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Price and Wage Setting in Japan: An Empirical Investigation

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Abstract

This paper empirically analyzes whether a hypothesis from Aukrust (1977) applies to two phenomena in Japan: wage spillover between internationally competitive industries (exposed sectors) and domestically protected industries (sheltered sectors), and wage- and price- setting in those industries. We find that Aukrust's assumptions hold in the case of Japan, as all three of the cointegrating relations assumed by the Aukrust model are confirmed to exist. We also find the causal relations in Japan are more complex than the relations assumed by Aukrust.

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1 Introduction

This paper tests whether a hypothesis from Aukrust (1977) applies to two phenomena in Japan: wage spillover between internationally competitive industries ("exposed sectors") and domestically protected industries ("sheltered sectors"), and wage- and price- setting in those industries. The traded goods industries in an open economy are exposed to competition with other countries, and the prices of those goods are determined by the international market. As a result, the prices of competitive goods are imposed exogenously. Real wages are equal to marginal productivity in competitive goods industries, hence nominal wages are set based on the prices of goods determined by the international market. Sheltered sectors, on the other hand, are shut off from international competition and thus unrestricted by price competition. Yet the movement of labor within the domestic labor market leads to a convergence of wages in the two sector groups, hence wages in the exposed sectors can be presumed to lead wages in the sheltered sectors. The prices of goods in sheltered sectors are determined by wages as those wages are determined by the labor market. This is the Aukrust hypothesis.

Japan has both exposed sectors and sheltered sectors, and the labor market between the two is arguably integrated. Aukrust's assumptions seem to fit the Japanese economy closely, and may apply to wage- and price-setting in Japan. By testing the Aukrust hypothesis we can yield important information on the wage- and price-setting processes even in the present. For our tests we adopt recent methods of time series analysis, relying closely on cointegration analysis.

The Aukrust hypothesis can be summed up as two assumptions. First, it assumes the existence of three cointegrating relations: (i) one among wages, prices, and labor productivity in exposed sectors; (ii) one between wages in exposed sectors and wages in sheltered sectors; and (iii) one among wages, prices, and labor productivity in sheltered sectors. Second, it assumes the existence of three spillover paths: (i) a causal relation from prices in exposed sectors to wages in exposed sectors; (ii) a causal relation from wages in exposed sectors to wages in sheltered sectors; and (iii) a causal relation from wages in sheltered sectors to prices in sheltered sectors.

Many researchers have recognized the importance of the Aukrust model and taken the model up as a basis for subsequent study. The works of Frisch (1977) and Nymoen (1991) are prominent and representative. Friberg (2003) used causality tests to examine the wage spill-over hypothesis, i.e., to test whether the exposed sector was a wage leader, in the case of Sweden. The public sector in his analysis was divided into central government and local government, and the private sector was divided into (1) manufacturing, (2) construction, (3) wholesale and retail, and (4) finance. Causality tests demonstrated a strong causality between the two sector groups, but neither of the groups seemed to preponderate as a wage leader. When Holmlund and Ohlsson (1992) and Jacobson and Ohlsson (1994) searched for wage linkages between the government sector and private sector (manufacturing), both studies concluded that the private sector was more of a wage leader than the government sector.

The wage- and price-setting mechanisms in Japanese competitive goods industries and non-competitive goods industries are empirically analyzed based on the specific characteristics of the Japanese economy in this paper. The analysis covers four exposed sector industries (transport machinery, iron & steel, chemicals, and metals) and one sheltered sector industry (electricity & gas). A well recognized feature of the Japanese economy is the coexistence of industries exposed to fierce international competition from overseas (e.g., transport machinery, iron & steel, chemicals, and metals) and industries sheltered by impediments to entry (e.g., electricity & gas).

