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Econometric analysis of expected price formation

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ABSTRACT

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The current report analyses the process of producers' expected price formation through the estimation of supply functions, using vegetables and green tea in Japan as an example.

At first, theoretical analysis shows that the factors which transform the producers' expected price formation from the lagged expectation to the rational expectation are as follows: decrease in information price, increase in managerial ability and/or organizational innovation, rightward shift of supply curve, and increase in price elasticity in supply curve.

Second, supply functions are estimated by using the price expectation formation which include the rational expectation and the lagged expectation as its extreme form.

Consequently, producers' price expectations were found to approach the rational expectations in the case of Chinese cabbage, lettuce and green tea, whose supply curves show high price elasticities, and whose producers' organizations gather price information and monitor the production more than other crops taken in this paper.

1. Introduction

The purpose of this paper is to demonstrate the possibility of the change of producers' price expectation theoretically and to verify it econometrically.

In the econometric model, the process of expectation formation which involves information gathering, information processing and prediction has not been treated explicitly. As a result the lagged expectations, which include static, extrapolative or adaptive expectation, and the rational expectation have been used for describing the producers' expected price formation in estimating the supply functions of agricultural products whose prices are determined by the market forces. This situation can be ascribed to the lack

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of recognition that information implies the management cost as well as the profit source.

In recent years, criticisms[1] have been voiced against the concept of both lagged expectation and rational expectation from viewpoints of producers' availability of information. Regarding the lagged expectation, it has been argued that the assumption that the producers maintain the lagged expectation in spite of their ability to improve their expectations and obtain benefits by using more information concerning the factors that shift the demand or supply curves, as well as information on past prices of their products, is not valid. The second criticism is that even if major producers' expectations consist of the lagged expectations, aggregated supply behavior in the market may become rational as a result of the arbitrage activities of minor rational producers.

The criticism against the rational expectation is that simple expectation such as the adaptive expectation seems to be truly rational in considering the large amount of information and the cost required for calculating the rational expectation.

Based on these criticisms, Lopez (1986) advocated the use of composite expectation composed of rational and lagged expectation. Lopez assumed two types of producers in the market, i.e. those who form their price expectations rationally and those who form them on the basis of past prices.

This paper, however, suggests the possibility that producers change their price expectations according to changes of information. In order to verify it, a behavioral model of expected profit maximisation will be presented in Section 2 to demonstrate theoretically that the expected price shifts from that based on lagged expectation to the rationally expected price in accordance with (a) the decrease in the information price, (b) improvement of managerial ability or organizational innovation, (c) rightward shift of supply curve, and (d) increase in price elasticity in supply curve.

In the third and fourth sections, the correlation between the rationality of the producers' expected price and price elasticity in supply will be analyzed empirically through the estimation of the supply functions of vegetables and green tea in Japan, as an example.

2. Theory of expected price formation

In this section, a behavioral model of profit maximisation of individual producer is developed to identify the factors that contribute to the shift of

[1] The cricicisms mentioned here have been discussed fragmentarily rather than systematically in several papers. The author referred to the publications of Carter and Maddock (1984), Sheffrin (1983), Shizuki and Muto (1981) and Simon (1979).

the producer's expected price from that based on lagged expectation into the rationally expected price.

Here, 'information' is defined as the means by which the future forecast of an economic actor leads to the rational expectation. Practically, it implies the use of statistics, computer, staffs in intelligence office, etc.

In this model, the individual producer is assumed to be a price taker who has a little share in the market and knows about his own cost function and previous prices of his products, but must predict future prices through the estimation of market demand-supply functions by paying the information cost required for this purpose.

