this case, equation (8) indicates that a fall in the interest rate accelerates capital accumulation by decreasing the capital share of indirect workers and increasing the rate of capacity utilisation. Thus, we obtain the following proposition.

Proposition 2. *A decrease in the interest rate reduces the equilibrium rate of the capital share of indirect workers, increases the rate of capacity utilisation, and increases the rate of capital accumulation if Assumption 1 is satisfied.*

4. Income inequality in terms of the Gini coefficient

4.1 Setting the baseline case

This section investigates the effects of changes in the mark-up rate and the interest rate on the Gini coefficient, which is graphically represented by the Lorenz curve. To draw the Lorenz curve, we must find the cumulative population and cumulative income. Therefore, we add new assumptions.

Assumption 2. There are four groups in the economy: in ascending order of per capita income, the unemployed with no income, direct workers, indirect workers, and capitalists. There are no income disparities within each group. In addition, capitalists always exist as a constant proportion of the economy.

One way to reduce income inequality is to rescue people from the unemployed pool. Therefore, as in Assumption 2, this section considers an unemployed person with no income. For the sake of simplicity, the population share of capitalists is assumed to be constant. Moreover, the employment growth rates of both direct and indirect workers are equal to the rate of capital accumulation.[14] However, the population share of the unemployed is unclear because it depends not only on the rate of capital accumulation but also on the population (labour supply) growth.

Based on these assumptions, we first consider the cumulative population ratio. Here, we assign arbitrary value to each share as a baseline case[15]: the share of the unemployed in the total population is 10 percent, the share of the employee including direct and indirect workers is 80 percent, and the share of capitalists is 10 percent. Moreover, the ratio of indirect to direct workers follows $N_f/N_v = f/u$, which shows that the ratio decreases when the capacity utilisation rate increases. Now, in the baseline case, suppose $f = 0.5$ and $u = 0.6$; then N_f/N_v is equal to 0.833 and the share of direct workers is approximately 55 percent (i.e. the share of indirect workers is 25 percent). Needless to say, the ratio of direct to indirect workers varies, because the capacity utilisation rate is endogenously determined.

Next, we consider the cumulative income ratio. The income share of the unemployed is zero under Assumption 2. The income share of direct workers, the share of indirect workers, and the share of capitalists are represented by

$$\frac{\Pi_{vw}}{pY} = \frac{1}{\Delta}, \quad (14)$$

$$\frac{\Pi_{fw}}{pY} = \frac{\sigma f}{\Delta u} + \frac{i\lambda}{u}, \quad (15)$$

$$\frac{\Pi_c}{pY} = 1 - \frac{1}{\Delta} - \frac{\sigma f}{\Delta u} - \frac{i\lambda}{u}. \quad (16)$$

As equation (14) shows, the income share of direct workers is constant, because the number of direct workers increases as much as the value added in the economy. Equation (15) shows that the income share of indirect workers moves counter-cyclically, whereas equation (16) indicates that the income share of capitalists varies pro-cyclically. However, both the income shares of indirect workers and capitalists are affected by a change in the capital share of indirect workers.

In Figures 1 and 2, where the horizontal axis shows the cumulative population ratio and the vertical axis shows the cumulative income ratio, the Lorenz curve in the baseline case is depicted by a solid line. The Gini coefficient is the area surrounded by the perfect equality line (line OB) and the Lorenz curve, divided by the area of the triangle OAB.

(Figure 1 here)

4.2 The effect of a change in the mark-up rate

Let us investigate the effect of a change in the mark-up rate on the Gini coefficient. First, we suppose that α is sufficiently small or the interest rate is sufficiently small, and thus a profit-led regime occurs. As equation (14) shows, a rise in the mark-up rate reduces the income share of direct workers. Moreover, Proposition 1 shows that a rise in the mark-up rate reduces the capital share of indirect workers and raises the rate of capacity utilisation, which in turn reduces the income share of indirect workers by decreasing both the first and second terms of the RHS in equation (15). As a result, capitalist income share increases. In Figure 1, since the income share of capitalists increases with their constant population share, point c in the baseline case moves to c'.

Furthermore, Proposition 1 shows that a rise in the mark-up rate stimulates capital accumulation, and thus growth rates of employment among both direct and indirect workers under the profit-led regime. If the rate of capital accumulation exceeds the growth rate of labour supply due to the increasing

mark-up rate, the population share of the unemployed continues to decrease. In Figure 1, we depict this case at a specific point in time where the intersection point of the Lorenz curve and the horizontal axis moves to point e, and thus the Gini coefficient decreases. However, when a rise in the mark-up rate increases the rate of capacity utilisation, the ratio of indirect to direct workers decreases according to $N_f/N_v = f/u$. The larger the value of f, the dramatically lower the ratio with decreasing capacity utilisation. As a result, point d in the baseline case moves to d'. A decrease in the ratio of indirect to direct workers positively affects the Gini coefficient because the income of the former is larger than that of the latter.