This paper focuses on the relationships of both causality and cointegration. Specifically, we ask three questions: whether Aukrust's assumptions hold on either basis, whether the cointegrating relations differ from those assumed by Aukrust, and whether we can simultaneously identify cointegrating relations consistent with those assumed by Aukrust and causality relationships different from those assumed by Aukrust.

The main conclusions drawn from our study can be condensed into two points. First, we can assert that Aukrust's assumptions hold in the case of Japan, as all three of the cointegrating relations assumed by the Aukrust model are confirmed to exist. Second, we find that the causal relations in Japan are more complex than the relations assumed by Aukrust. In the case of wages, for example, we encounter a bidirectional causality between the exposed and sheltered sectors, rather than a one-way spillover from the latter to the former. As previously demonstrated in the study by Friberg (2003), our result indicates that neither of the sector groups can be described as a wage leader. Our findings also suggest that the exposed sectors have pricing power even in international markets. If this is so, competitive Japanese companies cannot be characterized as the "price-taking" entities proposed in the Aukrust model. It thus appears that wages in the two sector groups are influenced by a wider variety of variables than assumed by Aukrust.

The remainder of this paper is organized as follows: Section 2 explains the Aukrust hypothesis; Section 3 introduces the data used in the paper; Section 4 presents the demonstration results; and Section 5 outlines the conclusions.

2 Aukrust's main-course model

Aukrust (1997) analyzes the processes of wage- and price-setting by establishing a two-sector model comprised of sectors exposed to international competition ("exposed sectors") and sectors protected from international competition ("sheltered sectors") in a small, open economy. Companies in exposed sectors produce competitive goods, while companies in sheltered sectors produce non-competitive goods. The market for non-competitive goods is protected by the national government or by high costs, leading to conditions which heighten the impediments to entry. The product prices in a market for non-competitive goods are determined on the basis of the mark-ups on top of wage costs.

The model developed by Aukrust (1977) can be specified as follows:

$$p_{e,t} = g_f + p_{e,t-1} + v_{1,t} \quad (1)$$
$$a_{e,t} = g_{a_e} + a_{e,t-1} + v_{2,t} \quad (2)$$
$$w_{e,t} - p_{e,t} - a_{e,t} = m_e + v_{3,t} \quad (3)$$
$$w_{s,t} = w_{e,t} + v_{4,t} \quad (4)$$
$$a_{s,t} = g_{s_e} + a_{s,t-1} + v_{5,t} \quad (5)$$
$$w_{s,t} - p_{s,t} - a_{s,t} = m_s + v_{6,t} \quad (6)$$

where $w_{e,t}$ is the nominal wage of a firm in E-sector at time t; $p_{e,t}$ is the output price of a firm in E-sector at time t; $a_{e,t}$ is the average labor productivity of a firm in E-sector at time t; $w_{s,t}$ is the nominal wage of a firm in S-sector at time t; $p_{s,t}$ is the output price of a firm in S-sector at time t; $a_{s,t}$ is the average labor productivity of a firm in S-sector at time t; $g_i(i = f, a_e, a_s)$ is the constant growth rate; $m_i(i = e, s)$ is the wage share of the i-th firm; $v_i(i = 1, ..., 6)$ are the stationary error terms. The suffices e and s indicate the E-sector and S-sector, respectively, and all of the variables are expressed in logarithms.

It follows from Eqs. (3), (4) and (6) that we obtain theoretical cointegrating and causal relations. For the causality, we obtain,

$$w_{e,t} - p_{e,t} - a_{e,t} = c_1 + \epsilon_1 \sim I(0), \quad (7)$$
$$w_{s,t} - w_{e,t} = c_2 + \epsilon_2 \sim I(0), \quad (8)$$
$$w_{s,t} - p_{s,t} - a_{s,t} = c_3 + \epsilon_3 \sim I(0). \quad (9)$$

For causality, we obtain

$$p_{e,t} \longrightarrow w_{e,t}, \quad (10)$$
$$w_{e,t} \longrightarrow w_{s,t}, \quad (11)$$
$$w_{s,t} \longrightarrow p_{s,t}, \quad (12)$$

where $\epsilon_i(i = 1, 2, 3)$ are disturbances.