Now, the producer's expected profit π^* is represented by the equation:

$$\pi^* = R^* - C = P^*Q - C \tag{2.1}$$

where R^* is the producer's expected revenue, C is the management cost, P^* is the producer's expected price, and Q is the production quantity. Management cost C is composed of three parts such as fixed cost C_0, production cost $C_1(Q)$ and information cost $C_2(\Omega)$ where Ω is the information input, and is represented by the equation:

$$C = C_0 + C_1(Q) + C_2(\Omega) \tag{2.2}$$

Next, the expected price P^* which is assumed to shift from that based on lagged expectation P^*_{lag} to the rationally expected price P^*_{re} in accordance with the increase in information input, is represented by the equation:

$$P^* = \alpha(\Omega)\, P^*_{\text{re}} + (1-\alpha(\Omega))P^*_{\text{lag}} \tag{2.3}$$

$$(0 \leqq \alpha(\Omega) \leqq 1,\ \alpha'(\Omega) > 0,\ \alpha(0) = 0,\ \alpha(\infty) = 1)$$

This expectation formatin included both the lagged expectation and the rational expectation as its extreme form. When the information input Ω is equivalent to zero, the expected price corresponds to that based on the lagged expectation as $\alpha(\Omega) = 0$, $P^* = P^*_{\text{lag}}$, whereas when the information input Ω is infinite, it corresponds to the rationally expected price as $\alpha(\Omega) = 1$, $P^* = P^*_{\text{re}}$.

By substituting equations (2.2) and (2.3) for equation (2.1), the producer's expected profit π^* is represented by the equation:

$$\pi^* = \{\alpha(\Omega)\, P^*_{\text{re}} + (1-\alpha(\Omega))P^*_{\text{lag}}\}Q - C_0 - C_1(Q) - C_2(\Omega) \tag{2.4}$$

By using expected profit maximization conditions $\partial\pi^*/\partial Q = 0$ and $\partial\pi^*/\partial\Omega = 0$, the equations

$$C_1'(Q) = \alpha(\Omega)\, P^*_{\text{re}} + (1-\alpha(\Omega))\, P^*_{\text{lag}} \tag{2.5}$$

$$C_2'(\Omega) = \alpha'(\Omega)\, \{P^*_{\text{re}} - P_{\text{lag}}\}Q \tag{2.6}$$

are obtained.

Equation (2.5) implies that the marginal production cost is equivalent to the expected price.

From equations (2.5) and (2.6) the equation

$$C_2'(\Omega) = \frac{\alpha'(\Omega)}{\alpha(\Omega)} [C_1'(Q) - P^*_{\text{lag}}] Q$$

$$= \frac{[C_1'(Q) - P^*_{\text{lag}}] Q \dfrac{\Delta\alpha(\Omega)}{\alpha(\Omega)}}{\Delta\alpha} \tag{2.7}$$

is obtained.

Here the relation according to which the marginal information cost is equivalent to the marginal revenue of information is shown in Fig. 1.

At first, the case in which the expected price is lower than the rationally expected price is analysed. The shaded square ▨ in Fig. 1(a) indicates the increase in expected revenue when the information input increases from Ω_0 to Ω_1 namely $\Delta\Omega$ under the equilibrium quantity Q, and it is equivalent to the numerator of the third item in equation (2.7). Thus the third item in equation (2.7) expresses the expected marginal revenue of information.

Conversely, the case in which the expected price is higher than the rationally expected price is analysed. The shaded square ▨ in Fig. 1(b) indicates the decrease in expected revenue when the information input increases from Ω_0 to Ω_1, namely $\Delta\Omega$ under the equilibrium quantity Q, and it is equivalent to the minus value of the numerator of the third item in equation (2.7). Thus the third item in equation (2.7) expresses the expected marginal revenue of information.

From the consideration presented in Fig. 1(a) and (b), equation (2.7) indicates that the marginal cost of information is equivalent to the expected marginal revenue of information.

From the above theoretical considerations, the expected price approaches the rationally expected one under the following four conditions:

Decrease in information price. When the information price decreases due to the development of an information-oriented society, the marginal cost curve of information $C_2'(\Omega)$ shifts to the right and the information input increases. As a consequence, the expected price approaches the rationally expected one.

