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The Keynesian Unemployment and Capital Shortage: A Simple Dynamic Approach with Trade Unions

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ABSTRACT

The purpose of this paper is to provide a dynamic analysis by utilizing the bargaining model which incorporates the relationship between the behavior of trade union and the macroeconomic performance in Japan. Our discussion focuses on the influence of trade union on wage and employment through the re-examination of its behavior, although the wage and employment effects of trade union were slighted during the stagnation of Japan's economy as the studies of Todate (2009) and Booth (2014). From the other aspect, the framework of today's macroeconomic policy by the Japanese government includes the expected roles of the prices and wages. In this sense, the effect of trade union in determining wages is worth investigating. Based on these aspects, this paper investigates the effects of trade union on macroeconomy and the change in the role of trade union in Japan by the theoretical and the empirical analyses.

The dynamic system of the bargaining process over wage and employment that this paper uses is the application of the trade union model. It gives a specific definition of the unemployment. Concretely, the trade union model splits unemployment into two categories: (1) unemployment due to capital shortage, and (2) unemployment due to demand shortage. Moreover, it analyses how the employment-wage (or the capacity utilization-wage) relation in the short-run arises as a consequence of the wage bargaining. By introducing a particular type of investment function into the dynamic model, the stability conditions are investigated and we have the following conclusions: (1) the stability of the economy depends on the bargaining power of the trade union, (2) the balanced growth path can occur where the union's monopoly power is sufficiently weak even if we have the Harrod-type investment function that is usually regarded as the major factor of leading the instability of the economy. In addition, we explore the relationship between the bargaining structure in the corporatist model and the stability condition, and then we find that a trade union's behavior can help the capitalist economy to remain taking a balanced growth path. Furthermore, the different types of unemployment including (a) unemployment due to capital shortage, and (b) the one due to demand shortage, are considered.

As for the analysis concerning the impact of the wage bargaining structure on the stability of the economy, there are many attempts to provide empirical researches on how the wage bargaining structure affects the macroeconomic performance. This paper conducted the estimations as the empirical researches by utilizing the "right to manage" model. Our estimations of wage equation for manufacturing industries by OLS and GMM showed that the "right to manage" model has a certain interpretability of trade union's behaviour in recent Japan. However, we could not find the clue to the structural change of wage determination structure and the strong bargaining process.

Key words: bargaining model, trade union, wage determination, GMM
JEL Classification Code: E24, J51

1. Introduction

In Japan, the impacts of wages and prices on the macroeconomy, as well as their relationship have been in the spotlight again recently. It is expected that inflation expectations, mainly due to monetary policy, will increase wages and aggregate demand, leading to the economic expansion. Under the policy framework called Abenomics, price determination mechanism as well as the wage determination process have become an important issue.

This paper investigates the following three points: the first is to examine the wage determination mechanism. From 1970-1990, including the stagnation period after the bubble economy in 1986-1991, there was a growing awareness of the essential importance of the trade union behavior for determining wages and the macroeconomic performance of the economy. Brunello and Wadhwani (1989) and Inoue et al. (2006) analyzed the wage equation based on the bargaining behavior between trade unions and firms. During the lost 20 years in Japan after the bubble economy, the influence of trade unions on wage determination was believed to have become smaller, but then, it is beginning to be reviewed in the power of the labor unions (Noda (2004), and Boeri and Ours (2013)). In this context, this paper focuses on the trade union and its bargaining process to determine wages.

The second is to examine the dynamic process of the bargaining process and stability of the economy. Bargaining theories have specified the negotiating process within the static models rather than the dynamic framework (see, for example, McDonald and Solow (1981) and Oswald (1985). However it must be inappropriate to analyze the nature of unemployment in such a static framework. As Klundert and Schaik (1990) has pointed out, the demand deficiency as well as capital accumulation have an effect on the actual unemployment. It will be misleading for the government to try to increase the effective demand in the case where there is no deflation gap, and it also seems to be misleading for the government to use a demand management policy for reducing the rate of unemployment in the case where there is a capital shortage. Thus, it should be the second aim of our study to clarify the category of the unemployment. In this paper, following and developing Klundert and Schaik (1990), the unemployment is broken down into two parts; unemployment due to demand shortage and unemployment due to capital shortage, where the features of the Keynesian type model with market restriction can be applied.

The third aim of the paper is to provide a dynamic analysis consistent with bargaining theories. After examining the workings of the dynamic model, we reach the major point that the stability condition is related to the union's bargaining behavior including the bargaining power. Moreover, it wil1 also be proved that whether the instability principle in the Harrodian sense can be ensured or not depends on how the trade unions behave in the wage bargaining process. In this context, a wage equation with trade union behavior will be estimated in order to confirm whether the bargaing power has changed or not.

The paper proceeds as follows. In section 2 we present a basic framework for the firm's actual labor demand function and give a rigorous definition of the unemployment. Section 3 provides the "monopoly union" model which gives the wage-unemployment outcomes with a specific union's monopoly power. In section 4, we analyse the features of the simple dynamic model which incorporates the investment function. In section 5, we intruduce the "right to manage" model which is applicable to the empirical study. In order to exmine the trade union behavior empirically, the estimatation of the wage equation is conducted in section 6. Concluding remarks are in section 7.

2. The Framework

Suppose that the production function by which national output (Y) is reated to notional labor demand(L) and cpaital (K) is given by a Cobb-Douglas form:

(1) $Y = AL^{\alpha}KL^{1-\alpha},\ 0 < \alpha < 1,\ A > 0,$

where A represents overall TFP (total factor productivity). In the short-run, both K and A must be fixed at given levels. The firm's notional real profit(π) in terms of capital stock is given by

(2) $\pi = Al^{\alpha} - Rl - r$,

where $l = \frac{L}{K}$. R is the real wage rate and r is the real cost of capital. Hence, the profit maximizing the level of notional labor-capital raition (l) can be written as

(3) $l = \frac{L}{K}$,

where $z = \frac{\alpha}{1-\alpha}$.

A representative firm will try to employ workers following equation (3) unless there is supply restriction in the labor market or demand restriction in the market.

As far as demand is concerned, we adopt a simple formula:

(4) $X = RN + C + I + G$,

where *X, I* and *G* refer to total expenditure, investment and government expenditure respectively. Assuming workers who receive wages do not save at all, total consumption equals consumption by workers ($R \times N$) and consumption by others (C). According to the demand restriction given by equation (4), the realized, not notional, output will be given by

(5) $X = AN^{\alpha}K^{1-\alpha}$,

where *N* is actual employment by firms.