In Figure 1, a new Lorenz curve with increasing mark-up under the profit-led regime is represented by a dashed line. Although an increase in the mark-up rate may reduce the Gini coefficient by increasing employment, the declines in both income shares of direct and indirect workers are remarkable. Thus, unless unemployment decreases significantly, increasing the mark-up rate can expand income inequality, even under a profit-led demand regime.

Next, we consider how a mark-up rate change affects the Gini coefficient under a wage-led demand regime. A rise in the mark-up rate always reduces the income share of direct workers. On the other hand, unlike the profit-led regime, the effects of a rise in the mark-up rate on the income shares of indirect workers and capitalists are ambiguous. This is because a rise in the mark-up rate increases Δ but decreases the capacity utilisation rate, and thus has an ambiguous effect on the first term of the RHS in equation (15). Moreover, a rise in the mark-up rate decreases both the capacity utilisation rate and capital share of indirect workers, and thus has an unclear effect on the second term. There are three patterns in which a rise in the mark-up rate affects the income shares: the income share of indirect workers increases, but that of capitalists decreases (Pattern 1); the income shares of both indirect workers and capitalists increase (Pattern 2); and the income share of indirect workers decreases, but that of capitalists increases (Pattern 3). Patterns 2 and 3 have in common that capitalists benefit from a significant decrease in the income share of direct workers, for example due to a large increase in the mark-up rate. In Figure 1, we depict Pattern 2, where point c moves to point c" and point d to d".

Even if a rise in the mark-up rate occurs under a wage-led regime, it does not necessarily stagnate capital accumulation, because we find either $d(I/K)/d\Delta > 0$ or $d(I/K)/d\Delta < 0$ in Section 2.2. In the latter case, the growth rate of employment is likely to be smaller than the growth rate of labour supply, and thus the population share of the unemployed continues to increase, as depicted by point h. However, a rise in the mark-up rate decreases the rate of capacity utilisation, which in turn increases the ratio of indirect workers to direct workers. As a result, it contributes slightly to a decrease in the Gini coefficient.

A new Lorenz curve with an increasing mark-up rate under the wage-led regime is depicted by the dotted line in Figure 1. This case, with increasing Gini coefficient, depends on the supposition that an increase in the mark-up rate reduces the capital accumulation below the growth rate of labour supply and produces Pattern 2. However, there may be a possibility that an increase in the mark-up rate reduces the Gini coefficient under the wage-led regime. For instance, this case holds under the condition that a rise in the mark-up rate significantly increases the growth rate of employment despite the wage-led regime.

4.3 The effect of monetary easing

Let us consider the effect of a decrease in the interest rate on the Gini coefficient. From the viewpoint of the theory of endogenous money supply, central banks can control the policy interest rate instead of money supply: monetary easing by the central bank negatively affects interest rates.

How does a change in the interest rate affect the Gini coefficient? Even if the interest rate changes, the income share of direct workers does not change. As Proposition 2 shows, a fall in the interest rate reduces the capital share of indirect workers and raises the rate of capacity utilisation, which decreases the income share of indirect workers (see equation (15)). As a result, the income share of capitalists increases. In Figure 2, since the income share of capitalists increases with their constant population share, point c in the baseline case moves to c'''.

(Figure 2 here)

From Proposition 2, a fall in the interest rate accelerates capital

accumulation and employment growth. If monetary easing is effective enough and capital accumulation is higher than labour supply growth, the population share of the unemployed will decrease. In Figure 2, we depict the case at a specific point in time where the population share of the unemployed decreases to point e. Moreover, when the rate of capacity utilisation increases with monetary easing, the ratio of indirect workers to direct workers decreases. In an extreme case, it may change point d to d'''.

As the dashed line Lorenz curve in Figure 2 shows, monetary easing negatively affects the Gini coefficient by increasing employment, but positively affects the coefficient by increasing the income share of capitalists and decreasing the ratio of indirect to direct workers. So, how can the negative effect on the Gini coefficient be greater? Let us now consider a case where the population share of the unemployed has decreased due to a fall in the interest rate, but point d remains in the same position by chance as a result of the decrease in the ratio of indirect to direct workers, which is represented by a dotted line. In this case, the Gini coefficient decreases by doubling the triangle area $[(10-e)/100](\Pi_{vw}/pY)$. Therefore, the negative effect of a fall in the interest rate on the Gini coefficient depends not only on the degree of a decrease in the population share of the unemployed as well as the income share of the direct workers. How can we increase the income share of direct workers? It is obvious that the decreasing mark-up rate or decreasing wage premium, σ, leads to a decrease in Δ and an increase in their income share. Thus, to reduce income inequality, it is necessary not only to reduce the interest rate but also to raise real wages so that the income share of direct workers increases.

