WAGE ADJUSTMENTS IN POSTWAR JAPAN: AN ALTERNATIVE APPROACH TO THE PHILLIPS-LIPSEY CURVE

By RYOSHIN MINAMI* **

I. *Introduction*

Weakness Inherent in PLC

Following the pioneering works by A.W. Phillips [15] and R.G. Lipsey [6], a large number of contributions have been made to estimate the relationship between the rate of growth in the money wage rate and the rate of unemployment for various countries including Japan.[1] This relationship is widely known as the Phillips-Lipsey Curve (PLC). The theoretical significance of the PLC, expressed by Lipsey himself [6, p. 13], is that the PLC is a wage adjustment function (WAF): that is, the rates of unemployment embodied in the PLC is a substitute for the rate of excess demand for labor (or, conversely, the rate of excess supply of labor).[2]

There is no denial of the fact that the PLC presents a very convenient way to study wage changes. We are not fully satisfied, however, because there is no proof that official statistics for the rate of unemployment reflect exactly levels and changes in the excess demand for labor. For instance, consider the following two problems.

(1) In a labor surplus economy, disguised unemployment in the low productivity sectors like agriculture and services is much more important compared with open unemployment. If we use the PLC as a substitute for the WAF, it should be assumed that the rate of disguised unemployment is closely related with the rate of unemployment. (2) When the rate of unemployment decreases to such a low level as, say, one per cent, the rate of unemployment begins to be unresponsive to changes in the excess demand for labor. In this case, the PLC is not interchangeable with the WAF any more.[3]

These problems (1) and (2) might be overcome by using a better index for the excess

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[1] The study in this field for the Japanese case was originated by Tsunehiko Watanabe [17]. See footnote 5 for the other contributions using pre-war and post-war data.

[2] Another interpretation of the PLC, proposed by E. Kuh [5, p. 339], is to consider the rate of unemployment as an index for the bargaining power of trade unions.

[3] As is shown in Chart 2, the rate of unemployment in this country reached its lowest level in the 1960's and has since then ceased to change flexibly. See also [10].

demand for labor in place of the rate of unemployment.[4] In Japan's case, job-securing statistics (e.g., a ratio of applicants to openings and a ratio of placements to openings) and statistics for labor turn-over (e.g., a quit rate) may be used as alternative substitutes for the excess demand for labor.[5] Assuming we obtain a good index for the excess demand for labor, will it be sufficient to estimate the relationship between these indexes for the excess demand for labor and the rate of growth in money wages as a comprehensive analysis of wage changes? The writer doubts it. To estimate the PLC does not give a sufficient analysis of wage changes, unless we can explain how the new index for the excess demand for labor, whatever it is, is determined.

An Alternative Approach

In this paper we will present a new WAF which does not include the rate of unemployment nor any other substitutes for the excess demand for labor, but does include explicitly the demand and supply functions of labor.[6] In other words, wage changes are considered as a function of the difference between demand for and supply of labor as well as the rate of growth in consumer prices. In the writer's opinion, such a WAF may be a good alternative to the PLC in analyzing wage changes.

In Section II we will develop a theory of our WAF and set forth the functions to be estimated. In Section III application of the WAF to post-war Japanese data (1954-1968) is made, and the results of the estimation are examined. Summary and conclusions are included in Section IV.

II. *Model to be Estimated*

Structural Equations

Our basic assumption is that wage increases stem from two types of wage adjustments; the 'cost of living adjustments' and the 'adjustments for the excess demand for labor'. Under this assumption our WAF is set forth as follows:

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[4] L.A.Dicks-Mireaux and J.C.R. Dow made a suggestive attempt in constructing a new index for the excess demand for labor by adjusting unemployment statistics [1]. Various indexes for the excess demand for labor in Japan have been examined by the writer [10].

