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Adjustment Capacity of Korean Farm Household

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Abstract

Structural adjustment is defined as the farm household's behavior of changing its existing farm asset distribution toward more specialized or diversified directions. Farm households are classified into agricultural or non-agricultural based ones. Estimated expected income through switching regression model reveals that higher revenue is expected when adjustment paths toward more specialization and more non-agricultural based activities are chosen.

Keywords: trade policy reform, structural adjustment, expected income, switching regression model, farm household.

JEL codes Q100, Q180

1. INTRODUCTION

The consecutive multilateral trade negotiations under the auspices of WTO and spreading out of Free Trade Agreements (FTA) with major trading partners bring about big struggles for adjustment to Korean farm households which have been protected for long time under the government market price support. Recent researches related with agricultural adjustment stress the differences in their adjustment capacity across individual farm household (Burfisher et al. (2006)). We can easily acknowledge the heterogeneous adjustment capacity resulted from various reasons across individual farm household. For example, heterogeneous human capital of operator may be linked to different managerial capacity and/or off-farm work opportunity which are very important factors defining the adjustment capacity of farm household.

Recently Korean government declares new farm policy, 'farm household registration system', designed to assist the adjustment process based on the characteristics specific to each farm household. This implies a policy shift from traditional uniform assistant system to new differentiated system reflecting the heterogeneous adjustment capacity of individual farm household. We assume that the income shocks from global trade policy reform and adjustment capacity corresponding to the shocks vary from household to household. Furthermore, it is assumed that adjustment process should accompany adjustment cost which is directly related with the adjustment capacity of each farm household.

In this study, every farm household has two different strategic options. One is to choose economic activities from which it derives its income and the other is to choose farm asset allocations over its chosen economic activities. Then adjustment cost for each farm household will be estimated and compared in order to investigate differences in the adjustment capacity across individual farm household. Finally optimal adjustment paths for farm households to take are suggested according to the income increase expected by changing strategic options from current economic activities and farm asset allocations to other activities and allocations.

2. FARM STRUCTURE AND STRUCTURAL ADJUSTMENT

2.1 Definition of Farm Structure and Structural Adjustment

In order to discuss about adjustment capacity, we first need to define 'farm structure'. And then the meaning of 'structural adjustment' corresponding to income shocks from global changes in trade environment would become clear. Despite the multi-facet of 'farm structure', it is defined as follows. A farm household is maximizing its utility by allocating its endowed (own or rented) assets to a number of income-creating economic activities and the resulted asset portfolio is called as a 'farm structure'. With the advent of shocks from the changes in global trading environments, farm household may try to change its asset portfolio by reallocating the assets to different combination of economic activities. The behavior of changing asset portfolio depends on the livelihood strategy of a farm household and is regarded as a structural adjustment.

The possible direction of structural adjustment, or the possible pattern of new asset portfolio resulted from the advent of exogenous shocks could take one of the following three forms.

i) Specialization: concentration of endowed assets to a smaller number of economic activities, which may reduce the variance of asset portfolio

ii) Diversification: dispersion of endowed assets to a larger number of economic activities, which may increase the variance of asset portfolio

iii) Simple portfolio change: simple changes of the combination of economic activities without altering the variance of asset portfolio

Prior to discussing the capacity of structural adjustment, that is, the capacity of changing asset portfolio, we need to first measure the asset portfolio. Although we now have a clear definition of an asset portfolio, we still have some difficulty in measuring it empirically. The difficulty mainly comes from the fact that the stock of most farm assets is indivisible. The indivisibility makes it difficult for us to estimate the amount of farm assets allocated to a certain economic activity. We will circumvent this difficulty by measuring revenue distribution across income-creating economic activities. It is reasonable for an operator to decide the amount of a farm asset to be allocated to an economic activity according to his expected revenue from that activity. In this context, we adopt the revenue distribution across income-creating economic activities as a proxy of farm asset portfolio.

We've now come to the point to define the income-creating economic activities available to Korean farm households. This study includes total 23 activities which are covered by the government farm household survey data set. Table 1 shows the 23 income-creating economic activities and the average revenue distribution across those activities for total 12,263 sample farm households. As expected, rice farming takes the highest portion (31.8%) followed by vegetable farming (18%), general employment (13.6%), and fruit farming (8%).