3 Data

The analysis in this paper uses monthly Japanese data from January 1988 to December 2005. Manufacturing is taken as an example of an exposed sector and services are taken as an example of a sheltered sector. Manufacturing is represented by four industries: transport machinery, iron & steel, chemicals, and metals. The service sector is represented by electricity & gas.

The industrial production index is obtained from Ministry of Economy, Trade and Industry. The domestic producer's price index is obtained from Bank of Japan. Wage and employment data are obtained from the Japan Institute for Labor Policy and Training.

Automaking, iron and steel, chemicals, and metals are all industries subject to competition. The auto industry, which is included under transport machinery, is one of Japan's most competitive industries. Iron and steel represents heavy industry and is amply competitive due in part to competition with foreign companies. Chemicals and metals can also be considered competitive. As competition takes place in all four industries, they can be analyzed as exposed sectors.

Electricity and gas are regional monopolies in Japan, and domestic demand is covered by domestic production. Electricity & gas thus face no competition as an industry and can be analyzed as a sheltered sector.

Hence, we analyzed the following four cases:

- Case 1: (Exposed sector, Sheltered sector) = (transport machinery, electricity & gas)
- Case 2: (Exposed sector, Sheltered sector) = (iron & steel, electricity & gas)
- Case 3: (Exposed sector, Sheltered sector) = (chemicals, electricity & gas)
- Case 4: (Exposed sector, Sheltered sector) = (metals, electricity & gas)

Output levels were measured by indexes of industrial production and tertiary industry activity. Prices were measured by a price index for domestic corporate goods (excluding the consumption tax), wages were measured by an index of total cash earnings, and the number of employees was calculated based on the employment index of regular workers. The seasonal adjustments for output, electricity & gas prices, wages, and the number of workers were conducted using XI2.

4 Empirical Analysis

4.1 Cointegration

To examine whether Aukrust's main-course model of wage-setting and price-setting applies to the Japanese economy, we analyze the cointegrating relation expressed by Eqs. (7), (8) and (9).

First, and ADF test (Dickey and Fuller, 1979), PP test (Phillips and Perron, 1988), DF-GLS test (Elliott et al, 1996) and KPSS (Kwiatkowski et al, 1992) test are performed to analyze if each variable has a unit root. The lag length is chosen using an AIC with a maximum length of 6. As Table 1 indicates, each variable is likely to have a unit root.

Having found that each variable has a I(1) process, we now move on to the cointegration analysis among variables. Given that the cointegration vector is theoretically known, sufficient information can be collected by carrying out a unit root test on $(w_{e,t} - p_{e,t} - a_{e,t})$, $(w_{s,t} - w_{e,t})$ and $(w_{s,t} - p_{s,t} - a_{s,t})$. The ADF test and Phillips-Perron test are applied for this purpose. The empirical results shown in Table 2 support the cointegrating relation for each of the four cases (Case 1 through Case 4). Here, we adopt the result of PP test from the problem of power. Thus, our results on Japan support three cointegrating relations from the Aukrust hypothesis. Furthermore, we implement Exp-F test to check a structural change (Andrews and Ploberger, 1994). This test is known to be more powerful test against distant local alternatives. This tests for the null of parameter constancy against the alternative that regression coefficients change at an unknown date. The first and last 15 The lag length is chosen using an AIC with a maximum length of 12. From table 2, it is found that the null hypothesis of no structural change is accepter for every case.

Next, we perform the Johansen test for the six variables ($w_{e,t}$, $w_{s,t}$, $p_{e,t}$, $p_{s,t}$, $a_{e,t}$, and $a_{s,t}$) to reinforce our empirical results. The lag length of the vector error correction model is selected using the AIC. As shown in Table 3, the cointegrating rank is equal to three for each case. Judging from Tables 2 and 3, the three cointegrating relations implied by Aukrust's main-course model appear to hold in Japan.