[5] Akira Ono estimated the PLC in the post-World War II Japan by using various substitutes for the excess demand for labor and got the best fit when he used a quit rate as a proxy [14, p. 210]. Konosuke Odaka, who studied the prewar wages, concluded that the ratio of applications to openings was the best proxy for the excess demand for labor [12, pp. 48-49].

[6] A very illuminating paper by R.E. Lucas, Jr. and L.A. Rapping has the same intention as the present paper does. That is, the writers intended to analyze *real* wages by applying an econometric model including the demand and supply functions of labor to the United States data [7]. On the other hand, in this paper, *nominal* wages are studied under the supposition that they are adjusted dependent on the WAF. There are two justifications for using nominal wages as a dependent variable: (1) In the writer's opinion, wage adjustments seem to be made in nominal terms, never in real terms. (2) It is hard to find a unique price deflator appropriate both to labor demand and to labor supply. Different price indexes should be included in the labor supply and the labor demand functions, respectively. (In this paper, the consumer price index and the wholesale price index are used, respectively, in the labor supply and in the labor demand functions.) It may be the second best approach, as was employed by Lucas and Rapping, to use such an aggregate price index as the GNP deflator. In Japan where relative prices have been conspicuously changing, however, such an approximation may not be applicable. (See [11] [17, p. 31] for the changes in relative prices in this country.)

(1) $$w_t - w_{t-1} = \lambda \frac{q_{t-1} - q_{t-3}}{2} + \theta(1_t^D - 1_t^S) \qquad \lambda > 0 \quad \theta > 0.$$

Here a small character denotes the natural log of a large character; for instance, $w = \ln W$. W, Q, L^D and L^S stand for nominal wages, the consumer price index, demand for labor and supply of labor, respectively. The first term on the right hand side of the WAF is the rate of growth in wages dependent on the cost of living adjustments. Parameter λ stands for the elasticity of the wage increase with respect to the increase in consumer prices. $(q_{t-1} - q_{t-3})/2$ indicates the average semi-annual rate of growth in the consumer price index during the one year period beginning one and one half years before.[7] (Note that semi-annual statistics will be used in this study.) The second term indicates the rate of growth in wages coming from the adjustments for the excess demand for labor. Parameter θ is the elasticity of the wage increase with respect to a change in the ratio of labor demand to labor supply, L^D/L^S. Parameters λ and θ, which are expected to be positive, may be called the coefficient of the cost of living adjustments and the coefficient of the adjustments for the excess demand for labor, respectively.

Assuming that the ratio of labor supply, L^S, to the working age population, M, is a function of nominal wages and of the consumer price index,[8] we can set forth an aggregate labor supply function as follows.

(2) $$\frac{L_t^S}{M_t} = e^{\alpha} W_t^{\beta} Q_t^{\gamma}$$

or

(3) $$1_t^S = \alpha + \beta w_t + \gamma q_t + m_t.$$

Parameters β and γ express the elasticities of labor supply with respect to nominal wages and to consumer prices, respectively. Sign conditions of these parameters cannot be presumed *a priori.*

We are using two types of aggregate labor demand functions; one is introduced from a CES production function (Model I) and the other is from a Cobb-Douglas function (Model II).

Model I: The CES production function is formulated as

(4) $$\frac{Y_t}{P_t} = Ae_t^{\tau}[BL_t^{-\rho} + (1-B)K_t^{-\rho}]^{-\frac{1}{\rho}},$$

where Y, L, K, P, A, B, τ and ρ stand for nominal GNP, employment, capital stock, the wholesale price index, the initial level of production function, the distribution parameter, the rate of neutral technological progress and the substitution parameter, respectively. ρ is defined as $(1-\sigma)/\sigma$, where σ expresses the elasticity of substitution. Equilibrium is attained when the real wages, W / P, are equal to the marginal productivity of labor, MPL. It may be much more realistic, however, to suppose that W / P constitutes a constant proportion of MPL; that is

[7] The rate of growth in the consumer price index can be formulated in various ways such as $q_t - q_{t-1}, q_{t-1} - q_{t-2}$, $(q_t - q_{t-2})/2$ and so forth. In estimating WAFs under these alternative specifications for the cost of living adjustments, we obtained the best result when we employed such a formulation as was made in equation (1).

