AN ECONOMETRIC COMPARISON OF FARM HOUSEHOLDS: ECONOMIC BEHAVIOR IN JAPAN, KOREA, AND TAIWAN

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I. INTRODUCTION

THE PURPOSE OF this paper is to show, by means of an econometric model, what the economic behavior of farm households was in Japan, South Korea, and Taiwan in the 1960s.[1] The model can be used to evaluate agricultural policies in these countries. Needless to say, the farm households' economic behavior is very complex in nature. The household heads are entrepreneurs. They select crop types, purchase material for intermediate inputs, for instance, fertilizer, pesticides, and livestock feed, and invest their savings into agricultural capital such as agricultural machines, large animals, and plants. At the same time, they manage their households: determine labor supply by family members and decide their saving ratio based on their income level. Since these two types of behavior are interdependent, a simple model cannot explain the behavior. The model would be more complicated if there will be income from sidelines. In this paper we first attempt to construct a model that will simultaneously explain this behavior.

Though it is not impossible to make a complicated theoretical model, it is very difficult to find data to make the estimations. The model demands detailed figures not only of production activity but also from accounts on household income and expenditure as well as assets. Luckily, we found time-series data from farm household economic surveys in these three countries. These surveys collect nearly all the information mentioned above. The reliability of data has improved markedly by the use of modern sampling techniques, in Japan since 1950, since 1962 in Korea, and since 1964 in Taiwan.[2] Our econometric model is constructed by using these data as the basic materials for estimation.

1 This paper is a result of one of the analytical studies of the farm household economic behavior in developing countries supported financially by the Japan Economic Research Center. The paper was read at the KDI-DAS Conference (Korea Development Institute and Development Advisory Service of the Harvard University Conference) in Seoul, October 1973. This writer received precious suggestions from Professors Shigeru Ishikawa, Mataji Umemura, Yoshirō Matsuda of Hitotsubashi University, Han-Yu Chang of Taiwan National University, Hideyoshi Sakai of the Institute of Developing Economies, and people attending the KDI-DAS Conference. Computation was made by using the NEAC 3100 computer with staff support from the computation center of the Institute of Economic Research, Hitotsubashi University.

2 Farm household economic surveys have a long history. A pioneer large-scale survey was conducted in the mid-1920s in Japan. We find interesting reports on Japan, Korea, Taiwan, Manchuria, and Northern China before the Second World War. These surveys

In addition to this favorable data situation, we can find positive reasons for comparing the behavior in these three countries. First, rice is a major agrarian product constituting about 60 per cent of agricultural receipts. This is very convenient when production behavior is compared. Second, in the land reform of the early 1950s, agriculture was placed in the hands of a large number of landed farmers with small farms. In order to hinder the revival of the landlord, laws restricted transactions on farmland. Though land reform increased agrarian productivity at the time, the restriction prevented the development of large-scale farming. Since such land reform is now being discussed in some Asian countries the study on these three countries is meaningful.

Third, there has been remarkable economic growth in the three countries. In the 1960s, the growth rate was very high in South Korea and Taiwan compared to other countries though it was not as high as in Japan. How has this kind of economic development violently influenced the farm household economy? This interesting question can be answered by comparing the effects of economic growth among these countries.

II. THEORETICAL MODEL

Our theoretical model is derived from a utility function, production function, and some obvious definitional equations. Therefore, our model would be acceptable to those who do not have objections to our utility function. Our utility function is defined as follows:

$$U = U\left(\frac{C}{P'_c}, \frac{S+A}{P'_c}, L\right), \tag{1.1}$$

where U is the utility of head of the household, C and S are the household's consumption and savings respectively, L is the supply of family labor, A is defined as the net worth at the beginning of the year, and P_c is consumer prices. The variables with primes are assumed to be exogenous in our model. The first derivative of U is assumed to be positive for the first and second variable and negative for the third. The second derivatives are assumed to be inverse to the first. This function is not unique. If L is constant, the function is known as the utility function in the study of consumption function. When $S + A$ is constant, the function represents the income-leisure preference. The list of notation of variables is shown in Table I.