4.4 Discussion

Section 2 confirms that developed countries have experienced an expansion in income inequality. This subsection briefly discusses the factors that widen inequality and investigates their solutions in those countries.

The above simple analysis reveals that a rise in the mark-up rate is one of the main factors that expands inequality, even under the profit-led demand regime. From the Kaleckian viewpoint, it is emphasised that the bargaining power of workers and market structure affect the level of the mark-up rate.[16]

Let us consider the bargaining power of workers. Here, we identify the sources of bargaining power as the union density rate and collective bargaining coverage. The former is the most traditional and useful index reflecting workers' bargaining power. However, if the collective agreement is legally guaranteed to apply to unionised workers, the union is still the representative of all workers, and thus the union becomes powerful.

Figure 3 plots the combination of density rate and the bargaining coverage of each country in 1990s and in 2010s. It is clear from this figure that the bargaining power of workers cannot be measured by the density rate alone. Although the density rate in France remains low, the collective bargaining coverage is the highest among the countries considered here. As a result, it seems that a fall in the income share of the lower income group was suppressed, and thus the Gini coefficient increased only slightly.

(Figure 3 here)

In contrast, Germany experienced a significant decrease in density rate. According to Thelen (2017), although labour market reforms in Germany progressed in the early 2000s, workers who engaged in industries other than core manufacturing were not organised. Even in the core industries, while the employment of core workers continues to be protected, the increasing number of short-term employees are excluded from the existing labour–management relations. The coverage of collective bargaining declined significantly in proportion to a decrease in the density rate. Thus, the wages of the so-called mini jobs have been reduced, and the Gini coefficient has increased significantly. This is the reason why the legal minimum wage was introduced in 2015.

The situation in Japan is similar to that in Germany. In Japan, both the density rate and coverage of collective bargaining are low, and these downward trends cannot be stopped. In particular, deregulation of the labour market has progressed since the late 1990s, and non-regular workers, which currently account for about 40 percent of total workers, have not been sufficiently organised. On the other hand, the minimum wage is set separately by each prefecture. Although the Gini coefficient is increasing, the incidence of low-pay is declining due to the improvement in the minimum wage year over year.

Now, we turn to the market structure, which affects the mark-up rate. As the 'superstar hypothesis' of Autor et al. (2020) suggests, some technologically superior companies gain a higher market share, resulting in high mark-up rates. Autor et al. (2020) statistically show that market share tends to increase in six major US industries. However, unlike the United States, Cavalleri et al. (2019) find that market share is stable in the EU. In Japan, where some traditional manufacturing companies are leading the macro economy, the hypothesis that weakening the bargaining power of workers increases the mark-up rate seems more valid. Furthermore, we have to see product market regulation as a factor that influences the market structure. Roughly speaking, when product market regulation is strong, the market tends to be oligopolistic. However, by checking product market regulation indicators (PMR) in the OECD, we do not find that regulation has been tightened: according to the comparable 1998 and 2013 indicators, the PMR was smaller in 2013 than in 1998 in any country.[17]

Finally, we examine the conditions for monetary easing to improve income inequality. In developed countries, untraditional monetary policy has caused the base rates (US Fed funds rate, ECB main refinancing rate, and Japanese overnight call rate) to fall to extremely low levels. However, whether such policy succeeds in improving inequality depends on the mark-up rate. In some countries with low bargaining power of workers, such as Germany, the United States, and Japan, even if monetary easing improves employment, the effect of suppressing inequality is offset by the effect of lower interest rates, leading to a higher income share for capitalists. Thus, in order to improve pre-tax and pre-transfer income inequality in those countries, it is necessary to intervene in the wage determination process by raising the minimum wage, which is called 'direct redistribution' in Piketty (2015).

5. Conclusion

This study builds a theoretical framework that connects functional income distribution and personal income distribution from the Kaleckian viewpoint, and investigates the effects of changes in the mark-up rate and of monetary policy on income inequality, which is expressed in terms of the Gini coefficient. Our results can be summarised as follows.

First, a rise in the mark-up rate is likely to increase the Gini coefficient, regardless of whether there is a profit-led or wage-led demand regime. A rise in the mark-up rate leads to a decline in the capital share of indirect workers, which in turn increases the income share of capitalists while putting downward pressure on the financial income of indirect workers. At the same time, a rise in the mark-up rate always reduces the labour income of direct workers, which positively affects the Gini coefficient.

Second, a decrease in the interest rate due to monetary easing has positive and negative effects on the Gini coefficient. On the one hand, a lower interest rate reduces the income share of indirect workers, increases the income share of capitalists, and thus increases the Gini coefficient. On the other hand, a fall in the interest rate increases employment growth and decreases the Gini coefficient. The combination of these two contradictory effects determines what the Gini coefficient will ultimately be. To increase the effect of lowering the Gini coefficient, it is necessary to reduce the mark-up rate sufficiently. In other words, monetary easing and reduction of the mark-up rate must be implemented as a set to improve inequality. This will be an answer to the question of why the untraditional monetary easing in developed countries does not have enough effect on the reduction of inequality.