[8] The conventional way of formulating this function is to assume that labor supply is dependent on the wages deflated by the consumer price index. This formulation is expressed as a special case, $\beta = \gamma$, of our function.

$$\frac{W_t}{P_t}=d\cdot MPL_t. \qquad 0<d\leqq 1.$$

Parameter d depends upon the degrees of imperfection in both the labor market and the product market. Then our equilibrium condition becomes

$$\text{(5)} \qquad \frac{W_t}{P_t}=dB(Ae^{\tau t})^{-\rho}\left(\frac{Y_t}{L_tP_t}\right)^{1+\rho}.$$

From this we get the labor demand function

$$\text{(6)} \qquad l_t^D=[\sigma\varphi+a(\sigma-1)]+(\sigma-1)\tau t+y_t-\sigma w_t+(\sigma-1)p_t,$$

where $\varphi=\ln dB$.

Model II: Cobb-Douglas production function (linear homogeneous) is given as

$$\text{(7)} \qquad \frac{Y_t}{P_t}=Ae^{\tau t}L_t^BK_t^{1-B},$$

where B expresses the output elasticity with respect to labor. Assuming this function, the equilibrium condition becomes

$$\text{(8)} \qquad \frac{W_t}{P_t}=dB\frac{Y_t}{L_tP_t}.$$

Here there is no need to consider that dB is constant over time. Let us assume dB is a function of time;

$$\ln dB=\varphi_0+\varphi t.$$

By substituting this relation for equation (8), we obtain the labor demand function

$$\text{(9)} \qquad l_t^D=\varphi_0+\varphi t+y_t-w_t.$$

Denoting error terms for the wage determination function, the aggregate labor supply function and the aggregate labor demand function, respectively, by ϵ,[1] ϵ^2 and ϵ^3, these structural equations are rewritten as follows;

$$\text{(1)} \qquad w_t-w_{t-1}=\lambda\frac{q_{t-1}-q_{t-3}}{2}+\theta(l_t^D-l_t^S)+\epsilon_t^1,$$

$$\text{(3)} \qquad l_t^S=\alpha+\beta w_t+\gamma q_t+m_t+\epsilon_t^2,$$

$$\text{(6)} \qquad l_t^D=[\alpha\varphi+a(\sigma-1)]+(\sigma-1)\tau t+y_t-\sigma w_t+(\sigma-1)p_t+\epsilon_t^3 \qquad \text{(Model I)}$$

and

$$\text{(9)} \qquad l_t^D=\varphi_0+\varphi t+y_t-w_t+\epsilon_t^3. \qquad \text{(Model II)}$$

Here we assume $E\epsilon_t^1=E\epsilon_t^2=E\epsilon_t^3=0$ for each t.

Reduced Form Equations

Substituting equations (3) and (6) for (1), we can derive the following:

$$\text{(10)} \quad w_t=A_0+A_1w_{t-1}+A_2(y_t-m_t)+A_3\frac{q_{t-1}-q_{t-3}}{2}+A_4q_t+A_5p_t+A_6t+\epsilon_t, \qquad \text{(Model I)}$$

where

$$A_0=\frac{\theta[\sigma\varphi+a(\sigma-1)-\alpha]}{1+\theta(\sigma+\beta)},\quad A_1=\frac{1}{1+\theta(\sigma+\beta)},\quad A_2=\frac{\theta}{1+\theta(\sigma+\beta)},$$

$$A_3=\frac{\lambda}{1+\theta(\sigma+\beta)},\quad A_4=\frac{-\theta\gamma}{1+\theta(\sigma+\beta)},\quad A_5=\frac{\theta(\sigma-1)}{1+\theta(\sigma+\beta)},$$

$$A_6=\frac{\theta(\sigma-1)\tau}{1+\theta(\sigma+\beta)},\quad \text{and}\quad \epsilon_t=\frac{\theta(\epsilon_t^3-\epsilon_t^2)+\epsilon_t^1}{1+\theta(\sigma+\beta)}.$$

