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Abstract

This study estimates two types of Phillips curves—the price Phillips curve and nominal wage Phillips curve—for the Japanese economy and analyses the institutional structure of the dynamics of effective demand and income distribution in each period from 1977 to 2007. The estimated results allow us to make the following four findings. First, the Japanese economy was a profit-led regime and a counter-cyclical wage share regime until the 1990s. Second, although the combination of regimes can make the dynamics of effective demand and income distribution unstable, such dynamics were actually stable until the 1980s because wage share was sufficiently regulated by labour–management cooperation. Third, however, during the 1990s, the dynamics became unstable, because this regulation mechanism was weakened by a proportional increase in non-regular workers who were not members of labour unions. Finally, after the 2000s, the dynamics restabilized because Japanese firms quickened their speeds of employment adjustment and the distributive regime in Japan switched from a counter-cyclical wage share one to a pro-cyclical wage share regime.

Keywords: price Phillips curve, nominal wage Phillips curve, income distribution, demand regime, Kaleckian model

JEL Classification: E12; J53

1 Introduction

In this study, we estimate two types of Phillips curves—the price Phillips curve and the nominal wage Phillips curve—for the Japanese economy, and analyse the institutional structure of the dynamics of effective demand and income distribution.

Recently, some models that separate these two types of Phillips curves have been constructed.[1] In these models, the price Phillips curve and nominal wage Phillips curve are considered to show different institutional structures, with the former related to the goods market and the latter to the labour market. Separating these two types of Phillips curves thus highlights the various patterns of income distribution dynamics over the business cycle.

These studies are significant for the development of dynamic models based on Kaleckian theory. Kaleckian models focus on how a change in income distribution influences effective demand and examine various demand regimes, notably profit-led and wage-led demand regimes. However, many Kaleckian models assume that wage share is exogenously given and overlook how fluctuations in effective demand influence income distribution. To analyse the relationship between effective demand and income distribution, we must focus on not only demand regimes but also distributive regimes that change wage share over the business cycle. By introducing two types of Phillips curves into the Kaleckian model, we can formulate both the demand regime and the distributive regime and examine the interaction between effective demand and income distribution. For example, Proano et al. (2011) combine the Kaleckian demand regime with the distributive regimes deriving from these two types of Phillips curves and analyse the stability of the dynamics of effective demand and income distribution.[2]

However, while Proano et al. (2007) empirically estimate these two types of Phillips curves for the United States and Eurozone, no studies have thus far estimated them for Japan. In order to bridge this gap in the literature, we estimate these two Phillips curves in Japan and consider how institutional structures specific to the Japanese economy affect the dynamics of effective demand and income distribution.

The remainder of this paper is organized as follows. Section 2 presents our model. Section 3 estimates the demand regime, price and nominal wage Phillips curves, and rate of change in labour productivity in Japan between 1977 and 2007 to examine the stability of the dynamic system. Section 4 estimates some equations by subdividing the estimation period to examine structural change in Japan. Section 5 concludes.

2 Model

In this section, we formulate the demand regime and distributive regime, and construct a dynamic model of the rate of capacity utilization and wage share.

2.1 Phillips curves and real wage dynamics

We define the price and nominal wage Phillips curves as follows:

$$\hat{P}_t = \alpha_1 (u_t - \bar{u}) + \alpha_2 \hat{W}_t + \alpha_3 \pi^e{}_t + C_p, \qquad (1)$$

$$\hat{W}_t = \beta_1 (u_t - \bar{u}) + \beta_2 \hat{P}_t + \beta_3 \pi^e{}_t + \beta_4 (\psi_t - \bar{\psi}) + C_W, \qquad (2)$$

where $\hat{P}_t$ denotes the rate of change in the price of goods P, u_t the rate of capacity utilization at time t, $\bar{u}$ the standard rate of capacity utilization, $\hat{W}_t$ the rate of change in the nominal wage level W, $\pi^e{}_t$ the expected inflation rate, ψ_t wage share at time t, and $\bar{\psi}$ the target wage share. C_P and C_W are constant terms.

Equation (1) represents a price Phillips curve.

The first term on the right-hand of equation (1) shows that a fluctuation in demand affects the price of goods. The sign of the coefficient α_1 is ambiguous. If firms raise the price of goods when demand increases, we have $\alpha_1 > 0$. By contrast, if firms decrease the price of goods to deter new entries in a boom, we have $\alpha_1 < 0$.[3]

The second term on the right-hand of equation (1) shows that a change in the nominal wage level affects the price of goods because firms determine the price of goods by marking-up unit labour costs. We assume 'myopic perfect foresight,' namely, firms are considered to be able to reflect the inflation rate of nominal wage in this term on the price of goods. Therefore, we have $\alpha_2 > 0$.

The third term on the right-hand of equation (1) shows that a change in the price of goods reflects the expected inflation rate. Therefore, we assume that $\alpha_3 > 0$. This means that equation (1) expresses a hybrid Phillips curve that incorporates both forward-looking and backward-looking price-setting behaviours.

Equation (2) represents a nominal wage Phillips curve.