The rate of capacity utilization (δ) can be defined by

(6) $\delta \equiv \frac{X}{Y}$,

the ratio of an actual putput restrcted by effective demand (X) to notional output (Y) that firms warrant at a normal level of capacity utilixzation. From equations (1), (5) and (6) as well, we obtain

(7) $n = \delta^{\frac{1}{\alpha}} l$,

where n ($\equiv \frac{N}{K}$) denotes the labor-capital ratio. As for the consumption C, a part of total consumption, asseme that it is positively related to the degree of capacity utilization. Then a linear relationship between *C* and δ can be given as

(8) $C = c\delta K, c > 0$ const.

Substitution of equations (3), (7) and (8) into equation (4) yields

(9) $x = z\delta^{\frac{1}{\alpha}} + c\delta + g + f$

where $x = \frac{X}{K}$, $g = \frac{I}{K}$, $f = \frac{G}{K}$. From equations (3), (5) and (7), taking account of the definition of x, we obtain another formula for x:

(10) $x = A\left(\frac{z}{R}\right)^{\alpha}\delta$.

Hence, we use (9) and (10) to derive

(11) $A\left(\frac{z}{R}\right)^{\alpha}\delta - z\delta^{\frac{1}{\alpha}} - c\delta = g + f$,

and solving (11) for use below, we express (11) in the implicit function:

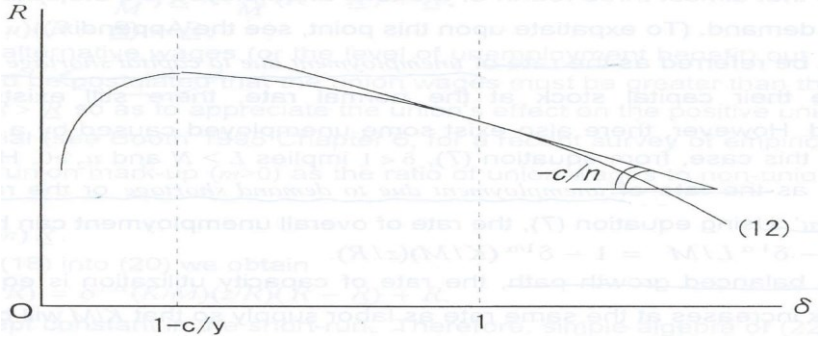
(12) $\Phi(\delta, R; r, \alpha, A, c, g, f) = 0$.

Differentiating (11) with respect to *R* to verify the sign of $\frac{dR}{d\delta}$, we use y $\equiv \frac{Y}{K}$ to find

(13) $\frac{dR}{d\delta} = \frac{y\left\{1 - \frac{c}{y} - \delta^{\frac{1-\alpha}{\alpha}}\right\}R}{z\delta}$.

It should be noted that $\frac{c}{y}$ is equal to $\frac{C}{X}$, the ratio of non-worker`s consumption to actual output and thus it is small but positive. For a given set of $\{r, g, f\}$, the slope of (12) in the $R - \delta$ space will be simply positive in the case where $\delta < (1 - \frac{c}{y})^{\frac{\alpha}{1-\alpha}}$ is assured and vice versa. Theoefore, the alternative combinations of variables in equation (12) which will produce equilibrium in the product market can be drawn in Figure 1 as the hump-shaped curve. It may be notable to find

Figure 1 ($\alpha = 0.5$)



that when δ=1, the slope of (12) becomes $-\frac{c}{n}$, per capita non-workers' consumption. Moreover, it should be also noted that a decrease in g will induce a decrease in real wages and shift this curve downwards, as is shown in Figure 1[1].

As we have already shown, firms will estimate the level of notional labor demand so as to make capital operate at the normal rate. However, they are bound to employ even less number of workers than the notional level if the degree of capacity utilization is less than unity, the case where there is the positive output gap. Therefore, the planned employment can be realized if and only if there is no gap between notional and actual output. It may be natural to define the employment gap, that is unemployment, by the following simple formula:

(14) $u \equiv \frac{M-N}{M}$,

where M represents the labor supply in the society and u denotes the rate of unemployment. The percentage growth rate of labor supply is assumed to be $\nu > 0$ which is given exogenously. A careful consideration would make it clear that if the rate of capacity utilization is less than unity so that the notional demand for labor is greater than the actual employment, then the rate of unemployment must be broken down into two parts, u_1 and u_2, defined by

(15) $u \equiv u_1 + u_2 \equiv \frac{M-L}{M} + \frac{L-N}{M}$, for $M \geq L \geq N$.

Using (15), the percentage contribution of u_1 to u($u_1^{\%}$) as well as that of u_2 to u($u_2^{\%}$) are defined by

(16) $u_1^{\%}$=$100\times (1-\frac{L}{M})/(1-\delta^{\frac{1}{\alpha}}\frac{L}{M})$,

and

(17) $u_1^{\%} = 100\times \left\{(1-\delta^{\frac{1}{\alpha}})\frac{L}{M}\right\}/(1-\delta^{\frac{1}{\alpha}}\frac{L}{M})$,

respectively. Let give a numerical example. Assume L/M, and δ and α to be 0.95, 0.95 and 0.7 respectively. In this case u_1=5% and u_2=6.7% and we find that $u_1^{\%}$becomes 27.4%. This means that almost three fourth of the total unemployed are attributable to a deficiency of the effective demand.

u_1 can be referred as *the rate of unemployment due to capital shortage* because even if firms utilize their capital stock at the normal rate, there still exists a number of unemployed. However, there also exist some unemployed caused by a lack of effective demand. In this case from equation (7), δ<1 implies L>N and, u_2 >0. Hence, u_2 should be referred as the rate of unemployment due to demand shortage or the rate of 'keynesian unemployment'. Using equation (7), the rate of overall unemployment can be rewritten as

(18) $u = (1-\delta^{\frac{1}{\alpha}})\frac{L}{M} = 1-\delta^{\frac{1}{\alpha}}(\frac{K}{M})(\frac{Z}{R})$

[1] As for the locus where $\frac{dR}{d\delta}$ is assured for equation (12), that is the locus of $1-\frac{c}{y}-\delta^{\frac{1-\alpha}{\alpha}}=0$, it is clear that $\frac{dR}{d\delta}<0$ and that $\delta \to 1$ implies $R \to 0$.