Substituting (3) and (9) for (1), we obtain

$$(11)\qquad w_t=A_0+A_1w_{t-1}+A_2(y_t-m_t)+A_3\frac{q_{t-1}-q_{t-2}}{2}+A_4q_t+A_6t+\epsilon_t{}^{9},$$

(Model II)

where

$$A_0=\frac{\theta(\varphi_0-\alpha)}{1+\theta(1+\beta)},\quad A_1=\frac{1}{1+\theta(1+\beta)},\quad A_2=\frac{\theta}{1+\theta(1+\beta)},$$

$$A_3=\frac{\lambda}{1+\theta(1+\beta)},\quad A_4=\frac{-\theta\gamma}{1+\theta(1+\beta)},\quad A_6=\frac{\theta\varphi}{1+\theta(1+\beta)},\quad \text{and}$$

$$\epsilon_t=\frac{\theta(\epsilon_t^3-\epsilon_t^2)+\epsilon_t^1}{1+\theta(1+\beta)}.$$

In both of these equations, $E\epsilon_t=0$, because of our assumption $E\epsilon_t^1=E\epsilon_t^2=E\epsilon_t^3=0$. By applying time series data for w, y, q to the reduced form equations, we estimate the parameters of these equations. Next, from these parameters, we can calculate the parameters for the structural equations, i.e., λ, θ, β, γ, τ, σ and φ.[10] Furthermore, substituting $\bar{w}$ (the estimated value for w in equation (10) and (11), q, and estimated parameters λ and θ for equations (1), we can obtain the predicted value for 1^D-1^S and calculate the rate of excess demand for labor, $(L^D-L^S)/L^S$.[11]

In our model W is expressed as a function of Y, P and Q. Actually, however, wage increase may affect Y, P and Q. Considering these possible interrelationships among variables,[12] we will estimate the reduced form equations (10) and (11) by applying the two stage least square method. In the first stage, we are estimating the equations regressing Y, P and Q on exogenous variables; the working age population (M) as well as government expenditures, exports and, the price index for products whose prices are regulated by the government,[13] and calculate the estimated values for Y, P and Q. In the second stage, by using the estimated values for Y, P and Q, equations (10) and (11) are estimated.

[9] Variable $y-m$ in equations (10) and (11) may be called 'potential' productivity of labor in current prices. This is 'potential' in the sense that this is not the actual productivity but the productivity which is expected to be realized only if the population (M) is all supplied to the labor market and fully employed. Many contributions have been made by other authors to estimate PLC which includes labor productivity. They seem to be divided into two groups from the viewpoint of interpretations of this variable. In the first group, for instance, the studies by Akira Ono [13] [14] and John Vanderkamp [16], this variable is employed as an index for the 'ability to pay' of enterprises. The second group, which includes the study by E. Kuh (5), takes this variable as a shifting parameter in the demand function for labor. In this respect the study in this paper belongs to the second group.

[10] We obtain $\sigma\varphi+a(\sigma-1)-\alpha$ in Model I and $\varphi_0-\alpha$ in Model II. However we cannot estimate φ, a and α in Model I nor φ_0 and α in Model II.

[11] We cannot estimate the labor supply and labor demand separately, owing to the fact which was pointed out in footnote 10.

[12] The interrelationship between wages and prices in Japan was stressed and examined by Akira Ono and the present writer [11], and by Tsunehiko Watanabe [17].

[13] Figures prepared by the EPA are used for these exogenous variables. See footnote 17.