Second, let us define a well behaved production function as

$$O = F(G', L_a, K, M), \tag{1.2}$$

where O is agricultural product, G is farmland, L_a, K, and M are the inputs of labor, agrarian capital, and the intermediate materials. We considered G as an

were succeeded in Japan, South Korea, and Taiwan after the war. Sources of data we used are: for Japan [2], in Japanese; for South Korea [3], in Korean with English notes; and for Taiwan [5], in Chinese with English notes; all of which are published annually.

TABLE I
NOTATIONS OF VARIABLES

Variables	Units	Definitions
A	N*	Net worth
C	N*	Consumption expenditure of households
E	N*	See text
G	hectare*	Farmland
G_r	hectare*	Rented farmland
i	100 per cent	Interest rate
K	R*	Agrarian capital
K_r	R*	Rented agrarian capital
K_o	R*	Fixed assets other than K and G
L	hour*	Labor input for agriculture
L_w	hour*	Net labor input for sidelines (labor input for sidelines minus employed labor for agricultural production)
L_o	hour*	Other labor input
M	R*	Intermediate inputs for agriculture
O	R*	Agrarian production
P_c	index	Consumer prices
P_f	index	Prices of agrarian products
P_g	index	Land prices
P_k	index	Prices of agrarian capital
P_m	index	Prices of agrarian intermediate inputs
P_o	index	Prices of K_o
R	N*	Liquid assets minus liabilities
r	N	Rent of farmland
S	N*	Saving
T	N*	Tax
t	—	Time trend
U	—	Utility
w	N	Wage rate
X	N*	Capital gain
Y	N*	Disposable income
Y_o	N*	Incomes from receipts other than agriculture and sidelines
$Z(-1)$	—	Z is a variable with time lag of one year
$(Z/V)_{-1}$	—	$Z(-1)/V(-1)$
Z'	—	Z is an exogenous variable

Notes: 1. Notations in the column of units are as follows: N is nominal value (yen in Japan, 100 won in South Korea, and yuan in Taiwan), indicates real value, and asterisks show that variables are deflated by family size.

2. The base of indices is 1960 for Japan, and 1965 for Taiwan and Korea.

3. Assets and liabilities are defined as values at the beginning of an accounting year.

exogenous variable here because the transaction of land has been restricted by noneconomic factors.

We can also introduce six definitional equations. The first is the income formation function,

$$Y = P'_fO - P'_mM - r'G'_r + w'L_w + i'(R - P'_kK'_r) + Y'_o - T' . \quad (1.3)$$

In this equation, disposable income is considered as coming from three origins. First, agrarian income is defined as agricultural production evaluated in current prices, P_fO, minus direct costs, $P_mM + rG_r$, where P_m is price of M and, G_r and r are rented farmland and rent. Because the area of rented land is relatively small in these countries, we treat G_r as exogenous. The second origin is income wage employment, wL_w, where L_w is the supply of family labor for wage type employment with wage rate w.[3] Thirdly, farm households can obtain property incomes by entrusting *net* financial assets (balances of financial assets minus liability) R with the interest rate i.[4] However, they must pay the costs for rented capital, P_kK_r, where K_r is rented agrarian capital and P_k is prices of agrarian capital. Y_o is other income including transfers and T is taxes.

Let us introduce two definitional equations so obvious that no additional explanation will be necessary.

$$Y = C + S , \quad (1.4)$$

$$L = L_a + L_w + L'_o , \quad (1.5)$$

where C and S are the consumption and savings, and L_o, an exogenous variable, is miscellaneous labor supply, for example, that for joint works by the community.