In the balanced growth path, the rate of capacity utilization is equal to unity and capital stock increases at the same rate as labor supply so that *K/M* will be kept constant. Therefore, the employment rate *L/M* remains constant unless both z and *R* alter and then the rate of unemployment would be fixed at the following level:

(19) $u^* = 1 - (\frac{L}{M})$.

Because a steady state requires a constant employment rate which is very likely to be less than unity, the steady state rate of unemployment, u^*, may be positive. Steady state also implies *L=N* so that this unemployment is justified to be caused by capital shortage. Therefore, we will find that the steady state rate of unemployment cannot be reduced by any demand-side procedures such as the demand management policy.

We will reach a complete system made up three indigenous variables, δ, *R* and *g* after analyzing how *R* as well as *g* are determined. These are subjects in the following sections.

3. The Monopoly Union Model

Micro-foundations related to the trade union behavior have played an important role to explain the wage-employment settlement between trade unions and firms. Many papers tackled this bargaining problems have categorized two dominant bargaining models: the "monopoly union" model and the efficient bargaining model (see, for example, MacDonald and Solow (1981), Oswald (1985), Calmfors (1985) and Booth (1995)). In the sequel of this paper we will use the "monopoly union" model in which the trade union can choose the wage by bargaining with the firm whereas the level of employment is determined unilaterally by the firm.

Suppose that the trade union has the welfare function (*W*) concerning its members' expected utility. Using (14), we obtain the welfare function of the form

(20) $W = \frac{N}{M}R + \left(1 - \frac{N}{M}\right)\underline{R} = \frac{N}{M}\left(R - \underline{R}\right) + \underline{R}$
$= (1 - u)\left(R - \underline{R}\right) + \underline{R}$,

where $\underline{R}$ is the alternative wages (or the level of unemployment benefit) out of the union sector. It is assumed that the union wages must be greater than the alternative wages, that is $R > \underline{R}$, so as to appreciate the union`s effect on the positive union-nonunion wages differential (see chapter 6 of Booth 1995, for a survey of empirical research). Introducing the union markup ($m > 0$) as the ratio of union wages to non-union wages ,we obtain

(21) $R = (1 + m)\underline{R}$.

By substituting (18) into (20), we obtain

(22) $W \equiv W(\delta, R) = \delta^{\frac{1}{\alpha}}\left(\frac{K}{M}\right)\left(\frac{z}{R}\right)\left(R - \underline{R}\right) + \underline{R}$,

where *K/M* is kept constant in the short-run. Therefore, simple algebra of (22) shows that the marginal rate of substitution ($MRS_{R\delta}$) between real wages and the rate of capacity utilization is given by the equation

(23) $MRS_{R\delta} \equiv \frac{dR}{d\delta} = -\frac{(R-\underline{R})R}{\alpha\delta\underline{R}} < 0$.

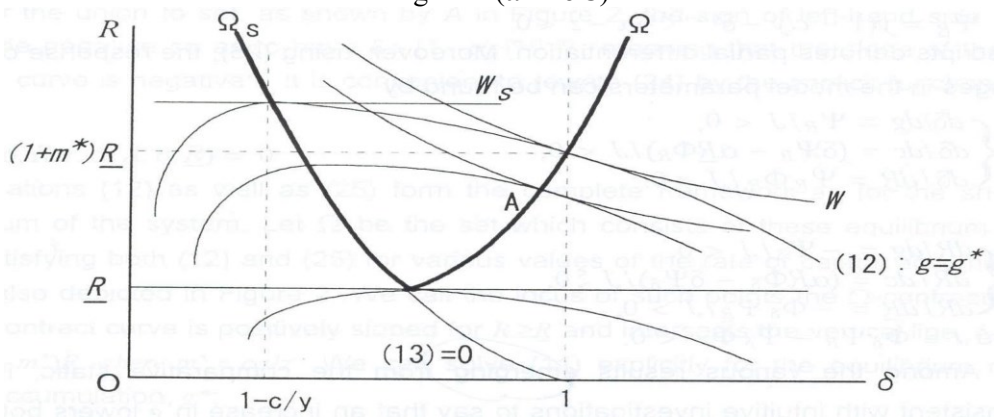
As for the $MRS_{R\delta}$, it is clear from (23) that the absolute value of $MRS_{R\delta}$ tends to be zero as *R* decreases towards $\underline{R}$ and that it also decreases as δ increases.

Suppose that the trade union maximizes *W* given by (20) with subject to (11) for a given set $\{g, f, A, K, M, \alpha, z, \underline{R}\}$. As far as a short-run equilibrium is concerned, the first-order condition for the trade union's desired wages can be written as

(24) $\frac{y(1 - \frac{c}{y} - \delta^{\frac{1-\alpha}{\alpha}})R}{z\delta} = -\frac{(R-\underline{R})R}{\alpha\delta\underline{R}}$.

(24) implies that the left- hand side which represents the slope of the labor demand schedule given by (13) must be equal to $MRS_{R\delta}$, the right-hand side. Therefore, as for the point for the union to set, as shown by *A* in Figure 2, the sign of left-hand side of (24) should be negative so

Figure 2 ($\alpha = 0.5$)



as to have $\delta > (1-\frac{c}{y})^{\alpha(1-\alpha)}$, meaning that the slope of the labor demand curve is negative[2]. It is convenient to rewrite (24) by the implicit function of the form:

(25) $\Psi(\delta, R; r, \alpha, A, c, \underline{R}) = 0$

Equations (12) and (25) form a complete framework as for the short-run equilibrium of the system. Let Ω be the set which consists of these equilibrium points (δ, R) satisfying both (12) and (25) for various values of the rate of capital accumulation. This is also depicted in Figure 2. We call the locus of such points the Ω-contract curve. A Ω-contract curve is positively sloped for $R \geq \underline{R}$ and intersects the vertical line, δ=1 at $R^* = (1+m^*)\,\underline{R}$ where $m^*=c\alpha/z$. We can solve (11) explicitly for the equilibrium rate of capital accumulation, g^*

(26) $g^* = A\left(\frac{z}{R^*}\right)^{\alpha} - z - c - f,$

at the point $(1, R^*) \in \Omega$. Therefore, $g^*$is identical with "the warranted rate of growth" in the Harrodian sense because this assures the normal utilization of capital (see, for example Harrod 1973). Notice that there is no Keynesian unemployment on the warranted growth path and only unemployment due to capital shortage matters. In this case, as observed before, the steady state rate of unemployment, u^* given in (19), is very likely to be positive but variable in the long-run. This is because the employment rate can change if the rate of capital accumulation, g^* is not equal to the rate of labor supply growth, v, which is referred as natural rate of growth in the Harrodian sense. It is clear that if $g^*<v$, for example, then the employment rate will fall and u^* will rise. Policies should be directed towards raising the level of g^* so as to avoid an increase of u^*.This may be achieved by some supply-side procedures, such as a decrease in $\underline{R}$ and a fall in c.