III. *Estimation Results and Their Implications*

Data

Semi-annual statistics on a fiscal year basis[14] and adjusted for seasonal fluctuations[15] are used in our calculations. Usage of semi-annual data may be justified because in this country wage negotiations are made twice a year; in the spring time for regular wages and at the end of a year for bonuses. The estimation period is limited to 1954-68, because of abnormal economic activity during the post-war reconstruction period before 1954. Sources of data used in this study are as follows:

W=wage earnings per employee[16] (thousand yen; the Economic Planning Agency (EPA) estimates),

Y=nominal GNE (thousand million yen; EPA estimates),

P=the wholesale price index (1965=1; Bank of Japan estimates),

Q=the consumer price index (1965=1; estimates by the Bureau of Statistics, the Office of the Prime Minister),

M=the size of the population aged fifteen years and over (thousand persons; the estimates by the BS, OPM).

For W, Y, P, and Q, unpublished data prepared by the Economic Research Institute of EPA are used.[17]

Results of Regressions

Table 1 summarizes the results of estimation of the reduced form equations. Determination coefficients are estimated to be very large. On the other hand, small Durbin-Watson statistics signify that these regressions are not free from amount of serial correlation.

TABLE 1. PARAMETER ESTIMATES FOR REDUCED FORM EQUATIONS

		A_0	A_1	A_2	A_3	A_4	A_5	A_6	$\bar{R}^2$	d
Model I		0.46	0.68	0.26	0.48	0.11	0.09	▲0.0010	0.9995	1.34
		(0.6)	(4.7)	(3.4)	(1.8)	(5.1)	(0.5)	(0.4)		
Model II	a	0.39	0.69	0.26	0.42	0.11		▲0.0016	0.9995	1.34
		(0.6)	(4.9)	(3.5)	(1.7)	(5.3)		(0.6)		
	b	0.61	0.68	0.23	0.42	0.16			0.9995	1.29
		(1.1)	(5.0)	(4.3)	(1.8)	(0.8)				

Remarks: ▲indicates negative value.

[14] The first term of a fiscal year (indicated as I in Table 3) is from April to September, while the second term (II) is from October to March of the next year.

[15] Figures are adjusted for seasonal fluctuations by the EPA method.

[16] Following the study by Tsunehiko Watanabe [17], we use wage earnings per person not the hourly wage rate as a wage variable. It is because laborers in this country are widely believed to be interested in wage earnings, not in hourly wage rate. Even if we use the hourly wage rate, results of the estimation will not be altered considerably, because labor hours have been actually constant.

[17] Figures up to 1967 have been published in [4].

By using these figures, parameters in the structural equations are calculated and shown in Table 2. In Table 1 parameter A_5 is not statistically significant at the conventional significance level. This indicates that the elasticity of substitution, $\sigma(=A_5/A_2+1)$, can be

TABLE 2. PARAMETER ESTIMATES FOR STRUCTURAL EQUATIONS

		λ	θ	β	γ	φ
Model II	a	0.61	0.38	0.18	▲0.44	▲0.0060
	b	0.62	0.34	0.40	▲0.68	

taken as unity. (The estimate for this parameter is 1.4.) Thus we may state that the aggregate production function in the postwar Japanese economy can be approximated by the Cobb-Douglas type.[18] Therefore let us shift our attention to Model II which is dependent on this type of production function. Findings from the estimates of this model may be summarized as follows:

(1) The cost of living adjustment coefficient, λ, is around 0.6. This is calculated as A_3/A_1. However, parameter A_3 is not statistically significant. Therefore it cannot be stated that cost of living adjustments exist significantly in wage determinations in this country. Such a conclusion may be understandable, in the writer's opinion, because trade unions in this country are not as strong as those in the Unites States.

(2) The wage adjustment coefficient, θ, which is calculated as A_2/A_1, is about 0.4. Because parameters A_1 and A_2 are both statistically significant, the estimate for θ is reliable. That is to say a one percent increase in the excess demand for labor (strictly, a ratio of labor demand to labor supply) tends to give rise to a 0.3 percent increase in nominal wages.