Farmer's net worth, A, can be defined by two different formulas. First, the increases in net worth can be related to the savings and capital gains X:

$$A = A(-1) + S(-1) + X(-1) , \quad (1.6)$$

where -1's in brackets show that the variables belong to the previous year. We can also divide A into various assets:

$$A = P'_g(G' - G'_r) + P'_k(K - K'_r) + P'_oK'_o + P'_fK'_i + R , \quad (1.7)$$

where P_g and P_k are prices of farmland and agrarian capital, K'_o and K'_i are other household's assets including residential houses and inventories, and P_o is prices of K_o. Finally, we define capital gains as follows:[5]

$$X = \{P'_g - P'_g(-1)\}(G' - G'_r) + \{P'_k - P'_k(-1)\}(K - K'_r) + \{P'_o - P'_o(-1)\}K'_o + \{P'_f - P'_f(-1)\}K'_i . \quad (1.8)$$

Because we have twelve endogenous variables, ($A,C,K,L,L_a,L_w,M,O,R,S,X$, and Y), we need five additional equations in order to close our model. To do this

3 We include the supply of family labor for sidelines into L_w by dividing the income from sidelines by w.

4 L_w, G_r, and K_r are defined in the net concepts, i.e., L_w is the difference between the supply of family labor for wage type employment and hired labor for agricultural production, and the other two variables are defined in the same manner.

5 We do not include the capital gain on financial assets into X because of lack of data.

let us find the condition in which U can be maximized under the restrictions shown by the equations from (1.2) to (1.8). The results can be shown by the following five equations:

$$\frac{\partial F}{\partial L_a} = \frac{w'}{P'_f}, \tag{1.9}$$

$$\frac{\partial F}{\partial K} = \frac{i'P'_k}{P'_f}, \tag{1.10}$$

$$\frac{\partial F}{\partial M} = \frac{P'_m}{P'_f}, \tag{1.11}$$

$$\frac{\partial U}{\partial(C/P'_c)} = \frac{\partial U}{\partial([S+A]/P'_c)}, \tag{1.12}$$

$$\frac{\partial U}{\partial(C/P'_c)} = \left(\frac{P'_c}{w'}\right)\left(\frac{\partial U}{\partial L}\right). \tag{1.13}$$

In order to derive the estimable model, we must specify functions, F and U. Regarding F, let us assume the Cobb-Douglasian function

$$\frac{O}{G'} = B_1 e^{dt}\left(\frac{L_a}{G'}\right)^a\left(\frac{K}{G'}\right)^b\left(\frac{M}{G'}\right)^c, \tag{1.2.a}$$

where B_1,a,b,c, and d are positive constants. We also assume the multiplicative form of the utility function for U:

$$U = B_2\left(\frac{C}{P'_c}\right)^f\left(\frac{S+A}{P'_c} + B_3\right)^g (L + B_4)^{-h}, \tag{1.3.a}$$

where B_i $(i = 2,3,4,)$, f,g, and h are positive. This type of function is not unique though it is not as familiar as the quadratic form function. B_3 and B_4 are introduced here to avoid unrealistic cases; viz, U becoming negative or indefinite. The equations (1.12) and (1.13) can be transformed into

$$\frac{C}{P'_c} = j + k\left(\frac{Y}{P'_c}\right) + m\left(\frac{A}{P'_c}\right), \tag{1.12.a}$$

$$L = n + q\left(\frac{C}{w'}\right). \tag{1.13.a}$$

The former is well known as a consumption function and the latter is a kind of labor supply function.

Some comments can be anticipated regarding (1.9) and (1.10). The former will probably be criticized as an old-fashioned model by development economists after Fei-Renis. Though our model does not assume, in advance, the marginal principle for agricultural production, the principle is valid in the conclusion. However, we have dared to use this *classical* model for the following reasons. First, our system of equations is more elastic than was our first impression. Even if there is a so-called disguised unemployment, what we should do is to assume

b_2 as zero then we need not correct the other equations. Second, the Korean and Taiwanese economies have developed at faster rates than the typical developing country. It is true that the urban employment capacity is not great enough to absorb all surplus labor in the rural sector, but farmers have engaged in various sideline occupations other than agrarian wage employment such as commerce. These sidelines include vending, forestry, and fishing. This makes it possible to apply the marginal principle for agrarian labor.