4.2 Causality

Next we analyze the causal relations shown by Eqs. (10), (11) and (12). To consider this problem, we estimate the following vector error correction model (VECM):

$$\Delta \boldsymbol{y}_t = \boldsymbol{\alpha} EC_{t-1} + \Sigma_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \boldsymbol{y}_{t-i} + \boldsymbol{u}_t, \tag{13}$$

$$EC_t = \boldsymbol{\beta}' \boldsymbol{y}_t = \begin{bmatrix} w_{e,t} - p_{e,t} - a_{e,t} \\ w_{s,t} - w_{e,t} \\ w_{s,t} - p_{s,t} - a_{s,t} \end{bmatrix} \tag{14}$$

where $\boldsymbol{y}_t = \{w_{e,t}, w_{s,t}, p_{e,t}, p_{s,t}, a_{e,t}, a_{s,t}\}'$, $\boldsymbol{u}_t$ is a vector of disturbances, $\boldsymbol{\alpha}$ is a vector of adjustment coefficients, and $\boldsymbol{\beta}$ is a 6×3 cointegrating vector. The lag length of the VAR(p) model is chosen using the AIC.

We consider the causality by focusing on the vector of adjustment coefficients $\boldsymbol{\alpha}$, as given by,

$$\boldsymbol{\alpha} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \vdots & \vdots & \vdots \\ \alpha_{61} & \alpha_{62} & \alpha_{63} \end{bmatrix}. \tag{15}$$

The wage of each industry is given by,

$$\Delta w_{e,t} = \alpha_{11}(w_e - p_e - a_e)_{t-1} + \alpha_{12}(w_s - w_e)_{t-1} + \alpha_{13}(w_s - p_s - a_s)_{t-1} + \ldots. \tag{16}$$

$$\Delta w_{s,t} = \alpha_{21}(w_e - p_e - a_e)_{t-1} + \alpha_{22}(w_s - w_e)_{t-1} + \alpha_{23}(w_s - p_s - a_s)_{t-1} + \ldots. \tag{17}$$

According to the Aukrust hypothesis, the wage in competitive industries is influenced by the world output price, but not by the wage in domestic protected industries. Thus, we obtain,

$$\alpha_{11} \neq 0,\ \alpha_{12} = 0,\ \alpha_{13} = 0. \tag{18}$$

Additionally, the wage movements in protected industries are adjustments to reduce the disparity from the wage in competitive industries. Thus, we obtain

$$\alpha_{21} = 0,\ \alpha_{22} \neq 0,\ \alpha_{23} = 0. \tag{19}$$

The price-setting equation in domestic protected industries is shown by,

$$\Delta p_{s,t} = \alpha_{41}(w_e - p_e - a_e)_{t-1} + \alpha_{42}(w_s - w_e)_{t-1} + \alpha_{43}(w_s - p_s - a_s)_{t-1} + \tag{20}$$

Given the wage and technical progress, the prices presumably move as adjustments to reduce the disparity, as follows:

$$\alpha_{41} = 0,\ \alpha_{42} = 0,\ \alpha_{43} \neq 0. \tag{21}$$

From Eqs. (1), (2) and (5), the technical progress in two industries $(\Delta a_{e,t}, \Delta a_{s,t})$ and the output price in competitive industries $(\Delta p_{e,t})$ are unit root processes, and thus given exogenously. In summary, the coefficients implied by the Aukrust model can be shown as follows: [1]

$$\boldsymbol{\alpha} = \begin{bmatrix} \alpha_{11} & 0 & 0 \\ 0 & \alpha_{22} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & \alpha_{43} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}. \tag{22}$$

Next, we estimate the vector of adjustment coefficients and compare the results with the results expected under the Aukrust theory. As the cointegrating vector of each equation is known, the VECM can be estimated using OLS instead of the maximum likelihood method. It thus suffices to estimate Eq. (13) for Cases 1 through 4.