The issues remaining after this study are now briefly described. First, this study abstracts from workers whose consumption is based on debt accumulation. Although household debt accumulation has slowed since the financial crisis in 2008, lower interest rates leave room to improve inequality by curbing households' interest payment burden. Second, by endogenizing the employment rates, the shares of the unemployed and the employed can actually be calculated. In this case, the assumption of constant labour productivity is relaxed.

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Appendix (a)

The growth rate of the capital share of indirect workers is given by

$$\dot{\lambda} = \left(\frac{\dot{L}}{L} - \frac{\dot{K}}{K}\right)\lambda = \frac{\dot{L}}{pK} - \frac{S}{K}\lambda. \quad \text{(A1)}$$

We have $\dot{p}/p = 0$ from equation (2) and $\dot{K}/K = I/K = S/K$ because the goods market clears.

An increment of debt in a firm is the difference between investment and firms' (capitalists') retained earnings. From equations (7) and (8), we have:

$$\frac{\dot{L}}{pK} = s_w\left(\frac{\sigma f}{\Delta} + i\lambda\right). \quad \text{(A2)}$$

Substituting equations (8), (10), and (A2) in (A1) and rearranging yields:

$$\dot{\lambda} \equiv F(\lambda) = \frac{s_w\beta i}{s_c - \beta}\lambda^2 + \left[s_w i + \frac{-s_c\alpha\Delta + s_w\beta\sigma f}{(s_c - \beta)\Delta}\right]\lambda + \frac{s_w\sigma f}{\Delta}. \quad (11)$$

The equilibrium value of the capital share of indirect workers λ^* is obtained by solving $F(\lambda^*) = 0$. Using the $(\lambda, \dot{\lambda})$ plane, as shown in Figure 4, the existence of a positive equilibrium value and its local stability can be easily verified. The function $F(\lambda)$ shows a parabola with its vertex oriented downward, and its intercept is always positive. The necessary and sufficient conditions for the existence of a positive equilibrium value are that the discriminant of $F(\lambda) = 0$ is positive. If α is sufficiently large, the discriminant is positive, which we assume in the following discussion.

(Figure 4 here)

Appendix (b)

Figure 4 shows that our model has multiple equilibria $(\lambda_1^*, \lambda_2^*)$, where the low equilibrium, λ_1^*, is locally stable and the high one, λ_2^*, is locally unstable. Additionally, note that the following condition is always satisfied in the stable positive equilibrium:

$$\frac{d\dot{\lambda}}{d\lambda} = \frac{\partial F(\lambda)}{\partial \lambda} = 2\frac{s_w \beta i}{s_c - \beta}\lambda^* + \left[s_w i + \frac{-s_c \alpha \Delta + s_w \beta \sigma f}{(s_c - \beta)\Delta}\right] < 0. \quad \text{(A3)}$$

Equation (A3) holds if α is sufficiently large or i is sufficiently small. We assume a stable equilibrium, λ_1^*.

Appendix (c)

Totally differentiating $F(\lambda_1^*; \Delta) = 0$ yields

$$\frac{d\lambda_1^*}{d\Delta} = -\frac{\left(\frac{\partial F(\lambda_1^*; \Delta)}{\partial \Delta}\right)}{\left(\frac{\partial F(\lambda_1^*; \Delta)}{\partial \lambda}\right)}, \quad \text{(A4)}$$

where the numerator is given by

$$\frac{\partial F(\lambda_1^*; \Delta)}{\partial \Delta} = -\frac{s_w \beta \sigma f}{(s_c - \beta)\Delta^2}\lambda_1^* - \frac{s_w \sigma f}{\Delta^2} < 0.$$

The sign of $\partial F(\lambda^*; \Delta)/\partial \lambda$ is negative from equation (A4), and thus we obtain $d\lambda^*/d\Delta < 0$.

Totally differentiating $F(\lambda_1^*; i) = 0$ yields

$$\frac{d\lambda^*}{di} = -\frac{\left(\frac{\partial F(\lambda_1^*; i)}{\partial i}\right)}{\left(\frac{\partial F(\lambda_1^*; i)}{\partial \lambda}\right)}, \quad \text{(A5)}$$

where the numerator is given by:

$$\frac{\partial F(\lambda^*; i)}{\partial i} = 2\frac{s_w \beta}{s_c - \beta}\lambda_1^{*2} + s_w \lambda_1^* > 0.$$

Thus, we obtain $d\lambda^*/di > 0$.