Some may doubt the validity of the equation (1.10). For example, there are arguments in Japan that agricultural machines have not been used efficiently because farm size is too small. But the first reason for using the equation (1.9) may answer this objection. There may be another objection concerning the interest rate. Since agricultural production has some margin of risk, the marginal productivity should be compared with the real interest rate i_r which is higher than i. But it is highly probable that i_r moves proportionally with i in the time-series data. In such a situation, our model is valid in explaining farm household economic behavior.

III. METHOD OF ESTIMATION

Now let us convert our theoretical model into the estimable system of equations. We first introduce what has been called the adjustment process. Though we obtain our set of equilibrium values from the theoretical model, there may be some time lag between the theoretical estimation and actual behavior. With this consideration in mind let us introduce the following equations:

$$\log\left(\frac{O^*}{L^*_a}\right) = \alpha_1 + \beta_1 \log\left(\frac{O}{L_a}\right)_{-1}, \tag{1.14}$$

$$\log\left(\frac{O^*}{K^*}\right) = \alpha_2 + \beta_2 \log\left(\frac{O}{K}\right)_{-1}, \tag{1.15}$$

$$\log\left(\frac{O^*}{M^*}\right) = \alpha_3 + \beta_3 \log\left(\frac{O}{M}\right)_{-1}, \tag{1.16}$$

$$C^* = \alpha_4 + \beta_4 C + \gamma_4 C(-1), \tag{1.17}$$

$$L^* = \alpha_5 + \beta_5 L + \gamma_5 L(-1). \tag{1.18}$$

Here, the asterisked variables are realized values. Further we can assume six definitional equations corresponding from (1.3) to (1.8) for realized values. Thus we can obtain a solution for asterisked variables if we assume the production function to be valid for asterisked variables also.

By solving these equations, we obtain the recursive type of structural equation. Because all variables in the following equations are realized variables, we skip the asterisked ones. Further, the equation (2.5) and (2.6) should include R, but we exclude this variable in order to avoid the multicollinearity between A and R.

$$\log\left(\frac{O}{G'}\right) = a_1 + b_1 \log\left(\frac{L_a}{G'}\right) + c_1 \log\left(\frac{K}{G'}\right) + d_1 \log\left(\frac{M}{G'}\right) + e_1 t\,, \tag{2.1}$$

$$\log\left(\frac{O}{L_a}\right) = a_2 + b_2 \log\left(\frac{w'}{P'_f}\right)_{-1}, \tag{2.2}$$

$$\log\left(\frac{O}{K}\right) = a_3 + b_3 \log\left(\frac{P'_k i'}{P'_f}\right)_{-1}, \tag{2.3}$$

$$\log\left(\frac{O}{M}\right) = a_4 + b_4 \log\left(\frac{P'_m}{P'_f}\right)_{-1}, \tag{2.4}$$

$$\frac{C}{P'_c} = a_5 + b_5\left(\frac{w'}{P'_c}\right) + c_5\left(\frac{E}{P'_c}\right) + d_5\left(\frac{A}{P'_c}\right) + e_5\left(\frac{C}{P'_c}\right)_{-1}, \tag{2.5}$$

$$L = a_6 + b_6\left(\frac{P'_c}{w'}\right) + c_6\left(\frac{E}{w'}\right) + d_6\left(\frac{A}{w'}\right) + e_6 L(-1)\,, \tag{2.6}$$