Tables 4, 5, 6, and 7 report the OLS estimates of adjustment coefficients corresponding to Case l, Case 2, Case 3, and Case 4. Note that the tables omit results for lagged and constant terms.

First, let us consider the empirical results of coefficients α_{11}, α_{22} and α_{43}. The coefficient of wage determination in competitive industries, α_{11}, is statistically significant for Case l, Case 2, and Case 4. The coefficient to adjust the disparity between the wage in domestic protected industries and the wage in competitive industries, α_{22}, is statistically significant for Case 1, Case 3, and Case 4. These results are consistent with the Aukrust model. We also find,

[1] Strictly speaking, $|\alpha_{ij}| = 1$ because of the instantaneously adjustment, hence the VAR in first differences becomes zero.

however, that the coefficients of price determination in protected industries, α_{41}, α_{42}, and α_{43}, lack statistical significance. This finding is inconsistent with the Aukrust model.

Given that α_{12} and α_{22} are statistically significant for Case l, Case 3, and Case 4, the wages in both industry groups move to adjust the wage disparity. Specifically, α_{12} is statistically significant in all cases, hence neither of the industry groups can be singled out as the wage leader. The coefficients of wage adjustment in competitive and protected industries, α_{13} and α_{31}, are statistically significant in most cases, hence a causal relation from prices to wages can be confirmed. The coefficient of adjustment, α_{31}, is statistically significant in every case, hence the prices of traded goods are set to adjust the disparity of real wages.

These findings confirm the existence of a unilateral causal relation from one industry group to the other, just as Aukrust's main-course model assumes.

5 Conclusions

This paper empirically analyzed whether the empirical hypotheses proposed by Aukrust (1977) applies to Japan.

First, we confirmed that Aukrust's three cointegrating relations hold for Japan. As the Aukrust (1977) model asserts, long-run relationships can be identified in the wages, prices and labor productivity of exposed sectors; in the wages of exposed sectors and wages of sheltered sectors; and in the wages, prices, and labor productivity of sheltered sectors.

Second, we obtained spill-over paths that differed overall from the spill-over paths asserted in the Aukrust (1977) model. The results of our analysis seemed to point to the following directionality in spill-over effects: (1) the wages of sheltered sectors and wages of exposed sectors impact each other; (2) the prices of sheltered sectors impact the wages of sheltered sectors; and (3) the wages of exposed sectors and the prices of exposed sectors impact each other. Overall, there was no evidence to suggest that the wages in sheltered sectors impacted the prices in sheltered sectors.

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Table 1: Unit root test

	industry	ADF	PP	DF-GLS	KPSS
w	electricity & gas	-4.097**	-3.321*	1.565	1.556**
	transport machinery	-3.348*	-2.556	1.244	1.633**
	iron & steel	-3.101*	-10.868**	0.952	1.095**
	chemicals	-3.590**	-3.551**	1.853	1.652**
	metals	-4.477**	-4.664**	0.634	0.970**
p	electricity & gas	-0.437	-0.475	1.036	1.716**
	transport machinery	0.616	2.449	1.204	1.762**
	iron & steel	-1.927	-0.538	-1.582	0.725*
	chemicals	-1.304	-1.227	-1.109	0.890**
	metals	-1.105	-1.106	-0.860	0.978**
a	electricity & gas	0.010	-0.171	2.985	1.854**
	transport machinery	-0.806	-2.179	0.022	1.238**
	iron & steel	-1.053	-0.567	-0.233	1.617**
	chemicals	-0.986	-1.047	1.544	1.851**
	metals	-3.010*	-5.839**	-2.546*	0.124
Δw	electricity & gas	-10.731**	-46.305**	-5.162**	0.461
	transport machinery	-9.405**	-40.901**	-2.963**	0.310
	iron & steel	-14.167**	-52.770**	-0.983	0.156
	chemicals	-12.700**	-47.434**	-0.799	0.399
	metals	-12.164**	-43.202**	-0.668	0.501*
Δp	electricity & gas	-14.397**	-14.402**	-13.496**	0.059
	transport machinery	-3.142*	-12.580**	-2.534*	0.897**
	iron & steel	-2.833	-6.303**	-1.493	0.622*
	chemicals	-5.236**	-10.490**	-4.790**	0.406
	metals	-8.974**	-9.039**	-3.720**	0.305
Δa	electricity & gas	-13.645**	-30.120**	-0.961	0.118
	transport machinery	-24.931**	-26.390**	-1.077	0.111
	iron & steel	-4.178**	-14.922**	-1.004	0.084
	chemicals	-23.178**	-23.337**	-23.138**	0.035
	metals	-7.779**	-25.371**	-1.098	0.040