The first term on the right-hand of equation (2) shows how a fluctuation in the rate of capacity utilization influences the nominal wage level. We assume that $\beta_1 > 0$. Previous studies of these two types of Phillips curves, have assumed that the explanatory variable of the price Phillips curve is the rate of capacity utilization, while that of the nominal wage Phillips curve is the rate of employment, because a change in the price of goods is caused by an adjustment of the goods market and a change in nominal wage is caused by an adjustment of the labour market. Nevertheless, we adopt the rate of capacity utilization as an explanatory variable for the nominal wage Phillips curve.

There are two main reasons for taking this approach. One is that, the rate of unemployment in Japan is stable and low and hence the correlation between a change in the rate of capacity utilization and a change in the employment rate is often unclear. The other is that we introduce into our model the mechanism that a fluctuation in output causes a change in labour productivity through the labour hoarding effect. As we see later, this mechanism reflects the flexibility of the Japanese labour market. If we adopt the rate of employment as an explanatory variable for the nominal wage Phillips curve, we must add the equation of Okun's law into our model to relate the rate of capacity utilization to the employment rate. However, two equations reflect labour market flexibility in our model, because Okun's law is also determined by such flexibility. As a result, to avoid the problem of overdeterminancy, we do not introduce Okun's law into our model explicitly and adopt the rate of capacity utilization as an explanatory variable for the nominal wage Phillips curve.

The second term on the right-hand of equation (2) shows that a change in the price of goods affects the rate of change in the nominal wage level through labour–management negotiation. We again assume myopic perfect foresight as well as for the price Phillips curve, and therefore have $\beta_2 > 0$.

The third term on the right-hand of equation (2) shows that a change in the level of nominal wage reflects the expected inflation rate, and we assume that $\beta_3 > 0$.

The fourth term on the right-hand of equation (2) is important as it shows the degree to which the level of wage share affects the rate of change in nominal wage. In Japan, labour unions demand that firms protect their employment, however, they also tend to accept wage cuts to prevent firms from firing workers owing to profit squeezes. Therefore, when wage share ψ_t exceeds the target wage share $\overline{\psi}$, the change in nominal wage declines because of the presence of labour unions. Accordingly, we assume that $\beta_4 < 0$.

From equations (1) and (2), for changes in the price of goods and in nominal wage, we obtain the following partial derivatives with respect to the rate of capacity utilization:

$$\partial \hat{P}_t \big/ \partial u_t = \frac{\alpha_1 + \alpha_2 \beta_1}{1 - \alpha_2 \beta_2}, \tag{3}$$

$$\partial \hat{W}_t \big/ \partial u_t = \frac{\alpha_1 \beta_2 + \beta_1}{1 - \alpha_2 \beta_2}, \tag{4}$$

where $\omega = W/P$ denotes the real wage level and $\hat{\omega}_t = \hat{W}_t - \hat{P}_t$ holds. Therefore, from equations (3) and (4), we can obtain

$$\partial \hat{\omega}_t \big/ \partial u_t = \frac{\alpha_1(\beta_2 - 1) + \beta_1(1 - \alpha_2)}{1 - \alpha_2 \beta_2}. \tag{5}$$

The sign on the right-hand side of equation (5) is ambiguous. If it is positive, because the rate of increase in nominal wage is larger than that in the price of goods when the rate of capacity utilization rises, real wage is pro-cyclical to output (i.e. a labour market-led regime). If it is negative, because the rate of increase in the price of goods is higher than that in the nominal wage when the rate of capacity utilization rises, real wage is counter-cyclical to output (i.e. a goods market-led regime).

Similarly, we can obtain the partial derivative with respect to wage share:

$$\partial \hat{\omega}_t \big/ \partial \psi_t = \frac{\beta_4(1 - \alpha_2)}{1 - \alpha_2 \beta_2}. \tag{6}$$

The sign on the right-hand side of equation (6) is also ambiguous.

2.2 The rate of change in labour productivity and wage share dynamics

In this subsection, we specify the dynamics of labour productivity. Much previous research on price and nominal wage Phillips curves assumes that the rate of change in labour productivity is constant; however, in reality, this rate of change fluctuates under the influence of the rate of capacity utilization and wage share.

We specify the rate of change in labour productivity as follows:[4]

$$\hat{a}_t = \gamma_1(u_t - \overline{u}) + \gamma_2(\psi_t - \overline{\psi}) + C_a, \tag{7}$$

where a denotes labour productivity and C_a is a constant term.

The first term on the right-hand of equation (7) shows that labour productivity changes because of the labour hoarding effect. If the labour market is rigid and firms cannot adjust employment levels following a decrease in output, then labour productivity falls when the rate of capacity utilization declines, that is, $\gamma_1 > 0$. If the labour market is flexible, by contrast, and firms can easily reduce labour input following a decrease in output, then $\gamma_1 > 0$ is small or zero.

The second term on the right-hand of equation (7) shows that labour productivity tends to rise when wage share is high, since firms want to adopt labour-saving technology when wage share rises (termed the 'reserve-army creation effect').[5] Therefore, we assume that $\gamma_2 > 0$.