Table 1. Average Revenue Distribution across Income-creating Economic Activities(total

Income-creating Economic Activities			Average	Standard Deviation
Agricultural Activities	Crop Cultivation	Rice	0.3184	0.3026
		Barley	0.0049	0.0276
		Miscellaneous Grain	0.0081	0.0467
		Pulse	0.0226	0.0530
		Potato	0.0150	0.0707
		Vegetable	0.1804	0.2576
		Oilseeds and Specialty Crops	0.0305	0.1109
		Fruit	0.0891	0.2282
		Flower	0.0076	0.0772
		Other Crops	0.0049	0.0489
	Livestock	Large Animal	0.0573	0.1678
		Small Animal	0.0021	0.0348
		Other Livestock	0.0181	0.1197
Non-Agricultural Activities	Non-Farm Business	Forestry and Fishery	0.0124	0.0702
		Manufacture	0.0058	0.0421
		Construction	0.0041	0.0475
		Other Non-Farm Business	0.0463	0.1467
	Employment	Non-Farm Employment	0.1358	0.2278
		Farm Employment	0.0145	0.0510
	Financial Assets and Rents	Interests and Dividends	0.0032	0.0098
		Securities	0.0084	0.0346
		Rent for Farmland	0.0004	0.0166
		Other Rents	0.0101	0.0480

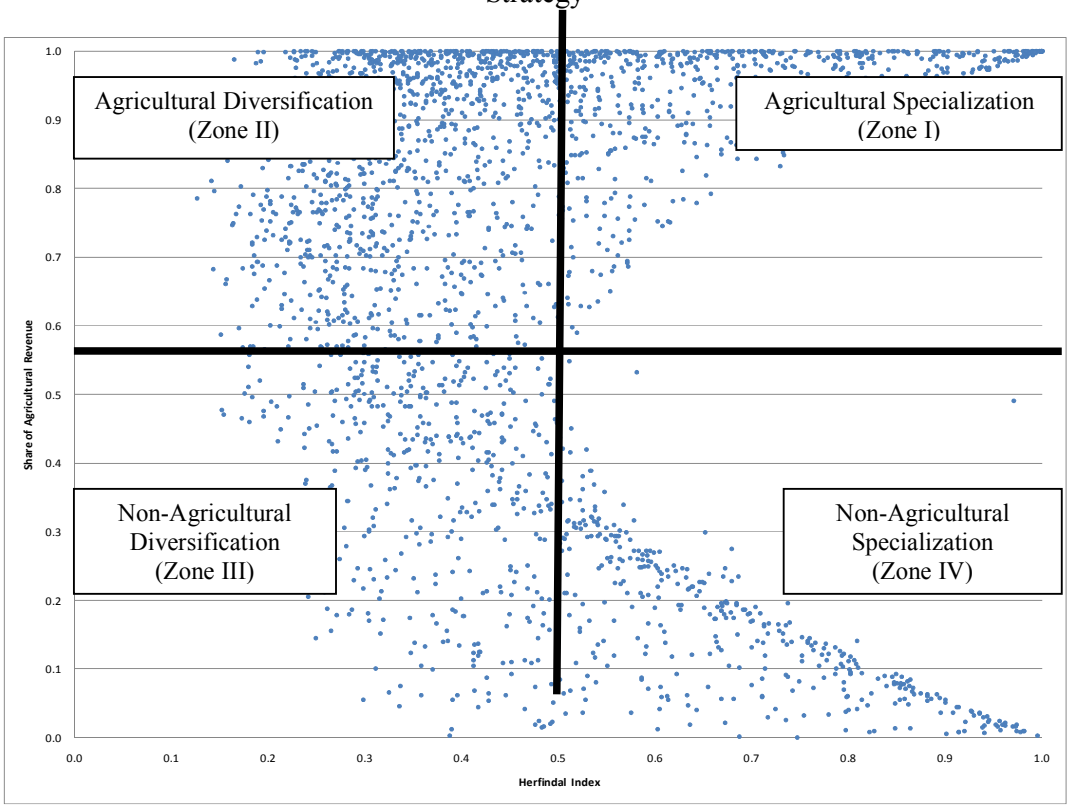
2.2 Classification of Farm Households by Different Strategic Options

We can classify farm households into four different groups according to their current livelihood strategy. First, a household is classified into agricultural farm household if it derives its income more than 50% from agricultural activities. Then non-agricultural farm household derives its income more than 50% from non- agricultural activities.

Second, a household is also classified into specialized or diversified farm household depending on the degree of its farm asset spread. Here, we need to measure the degree of its farm asset spread. As mentioned before, since that specialization means relatively small variance, and diversification, large variance, the range of specialization or diversification could be set up according to the variance of asset portfolio. Herfindahl Index (H) is applied to the variance of asset portfolios. H ranges from 0 to 1 measuring the level of specialization, hence, 1- H measures the level of diversification.

With this classification a farm household may fall into one of four quadrants in Figure 1 where vertical axis represents share of farm household income from agricultural activities and horizontal axis measures the Herfindal Index which measures specialization or diversification.