Note: ** (*) indicates significance at 1% (5%).

Table 2: Cointegration test

Industry		PP test	ADF test	Exp-F test
Case 1)	$(w_{e,t} - p_{e,t} - a_{e,t})$	-3.115**	-2.409*	0.421
	$(w_{s,t} - w_{e,t})$	-13.436**	-2.498*	0.384
	$(w_{s,t} - p_{s,t} - a_{s,t})$	-6.815**	-0.697	0.504
Case 2)	$(w_{e,t} - p_{e,t} - a_{e,t})$	-2.967**	-0.663	1.374
	$(w_{s,t} - w_{e,t})$	-10.145**	-0.944	1.004
	$(w_{s,t} - p_{s,t} - a_{s,t})$	-	-	-
Case 3)	$(w_{e,t} - p_{e,t} - a_{e,t})$	-3.080**	-0.799	0.630
	$(w_{s,t} - w_{e,t})$	-14.760**	-2.344*	0.479
	$(w_{s,t} - p_{s,t} - a_{s,t})$	-	-	-
Case 4)	$(w_{e,t} - p_{e,t} - a_{e,t})$	-3.531**	-2.470*	0.485
	$(w_{s,t} - w_{e,t})$	-11.432**	-1.261	0.600
	$(w_{s,t} - p_{s,t} - a_{s,t})$	-	-	-

Note: PP test and ADF test are unit root test. Exp-F test is a structural change test.
Test statistics of $(w_{s,t} - p_{s,t} - a_{s,t})$ are the same for all four cases.
** (*) indicates significance at 1% (5%).

Table 3: Cointegration rank tests

null hypothesis (trace tests)	Case 1)	Case 2)	Case 3)	Case 4)
$r = 0$	165.966**	202.196**	204.785**	128.197**
$r \leq 1$	100.054**	111.507**	95.114**	75.855*
$r \leq 2$	56.034**	62.993**	49.735*	48.148*
$r \leq 3$	22.486	28.217	25.644	27.368
$r \leq 4$	10.663	9.980	9.061	9.081
$r \leq 5$	1.437	3.038	3.389	0.123
null hypothesis (max-eigenvalue tests)	Case 1)	Case 2)	Case 3)	Case 4)
$r = 0$	65.912**	90.690**	109.671**	52.342**
$r \leq 1$	44.021**	48.513**	45.380**	27.707
$r \leq 2$	33.548**	34.776**	24.090	20.780
$r \leq 3$	11.823	18.237	16.584	18.287
$r \leq 4$	9.226	6.942	5.672	8.959
$r \leq 5$	1.437	3.038	3.389	0.123

Note: ** (*) indicates significance at 1% (5%).