		Gini coefficient from LIS		Gini coefficient from SWIID		Pre-tax income share of bottom 50% from WID	Low-pay incidence from OECD
		Pre-tax	Post-tax	Pre-tax	Post-tax		
France	1990s	0.486	0.284	0.476	0.282	21.352	
	2000s	0.473	0.286	0.478	0.284	22.022	N.A.
	2010s	N.A.	N.A.	0.490	0.297	22.367	
Germany	1990s	0.456	0.260	0.461	0.257	22.991	15.560
	2000s	0.502	0.282	0.505	0.278	20.851	17.789
	2010s	0.512	0.292	0.519	0.289	18.770	18.556
Italy	1990s	0.465	0.331	0.466	0.327	23.099	10.056
	2000s	0.485	0.328	0.485	0.327	22.399	9.298
	2010s	0.549	0.336	0.513	0.335	21.328	8.443
Sweden	1990s	0.461	0.236	0.469	0.235	27.046	
	2000s	0.445	0.248	0.483	0.245	25.624	N.A.
	2010s	N.A.	N.A.	0.507	0.261	24.778	
Japan	1990s			0.419	0.299		15.43
	2000s			0.442	0.310	N.A.	14.947
	2010s			0.451	0.319		13.241
US	1990s	0.478	0.365	0.476	0.355	15.296	24.353
	2000s	0.491	0.378	0.490	0.366	14.057	24.175
	2010s	0.508	0.383	0.508	0.380	12.623	24.700

Table 1. Gini coefficients and other indicators in developed countries.

Source: Luxembourg Income Study Database (author's calculation), Solt, F (2019) "Measuring Income Inequality across Countries and Over Time: The Standardized World Income Inequality Database." SWIID version 8.2, November 2019, World Inequality Database,

OECD stat. database.

Note: We omits the Gini coefficient in Japan because there are only data for 2008, 2010, and 2013. The WID has no data on the pre-tax income share of the bottom 50 percent in Japan, and the OECD has no data on low-pay incidence in France and Sweden. All values are averages.