Since $\psi = \omega/a$, the following equation holds:

$$\hat{\psi}_t = \hat{\omega}_t - \hat{a}_t . \tag{8}$$

From equations (5)–(8), we obtain

$$\partial\hat{\psi}_t \big/ \partial u_t = \frac{\alpha_1(\beta_2 - 1) + \beta_1(1-\alpha_2)}{1-\alpha_2\beta_2} - \gamma_1 = \Omega_1 , \tag{9}$$

$$\partial\hat{\psi}_t \big/ \partial \psi_t = \frac{\beta_4(1-\alpha_2)}{1-\alpha_2\beta_2} - \gamma_2 = \Omega_2 . \tag{10}$$

In equation (9), the sign of Ω_1 represents distributive regimes. If $\Omega_1 > 0$, an increase in the rate of capacity utilization raises wage share and hence this distributive regime can be defined as pro-cyclical wage share. On the contrary, if $\Omega_1 < 0$, an increase in the rate of capacity utilization reduces wage share and hence this distributive regime can be defined as counter-cyclical wage share. Further, in equation (10), the sign of Ω_2 is ambiguous.

2.3 Demand regime

We specify the demand regime that represents how a change in wage share affects the rate of capacity utilization. We specify the rate of change in the rate of capacity utilization as

$$\hat{u}_t = \phi_1(u_t - \bar{u}) + \phi_2\psi_t + C_u , \tag{11}$$

where C_u is a constant term.

The first term on the right-hand of equation (11) shows the quantity adjustment of the goods market. We assume that $\phi_1 < 0$, which corresponds to the Keynesian stability condition.

The second term on the right-hand of equation (11) shows how wage share affects the rate of capacity utilization, and the sign of ϕ_2 corresponds to demand regimes. If $\phi_2 > 0$, the economy is in a wage-led demand regime. If $\phi_2 < 0$, the economy is in a profit-led demand regime.

2.4 Stability of dynamics

From equations (9)–(11), we can obtain the Jacobian matrix that is evaluated at the steady-state equilibrium values:

$$J = \begin{pmatrix} \partial \dot{u}/\partial u & \partial \dot{u}/\partial \psi \\ \partial \dot{\psi}/\partial u & \partial \dot{\psi}/\partial \psi \end{pmatrix} = \begin{pmatrix} \phi_1 & \phi_2 \\ \Omega_1 & \Omega_2 \end{pmatrix}. \tag{12}$$

We can examine the stability of this dynamic system. The necessary and sufficient conditions for the local stability of the steady-state equilibrium are given by $traceJ = \phi_1 + \Omega_2 < 0$ and $\det J = \phi_1 \Omega_2 - \Omega_1 \phi_2 > 0$. In addition, we assume that $\Omega_2 < 0$. Then, we have $traceJ = \phi_1 + \Omega_2 < 0$ because $\phi_1 < 0$.

If $\phi_2 < 0$ and $\Omega_1 > 0$, in other words, the demand regime is a profit-led demand regime and the distributive regime is a pro-cyclical wage share regime, we have $\det J = \phi_1 \Omega_2 - \Omega_1 \phi_2 > 0$. Therefore, in this case, the dynamic system is stable. Similarly, if $\phi_2 > 0$ and $\Omega_1 < 0$, in other words, the demand regime is a wage-led demand regime and the distributive regime is a counter-cyclical wage share regime, we have $\det J = \phi_1 \Omega_2 - \Omega_1 \phi_2 > 0$, and accordingly, the dynamic system is stable.

If $\phi_2 > 0$ and $\Omega_1 > 0$ —wage-led demand and pro-cyclical wage share regimes—or

$\phi_2 < 0$ and $\Omega_1 < 0$—profit-led demand and counter-cyclical wage share regimes, these combinations can make the steady-state equilibrium unstable because $\Omega_1\phi_2 > 0$ and $\det J = \phi_1\Omega_2 - \Omega_1\phi_2$ can be negative. However, if $|\phi_1\Omega_2| > |\Omega_1\phi_2|$, even under these combinations, the steady-state equilibrium is stable because the condition of $\det J = \phi_1\Omega_2 - \Omega_1\phi_2 > 0$ is satisfied.

Table 1 shows the stability of dynamics under each combination of these demand and distributive regimes.

[Insert Table 1]

3 Estimation

In this section, we estimate the price and nominal wage Phillips curves, rate of change in labour productivity, and demand regime by using data on the Japanese economy to analyse the dynamic system of demand and income distribution.

3.1 Data

We use quarterly data for the presented estimation.

Wage share ψ is obtained by dividing total labour costs by total labour costs plus operating profits plus depreciation costs in all industries. The source of all data series is the *Corporation Statistics* published by the Statistics Bureau, Ministry of Internal Affairs and Communications.[6]

We adopt the output-capital ratio as a proxy variable of the rate of capacity utilization u (the average of 1990=100).[7] This ratio is obtained by dividing real output by real capital stock. Real output is obtained by dividing value-added nominal output in all industries and in all scales by the GDP deflator in all industries. The source of value-added nominal output is the *Corporation Statistics*, and that of the GDP deflator is the *Report on National Accounts*. Real capital stock is the average of real fixed capital stock at the beginning and end of the period. The source of this is the *Preliminary Quarterly Estimates of the Gross Capital Stock of Private Enterprises* published by the Statistics Bureau.