$$E = P'_f O - P'_m M - r'G'_r - i'P'_k K'_r + Y'_o - T'\,, \tag{2.7}$$

$$Y = E + w'L_w + i'R\,, \tag{2.8}$$

$$Y = C + S\,, \tag{2.9}$$

$$L = L_a + L_w + L'_o\,, \tag{2.10}$$

$$A = A(-1) + S(-1) + X(-1)\,, \tag{2.11}$$

$$A = P'_g(G' - G'_r) + P'_k(K - K'_r) + R + P'_o K'_o + P'_f K'_i\,, \tag{2.12}$$

$$X = \{P'_g - P'_g(-1)\}(G' - G'_r) + \{P'_k - P'_k(-1)\}(K - K'_r) + \{P'_o - P'_o(-1)\}K'_o + \{P'_f - P'_f(-1)\}K'_i\,. \tag{2.13}$$

We try to estimate this model by using farm household economic surveys covering the following periods: Japan, from 1957 to 1966; South Korea, from 1962 to 1970; and Taiwan, from 1964 to 1970.

We take all reliable data available for Korea and Taiwan. In Japan, a large-scale revision of the survey method was made in 1957, and it is very difficult to link the figures before and after this revision. We omit data after 1967 because the economic behavior of Japanese farmers is a bit unusual due to government agricultural policies.[6]

6 Since 1967, the Japanese government has regulated the amount of rice production to decrease the inventory of rice by subsidies. Owing to this policy, the supply of farm labor for the nonagricultural sector has increased remarkably.

There are some problems in relating the statistical figures to theoretical variables, but we will make only two remarks here in order to save space. The first concerns the calculation of K. We can find the nominal value of agrarian capital in these three countries, but we cannot find the official deflators for agrarian capital. For Japanese data, reliable figures can be obtained both for nominal investments and their deflators. Then, K is calculated by adding real investment to nominal capital succeedingly in the base year. In the Taiwanese data, figures for nominal capital seem to be more reliable than those for investment. For our preliminary approach, the deflator for agrarian capital is constructed by using both deflators for agrarian investment and composition of agricultural capital in the base year. Korean K is obtained by constructing a quantitative index corresponding to the major components of agrarian capital.

Secondly, we make note of some of the devices attached to M. In Taiwan and Korea, expenditures for seed have occupied relatively large shares of intermediate input. In order to find out what the direct effects of fertilizer, pesticide, and other intermediate inputs are, we subtract expenditures for seed both from intermediate inputs and agrarian products.

Generally speaking, we want to estimate our model by using time-series data. But in our case, the number of samples is not large enough to obtain a reliable estimate. We then try to increase degrees of freedom by pooling the time-sequences of cross-section data with the techniques of covariance analysis. In Japan, samples other than those of Hokkaidō are classified into six groups according to farm size. Since average farm size is much larger in Hokkaidō than other areas of Japan, we treat the samples of Hokkaidō as a seventh group. A nearly equivalent classification can be found in Korea and Taiwan; i.e., all samples classified into five according to farm size. We should note again that farm size is determined by non-economic factors, so it is not surprising that some differences exist in behavior according to farm size.[7] However, we can exclude these differences somewhat by introducing dummy variables and using the technique of covariance analysis.

We use the ordinary least-squares method in our calculations. Since our model can be converted into the pure recursive system our estimates have no statistical biases.[8] In regression analysis, multiple correlations are usually used to make the reliability of estimates known. However, in our case, it is possible that correlations may depend on dummy variables only. To avoid such a meaningless case, we compare the variances of residuals in our model with those of the equations including only dummy variables. The results of the F test will be shown in the following table instead of the multiple correlation coefficient.

7 There are some studies on differing behavior of Japanese farmers according to farm size. For example, on the consumption function, see [4].