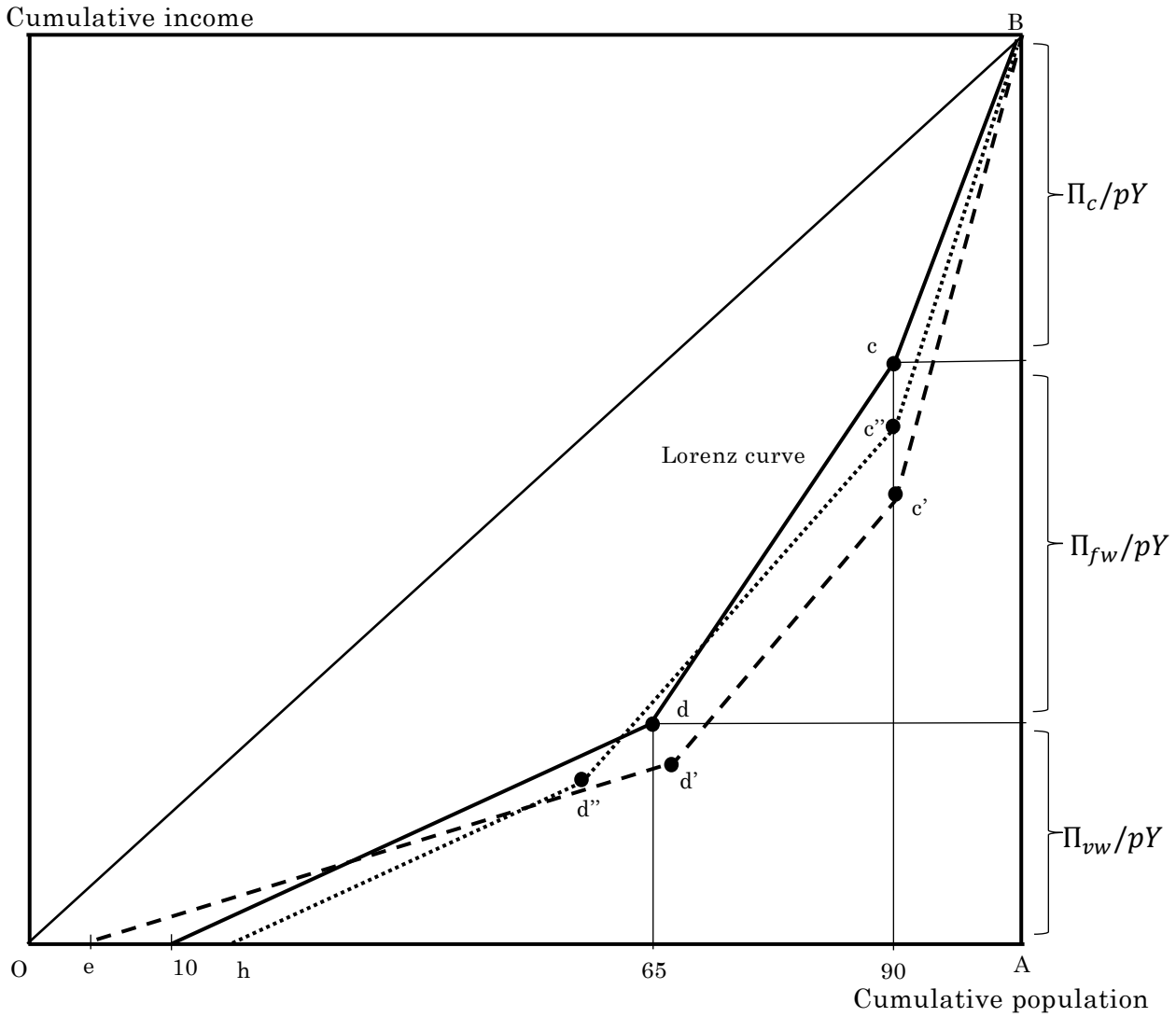

Figure 1. Shift of Lorenz curve with increasing mark-up rate

Note: The solid line indicates the baseline case, the dashed line indicates the shift under the profit-led demand regime, and the dotted lines indicate the shift under the wage-led regime.

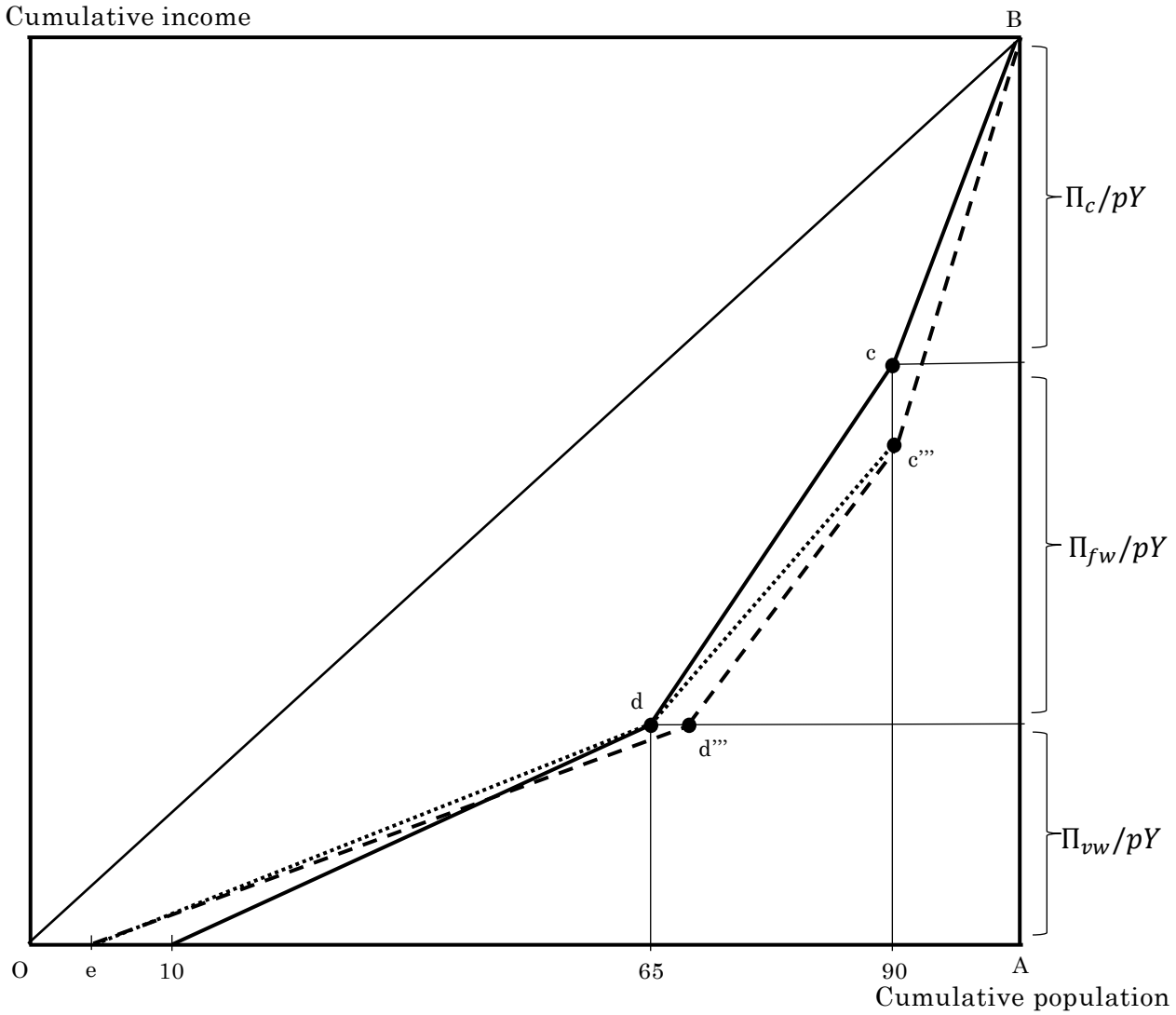

Figure 2. Shift of Lorenz curve with decreasing interest rate

Note: The solid line indicates the baseline case, and both dashed and dotted lines indicate the case of decreasing interest rates.