Differentiation of (12) and (25) leads in the conventional way to

(27) $\begin{bmatrix}\Phi_\delta & \Phi_R \\ \Psi_\delta & \Psi_R\end{bmatrix}\begin{bmatrix}d\delta \\ dR\end{bmatrix} = \begin{bmatrix}1 \\ 0\end{bmatrix} dg + \begin{bmatrix}\delta \\ \alpha\underline{R}\end{bmatrix} dc + \begin{bmatrix}0 \\ -\Psi_{\underline{R}}\end{bmatrix} d\underline{R},$

where

$$\Phi_\delta = y\left(1 - \frac{c}{y} - \delta^{\frac{1-\alpha}{\alpha}}\right) < 0,$$

$$\Phi_R = -\frac{y\alpha\delta}{R} < 0,$$

[2] Using the bordered Hessian matrix (H) for his constrained optimization problem, the second-order condition can be given by

$$\det H = \begin{vmatrix}0 & \Phi_\delta & \Phi_R \\ \Phi_\delta & \mathrm{L}_{\delta\delta} & \mathrm{L}_{\delta R} \\ \Phi_R & L_{R\delta} & L_{RR}\end{vmatrix} > 0,$$

where $L = W(\delta, R) - \lambda\Phi(\delta, R)$, and λ is the *Lagrangian* multiplier. It can be easily shown that this condition is satisfied by some additional restrictions related to a small α ($\alpha > \frac{1}{3}$) and a small m ($m < \delta^{\frac{1-\alpha}{\alpha}}$).

$$\Psi_\delta = -y\left\{(1-\alpha)\delta^{\frac{1-2\alpha}{\alpha}}\right\}\underline{R} < 0$$

$$\Psi_R = \frac{-y\left(1-\delta^{\frac{1-\alpha}{\alpha}}-\frac{R}{\alpha\underline{R}}\right)\alpha^2\underline{R}}{R} > 0$$

and

$$\Psi_{\underline{R}} = y\left(1-\frac{c}{y}-\delta^{\frac{1-\alpha}{\alpha}}\right)\alpha - z < 0.$$

Subscripts denote partial differentiation. Moreover, using (26), the response of δ or R to changes in the model parameters can be found by

$$(28)\begin{cases}\frac{d\delta}{dg} = \frac{\Psi_R}{J} < 0,\\ \frac{d\delta}{dc} = \frac{-\alpha\underline{R}\Phi_R}{J} < 0,\\ \frac{d\delta}{d\underline{R}} = \frac{\Psi_{\underline{R}}\Phi_R}{J} < 0,\end{cases}$$

and

$$(29)\begin{cases}\frac{dR}{dg} = -\frac{\Psi_\delta}{J} < 0,\\ \frac{dR}{dc} = \frac{\alpha R\Phi_\delta - \delta\Psi_\delta}{J} \gtreqless 0,\\ \frac{dR}{d\underline{R}} = \frac{-\Phi_\delta\Psi_{\underline{R}}}{J} > 0,\end{cases}$$

where $J \equiv (\Phi_\delta\Psi_R - \Psi_\delta\Phi_R) < 0$.

Among the various results emerging from the comparative static, it may be inconsistent with intuitive investigations to say that an increase in *g* lowers both the rate of capacity utilization and the union`s real wage rate. An increase in *g* itself seems to increase the effective demand so as to raise the rate of capacity utilization. However, this is not the case. A rise in *g* leads to a fall in *R* as well as a rise in *y*, the firm's production capabilities, and this inevitably causes an excess supply for goods. Hence, the rate of capacity utilization must fall so as to keep the balance in the market. Moreover, it is clear from (28) and (29) that an increase in alternative wages raises the union's wage rate but lowers the rate of capacity utilization.

However, it is also notable that the effect of a change in *g* has on the rate of capacity utilization, in particular, will depend on just what type of welfare function the trade union has. To prove this, we shall investigate the simplest example. Assume a different type of union's welfare function from (20), which is simply given by

(30) $W_s = R - \underline{R}$

This type of welfare function implies that the trade unions only take the union-nonunion wages differential into consideration and that they have no need of taking care of their jobs[3]. From (30), it is clear that $MRS_{R\delta}(\equiv dR/d\delta)$ becomes zero. The best wage for the union to set is determined in the way by the tangency of an indifference curve of *Ws*, with the labour demand curve as depicted in Figure 2. Let Ω_s be the set of the equilibrium points in this case to compare with Ω. The Ω_s-contract curve is negatively sloped for $R>\underline{R}$, as shown in Figure 2. Following the same procedures as before to verify the effect of changes in *g* on *R* and δ, we obtain

$$\frac{dR}{dg} < 0,\ \frac{d\delta}{dg} > 0,\ \text{for } R > \underline{R}.$$

It should be noted here that if the union's welfare is given by (30) instead of (20), then the effect of a rise in *g* on the rate of capacity utilization becomes opposite to that given in (29). The implication of the difference in the sign of $d\delta/dg$ for the dynamic property of the system in the long-run will be discussed in the next section.

[3] In the seniority model, it is proved that there is a seniority rule among union members by which their jobs are ensured at least in the short-run and the union is bound to bargain over the wages. Therefore, this case may be classified as a trade union model in line with such a seniority rule (see Oswald 1984).

4. A Dynamic System

In the case where the output gap arises either from the excess demand for goods or from the deficiency of effective demand and, hence, $\delta \gtrless 1$, the gap will closed over time by two operating mechanisms: *the price mechanism* by which prices change with the degree of capacity utilization and *the investment mechanism* by which the stock of capital also changes with the degree of capacity utilization. We assume that prices are fixed and that there is no Pigou effect, with the objectives of clarifying the trade union's behavior represented by a welfare function defined in real terms. Assuming a price rigidity along traditional lines will make the analysis concerning the effect of investment on the growth path of the economy be more prominent.