Improvement of managerial ability and/or organizational innovation. The improvement of the ability of managers or staffs engaged in information processing activities, or organizational innovation for an information-

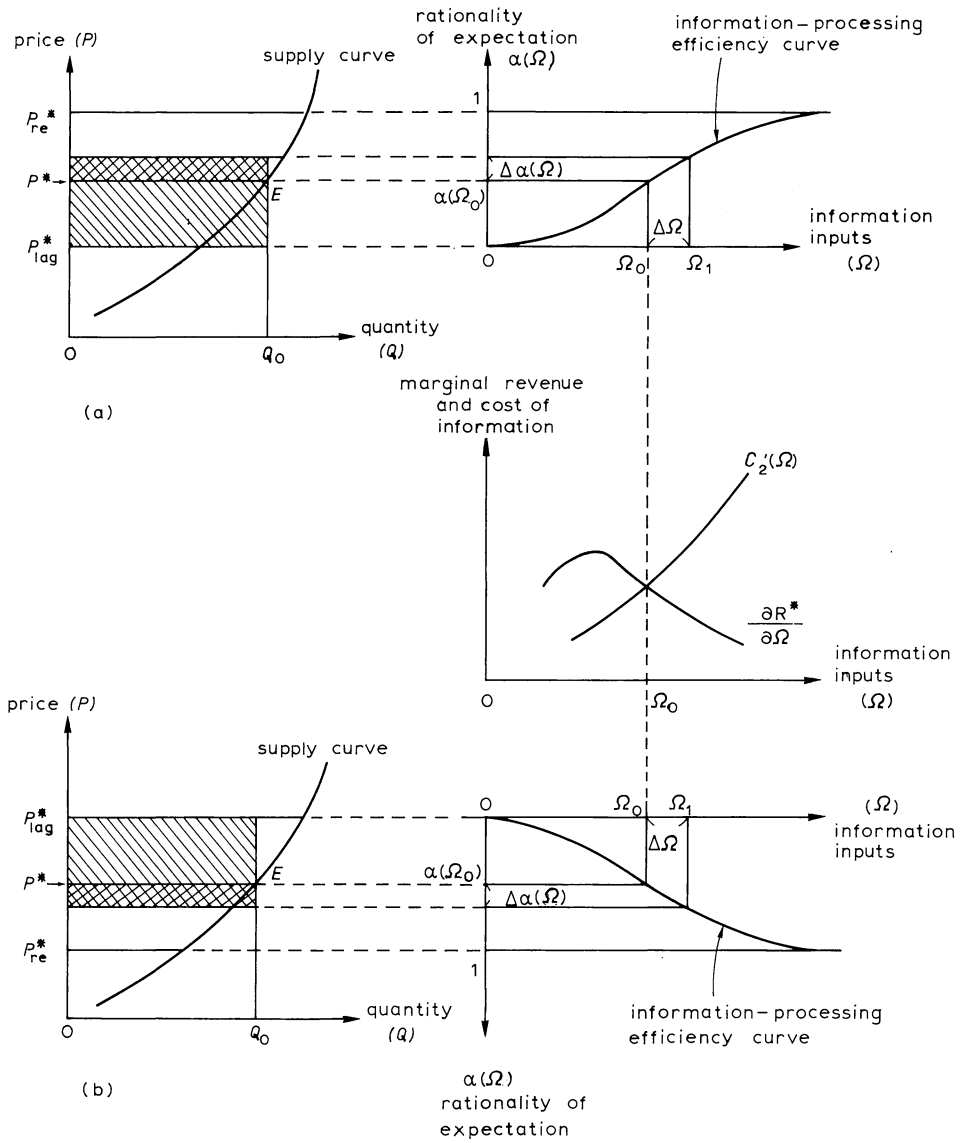

Fig. 1. Information and expected price formation:
(a) in case $P^* < P^*_{re}$
(b) in case $P^* > P^*_{re}$.

oriented society reduces the information input required for a certain prediction. That is to say, the upward shift of the information-processing efficiency curve ($\Omega - \alpha(\Omega)$ curve in Fig. 1) results in a shift of the expected price

from that based on the lagged expectation to the rationally expected price for the same information input.