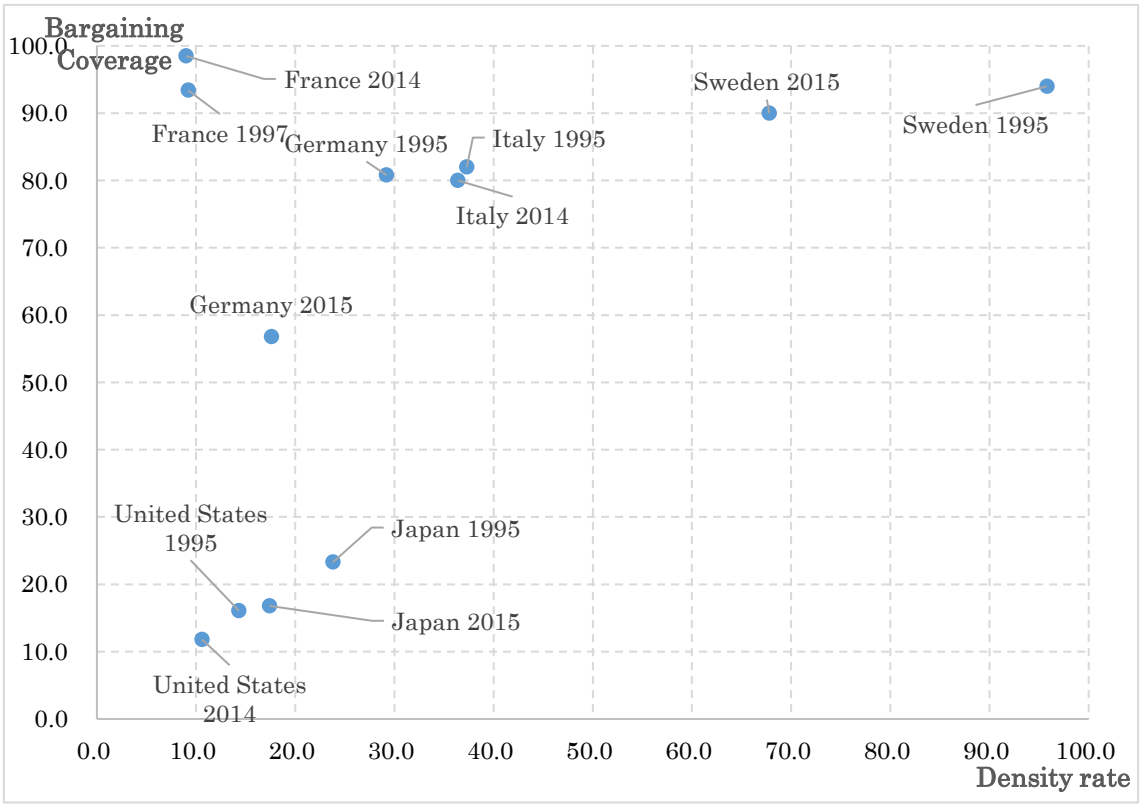

Figure 3. Union density rate and collective bargaining coverage

Source : OECD.stat database.