Figure 1 Distribution of Farm Household by Its Current Livelihood Strategy



Adjustment capacity or cost may vary from household to household mainly depending on its farming structure. Interesting findings are expected if we consider the farm structural heterogeneity. In this context, we introduce four types of heterogeneities

existing in farm household structure according to the similarities of livelihood strategies: Agricultural Specialization in Zone I; Agricultural Diversification in Zone II; Non-Agricultural Diversification in Zone III; Non-Agricultural Specialization in Zone IV.

3. ESTIMATION OF ADJUSTMENT CAPACITY

Farm structure was defined as the farm asset distribution across economic activities from which farm households derive their income. Structural adjustment means the farm household's behavior of changing the existing farm asset distribution toward three directions, specialization, diversification, and simple asset portfolio change. In this study we especially focus on the structural adjustment toward specialization or diversification with the reason that the case of simple asset portfolio change requires an approach quite different from the approaches for the first two cases. In addition, the main focus of Korean government's new policy is also directed to assist the adjustment toward the first two cases.

We might easily agree that there is no way to directly estimate the level of farm household's adjustment capacity because of its intangible character. Thus, an applicable measure should be introduced to estimate the adjustment capacity. Any kind of structural adjustment, whether toward specialization or diversification, accompanies adjustment cost. The higher the adjustment cost is, the higher barriers the household confronts in implementing adjustment. In this context, adjustment cost is closely related with adjustment capacity hence, we will estimate the adjustment capacity indirectly by introducing adjustment cost.

3.1 Specification of Structural Adjustment

On the distribution of farm household based on the share of agricultural revenue and Herfindahl Index, as seen in Figure 1, are specified four zones, one of which could be chosen by a farm household according to its livelihood strategy: i) Zone I (Agricultural Specialization) belongs to first quartile; ii) Zone II (Agricultural Diversification), second quartile; iii) Zone III (Non-Agricultural Diversification), third quartile; iv) Zone IV (Non-Agricultural Specialization), forth quartile.

The structural adjustment means the movement of a farm household from one to another quartile. A farm household which takes diversification strategy to cope with an external shock would move from right to left-hand side Zone, or a household which

takes specialization strategy would move from left to right-hand side Zone. Likewise, a farm household which takes off-farm income strategy would move from upper to lower Zone, or a household which takes farm income strategy would move from lower to upper Zone. Any movement from one to other Zone should be accompanied by adjustment cost which will be estimated later.

3.2 Specification of Adjustment Cost

Let's assume that a farm household whose asset portfolio is currently located in Zone II in Figure 1 encounters external shock from global trade policy reform and it is trying to concentrate its farm assets to a smaller number of economic activities by moving to Zone I. If we specify the adjustment cost in this case, it will easily be generalized to other paths of adjustment cases.

Let $y_j\ (j = I,\ II)$ be the income of the farm household when it is located in Zone j and x be the farm household's characteristics determining its income. Then we can write an income as a function of x;

$$y_j = y_j(x) \qquad (1)$$

The evaluated value of farm assets owned by a farm household would depend on its location, Zone I or Zone II because of different revenue or income opportunity. Let V_I and V_{II} be the evaluated asset values in Zone I and Zone II respectively. Assuming $V_I > V_{II}$, and denoting interest rate as r, adjustment cost as C, and probability of moving from zone II to I as m, we can set following asset-return equations.

$$rV_{II} = y_{II}(x) + m\ \mathrm{Max}\{0;\ V_I - V_{II} - C\} \qquad (2)$$

The left-hand side represents normal return on asset and the right-hand side is the sum of household income and expected additional asset revenue when the household moves from Zone II to I. We assume that if $V_I - V_{II} - C > 0$ in equation (2), then m = 1. It

means that the household definitely moves to Zone I, if the expected asset values in Zone I exceeds the sum of current asset values in Zone II and adjustment cost C in addition to the income to earn with its current characteristic x. Then equation (2) becomes;

$$V_{II} = \frac{1}{1+r} y_{II} + \frac{1}{1+r}(V_I - C) \qquad (3)$$

The normal return on asset of farm household located in Zone I, rV_I, equals to its income because it cannot expect additional asset revenue by moving to Zone II under the condition of $V_I \geq V_{II}$. Here, we get equation (4).

$$rV_I = y_I(x) \qquad (4)$$

Equation (5) follows from equation (3) and (4)·

$$rV_{II} = \frac{r}{1+r} y_{II} + \frac{1}{1+r} y_I - \frac{r}{1+r} C \qquad (5)$$

The adjustment process stops when $V_I - V_{II} - C = 0$, and reaches an equilibrium at which we get $rV_{II} = y_{II}$ from equation (2). Substituting it into equation (5) and solving for C, we get the adjustment cost,

$$C = \frac{\Delta y}{r}, \quad \text{where } \Delta y = y_I - y_{II} \qquad (6)$$

For a prospective farm household to move from Zone II to Zone I, the incomes appearing in equation (6) could be interpreted as expected value such as $\Delta y = E(y_I / x) - E(y_{II}/x)$. The adjustment cost specified in equation (6) tells us that it is a discounted value of additional income a farm household would receive when it

moves from Zone II to Zone I. In other words, it is an opportunity cost a farm household would put up with when it remains in Zone II under the condition of $V_I > V_{II}$. If the adjustment cost, C, exceeds the opportunity cost, no adjustment would occur and vice versa. In this context, a discounted value of additional income a farm household would receive with adjustment sets a low limit of cost required for an adjustment.