Rightward shift of supply curve. Rightward shift of supply curve enlarges the shaded square ▨ in Fig. 1, that is to say, it shifts the expected marginal revenue curve of information upward, and the information input Ω increases. As a consequence, the expected price approaches the rationally expected one.

Increase in price elasticity in supply curve. Increase in price elasticity in the supply curve enlarges the shaded square ▨ in Fig. 1. As a result, the expected price approaches the rationally expected one (provided that the new supply curve crosses $P = P^*$ at a point located to the right of equilibrium point E).

The specification of the producer's price expectation developed in this section is compatible with the concept of both 'homo economics which assumes the efficient use of every available source of information and 'bounded rationality' which considers economic actor as an imperfect information processing system.

3. Estimation of supply functions

In this section, aggregated producers' expected prices are analysed through the estimation of supply functions aggregated in the market.

Functions consisting of planted area, yield, supply and demand aggregated in the market at the national level, and demand-supply equilibrium equation are specified for major vegetables and green tea as follows. Here, the producers who know about the parameters of these functions are assumed to expect future prices of their products rationally.

Planted-area function

$$\log S_t = a \log P_t^* + b \log S_{t-1} + c \log T + dD + e + \epsilon \qquad (3.1)$$

Here, the planted area S_t is expressed by the expected price of the product P_t^*, planted area of the product in the preceding year S_{t-1}, trend variable T, dummy variable D, constant term e and disturbance term ϵ. P_t^* is deflated by the consumer price index because any goods seem to be substitutive in the long run. S_{t-1} is used as a partial adjustment lag reflecting the adjustment cost for converting the planted area into the production of other commodities. T is a trend variable reflecting the changes in the pro-

duction cost[2]. D is a dummy variable with a value of zero before the year 1976 and one thereafter, reflecting the decline in the risk of price fluctuations associated with the promotion of *The Vegetables Price Suplementary Scheme* or the expansion of the converted planted area from paddy fields implemented by The Ministry of Agriculture, Forestry and Fisheries since 1977.

Yield function

– vegetables:

$$\log Y_t = f \log P_t^* + g \log T + h + \eta \tag{3.2}$$

– green tea:

$$\log Y_t = f \log P_t + g \log T + h + \eta \tag{3.2'}$$

Here, yield Y_t is expressed by the expected price P_t (as for green tea, the current price P_t is used because picking tea is conducted simultaneously with price formation for $3-5$ months), trend variable T reflecting technological progress and production cost[2], constant term h and disturbance term η.

Supply function

From the definition of $Q_t^s = S_t Y_t$ (Q_t^s is the quantity of supply):

$$\log Q_t^s = \log S_t + \log Y_t \tag{3.3}$$

Demand function

$$\log Q_t^d = i \log P_t + j \log Q_{t-1}^d + k \log I_t + lD \log I_t + m + \xi \tag{3.4}$$

Here, the demanded quantity is expressed by the price of the product P_t, demanded quantity of the product in the preceding year Q_{t-1}^d, national income I_t, constant term m and disturbance term ξ. P_t is deflated by the consumer price index. Q_{t-1}^d is used as a partial adjustment lag reflecting eating habits which delay the demand response for price changes. Dummy variable D is used to reflect the change of income elasticity of the demand caused by the change of taste or eating habits. Income I_t is an index of real GNP represented by 100 in the year 1980.

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[2] Trend variable represents both technological progress and changes of factor prices. Since real wage rate and real fertilizer price have been monotonically increasing and decreasing, respectively, in Japan, their effects cannot be separated.