(3) The elasticity of labor supply with respect to wages, β, and the elasticity with respect to consumer prices, γ, are estimated to be 0.18-0.40 and ▲0.4-▲0.7, respectively.[19] That is, labor supply tends to increase and decrease when nominal wages and consumer prices increase, respectively.

(4) The shifting parameter, φ, which is estimated to have a negative value, should be considered as negligible, because parameter A_6 is not statistically significant. ($\varphi=A_6/A_2$.) Namely a combined effect of a change in the output elasticity of labor and of a change in the ratio of wage to marginal productivity of labor is eventually not influential. Because of this finding, we will employ Model II-b, which does not include parameter φ, as the best specification and use it in the following analysis.

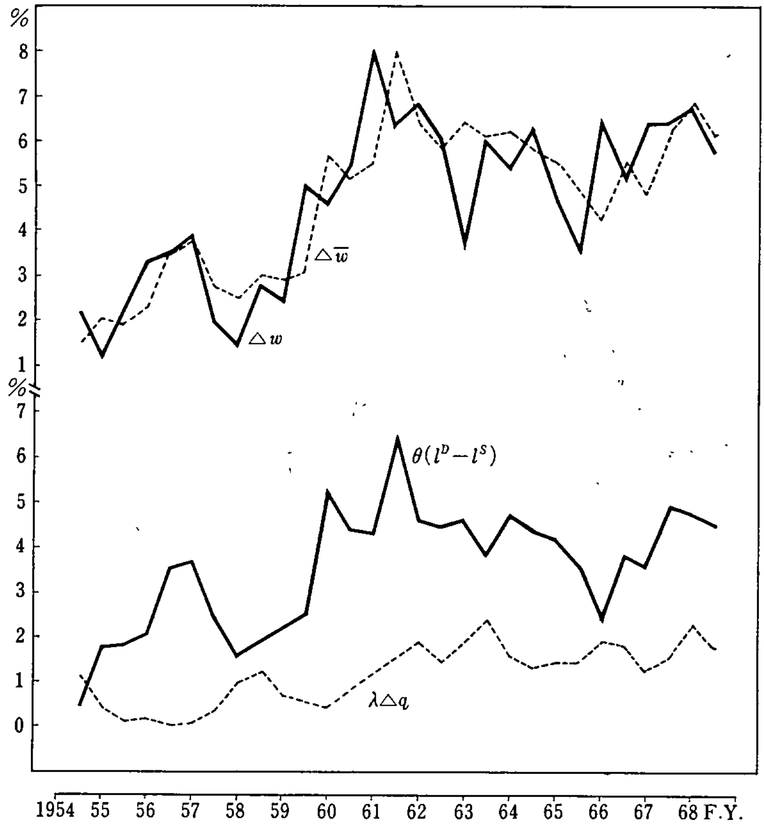
Factors in Wage Increases

Table 3 shows the semi-annual exponential rates of growth in wages, $\triangle w(=w_t-w_{t-1})$ and $\triangle \overline{w}(=\overline{w}_t-\overline{w}_{t-1})$ respectively in columns (1) and (2) for the entire observation

18 This is consistent with the results by other authors. Hiromitsu Kaneda, who estimated the CES production function in agriculture, concluded that the elasticity of substitution was not significantly different from unity [3, p. 168]. The elasticity of substitution in manufacturing industries as a whole was estimated by Fumimasa Hamada as 0.929 [2, p. 633].

19 These results can not be compared with other estimates, because a time-series estimation of the aggregate supply function has never been made in this country.