Table 4: The estimation result of $\boldsymbol{\alpha}$: Case 1)

	$(w_e - p_e - a_e)$	$(w_s - w_e)$	$(w_s - p_s - a_s)$
$\Delta w_{e,t}$	-0.054**	0.447**	-0.092*
p-value	(0.005)	(0.000)	(0.024)
$\Delta w_{s,t}$	-0.011	-0.311**	0.027
p-value	(0.513)	(0.001)	(0.423)
$\Delta p_{e,t}$	-0.002*	-0.009	0.007*
p-value	(0.027)	(0.169)	(0.027)
$\Delta p_{s,t}$	-0.004	0.013	0.006
p-value	(0.558)	(0.661)	(0.575)
$\Delta a_{e,t}$	0.050*	0.029	-0.041
p-value	(0.049)	(0.834)	(0.394)
$\Delta a_{s.t}$	-0.006	-0.161	0.083
p-value	(0.700)	(0.105)	(0.067)

Note: ** (*) indicates significance at 1% (5%).

Table 5: The estimation result of $\boldsymbol{\alpha}$: Case 2)

	$(w_e - p_e - a_e)$	$(w_s - w_e)$	$(w_s - p_s - a_s)$
$\Delta w_{e,t}$	-0.155*	0.394**	0.379*
p-value	(0.015)	(0.001)	(0.028)
$\Delta w_{s,t}$	0.056*	-0.062	-0.165*
p-value	(0.042)	(0.065)	(0.029)
$\Delta p_{e,t}$	-0.009*	0.004	-0.008
p-value	(0.045)	(0.360)	(0.355)
$\Delta p_{s,t}$	-0.006	-0.006	0.024
p-value	(0.314)	(0.473)	(0.114)
$\Delta a_{e,t}$	0.024	0.042*	-0.002
p-value	(0.088)	(0.015)	(0.960)
$\Delta a_{s.t}$	-0.060**	-0.005	0.176**
p-value	(0.001)	(0.838)	(0.000)

Note: ** (*) indicates significance at 1% (5%).

Table 6: The estimation result of $\boldsymbol{\alpha}$: Case 3)

	$(w_e - p_e - a_e)$	$(w_s - w_e)$	$(w_s - p_s - a_s)$
$\Delta w_{e,t}$	-0.040	0.602**	-0.077
p-value	(0.265)	(0.000)	(0.225)
$\Delta w_{s,t}$	0.083**	-0.348*	-0.119**
p-value	(0.002)	(0.014)	(0.009)
$\Delta p_{e,t}$	-0.018**	0.011	0.004
p-value	(0.009)	(0.427)	(0.647)
$\Delta p_{s,t}$	-0.007	-0.024	0.019
p-value	(0.442)	(0.381)	(0.134)
$\Delta a_{e,t}$	0.059*	-0.017	-0.027
p-value	(0.037)	(0.782)	(0.503)
$\Delta a_{s.t}$	-0.007	-0.024	0.019
p-value	(0.442)	(0.381)	(0.134)

Note: ** (*) indicates significance at 1% (5%).

Table 7: The estimation result of $\boldsymbol{\alpha}$: Case 4)

	$(w_e - p_e - a_e)$	$(w_s - w_e)$	$(w_s - p_s - a_s)$
$\Delta w_{e,t}$	-0.077**	0.170*	0.149**
p-value	(0.001)	(0.039)	(0.009)
$\Delta w_{s,t}$	-0.007	-0.309**	-0.157**
p-value	(0.732)	(0.000)	(0.001)
$\Delta p_{e,t}$	-0.006**	-0.001	-0.006
p-value	(0.009)	(0.824)	(0.176)
$\Delta p_{s,t}$	-0.003	0.011	0.019
p-value	(0.682)	(0.527)	(0.136)
$\Delta a_{e,t}$	0.014	0.057	0.050
p-value	(0.410)	(0.250)	(0.145)
$\Delta a_{s.t}$	-0.021	0.065	0.045
p-value	(0.277)	(0.445)	(0.429)

Note: ** (*) indicates significance at 1% (5%).