Demand–supply equilibrium equation

$$Q_t^{\mathrm{d}} = Q_t^{\mathrm{s}} = Q_t \tag{3.5}$$

Now if equations (3.1) and (3.2) are substituted for equation (3.3) and if equations (3.3) and (3.4) are substituted for equation (3.5), the realized price at t period is represented by the equation:

$$\log P_t = [(a+f) \log P_t^* + b \log S_{t-1} + (c+g) \log T - j \log Q_{t-1} - (k+lD) \log I_t + dD + e + h - m + \epsilon + \eta - \xi]/i \tag{3.6}$$

Here, the expected price P_t^* is specified as mentioned in the previous section,

$$P_t^* = P_{\mathrm{re},\,t}^{*\alpha(\Omega_t)} P_{\mathrm{lag},\,t}^{1-\alpha(\Omega_t)} \tag{3.7}$$

$$(0 \leqq \alpha(\Omega_t) \leqq 1,\ \alpha'(\Omega_t) > 0,\ \alpha(0) = 0,\ \alpha(\infty) = 1)$$

Where $P_{\mathrm{re},\,t}^*$, $P_{\mathrm{lag},\,t}^*$, Ω_t and $\alpha(\Omega_t)$ are the rationally expected price, expected price based on lagged expectation, information input and rationality coefficient of expected price, respectively.

Based on the theoretical considerations mentioned in the previous section, it is proved that the factors that modify the rationality of expected price include changes in the information price, managerial ability or price elasticity in supply curve, etc. Thus the rationality coefficient of the expected price should be determined on the basis of such factors.

Here, the information price is represented by the trend variable since the producers' accessibility to such information as planted area, national income, etc. which is required for forecasting the prices of their products has been improved[3], the managerial ability seems to be rising along with their experience gained, the supply functions are assumed to shift by trend and the price elasticities are assumed to be constant in equations (3.1) and (3.2).

Therefore the rationality coefficient of the expected price α is specified as:

$$\alpha = \alpha(\Omega_t) \fallingdotseq \alpha(T) = \alpha_0 + \alpha_1 T \tag{3.8}$$

Substituting equation (3.8) for equation (3.7) and substituting equation (3.7) and equation (3.9) which expresses the rationally expected price (Φ_t is all available information at t period):

[3] The statistical data of the increasing number of computers used in the agricultural cooperations implicitly implies such trended movements, though the data has not been surveyed annually. This fact implies that information price has been decreasing and input of information has been increasing.

$$P^*_{\text{re},\,t} = E\,[P_t \mid \Phi_{t-1}] = \underset{t-1}{E}\,[P_t] \tag{3.9}$$

for equation (3.6), and determining the mathmatical expectation based on the information at $t-1$ period in both parts of equation (3.6), the equation

$$\begin{aligned}\log \underset{t-1}{E}\,[P_t] = {} & [(a+f)\,\{(\alpha_0 + \alpha_1 T)\log P^*_{\text{re},\,t} \\ & + (1-\alpha_0-\alpha_1 T)\log P^*_{\text{lag},\,t}\} + b\log S_{t-1} + (c+g)\log T - j\log Q_{t-1} \\ & - (k + lD)\log \underset{t-1}{E}\,[I_t] + dD + e + h - m]/\,i\end{aligned} \tag{3.10}$$

is obtained.

Consequently, the rationally expected price becomes a function of the predetermined variables and expected exogenous variables in the model; that is

$$\begin{aligned}\log P^*_{\text{re},\,t} = {} & \{j\log Q_{t-1} + k\log \underset{t-1}{E}\,[I_t] + lD\log \underset{t-1}{E}\,[I_t] \\ & - (a+f)(1-\alpha_0-\alpha_1 T)\log P^*_{\text{lag},\,t} \\ & - (c+g)\log T - dD - \mathrm{e} - h + m\}/\{(a+f)(\alpha_0+\alpha_1 T) - i\}\end{aligned} \tag{3.11}$$

By substituting the expected price formation equation (3.7) for the planted area function (3.1), equation

$$\begin{aligned}\log S_t = {} & a\log P^*_{\text{lag},\,t} + a\alpha_0(\log P^*_{\text{re},\,t} - \log P^*_{\text{lag},\,t}) \\ & + a\alpha_1 T(\log P^*_{\text{re},\,t} - \log P^*_{\text{lag},\,t}) + b\log S_{t-1} \\ & + c\log T + dD + e + \epsilon\end{aligned} \tag{3.12}$$

is obtained.