Price P is obtained from average monthly CPI data published by the Statistics Bureau.

Nominal wage W is obtained by dividing total labour costs by labour input. Labour input is obtained by multiplying the number of employees by working hours per employee. The source of the number of employees is the *Corporation Statistics*, and that of working hours per capita is the *Monthly Labor Survey* published by the Ministry of Health, Labor, and Welfare.

Labour productivity a is obtained by dividing real output by labour input.

Since none of the data series mentioned above is seasonally adjusted, we use them after seasonal adjustment based on X-12-ARIMA programs.

The rate of change in each variable is obtained by computing the rate in each quarterly data series on a year-on-year basis.

The expected inflation rate π^e is obtained by taking a linearly declining moving average of price inflation rates with linearly decreasing weights over the past 12 quarters.[8]

3.2 Estimation results

By using this data series, we estimate the price and nominal wage Phillips curves expressed as equations (1) and (2), rate of change in labour productivity (equation (7)), and demand regime (equation (11)).

The estimation period is from 1977Q1 to 2007Q3, a period that corresponds to the peak of the 8th cycle to the peak of the 14th cycle. Since this period is after the oil crisis and before the Lehman crash, we exclude disturbed periods from the estimation.

In our model, because some variables are interdependent and thus determined at the same time, we cannot estimate by using OLS. Therefore, we adopt GMM (General Method of Moments) as the estimation method[9] and use lagged explanatory variables as the instrumental variables. We then check whether our model specification including instrumental variables is correct by using J-tests.

If there are nonsignificant explanatory variables in the estimated results, we retain them as long as the adjusted R-square value of the estimated equation including them is higher than that of the estimated equation excluding them.

Finally, we use data at time t as the explanatory variables in general. However, if the adjusted R-square value of the estimated equation rises by using lagged data, we adopt lagged explanatory variables.

[Insert Table 2]

Table 2 shows the estimation results.[10]

In all estimated equations, from the p-values of the J-statistics, the null hypotheses that the model specification is correct are not rejected, even at the 10% significance level. Therefore, we can consider these models to be correct.

All estimated coefficients are statistically significant at the 5% level and their signs are all consistent with our assumptions. Further, the sign of α_1, which is ambiguous in equation (1), is positive, suggesting that Japanese firms tend to raise the price of goods during a boom.

Based on these estimated results, we analyse the distributive and demand regimes in Japan.

Firstly, we analyse real wage dynamics. As shown in Tables 2-(a) and 2-(b), $\alpha_1 = 0.054$, $\alpha_2 = 0.267$, $\beta_1 = 0.068$, and $\beta_2 = 0.462$. We substitute these estimation values into equation (5) to obtain

$$\partial \hat{\omega}_t \big/ \partial u_t = \frac{\alpha_1(\beta_2 - 1) + \beta_1(1 - \alpha_2)}{1 - \alpha_2 \beta_2} = 0.024 > 0 .$$

Therefore, real wage is found to be pro-cyclical to the rate of capacity utilization. In other words, the Japanese economy was a labour market-led regime during the study period.

Secondly, we analyse wage share dynamics. Table 2-(c) shows that $\gamma_1 = 0.404$. We substitute this estimation value into equation (9) to obtain

$$\partial \hat{\psi}_t \big/ \partial u_t = \frac{\alpha_1(\beta_2 - 1) + \beta_1(1 - \alpha_2)}{1 - \alpha_2 \beta_2} - \gamma_1 = \Omega_1 = -0.380 < 0 .$$

Since the sign of Ω_1 is negative, wage share is shown to be counter-cyclical to the rate of capacity utilization. In other words, the Japanese distributive regime was defined as a counter-cyclical wage share one during the study period because the rigidity of the domestic labour market. Since it was difficult for Japanese firms to reduce labour input as much as decreases in output, the rate of capacity utilization had strong positive effects on labour productivity. As a result, even though real wage was pro-cyclical to the rate of capacity utilization, wage share was counter-cyclical.

Thirdly, we analyse the Japanese demand regime. From Table 2-(d), we obtain

$$\phi_2 = -1.071 < 0 .$$

Therefore, we find that the Japanese economy was a profit-led demand regime during the study period. This estimated result is consistent with the empirical results on the Japanese economy shown in Naastepad and Storm (2007), Azetsu et al. (2010), and Nishi (2010).

Finally, we analyse the stability of the dynamic system. From the above-estimated results, we obtain the following Jacobian matrix:

$$J = \begin{pmatrix} \phi_1 & \phi_2 \\ \Omega_1 & \Omega_2 \end{pmatrix} = \begin{pmatrix} -0.539 & -1.071 \\ -0.380 & -0.936 \end{pmatrix}.$$

From the elements of J, we obtain $traceJ = -1.475 < 0$ and $\det J = 0.098 > 0$. Since all the stability conditions are satisfied, we can consider that the dynamic system of the rate of capacity utilization and wage share was stable in Japan during the study period. As shown in Table 1, the combination of a profit-led demand regime and counter-cyclical wage share can make a dynamic system unstable. However, in Japan, despite this combination, the dynamic system was actually stable, as $|\phi_1 \Omega_2| > |\Omega_1 \phi_2|$ holds. Since wage share had negative effects on nominal wage through labour–management cooperation ($\beta_4 < 0$) and positive effects on labour productivity through the reserve-army creation effect ($\gamma_2 > 0$), the sign of Ω_2 is negative and absolute value of Ω_2 is sufficiently large. Therefore, wage share was seen to be regulated within a constant range and the dynamic system was stable. We thus find that the stability of the Japanese economy depended on cooperative labour–management relations.