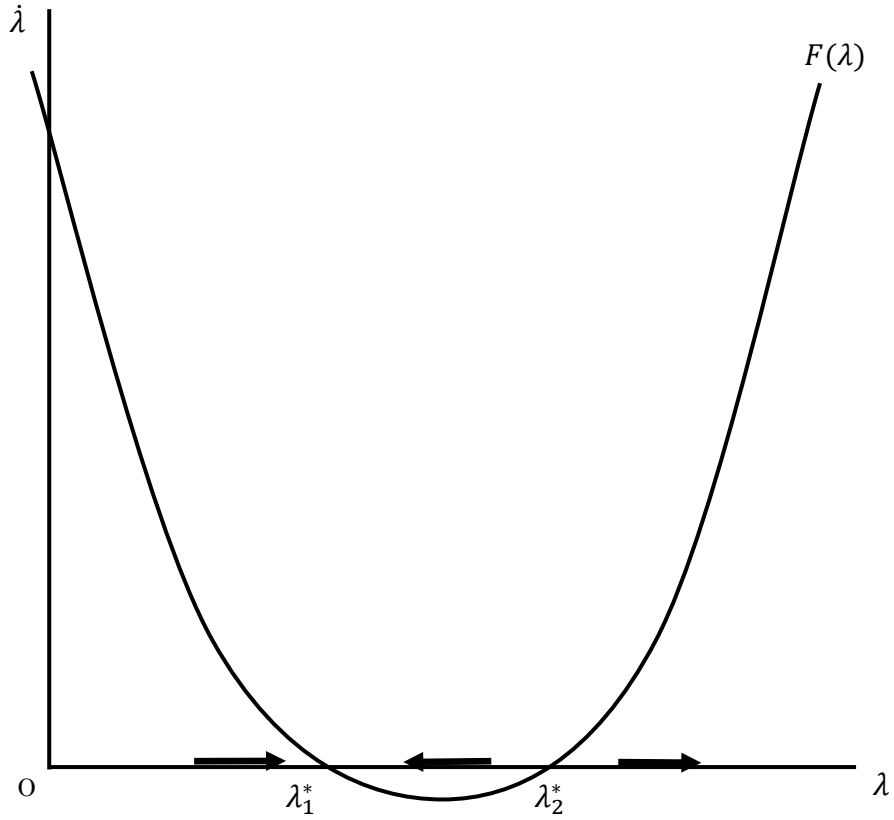

Figure 4. Equilibria of the capital share of indirect workers and their stability

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[1] The classical two-class model with capitalists and workers in Atkinson and Bourguignon (2000, pp.5-9) shows that a rise in the profit share positively affects the Gini coefficient, though this depends on the assumptions that workers acquire only wages, capitalists gain only profits, and per capita income within a class is completely equal. Our model is extended version of their model in several respects, which relates functional income distribution and the Gini coefficient.

[2] There are other interesting models. Carvalho and Rezai (2016) and Tavani and Vasudevan (2014) study the effect of inequality in personal income distribution on growth. Taylor et al. (2017) and Ederer and Rehm (2020b) investigate the fiscal policy and tax system effects on growth and inequality.

[3] Whether monetary easing has contributed to widening inequality or not has become a major issue in recent years. See Krugman (2014), Bernanke (2015), and Draghi (2016).

[4] According to Hall and Soskice (2001), capitalistic countries are divided into two types, coordinated market economies and liberal market economics, depending on institutional structure. Amable (2003), using actor analysis and cluster analysis, classifies them into five types: the social democratic type, such as Sweden and Finland; Europe continental type, such as Germany and France;

Mediterranean type, such as Italy and Spain; Anglo-Saxon type, such as the United States and the United Kingdom; and Asian type such as Japan and South Korea.

[5] Needless to say, however, the Gini coefficient is not universal. See Atkinson (2015) and Alvaredo et al. (2018) for the explanation.

[6] Monetary easing has the effect of increasing the price of financial assets, which widens the gap between those who have assets and those who do not. However, such a process does not seem to last due to the convergence of the bubbles. Thus, we abstract from dynamics of the asset market.

[7] For simplicity capitalists are assumed not to acquire any labour income.

[8] In Tavani and Vasudevan (2014), the ratio of managerial workers to productive workers is assumed to be always fixed because the former has to monitor the latter.

[9] Our model follows the formulations of Lavoie (2009) and Tavani and Vasudevan (2014).

[10] See Appendix (a) for the derivation of equation (11).

[11] See Appendix (b) for the local stability of the equilibrium.

[12] See Appendix (c) for the comparative statistics.

[13] Carvalho and Rezai (2016) demonstrates that the higher the income, the larger the propensity to save. Thus, this paper also assumes that the saving propensity of capitalists is higher than that of indirect workers.

[14] Since labour productivity of direct workers is assumed to be constant, the growth rate of their employment is equal to the growth rates of output and capital. Moreover, we assume the constant potential output–capital ratio and labour productivity of indirect workers, the growth rate of indirect workers' employment is equal to the rate of capital accumulation.

[15] We can calculate the rate of capital accumulation by substituting the equilibrium values of the capital share of indirect workers and the capacity utilization rate into equation (8). Thus, we can also calculate the intertemporal numbers of direct and indirect workers if the initial values and parameters of the model are given. Moreover, if the growth rate of labour supply and its initial value are given, we can calculate the number of the unemployed. However, our purpose can be fully archived without such a calculation.

[16] There are other factors that affect the mark-up rate: the interest rate and financialization. In our model, the interest rate is independent from the mark-up rate. Financialization raises financial payments such as dividends and interests by instilling shareholder value orientation in firms, which in turn pass on to a rise in the mark-up rate and reduces the wage share. This is empirically verified by Dünhaupt (2017) and Kohler et al. (2019).

[17] The PMR from 1998 to 2013 is roughly composed of three categories: state control, barriers to entrepreneurship, and barriers to trade and investment. In each country covered in this paper, all of these indicators decreased, with one exception: the US state control increased from 1.96 in 1998 to 2.70 in 2013.