Parameters in this equation can be estimated by the ordinary or general least squares method. Thus it becomes necessary to introduce proxy variables of unobservable variables $P^*_{\text{re},\,t}$ and $P^*_{\text{lag},\,t}$.

First, the proxy variable of the expected price based on the lagged expectation $P^*_{\text{lag},\,t}$ is introduced. Since various types of expectation formations such as static, extrapolative or adaptive expectations have been used as the lagged expectation, the adaptive expectation developed by Nerlove (1958), which shows the best fit to the statistical data, was adopted here. Practically, we express the approximation of the adaptively expected price as:

$$P^*_{\text{lag},\,t} = \sum_{n=1}^{\infty} \beta(1-\beta)^{n-1} P_{t-n} \fallingdotseq \sum_{i=1}^{k} W_i P_{t-i} \tag{3.13}$$

according to each $\beta = 0.1, 0.2, \ldots, 0.9, 1.0$, and select the β value that offers the best statistical fit to the planted area function (3.1).

TABLE 1

Estimation of the planted area functions (3.12)

Crops	Price Elasticity Short-run a	Long-run $(a/(1-b))$	Adjustment coefficient $(1-b)$	c	d	$\alpha_0 a$	$\alpha_1 a$	Corrected R^2	Durbin h	Method	Estimated period	
Chinese cabbage	0.22**	3.38	0.06**	–	0.018*	–	3.24×10^{-3}**	0.99	−0.46	GLS	1961 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=0.7$
	(9.2)		(95.6)		(2.3)		(4.9)					
Lettuce	0.40**	1.89	0.21**	0.46**	–	–	5.91×10^{-3}**	0.99	0.07	OLS	1966 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=0.9$
	(4.0)		(16.9)	(2.9)			(3.0)					
Green tea	0.13**	2.97	0.04**	−0.05**	–	–	2.87×10^{-3}**	0.99	0.24	GLS	1961 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=0.1$
	(3.8)		(81.2)	(−3.0)			(4.3)					
Cabbage	0.04**	0.38	0.11**	−0.08**	0.037*	–	–	0.95	0.06	OLS	1960 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=1.0$
	(3.0)		(16.4)	(−3.3)	(2.7)							
Radish	0.07	1.75	0.04**	−0.02	0.022	–	–	0.98	−0.57	GLS	1963 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=0.5$
	(1.9)		(58.6)	(−1.1)	(1.8)							
Carrot	0.08**	0.33	0.23**	–	0.018	–	–	0.83	−0.57	OLS	1961 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=1.0$
	(3.4)		(10.8)		(1.8)							
Welsh onion	0.06*	0.43	0.15**	−0.14**	0.048**	–	–	0.98	0.67	OLS	1962 – 1986	$P^*_{\log,t}$ is Nerlove's $\beta=0.6$
	(2.5)		(13.1)	(−7.4)	(4.7)							

[a] ( ) t value. **, 1% significance; *, 5% significance.

[b] Variables whose significances exceed 20% were omitted from the regression equation.