CHART 1. SEMI-ANNUAL RATE OF GROWTH IN WAGES AND ITS COMPONENTS



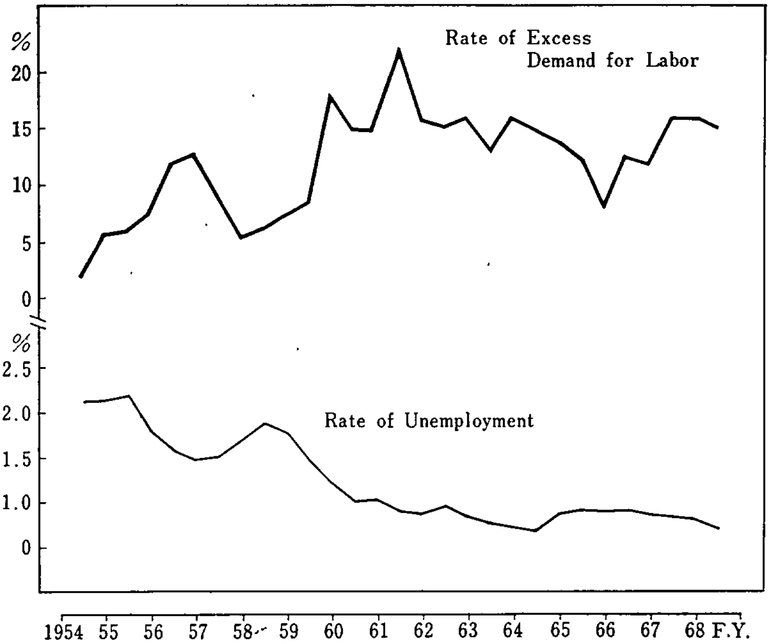
Remarks: See Table 3.

TABLE 3. SEMI-ANNUAL RATE OF INCREASE IN WAGES AND ITS COMPONENTS

Periods (Fiscal Year Basis)	Rate of Increase in Wages: Actual $\triangle w$ (1)	Estimated $\triangle\bar{w}$ (2)	Its Components: $\lambda\triangle q$ (3)	$\theta(1^D-1^S)$ (4)	(3)/(2) (5)	(4)/(2) (6)	Excess Demand for Labor: 1^D-1^S (7)	$\frac{L^D-L^S}{L^S}$ (8)
					(%)	(%)		(%)
1954 I-60 II	0.0309	0.0311	0.0053	0.0258	16.9	83.1	0.076	7.9
1961 I-64 II	0.0639	0.0633	0.0164	0.0469	25.9	74.1	0.139	14.9
1965 I-65 II	0.0564	0.0560	0.0165	0.0395	29.4	70.6	0.117	12.4
1954 I-68 II	0.0470	0.0468	0.0114	0.0354	24.4	75.6	0.105	11.1

Remarks: For the meaning of I and II in the column for periodization, see footnote 14.
$\triangle w=w_t-w_{t-1}$. $\triangle\bar{w}=\bar{w}_t-\bar{w}_{t-1}$. $\triangle q=(q_{t-1}-q_{t-3})/2$.
Figures are calculated based on the estimates of Model II-b.

CHART 2. ESTIMATED RATE OF EXCESS DEMAND FOR LABOR AND RATE OF UNEMPLOYMENT



Remarks: See Table 3 for the estimated excess demand for labor. The rate of unemployment is calculated as the ratio of totally unemployed persons to the total labor force. Figures for totally unemployed persons and for total labor force are from unpublished data provided by the EPA. (See footnote 17.)

period as well as for three sub-periods. w stands for the actual wage series and $\overline{w}$ for the estimated value of w. In calculating $\overline{w}$ the reduced form equation for Model II-b is used. In column (3), the first component of the wage increase as a function of the cost of living adjustments, $\lambda\triangle q=\lambda(q_{t-1}-q_{t-3})/2$, is calculated and shown. The second component depending on the excess demand for labor, $\theta(1^D-1^S)$, is calculated as a difference between $\triangle\overline{w}$ and $\triangle q$ and shown in column (4). Semi-annual figures for $\triangle w$, $\triangle\overline{w}$, $\triangle q$ and $\theta(1^D-1^S)$ are demonstrated in Chart 1. Looking at this chart one may easily discover two facts;

(1) The second component has been much larger than the first component for the entire span of observed years. According to columns (5) and (6) of Table 3, the first and the second components constitute, respectively, 24 percent and 76 percent of $\triangle\overline{w}$.