8 Only one exception is the equation (2.1), but some checks prove that there are few biases for our estimates.

IV. RESULTS OF ESTIMATES AND SOME IMPLICATIONS

The results of our estimates are shown in Table II. We find that these results support our theoretical model. Most of the estimates of parameters are statisti-

TABLE II

RESULTS OF ESTIMATION

Parameters	Explanatory Variables	Estimates			Elasticity in the Mean		
		Japan	Taiwan	Korea	Japan	Taiwan	Korea
Equation (2.1)	F	**	**	**			
b_1	$\log(L_a/G)$	0.1536	0.3118	0.0857			
		(0.0190)	(0.0798)	(0.0113)			
c_1	$\log(K/G)$	0.0280	0.0695	0.2194			
		(0.0150)	(0.0573)	(0.0107)			
d_1	$\log(M/G)$	0.5672	0.2722	0.1213			
		(0.0192)	(0.0566)	(0.0094)			
e_1	t	0.0002	0.0038				
		(0.0040)	(0.0052)				
Equation (2.2)	F	**	**	**			
b_2	$\log(w/P_f)_{-1}$	1.6014	0.8754	0.0349			
		(0.1590)	(0.0317)	(0.0044)			
c_2	t	−0.0819					
		(0.0060)					
Equation (2.3)	F	**	**	**			
b_3	$\log(iP_k/P_f)_{-1}$	0.3458	0.1895	0.3600			
		(0.1332)	(0.0120)	(0.0348)			
c_3	t	−0.0676					
		(0.0071)					
Equation (2.4)	F	**	**	**			
b_4	$\log(P_m/P_f)_{-1}$	0.9239	1.0332	0.1620			
		(0.1699)	(0.0158)	(0.0348)			
c_4	t	−0.0534	−0.0195				
		(0.0109)	(0.0014)				
Equation (2.5)	F	**	**	**			
b_5	w/P_c	284.65	227.21	30.19	0.4146	0.2857	0.1918
		(14.45)	(7.67)	(1.74)			
c_5	E/P_c	−0.0378	0.2272	0.4875	−0.0285	0.3612	0.4815
		(0.0135)	(0.0122)	(0.0112)			
d_5	A/P_c	0.0156	−0.0227	−0.0004	0.0606	−0.1633	−0.0003
		(0.0034)	(0.0014)	(0.0004)			
e_5	$(C/P_c)_{-1}$	0.5797		0.0850	0.5441		0.0820
		(0.0239)		(0.0152)			
Equation (2.6)	F	**	**	*			
b_6	P_c/w	4736.8	−3663.7	27.396	0.0454	−0.1445	0.3616
		(735.9)	(358.6)	(0.115)			
c_6	E/w	−0.2847	0.0920	−0.1370	−0.1465	0.1548	−0.3050
		(0.0438)	(0.0075)	(0.0724)			
d_6	A/w	0.0599	0.0043	0.1413	0.1540	0.0412	0.0077
		(0.0160)	(0.0015)	(0.0005)			
e_6	L_{-1}	0.3563	0.3590	0.0001	0.3547	0.3475	0.1981
		(0.0047)	(0.0243)	(0.0015)			

Notes: 1. Figures in parentheses are the standard error of estimates.
2. Asterisks show that F test is statistically significant; one star at the 5 per cent level and two stars at the 1 per cent level.

cally significant and their signs coincide with our assumptions at least from (2.1) to (2.4).[9] Since the parameters depend on the form of the utility function, we cannot decide in advance what the signs of parameters in equations (2.5) and (2.6) are. However, converting our results into the consumption function and labor supply function through the relations shown in (1.12.a) and (1.13.a), our results are not singular.

In our country-to-country comparison, we can summarize our findings as follows.

(1) The elasticity of agrarian capital is generally small in the equation (2.1) but relatively high in South Korea where holdings of capital are smaller than in the other countries.

(2) The elasticity of agrarian labor is significant in all countries in the equation (2.1). This is true not only in the labor shortage economy of Japan but also in the labor surplus economy in Taiwan and Korea.

(3) The elasticity of intermediate inputs is generally high. It is interesting that the estimate positively correlates with the average amounts of inputs in the country-to-country comparison.

(4) We cannot find the remarkable improvement of technology because the estimate of e is low.