As for the investment mechanism, we assume that the rate of capital accumulation changes as a function of the rate of capacity utilization:

(31) $\dot{g} = \beta(\delta - 1),\ \beta > 0,$

where dot $(\cdot)$ denotes the change in variables related over time. It is notable that even if demand shortage causes unemployment in the society, there is no incentive for firms to dissolve such an unemployment problem due to demand shortage. Equation (31) implies that if firms are bound to employ more (less) workers than those who they plan to employ in order to attain the optimality, that is $\delta > 1$ ($\delta < 1$), then firms are sure to enhance (decrease) their production capacity to avoid capital shortage (superflux)and it is referred as the Harrod type of investment function (see Harrod (1973)). It is easy to show that the system for $\{\delta, R, g\}$ completed by (12), (25) and (31), can be summed up by the following reduced equation;

(32) $\dot{g} = \beta(\delta(g) - 1),\ \delta' < 0$

Therefore, as far as the Ω-contract curve is concerned, the stability of the system can be ensured without any additive conditions $d\dot{g}/dg = \beta\delta' < 0$. As we have already mentioned in the former section, this system is related to the short-run stability because the equilibrium rate of capital accumulation must warrant the normal rate of capacity utilization so that the actual growth path becomes identical with the warranted growth path whereas it does not mean that the economy actually grows at the natural rate, that is the growth rate of labor supply.

It should be noted that the system developed here offers a remarkable contrast to the Instability Principle that the Harrodian models have proved. The stability results of the system, therefore, may be attributable not only to the type of investment function but also to the shape of the union's welfare function.

Moreover, it is also notable that if there is a competitive labor market for the non-union sector and the non-union wages can be affected by the demand-supply conditions of the labor market, then the long-run stability, concerning the relationship between the warranted growth path and the natural growth path, can be also ensured. To account for this aspects, we shall feature the following adjustment equation:

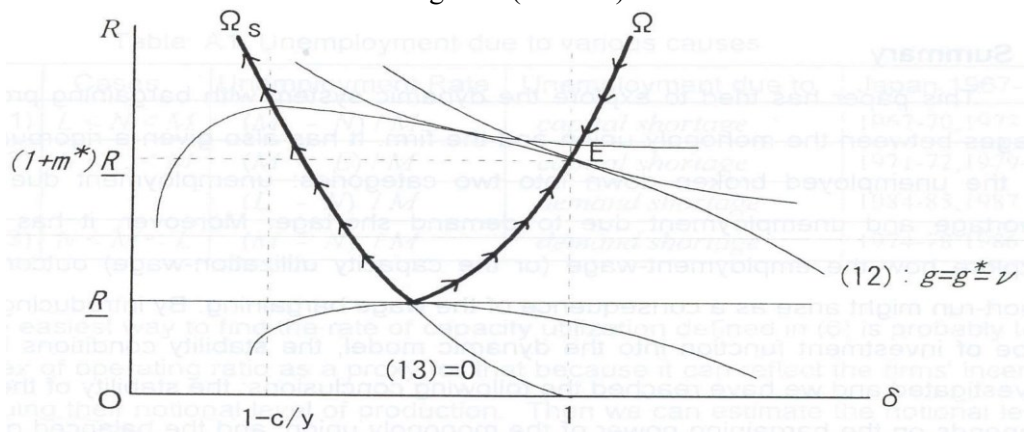
(33) $\dot{\underline{R}} = \gamma(g - v),\ \gamma > 0$

It is acceptable that if $g > v$, for example, then the employment rate increases so that u^* in (19) will decrease on the warranted growth path. Hence, the lowering unemployment rate will lead to a rise on the non-union wages. Elimination of (12) and (25) and substitution into (31) and (33) give a reduced form of the dynamic system in the rate of capital accumulation and the non-union wages:

(34)
$$\begin{cases} \dot{g} = \beta(\delta(\mathrm{g}, \mathrm{R}) - 1),\ \delta_g < 0,\ \delta_{\underline{R}} < 0, \\ \dot{R} = \gamma(g - v). \end{cases}$$

As can be easily checked, the dynamic system presented by (34) is stable because as for the Jacobi matrix of the system (J_Ω) evaluated at the steady state, we obtain trace of $J_\Omega = \beta\delta_g < 0$. Therefore, it follows that the dynamic path in the Ω-contract curve will possibly converge in due course of the time to the steady state where the actual growth path is identical both with the warranted growth path and with the natural growth path. Hence, the long-run steady state can be

Figure 3 ($\alpha = 0.5$)



attained when $g^* = v,\ \delta^* = 1,\ R^* = \left(1 + \frac{c\alpha}{z}\right)\underline{R}^*$ are assured and It has no unemployment due to the demand shortage.

What we have just mentioned the stability of the system is obviously conditional on the union's bargaining behavior, that is presented as the MRS_{RS} evaluated at the contract curve. As for the Ωs-contract curve, for example, using (12), (13) and (31), the short-run dynamic system in the Harrodian sense is given by the following equations:

$$(35)\begin{cases} R = R(\delta), R' < 0, \\ \varphi(\delta, R; r, \alpha, A, c, g, f) = 0,\ \varphi_\delta < 0,\ \varphi_R < 0,\ \varphi_g = -1 < 0, \\ \dot{g} = \beta(\delta - 1), \end{cases}$$

where the first equation of (35) is derived from taking the right-hand side of (13) to be zero. (35) can be easily summarized by

(36) $\dot{g} = \beta(\delta(g) - 1), \delta' > 0$

to compare with (32). Therefore, the short-run instability (not stability), that is the Instability Principle, can be ensured in the case of Ωs-contract curve.

As sketched out above it is clear whether the system becomes stable or not depends on the shape of the contract curve given by (24). As Johnson and Layard (1986) have proved, the monopoly power of the trade union can be defined by the elasticity of demand for labor with respect to the union wages and its reciprocal is measured by the left-hand side of (24). The monopoly power is also proved to be positively related to the union markup (see, for example, Yabuta (1993)). Moreover, it is clear from (24) that on the contract curve the slope of the labor demand schedule is equal to $MRS_{R\delta}$. Therefore, it follows that the smaller $MRS_{R\delta}$ is, the higher the union markup and the greater the union's bargaining power. As we have already shown, the Ωs-contract curve is the case where the trade unions have the smallest $MRS_{R\delta}$, that is zero. Hence, if the bargaining power of the monopoly union is strong enough, meaning that the union markup is sufficiently large, then the system with the Harrod type of investment function may be unstable. On the contrary, the stability of the economy can be ensured in the case where the monopoly power of the trade union is weak enough so that the contract curve can intersect the line δ=1 at the point E in Figure 3. Moreover, if there is a mechanism by which the non-union wages continuously are adjusted to clear the labor market, then the balanced growth path will be attained in due course of time. It is notable that the stability condition depends on the union's bargaining power.