4 Structural changes

In the previous section, we explained the characteristics of the structure of demand and income distribution in Japan between 1977 and 2007. However, structural changes occurred during this 30-year period. Accordingly, in this section, we examine the existence of structural changes in the Japanese labour market and their effect on the stability of dynamics.

We focus on the following two structural changes.

Firstly, the nominal wage Phillips curve may have changed around 1990. According to Uni (2009), nominal wage became sensitive to the change in output from the latter half of the 1980s, because the number of part-time female workers increased in this period, especially in the service sector. During the study period in Japan, the nominal wage of regular workers did not reflect changes in output because their employment was strongly secured. By contrast, the employment security of non-regular workers was weak and hence their nominal wage tended to reflect fluctuations in output and labour demand. Therefore, as the proportion of non-regular workers increased, average nominal wage became sensitive to the change in output. This structural change may have led to the change in β_1 in equation (2).

Furthermore, a proportional increase in non-regular workers may have changed how labour–management cooperation affected nominal wage. In Japan, the rate of unionization of non-regular workers is very low and hence collective bargaining does not affect their nominal wage of levels. Therefore, as the proportion of non-regular workers increased, the parameter β_4 that represents the effect of labour–management cooperation on average nominal wage may have become small. For these reasons, we estimate the nominal wage Phillips curve before and after this structural change.

Secondly, the rate of change in labour productivity may have changed around 2000. Before the late 1990s, the speed of employment adjustment was very slow in Japan, but this adjustment speed has quickened in recent years. If Japanese firms can adjust labour input flexibly, the parameter γ_1 that represents the effect of labour hoarding on labour productivity may become small. For this reason, we estimate the rate of change in labour productivity before and after this structural change.

4.1 Structural change in the nominal Phillips curve

We divide the estimation period of the nominal wage Phillips curve into 1977Q3–1991Q1 and 1991Q1–2007Q3. The former period runs from the peak of the 8th cycle to the peak of the 11th cycle, after which the bubble economy burst. The latter period runs from the peak of the 11th cycle to the peak of the 14th cycle. We check whether this breakpoint is appropriate by using

Wald and likelihood ratio tests.[11] From the results of these tests, we find that this breakpoint is statistically significant at the 1% level.

Table 3 shows the estimated results of the nominal wage Phillips curve in 1977Q3–1991Q1 and 1991Q1–2007Q3.

[Insert Table 3]

By comparing the two estimated results in Table 3, we find three remarkable differences.

Firstly, the coefficient of the rate of capacity utilization u_t is not statistically significant before 1991, even at the 10% level, whereas it is statistically significant at the 1% level thereafter. This result may reflect an increase in non-regular workers. Gordon (1982) and Grubb et al. (1983) claim that the nominal wage Phillips curve in Japan was steeper than that in the United States (i.e. nominal wage adjusted elastically when the unemployment rate changed). However, for a similar period, Kurosaka and Goto (1987) argue that Japanese nominal wage was rigid to a change in output, because the unemployment rate was stable and Okun coefficient very large. In other words, in Japan until the 1980s, because most workers were classified as regular whose employment was strongly secured, nominal wage did not reflect the change in output, explaining the lack of a correlation between the change in nominal wage and rate of capacity utilization in 1977Q3–1991Q1. By contrast, after the 1990s, as a result of the proportional increase in non-regular workers, nominal wage became sensitive to the change in output. Therefore, there is obvious clear correlation between the change in nominal wage and rate of capacity utilization in 1991Q1–2007Q3.

Secondly, the coefficient of the rate of change in price $\hat{P}_{t-2}$ is statistically significant at the 1% level before 1991, whereas it is not statistically significant thereafter, even at the 10%

level. The reason for this finding may be the chronic deflation in Japan after the 1990s. During most of the 1990s and the 2000s, the inflation rate was very low or even negative, and it was difficult for firms to let nominal wage reflect the change in the price of goods because of the downward rigidity of the former. Therefore, there was no correlation between change in nominal wage and the change in the price of goods in Japan after the 1990s.[12]

Thirdly, the coefficient of wage share ψ_{t-3} is statistically significant at the 1% level before 1991, whereas it is not statistically significant thereafter, even at the 10% level. The reason for this change may also be a proportional increase in non-regular workers. As mentioned above, nominal wage was strongly influenced by labour–management cooperation until the 1980s because workers were typically regular workers on long-term employment contracts. However, after the 1990s, the proportion of non-regular workers whose nominal wage was not influenced by collective bargaining increased, weakening the effect of labour–management compromise on nominal wage.

In summary, in Japan after 1991, the effect of the rate of capacity utilization on nominal wage strengthened, whereas the effects of the rate of change in price and wage share weakened.