Next, the proxy variable of the rationally expected price $P^*_{re,\,t}$ is introduced. From equation (3.11), the rationally expected price is shown to be a function of pre-determined variables and expected exogenous variables in the model. Here, for the purpose of operational simplification, the linearly regressed value of actual price P_t by S_{t-1}, Q_{t-1}, $P^*_{lag,\,t}$, $\underset{t-1}{E}\,[I_t]$, $D \cdot \underset{t-1}{E}\,[I_t]$, T, D

$$\hat{P}_t = g(S_{t-1},\ Q_{t-1},\ P^*_{lag,\,t},\ \underset{t-1}{E}\,[I_t],\ D \cdot \underset{t-1}{E}\,[I_t],\ T,\ D) \tag{3.14}$$

is used as an approximate value of equation (3.11). Regressed value $\hat{P}_t$ can become a substitute of the expected price of producers who know the values of the parameters in the structural equations (3.1) to (3.5) and (3.8) and (3.9), and of predetermined variables and expected exogenous variables in the model required for rationally calculating the expected price. This approach satisfies the criteria for the rational expectation suggested by Muth (1961):

$$P_t = \hat{P}_t + V_t,\ E[\hat{P}_t V_t] = 0,\ E[V_t] = 0$$

where V_t is a disturbance term.

Here the expected index of national income is calculated based on the prediction of the real gross national product by the Economic Planning Agency *Fundamental Principles for Economic Outlook and Economic Operation.* Though the prediction has a downward bias in a period of high economic growth (1960 to 1969), and upward bias in a period of low economic growth (1970 to 1986), it was used as an approximation of the rationally expected index of national income because its deviation from the actual value remained very limited in the long span from 1969 to 1986.

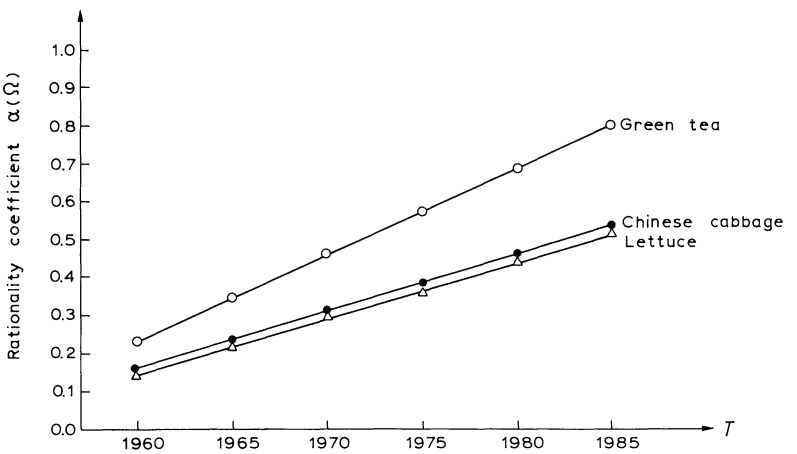

Fig. 2. Rationality of producers' price expectation.

Thereafter, the planted area functions (3.12) are estimated; the results are shown in Table 1. From these estimations, rationality coefficients of expected prices $\alpha = \alpha_0 + \alpha_1 T$ are calculated and shown in Fig. 2, which indicates that the rationality of the expected price of producers who grow Chinese cabbage, lettuce and green tea have been improved.

For saving space, the estimated results of yield and demand functions are omitted.

Data sources

Producers' price (P_t): Ministry of Agriculture, Forestry and Fisheries (MAFF), Statistics of Rural Prices and Wages.
Planted area (S_t): MAFF, Crops Statistics.
Production quantity (Q_t): MAFF, Crops Statistics.
Real gross national product (I_t): Economic Planning Agency, Economic Abstract.

4. Considerations in estimated results

Through the estimation of the supply functions presented in the previous section, it was shown that the prices expected by producers who grow Chinese cabbage, lettuce and green tea had shifted from those based on the lagged expectation to the rationally expected prices.

In this section, the differences in expected prices among crops will be analyzed. For this purpose, the conditions presented in the second section in which the expected price shifts to the rationally expected price are applied to different products.

Information price. There are few differences in the information cost among crops because information needed for forecasting future prices is not significantly different among crops.