It is clear that the trade union behavior seems to be of central importance because it determines the system's stability. Therefore, some issues may still remain concerning how the trade union's behavior as well as its bargaining structure is fixed in the economy; why they differ from nation to nation and how they affect the dynamic growth path. A possible way to tackle these issues seems to be the theories of Corporatism, which have argued the institutional

structure of wage bargaining over the 1980s (see, for example, Calmfors and Driffill (1988), Moene et al. (1993) or Booth (1995) for a survey). One of the major results of the corporatist model is that the confederation of trade unions knows the trade-off between the higher wages and the lower employment so that it tends to constrain its wage demand with the intention of taking into account the impact of higher union wages on the overall unemployment. Taking our terms used in this paper, this means that the centralized wage setting leads to the lower union markup or the higher $MRS_{R\delta}$[4]. Therefore, it is possible to conclude that the trade unions behavior with the centralized wage bargaining might have helped the capitalist economy to keep the balanced growth path stable.

5. The Model for Our Empirical Analysis

In the previous sections, the dynamic analysis with the "monopoly union" model which incorporates the relationship between the behavior of trade union and the macroeconomic performance is examined. However, it is hard to conduct empirical analysis for Japan by utilizing the "monopoly union" model because of the difficulty in obtaining the data set. Instead, the "right to manage" model, which also includes the framework of bargaining structure, can be applied for our empirical estimation. It was developed mainly by Nickell (1982) and Nickell and Andrews (1983) in an early stage. In this section, the basic structure of the "right to manage" model is introduced based on Yabuta (1989).

The "right to manage" model assumes that employment is determined unilaterally by the firm but the wage level is decided by bargaining process between the trade union and the firm. The firm is assumed to choose an optimal employment level so as to maximize its profits once wages are determined through negotiation between the unions and the firm. The utility function (U) of the union is

$$(37)\quad U = U\left(\frac{w}{P^e}, L, h\right),$$

where w is the hourly wage rate, P^e is the price of consumption goods presumed by workers, L is the level of employment, H is the number of working hours in a set if period. On the other hand, utility function (V) of the representative firm is given by

$$(38)\quad V = f(L, h, X, \delta K) - \left(\frac{w}{P}\right)hL - \left(\frac{P_x}{P}\right)X - rK,$$

where f is a production function, X is resources, K is the capital stock and it is in operation at δ% of its capacity as well as labor-related inputs (L and h), P_x is the price of raw materials, r is the rental cost of capital. If we represent the outcome of the bargaining process by an asymmetric Nash bargaining solution, this model is expressed as:

$$(39)\quad \max.\ \lambda \log U + (1-\lambda)\log V$$
$$\text{subject to } V_L = f_L - \left(\frac{w}{P}\right)h = 0,$$

where λ $(1 \geq \lambda > 0)$ represents the bargaining power to the union. By some calculations, we know that $\frac{dw}{d\delta}$ becomes positive if the union's preference takes priority over the wages rather than employment with a given level of λ, and vice versa.

The solution of the model can be written as

$$(40)\quad w = w(p, h, r, \delta, X, P_x, K),$$
$$\qquad\quad +\ 0\ -\ ?\ -\ -\ -$$

where the sign pattern of (40) is realized when the economy is in the optimal condition. The w also depends on various factors such as the bargaining power to the trade union although they do not appear explicitly in this equation. However, as mentioned above, the sign of $\frac{dw}{d\delta}$ would play the key role in our analysis.

[4] Because the level of wage markup is low in the system of centralized wage setting in Nordic countries, the economy will become more stable.

6. Empirical Results

This section is for our empirical study of the wage equation derived through "right to manage" model explained in section 5 for manufacturing industries in Japan. Our analysis aims not only to assess the statistical properties of the model but also to investigate the stability of the wage determination process in Japan. If there were a structural change in Japanese trade unions' behavior, we would be able to find the instability through the econometric test for structural break.

The sample period of estimation is 2008:M2 (February) − 2016:M3 (March). Our dataset is constructed by the following variables.[5]

w: Real Wage Index (total cash earnings, for Manufacturing, for establishments with 30 employees or more, 2010 average = 100)

P: Corporate Goods Price Index (major group, manufacturing industry products, CY2010 average = 100)

H: Hours Worked Indices (total hours worked, manufacturing, 2010 average = 100)

R: Average Contracted Interest Rates on Loans and Discounts (outstanding loans and bills discounted, long-term loans, domestically licensed banks) This is the proxy variable for rental cost of capital.

D: Indices of Operating Ratio (indices of industrial production, original indices by industry, manufacturing, 2010 = 100)

X: Index of Producer's Shipments (indices of industrial production, original Indices by industry, manufacturing, 2010 = 100) This is the proxy variable for index of raw materials consumption.

Px: Corporate Goods Price Index for Raw Materials (CY2010 average=100)

K: Gross Capital Stock of Private Enterprises (preliminary quarterly estimates, released at August 15, 93SNA, construction in progress, tangible fixed assets, all industries)

All items except "K" are monthly. The quarterly data on "K" is converted into monthly.[6] The rate of change from the previous month of real wage index, which is the dependent variable of our estimation, is based on "w".

The specification for our estimation is constructed as:

$$\log W = \alpha_0 + \alpha_1 \log P + \alpha_2 \log H + \alpha_3 \log R + \alpha_4 \log D + \alpha_5 \log X + \alpha_6 \log Px + \alpha_7 \log K,$$

where W is the wage inflation. As we have studied in the previous section, they theoretically imply at the micro-level that an increase in input costs, such as resource price or cost of capital, should bring the decrease in wage rate since it reduces the profit, and an increase in output price should cause wages to increase because of union's preference for raising real wages.