4.2 Structural change in the rate of change in labour productivity

Next, we divide the estimation period of the rate of change in labour productivity into two subperiods. As mentioned above, the structural change in the rate of change in labour productivity may have been caused by the change in the speed of employment adjustment.

Some empirical studies demonstrate that the speed of employment adjustment in Japan rose around 2000. For example, Kurosaka (2011) shows that the Okun coefficient in 2001–2007 was considerably smaller than that in 1981–2001 and claims that Japanese firms adjusted their employment flexibly during the 2000s. In addition, Nakata (2007) demonstrates that, after 2000, many large Japanese firms adjusted their employment levels of regular workers which had been strongly secured until the late 1990s.

We divide the estimation period into 1977Q3–2000Q3 and 2000Q3–2007Q3, with the former period running from the peak of the 8th cycle to the peak of the 13th cycle and the latter period from the peak of 13th cycle to the peak of 14th cycle. As before, we check whether this breakpoint is appropriate by using Wald and the likelihood ratio tests and find it to be statistically significant at the 1% level.

Table 4 shows the estimated results of the rate of change in labour productivity in 1977Q3–2000Q3 and 2000Q3–2007Q3.

[Insert Table 4]

By comparing the estimated results in Table 4, we find two remarkable differences.

Firstly, the coefficient of the rate of capacity utilization u_t is statistically significant at the 1% level before 2000, whereas it is not statistically significant thereafter, even at the 10% level. This change suggests that Japanese firms adjusted employment more flexibly. Before 2000, labour productivity and output were correlated because firms could not adjust their labour input flexibly in accordance with a change in output. However, after 2000, there was no correlation because firms adjusted their labour input flexibly and the labour hoarding effect was lost.

Secondly, the coefficient of wage share ψ_{t-4} is statistically significant at the 1% level before 2000, whereas it is not statistically significant thereafter, even at the 10% level. This change means that the reserve-army creation effect was lost in 2000–2007, when wage share declined continuously in Japan. As a result, firms lacked a strong incentive to introduce labour-saving technology.

In summary, in Japan after 2000, the effects of the rate of capacity utilization and wage share on the rate of change in labour productivity were lost.

4.3 The stability of dynamics in each period

Based on the estimated results, we analyse how these two structural changes influenced the stability of dynamics in 1977Q3–1991Q1, 1991Q1–2000Q3, and 2000Q3–2007Q3 (Table 5).

[Insert Table 5]

In 1977Q3–1991Q1, the sign of $\partial\hat{\omega}_t/\partial u_t$ was negative, implying that the Japanese economy was characterized as a goods market-led regime. In this period, the change in output did not affect nominal wage because most workers were employed in the long-term and as a result, real wage was counter-cyclical to the rate of capacity utilization. From $\Omega_1 < 0$, we find that wage share was also counter-cyclical to the rate of capacity utilization. Therefore, the distributive regime was defined as a counter-cyclical wage share one in this period.

As shown in Section 3, the Japanese economy was a profit-led demand regime. The combination of profit-led demand and counter-cyclical wage share may make the dynamics unstable. However, in this period, the dynamics were stable because the absolute value of Ω_2 was sufficiently large and $\det J > 0$ was satisfied. This finding implies that the regulation of wage share through labour–management cooperation stabilized the dynamics until the 1980s.

In 1991Q1–2000Q3, the sign of $\partial\hat{\omega}_t/\partial u_t$ was positive, suggesting that the Japanese economy switched from a goods market-led regime to a labour market-led one, driven by the fact that nominal wage began to reflect the change in output with an increase in the proportion of non-regular workers, leading real wage to become pro-cyclical to the rate of capacity utilization. However, on the contrary, wage share was still counter-cyclical in this period, because employment adjustment remained rigid and the rate of capacity utilization had positive effects on labour productivity.

In this period, there was a combination of profit-led demand and counter-cyclical wage share, and the absolute value of Ω_2 fell below that seen in 1977Q3–1991Q1. As a result, the sign of $\det J$ switched from positive and negative and hence the dynamics were unstable. The absolute value of Ω_2 was small because the mechanism for the regulation of wage share through collective negotiation was weakened by the proportional increase in non-regular workers excluded from labour unions. 1991Q1–2000Q3 corresponds to the 'lost decade' in Japan, the prolonged recession after the bursting of the bubble economy. In this period, Japanese firms suffered from a decline in the rate of capacity utilization and a profit squeeze with a rise in wage share. This fact is consistent with the instability of the dynamics in this period.

In 2000Q3–2007Q3, the dynamic system restabilized. However, the mechanism of stabilization was different from that in 1977Q3–1991Q1. In this period, it was a necessary condition that the sign of Ω_2 was negative and absolute value of Ω_2 sufficiently large because of the combination of the profit-led demand regime and counter-cyclical wage share. However, in 2000Q3–2007Q3, the value of Ω_2 was zero because neither labour–management cooperation nor the reserve-army creation effect regulated wage share.