(5) The estimates regarding equations from (2.2) to (2.4) are consistent with the production functions.

(6) In the equation (2.5), elasticity of w in the means is generally high. The elasticity of E is also high except in Japan.[10]

(7) The estimates are mostly unstable in the equation (2.6). The most important variable is L_{-1}. This means that we should reexamine the equation in the next step. Some comments should be given regarding the production function. First, the elasticity of capital is small in Japan and Taiwan. Since the mid-1950s, machines have been introduced to save agrarian labor in Japan. However, because average farm size is small, capacity has approached the saturation level. In Taiwan, the number of machines is small, but the number of large animals is relatively large. In Korea, agricultural capital, including large animals, is small and there remain areas in which productivity can be increased by additional investment.

Secondly, let us consider the relation between the elasticity of L_a and M. Ishikawa pointed out that the efficiency of intermediate inputs depends on agricultural technique [1]. In Taiwan, the technological level has been high in comparison to other Asian countries since the 1930s, and inputs of fertilizer have

9 Theoretically speaking, b's in the equations (2.2) to (2.4) should have the values between zero and one, but some exceed one when we use the original model. To explain, we consider the trend factors. For instance, actual increases in nonagricultural employment depend not only on wage rates but chances of employment. In such a situation, trend variables are efficient. However, in order to prevent following the easy way, we introduce the trend variables only when their parameters are significant at the 0.1 per cent level.

10 It is said that saving propensity has been increasing through increases in monetary income from wage type employment in Japan. This may partially explain the negative parameter on E.

been large. In this case, the increase in M demands additional labor, explaining the high marginal productivity of agrarian labor in Taiwan. However, in Japan, where the technological level is higher than in Taiwan, the intermediate inputs are a substitutional factor of labor. For example, a large amount of pesticides and herbicides have been used to save labor. This is why the marginal productivity of labor is not too high in spite of the decrease in agrarian labor input. The rural population in Korea is high, and of course the elasticity of labor is low.[11]

The third question may be why e is small in our production function. Part of this can be explained by the special definition of intermediate inputs mentioned above. However, we cannot deny the possibility that the results may depend on our method of estimation using the analysis of covariance. The question will be reexamined in the future.

Now, let us examine the differences in farm household economic behavior in these three countries. Because our model is composed of multiple equations including nonlinear functions, direct comprehensive comparisons are difficult. One of the attempts is shown in Table III. Here, we calculate the elasticity of major endogenous variables with the rise of exogenous variables by solving the system of equations. Because elasticity varies depending on the absolute level of endogenous variables, we restrict our study for final year average values in this study.[12] The results for i are not shown in this table because they are not very different from those for K. In the cases (A) to (D), we suppose that the exogenous variables can be controlled independently, but in the case of (E) and (F) we suppose that a 1 per cent rise in P_f and w induce a 0.5 per cent and 0.3 per cent rise of P_c respectively.

Though the results give various kinds of information, we investigate here only the elasticity of real disposable income of farm households. The rise of P_f induces an increase in real disposable income through the increase of agricultural income but gives a negative effect through the decrease of L_w. In Taiwan, the final effects are significantly positive. This is also true in Korea though the effects are not as remarkable as these in Taiwan. In contrast, the real disposable income remains constant or even decreases in Japan according to case (A) and (E).

The reverse tendency can be found for the effects of changes in w. Though the rise of w increases the real disposable income of Japanese farmers significantly, the effects are negligible in Korea. It should be noted, however, that this also

11 Dr. Sung Hwan Ban, Professor of Seoul National University, suggested that the elasticity of labor in our estimates is too low. In fact, elasticity is lower than previous estimates in Korea for the cross-sectional production function. But it is also known from the Japanese experience that the function is different when time-series data is used. However, the comments are very important for future studies.