The result of the estimation of wage equation for manufacturing industries by OLS methodology is indicated in Table 1. The standard errors and covariance are computed based on the Newey-West Heteroscedasticity and Autocorrelation Consistent (HAC) weighting matrix. The coefficients on hours worked index (for total hours worked), index of operating ratio (indices of industrial production), index of corporate goods price index for raw materials, and gross capital stock of private enterprises are significantly estimated at 1% level. The coefficient on the average contracted interest rates on loans and discounts as the proxy variables for the rental cost of capital is barely significant at 10%. With these estimated coefficients, one

[5] The data on "Real Wage Index," and "Hours Worked Indices" can be retrieved from the Website of the Ministry of Health, Labour, and Welfare. The "Indices of Operating Ratio," and "Index of Producer's Shipments" can be obtained from the website of the Ministry of Economy, Trade and Industry. The "Corporate Goods Price Index," "Corporate Goods Price Index for Raw Materials," and "Average Contracted Interest Rates on Loans and Discounts" are available at the website of the Bank of Japan. The data on "Gross Capital Stock of Private Enterprises" can be obtained from the Economic and Social Research Institute, Cabinet Office's website.

[6] The quarterly data on "K" is converted into monthly by simply allocating same figures on the three months in the corresponding quarter.

Table 1: OLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	269.8705	172.6532	1.563079	0.1215
log P	2.485260	1.843363	1.348221	0.1810
log h	6.038523	0.676269	8.929172	0.0000
log r	-2.505047	1.434348	-1.746471	0.0841
log δ	-3.322653	1.039340	-3.196887	0.0019
log X	2.594196	0.917030	2.828912	0.0058
log Px	-0.034892	0.176233	-0.197989	0.8435
log K	-14.53909	8.393850	-1.732112	0.0867
Adjusted R-squared	0.423510	F-statistic		11.17993
S.E. of regression	0.306571	Durbin-Watson stat.		2.172364

Notes: Dependent Variable: Change from the previous month of real wage index. Sample (adjusted): 2008M02 - 2016M03. Included observations = 98 (after adjustments). Standard errors and covariance computed using HAC weighting matrix (Bartlett kernel, Newey-West fixed bandwidth = 4). Convergence achieved after 32 weight iterations.

Table 2: Quandt-Andrews Unknown Breakpoint Test

Statistic	Value	Prob.
Maximum LR F-statistic (2011M05)	1.075253	0.9767

Notes: Null Hypothesis: No breakpoints within 15% trimmed data. Equation Sample: 2008M02 2016M03. Test Sample: 2009M05 2015M01. Number of breaks compared: 69. Probabilities calculated using Hansen's (1997) method.

important topic that we have to consider through the examination of the estimated coefficient on the index of operating ratio is the bargaining position of the Japanese trade unions. The sign of the coefficient is apparently negative, and it might be interpreted that the trade unions have weak bargaining positions or preferences for employment rather than wages. The other topic that we should pay attention is
the structural change of wage determination structure. In order to examine this problem, three kinds of test are implemented.

Table 2 displays the result of the Quandt-Andrews Unknown Breakpoint Test. The test statistic denies the possibility of the structural break. On the other hand, Figure 4 and 5 describe the results of CUSUM test and CUSUM of Squares Test, respectively. They also cannot find the clue to the structural change. Further, as to serial correlation problem, the Durbin-Watson test statistic indicated in Table 1 falls in the ambiguous region of the Durbin-Watson table of critical values. Thus, we cannot draw a conclusion with respect to serial correlation. In this respect, it is instructive for us to try another way of estimation.

As the next step, we examine the result of estimation by utilizing GMM (Generalized Method of Moments) by considering the correlation (between the explanatory variables and the error term) and the endogeneity of the variables. The GMM estimation is implemented with the Newey-West Heteroscedasticity and Autocorrelation Consistent (HAC) weighting matrix to deal with the possibility of serial correlation. (Details of this topic with respect to our estimation are described in the note under the Table 3.) Since we should take a critical stance toward estimation by GMM, the Hansen's test for over-identification, the C-test for instrumental variable's orthogonality, endogeneity test for variables, weak identification and bias, and the test utilizing Cragg-Donald statistic and Stock-Yogo critical values are implemented. Our GMM estimation is conducted with the assumption that the rental cost of capital and the gross fixed capital stock are endogenous.

Table 3 reports the result of GMM estimation. Considering the diagnostic test, the null hypotheses of over-identification for GMM estimation cannot be rejected by the Hansen's test, supporting the validity of the moment conditions, as shown by J-statistic and p-value in the

Figure 4: CUSUM Test

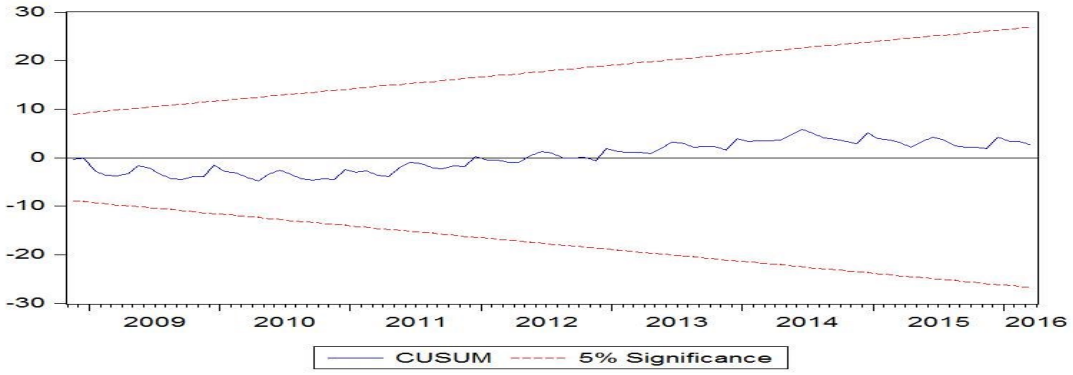


Figure 5: CUSUM of Squares Test

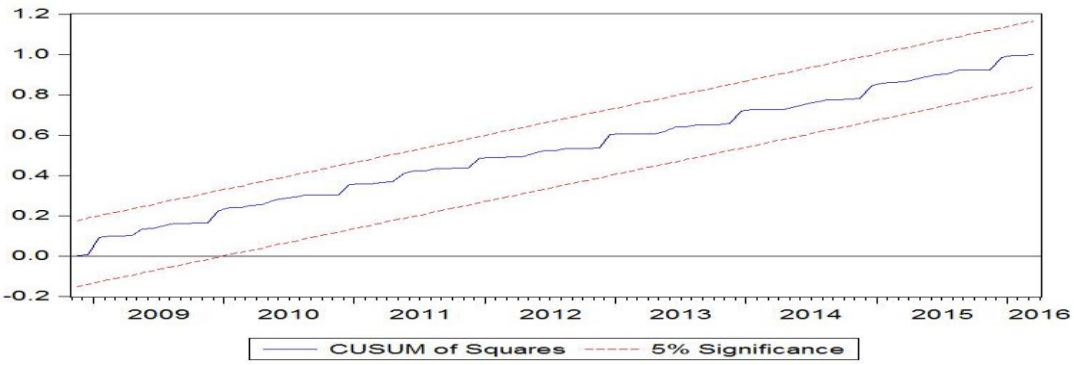


table. With regard to the estimated parameters, all coefficients except the one on corporate goods price index for raw materials are significant at 1% level. In particular, the coefficient on the operating ratio is significant with negative sign. It implies the trade unions in Japan have weak bargaining positions or preferences for employment rather than wages.