On the contrary, the sign of Ω_1 became positive in this period. In other words, the distributive regime switched from a counter-cyclical wage share one to a pro-cyclical wage share regime as firms quickened their speeds of employment adjustment and as the change in labour productivity owing to the labour hoarding effect was lost. As a result, the combination of the demand and distributive regimes resulted in the profit-led demand regime and pro-cyclical wage share. As shown in Table 1, this combination unambiguously makes the dynamics stable. Therefore, the dynamics in 2000Q3–2007Q3 were stabilized not by labour–management cooperation but by the flexible employment adjustment.

5 Conclusions

This study estimated the demand regime and distributive regimes in Japan between 1977 and 2007 and analysed the stability of the dynamics of the rate of capacity utilization and wage share.

Firstly, we found that the Japanese economy was characterized as a labour market-led regime in this period (i.e. real wage was pro-cyclical to the rate of capacity utilization). However, there was counter-cyclical wage share because labour productivity was influenced by the labour hoarding effect. In addition, the Japanese economy was a profit-led demand regime, as shown in some previous studies. Although the combination of the profit-led demand regime and counter-cyclical wage share can make the dynamics unstable, the dynamics were actually stable in Japan, since wage share was sufficiently regulated by labour–management cooperation and the reserve-army creation effect.

From the estimated results in the three subperiods, we find the following characteristics.

During 1977Q3–1991Q1, nominal wage did not reflect changes in output because most workers were employed in the long-term. As a result, real wage was counter-cyclical to the rate of capacity utilization and thus the Japanese economy was defined as a goods market-led demand regime during this period. Wage share was also counter-cyclical to the rate of capacity utilization. Labour unios cooperated with firms and thus nominal wage was regulated to keep wage share within a constant range. Therefore, despite the combination of the profit-led demand regime and counter-cyclical wage share, the dynamics were stable.

During 1991Q1–2000Q3, the Japanese economy switched to a labour market-led regime (i.e. real wage became pro-cyclical), as nominal wage reflected the change in output owing to increase in the proportion of non-regular workers. However, wage share was still counter-cyclical because of the labour hoarding effect. This proportional increase in non-regular workers also weakened the regulation mechanism of wage share because the wage of non-regular workers was influenced little by collective negotiation. As a result, the dynamics became unstable in this period, leading to the prolonged recession in Japan during the 1990s.

During 2000Q3–2007Q3, the distributive regime switched from a counter-cyclical wage share one to a pro-cyclical wage share regime as Japanese firms quickened their speeds of employment adjustment and the labour hoarding effect was lost. As a result, despite the lack of wage share regulation, the dynamics restabilized, because the combination of the profit-led demand regime and pro-cyclical wage share stabilized the dynamics unambiguously.

However, many problems remain unresolved.

Firstly, we did not deal with financial factors. Some studies of these two types of Phillips curves focus on the effect of monetary policy on macroeconomic stability.[13]

Secondly, we did not focus on the rate of employment to avoid the problem of overdeterminancy in our model.

Thirdly, we focused on data for whole industries. However, structural changes in labour markets differ by sector.

Finally, we analysed structural changes only in terms of the nominal wage Phillips curve and the rate of change in labour productivity. Future researchers should thus examine the possibility of a structural change in the price Phillips curve and demand regime.

Notes

1. See Asada et al. (2006) and Proano et al. (2011).
2. Barbosa-Filho and Taylor (2006) estimate similar two regimes in the United States and examine the effective demand curve and distributive curve.
3. For example, Chapter 5 of Kalecki (1971) refers to both scenarios.
4. Tavani et al. (2011) adopt a similar specification.
5. For the reserve-army creation effect, see Sasaki (2010, 2011).
6. In some studies, wage share is obtained by dividing employee compensation by national income with reference to the *Report on National Accounts*. However, the data on wage share obtained by using this method include self-employment. In this study, to focus on income distribution between firms and workers, we use the *Corporation Statistics*.
7. If we assume that technical capital productivity is constant, we can consider the output-capital ratio to be the rate of capacity utilization.
8. This definition is the same as that used by Proano et al. (2007).
9. Proano et al. (2007) carry out their estimation by using GMM.
10. We estimate all equations by using Eviews 7.0.
11. For these breakpoint tests, see Andrews and Fair (1988).
12. Fujita (2006) demonstrates that nominal wage in Japan became insensitive to changes in prices after 1991.
13. For this theme, see Proano et al. (2011) for example.

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Table 1: Combinations of regimes and stability of the dynamic model

Demand regime		Distributive regime	
		$\Omega_1 > 0$ Pro-cyclical wage share	$\Omega_1 < 0$ Counter-cyclical wage share
	$\phi_2 > 0$ Wage-led demand	Stable if $\lvert\phi_1\Omega_2\rvert > \lvert\Omega_1\phi_2\rvert$ Unstable if $\lvert\phi_1\Omega_2\rvert < \lvert\Omega_1\phi_2\rvert$	Stable
	$\phi_2 < 0$ Profit-led demand	Stable	Stable if $\lvert\phi_1\Omega_2\rvert > \lvert\Omega_1\phi_2\rvert$ Unstable if $\lvert\phi_1\Omega_2\rvert < \lvert\Omega_1\phi_2\rvert$

Table 2: Estimation results (1977Q1–2007Q3)