Managerial ability. There are some differences in the managerial ability depending on the crops due to the increasing trend of specialization in a particular crop in the main producing areas. In addition, information-gathering activities in the major producing areas of Chinese cabbage or *The Conference of Green Tea for Demand – Supply Stabilization* that provides information on demand – supply situations on the national level to the respective producing areas seem to have contributed to the improvement of the rationality in the producers' expected prices. These organized activities for gathering information also seem to be promoted by the incentive for more accurate price prediction, as mentioned below in *Price Elasticity of Supply.*

TABLE 2

Price elasticity and shift rate of supply curves

		Short-run price elasticities					Shift rates		
		Planted area	Yield	Supply	Demand	$\lvert\epsilon_s/\epsilon_d\rvert$	Planted area	Yield	Supply
Crops whose expected prices are composed of rational expectation and lagged expectation	Chinese cabbage	0.22	0.44	0.66	−0.12	5.46	0.00	0.69	0.69
	Lettuce	0.40	0.43	0.83	−0.09	9.33	0.46	0.76	1.22
	Green tea	0.13	0.19	0.32	−0.16	2.01	−0.05	−0.11	−0.17
Crops whose expected prices are composed of only lagged expectation	Cabbage	0.04	0.05	0.09	−0.09	0.94	−0.08	0.47	0.39
	Radish	0.07	0.12	0.19	−0.18	1.06	−0.02	0.25	0.23
	Carrot	0.08	0.00	0.08	−0.12	0.63	0.00	0.57	0.57
	Welsh onion	0.06	0.13	0.19	−0.14	1.36	−0.14	0.16	0.02

Shift of supply curve. There are no clear differences among the crops (Table 2).

Price elasticity of supply. Chinese cabbage, lettuce and green tea show high price elasticity of supply than other crops (Table 2). Thus the rationality of the expected prices seems to result from the incentive for accurate price forecast, because the producers get larger benefits from the improved price forecast and suffer greater losses from forecasting errors when short-run price elasticity of supply becomes higher.

Based on these considerations, incentives for accurate price forecast and/or the information activities of main producing areas, induced by the high price elasticity of supply, prompt the producers to improve their rationality in price expectation, which leads to the rational response of planted area[4].

5. Conclusion

The following two aspects were found through the estimation of supply functions of vegetables and green tea as an example, and the hypothesis that the producers' price expectations change according to the information situation was empirically supported:

(1) Conventional lagged or rational expectation is not sufficient for estimating the producers' expected price, and further flexible specification is necessary, as described in this paper, that would permit changes of expectation formation in accordance with the changes of information input.

(2) As for the producers who have relatively higher price elasticities of supply than of demand, the price expectation have been transformed to the rational expectation from the lagged expectation, because such producers get larger benefits from the improved price expectations.

Price fluctuations of agricultural products have been explained on the basis of the 'Cobweb' theory, under the assumption that producers' price ex-

[4] DeCanio (1979) theoretically showed that the necessary condition required to ensure that the expected price converges to the rationally expected one through experiences of economic actors is $| \epsilon_s / \epsilon_d | < 1$. (Here ϵ_s and ϵ_d represent the short-run price elasticity of supply and demand respectively.) This condition is equivalent to the convergency condition of expected price of the 'Cobweb' theory. However, by comparing the $| \epsilon_s / \epsilon_d |$ of Chinese cabbage, lettuce and green tea with those of other crops whose expected prices are formed of lagged expectation (Table 2), farmers whose products have a high $| \epsilon_s / \epsilon_d |$ tend to show a rationality in their expected prices, in contrast to the condition shown by DeCanio.

pectations are formed of the lagged expectation. According to the theory, the price should diverge when the supply shows higher price elasticity than demand. However, actual prices have not shown such divergent movements that the theory would predict. Based on the above estimations and considerations, the non-divergent movements of the prices could be ascribed to the producers' tendencies toward the rational expectations, and actual price fluctuations would be caused mainly by random disturbances such as climate changes.

In order to verify whether the aggregated producers' expectations of prices increasing rationality reflect the improvement of price expectations of individual producers, or reflect the arbitrage activity of minor rational producers versus major producers for which lagged price expectation prevails, further studies sould be carried out.

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