Next, we inspect our estimation specification. Table 4 displays the results of the orthogonality C-tests for each instrumental variable (except constant term). Namely, the test detects whether each instrumental variable satisfies the orthogonality condition. The instrumental variables used in our GMM estimation are the constant term and the variables indicated in the column of test instrument in Table 4. The results suggest that the null hypotheses of respective instrumental variable's orthogonality to the error term cannot be rejected at the conventional level for all cases. Moreover, the result of the endogeneity test for variables - rental cost of capital and gross fixed capital stock - is shown in Table 5. The null hypothesis of exogeneity cannot be rejected at the conventional level by the test statistic.

Further, to investigate the weak identification problem pointed out by some studies including Mavroeidis (2004), we use the Cragg and Donald (1993) statistic and Stock and Yogo (2005) critical values[7]. In Table 5, the Cragg-Donald F-statistic is larger than Stock-Yogo critical values for both relative bias and size. It means the null hypothesis of weak identification is rejected. Therefore, the test result implies our instrumental variables are not weak.

On the whole, our estimations of wage equation for manufacturing industries by OLS and GMM methods show that the "right to manage" model has a certain interpretability of the behaviour of trade unions in recent Japan. However, we cannot find the clue to the structural change of wage determination structure and the strong bargaining process.

[7] See Cragg and Donald (1993), Stock, Wright, and Yogo (2002), and Stock and Yogo (2002) in details.

Table 3: GMM Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	683.6721	225.9195	3.026176	0.0032
log P	9.279352	2.813324	3.298359	0.0014
log h	7.930461	0.838313	9.460025	0.0000
log r	-6.236308	1.868021	-3.338456	0.0012
log δ	-9.118244	1.760089	-5.180558	0.0000
log X	6.126551	1.327947	4.613551	0.0000
log Px	0.239692	0.243115	0.985919	0.3268
log K	-35.69489	11.10495	-3.214321	0.0018
S.E. of regression	0.409368	J-statistic		6.643991
Instrument rank	13	Prob(J-statistic)		0.248492

Notes: Dependent Variable: Change from the previous month of real wage index. Sample (adjusted): 2008M02 - 2016M03. Included observations = 98 (after adjustments). Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed bandwidth = 4). Standard errors and covariance computed using HAC weighting matrix (Bartlett kernel, Newey-West fixed bandwidth = 4). Convergence achieved after 39 weight iterations. Instrument specification: Constant, log P, log P(-1), log h, log h(-1), log r(-1), log δ, log δ(-1), log X, log X(-1), log Px, log Px(-1), log K(-1).

Table 4: Orthogonality C-Test for Instrumental Variables

Test instruments	Difference in J-stats			Restricted J-statistic	Unrestricted J-statistic
	Value	d.f.	p-value		
log P	0.357786	1	0.5497	6.643991	6.286205
log P(-1)	0.328929	1	0.5663	6.643991	6.315062
log h	4.793504	1	0.0286	6.643991	1.850488
log h(-1)	2.269817	1	0.1319	6.643991	4.374174
log r(-1)	0.328101	1	0.5668	6.643991	6.315891
log δ	2.019456	1	0.1464	6.643991	4.534535
log δ(-1)	0.314783	1	0.5748	6.643991	6.329209
log X	2.189410	1	0.1390	6.643991	4.454581
log X(-1)	0.615661	1	0.4327	6.643991	6.028331
log Px1	0.410505	1	0.5217	6.643991	6.233486
log Px(-1)	0.342635	1	0.5583	6.643991	6.301356
log K(-1)	0.222161	1	0.6474	6.643991	6.421830

Table 5: Endogeneity Test for Variables

Test instruments	Difference in J-stats			Restricted J-statistic	Unrestricted J-statistic
	Value	d.f.	p-value		
log r, log k	3.818297	1	0.1482	7.103874	3.285577

Table 6: Weak Instrument Diagnostics

Cragg-Donald F-stat		77.39638
Stock-Yogo critical values (relative bias)	5%	16.88
	10%	9.92
	20%	6.16
	30%	4.76
Stock-Yogo critical values (size)	10%	23.72
	15%	13.34
	20%	9.77
	25%	7.91

7. Concluding Remarks

This paper tried to explore the dynamic system with bargaining process over wages between the monopoly union and the firm. It also provided a rigorous definition of the unemployment broken down into two categories: unemployment due to capital shortage and unemployment due to demand shortage. Moreover, we considered how the employment-wage (or the capacity utilization-wage) outcomes in the short-run arise as a consequence of the wage bargaining. By

introducing a specific type of investment function into the dynamic model, the stability conditions were investigated and we reached the following conclusions: the stability of the economy depends on the bargaining power of the monopoly union; and the balanced growth path can occur where the union's monopoly power is sufficiently weak even if the investment function is of the Harrod-Okishio type which is usually regarded as the major factor that causes the instability of the economy. Furthermore, we also investigated the relationship between the bargaining structure in the corporatist model and the stability condition, and then we reached a conclusion that a trade union's behavior can help the capitalist economy to remain on the balanced growth path.

As for the analysis concerning the impact of the wage bargaining structure on the stability of the economy, there are many attempts to provide empirical researches on how the wage bargaining structure affects the macroeconomic performance. This paper conducted the estimations as the empirical researches by utilizing the "right to manage" model. Our estimations of wage equation for manufacturing industries in Japan by OLS and GMM methods showed that the "right to manage" model has a certain interpretability of trade union's behaviour in recent Japan. However, we could not find the clue to the structural change of wage determination structure and the strong bargaining process.

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