12 Since our model includes lagged variables, elasticity varies as time goes on. Starting from the base year, we calculate the endogenous variables, $W(i)$, keeping exogenous variables constant, i indicating the number of endogenous variables. After the exogenous variables increase at a 10 per cent rate, we obtain corresponding figures for endogenous variables, $W^*(I)$. Our elasticity for i-th endogenous variables is defined as

$$\frac{\{\log_e W^*(i) - \log_e W(i)\}}{\log_e 10}.$$

induces the real disposable income of Taiwanese farmers though elasticity is not as high as P_f's. The role of P_k and P_m seems to be less important in changing real disposable income, but only one exception can be found for the effects of P_m in Taiwan.

These findings can be used to evaluate previous agricultural economic policies from the farm household side. Our calculations suggest that a rise in w is the best way to increase, disposable income in Japan. Since the mid-1950s the growth rate of w has been higher than P_f. This has reduced O, but has increased disposable income through raises in wage income. There are arguments that P_f should be brought up to increase farm income, but as far as our calculations show this proposal would not be too effective.

According to our calculations, elasticities are generally low in Korea as shown in Table III. This means that agricultural policies are less effective in Korea than in Japan and Taiwan. However, the best method for Korea would be to pull up P_f and to draw P_m. We cannot support past policies of the Korean government which have kept P_f relatively low. We can find even a downward trend in time-series changes of P_f/P_m in Korea in the mid-1960s. Recently Korea changed her policy to pull up P_f, this being consistent with our proposal.

It is well known that Taiwanese agricultural development has been remarkable. This may be helped out by the flexible nature of Taiwanese farm households. Though a rise in P_f is best here, a rise in w can pull up real disposable income.

TABLE III

ELASTICITIES OF MAIN ENDOGENOUS VARIABLES TO THE CHANGES OF EXOGENOUS VARIABLES

Exogenous Variables Controlled		Elasticities of Endogenous Variables						
		O	L_a	K	M	L	C/P_c	Y/P_c
P_f (A)	Japan	3.104	4.705	3.450	4.027	−0.627	−0.006	0.008
	Korea	0.177	0.212	0.537	0.339	−0.165	0.654	0.665
	Taiwan	1.637	2.513	1.827	2.671	0.504	0.739	1.360
P_m (B)	Japan	−2.086	−2.086	−2.086	−3.010	0.395	−0.057	−0.042
	Korea	−0.034	−0.034	−0.034	−0.196	0.054	−0.133	−0.152
	Taiwan	−0.812	−0.812	−0.812	−1.845	−0.133	−0.198	−0.339
P_k (C)	Japan	−0.039	−0.039	−0.384	−0.039	0.006	−0.008	−0.003
	Korea	−0.138	−0.138	−0.498	−0.138	0.001	−0.061	−0.083
	Taiwan	−0.038	−0.038	−0.228	−0.038	−0.040	−0.098	−0.014
w (D)	Japan	−0.979	−2.581	−0.979	−0.979	0.131	0.447	1.481
	Korea	−0.005	−0.040	−0.005	−0.005	0.021	0.220	0.001
	Taiwan	−0.788	−1.663	−0.788	−0.788	−0.159	0.156	0.454
P_f and P_c (E)	Japan	3.140	4.705	3.450	4.027	−0.631	−0.364	−0.471
	Korea	0.177	0.212	0.537	0.339	0.300	−0.036	0.165
	Taiwan	1.637	2.513	1.827	2.671	0.414	0.526	0.777
w and P_c (F)	Japan	−0.979	−2.581	−0.979	−0.979	0.139	0.3156	1.187
	Korea	−0.005	−0.040	−0.005	−0.005	0.3842	−0.199	−0.212
	Taiwan	−0.788	−1.663	−0.788	−0.788	−0.211	0.039	0.102

The writer doubts that the Taiwanese government has taken the best policy in guiding Taiwanese agriculture. For example, aiming to increase Y, the government has decreased P_m in recent years. This is less effective than a rise in P_f. But the flexible nature of households mentioned above will help in the development of Taiwanese agriculture.

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