(2) Patterns in wage changes, expressed by $\triangle w$ and $\triangle\overline{w}$, have been uniquely dependent on the changes in the second component. These two facts signify that the level and the changes in the rate of wage increase have been almost entirely explained, respectively, by the level and by the changes in the excess demand for labor.

In column (7) of Table 3, the logarithmic value of the ratio of labor demand to labor supply, 1^D-1^S, is calculated. From this value, the rate of excess demand for labor, $(L^D$

$-L^S)/L^S$ is easily obtained. It is shown in column (8) of the same table.[20] Looking at Chart 2, which depicts this ratio as well as the rate of unemployment, the following three things may be pointed out:
(1) Excess demand for labor tends to increase in boom years (1957, 1961 and 1968) and to decrease in recessions (1955, 1958 and 1965). It is because the demand function for labor shifts upwards much faster in boom years.
(2) The unparalleled increase in this ratio during 1958-61 may confirm our conclusion, which was reached in the previous papers [8] [9] [10], that Japan succeeded in a transition from a labor surplus to a labor shortage economy at the end of the 1950's and at the beginning of the next decade. According to Table 3, the average figures for 1954-60, 1961-64 and 1965-68 are 7.9 percent, 14.9 percent and 12.4 percent, respectively.
(3) Comparing this ratio with the rate of unemployment, one may find a contrast between the 1950's and the 1960's: During the former decade, there is a negative association between the two series, whereas, during the latter decade, no association exists. That is, the rate of unemployment has become insensitive to the fluctuations in the excess demand for labor.

IV. *Summary and Conclusions*

In this paper we proposed an alternative approach to the PLC (Phillips-Lipsey curve) in analyzing wage changes. In the PLC approach, wage changes are simply explained by the rate of unemployment used as an index for the excess demand for labor. In our alternative approach, on the other hand, wage changes are explained in a general framework involving the demand and supply functions of labor. The labor demand functions are derived from two types production functions; the CES type and the Cobb-Douglas type. The labor supply function is formulated in such a way that the ratio of labor supply to population is dependent on money wages and the consumer price index.

Such an alternative WAF (wage adjustment function) was applied to the Japanese economy for 1954-68. Major conclusions which were attained in this study are summarized as follows: (1) Wage changes are well explained by the excess demand for labor. In the first place, the elasticity of a wage increase with respect to a change in the excess demand for labor has been found to be significant. In the second place, the adjustments for the excess demand for labor are responsible for three quarters of the rate of increase in wage. (2) On the other hand, the cost of living adjustments are barely significant. In the first place, the elasticity of wage increase with respect to a rise in the consumer price index is not significant at the conventional significance level. In the second place, only a quarter of the rate of wage increase is attributable to the cost of living adjustments. (3) The supply of labor tends to increase and to decrease, respectively, owing to wage increases and to price increases. (4) The rate of excess demand for labor tends to increase and

[20] Our WAF is formulated under the assumption that wage changes are completely explained by two types of adjustments; the cost of living adjustments and the adjustments for the excess demand for labor. If wage changes are dependent on other factors as well, our estimates for the rate of excess demand for labor are not free from over-estimations. Taking this fact into due consideration, we will not be concerned, in this paper, with the level itself in this rate but with the changes in it.

decrease, respectively, during boom years and during recession years. Besides these short-term fluctuations, this rate shows a big increase during 1958-61. This increase may reflect such a structural change in the labor market as a transition from a labor surplus to a labor shortage economy, which is thought to have occurred at the end of the 1950's and at the beginning of the 1960's.

Although our WAF is well-fitted to the Japanese labor market, such an approach alternative to the PLC may be applicable to other countries as well. In the writer's opinion, this approach should be particularly useful in both of two types of countries; developing countries for which reliable unemployment statistics are not available, and the developed countries in which there is nearly full employment and, therefore, the ordinary PLC does not work as a WAF.

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