(a) Price Phillips curve

Explained variable: $\hat{P}_t$

Instrumental variables: C, u_{t-1}, u_{t-2}, u_{t-3}, $\hat{W}_{t-1}$, $\hat{W}_{t-2}$, $\pi^e{}_t$

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-8.561399	3.853743	-2.221580	0.0282
u_t	0.053810	0.027139	1.982726	0.0497
$\hat{W}_t$	0.267203	0.067297	3.970488	0.0001
$\pi^e{}_t$	0.553909	0.067310	8.229184	0.0000

$\overline{R}^2$: 0.793574, J-statistic: 0.358372, p-value (J-statistic): 0.948701

(b) Nominal wage Phillips curve

Explained variable: $\hat{W}_t$

Instrumental variables: C, u_{t-1}, u_{t-2}, $\hat{P}_{t-2}$, ψ_{t-3}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	10.98686	10.00638	1.097985	0.2744
u_t	0.067786	0.024442	2.773347	0.0064
$\hat{P}_{t-2}$	0.461797	0.150496	3.068508	0.0027
ψ_{t-3}	-0.259450	0.120724	-2.149125	0.0336

$\overline{R}^2$: 0.698763, J-statistic: 0.752493, p-value (J-statistic): 0.385688

(Correlation with the rate of expected inflation is not found)

(c) The rate of change in labour productivity

Explained variable: $\hat{a}$

Instrumental variables: C, u_{t-1}, u_{t-2}, ψ_{t-4}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-103.7648	22.12798	-4.689303	0.0000
u_t	0.403551	0.090267	4.470630	0.0000
ψ_{t-4}	0.719121	0.185854	3.869287	0.0002

$\overline{R}^2$: 0.309743, J-statistic: 0.528845, p-value (J-statistic): 0.467093

(d) Demand regime

Explained variable: $\hat{u}_t$

Instrumental variables: C, u_{t-1}, ψ_{t-1}, ψ_{t-2}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	148.3812	20.72643	7.159034	0.0000
u_{t-1}	-0.538684	0.070359	-7.656253	0.0000
ψ_t	-1.071478	0.185803	-5.766742	0.0000

$\overline{R}^2$: 0.438897, J-statistic: 2.267655, p-value (J-statistic): 0.132100

Table 3: Estimation results of the nominal wage Phillips curve (1977Q3–1991Q1, 1991Q1–2007Q3)

(a) 1977Q3–1991Q1

Explained variable: $\hat{W}_t$

Instrumental variables: C, u_{t-1}, u_{t-2}, $\hat{P}_{t-2}$, ψ_{t-3}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	38.68424	12.39220	3.121660	0.0029
u_t	-0.003074	0.042440	-0.072430	0.9425
$\hat{P}_{t-2}$	0.467807	0.154905	3.019962	0.0039
ψ_{t-3}	-0.541660	0.177699	-3.048192	0.0036

$\overline{R}^2$: 0.530594, J-statistic: 0.115125, p-value (J-statistic): 0.734383

(b) 1991Q1–2007Q3

Explained variable: $\hat{W}_t$

Instrumental variables: C, u_{t-1}, u_{t-2}, $\hat{P}_{t-2}$, ψ_{t-3}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-20.89657	10.30071	-2.028653	0.0467
u_t	0.229061	0.072224	3.171553	0.0023
$\hat{P}_{t-2}$	0.450680	0.389938	1.155772	0.2521
ψ_{t-3}	-0.035078	0.078725	-0.445579	0.6574

$\overline{R}^2$: 0.544998, J-statistic: 0.408047, p-value (J-statistic): 0.522963

Table 4: Estimation results of the rate of change in labour productivity (1977Q3–2000Q3, 2000Q3–2007Q3)

(a) 1977Q3–2000Q3

Explained variable: $\hat{a}$

Instrumental variables: C, u_{t-1}, u_{t-2}, ψ_{t-4}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-116.5465	21.40461	-5.444925	0.0000
u_t	0.520163	0.102949	5.052619	0.0000
ψ_{t-4}	0.634835	0.189577	3.348686	0.0012

$\overline{R}^2$: 0.365479, J-statistic: 1.145476, p-value (J-statistic): 0.284498

(b) 2000Q3–2007Q3

Explained variable: $\hat{a}$

Instrumental variables: C, u_{t-1}, u_{t-2}, ψ_{t-4}

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-75.16856	65.51521	-1.147345	0.2621
u_t	0.047529	0.260319	0.182579	0.8566
ψ_{t-4}	0.756693	0.533085	1.419458	0.1681

$\overline{R}^2$: 0.108153, J-statistic: 1.249807, p-value (J-statistic): 0.263589

Table 5: Stability of dynamics in each period

	1977Q1–1991Q1	1991Q1–2000Q3	2000Q3–2007Q3
$\partial\hat{\omega}_t / \partial u_t$	-0.033 goods market-led	0.114 labour market-led	0.114 labour market-led
Ω_1	-0.553 counter-cyclical wage share	-0.406 counter-cyclical wage share	0.114 pro-cyclical wage share
Ω_2	-1.177	-0.635	0
$traceJ$	-1.610	-1.174	-0.539
$\det J$	0.042	-0.093	0.122
stability	stable	unstable	stable