3.3 Estimation Model of Adjustment Cost: Switching Regression Model

In our framework, income has been specified as a function of the characteristics of farm household, and the function is contingent on the zone in which a farm household is located. The effects of farm household's characteristics on income contingent on the zone can be estimated by switching regression treating switching point as an endogenous variable. An indicator function, I_i takes 1 when a farm household i adjusts by moving from one to another zone, say, from Zone II to Zone I. Each zone is determined by a latent variable, θ_i, with a certain level of criterion value, θ_i^*. A switching regression model with an endogenous switching point can be expressed as follows.

$$\ln y_{Ii} = X_{Ii}\beta_1 + \upsilon_{Ii} \qquad (7)$$

$$\ln y_{IIi} = X_{IIi}\beta_2 + \upsilon_{IIi} \qquad (8)$$

$$I_i = \delta(\ln y_{Ii} - \ln y_{IIi}) + Z_i\gamma + \varepsilon_i \qquad (9)$$

$$I_i = \begin{cases} 1 & \text{iff} \quad \theta_i \geq \theta_i^* \\ 0 & \text{iff} \quad \theta_i \leq \theta_i^* \end{cases} \qquad (10)$$

X_{ji} is the vector of household *i*'s characteristics affecting its income when it is in the Zone j ($j = I, II$) while Z_i, the the vector of household *i*'s other characteristics affecting its choice of zone. The Herfindahl Index is adopted as a latent variable (θ_i) in equation (10).

The covariance matrix of the error terms, υ_{Ii}, υ_{IIi}, ε_i in equation (7), (8), (9) is written as in (11) with the assumption of standardized normal distributions on the error terms.

$$\Sigma = \begin{bmatrix} \sigma^2_{\upsilon_I} & \sigma_{\upsilon_I\upsilon_{II}} & \sigma_{\upsilon_I\varepsilon} \\ \sigma_{\upsilon_{II}\upsilon_I} & \sigma^2_{\upsilon_{II}} & \sigma_{\upsilon_{II}\varepsilon} \\ \sigma_{\varepsilon\upsilon_I} & \sigma_{\varepsilon\upsilon_{II}} & \sigma^2_{\varepsilon} \end{bmatrix} \qquad (11)$$

In case of $\sigma_{\upsilon_I\varepsilon} = \sigma_{\varepsilon\upsilon_I} = \sigma_{\upsilon_{II}\varepsilon} = \sigma_{\varepsilon\upsilon_I} = 0$, the switching point becomes exogenous variable, which leads to such a definition as in equation (12).

$$v_i = \frac{1}{\sigma^*}(\varepsilon_i - \delta u_{Mi} + \delta u_{Si}) \qquad \sigma^{*2} = E(\varepsilon_i - \delta u_{Mi} + \delta u_{Si})^2 \qquad (12)$$

Now equation (9) can be rewritten as equation (13) by assuming $\sigma_v^2 = 1$, where $\delta\beta_1, \delta\beta_2, \gamma$ are coefficients to be estimated.

$$I_i^* = X_{Ii}\frac{\delta\beta_1}{\sigma^*} - X_{IIi}\frac{\delta\beta_2}{\sigma^*} + Z_i\frac{\Upsilon}{\sigma^*} - \nu_i = W_i\alpha - \nu_i \qquad (13)$$

Where $W_i = [X_{Ii}, X_{IIi}, Z_i]$, $\alpha = [\frac{\delta\beta_1}{\sigma^*}, \frac{\delta\beta_2}{\sigma^*}, \frac{\gamma}{\sigma^*}]^T$, and X_{ji} is the vector of household *i*'s characteristics affecting its income in the Zone j ($j = I, II$). Using this equation, equation (7) and (8) can be expressed in equation (14) and (15) with error term.

$$\ln y_{Ii} = X_{Ii}\beta_1 - \sigma_{Iv}\frac{\phi(W_i\alpha)}{\Phi(W_i\alpha)} + \xi_{Ii} \qquad (14)$$

$$\ln y_{IIi} = X_{IIi}\beta_2 - \sigma_{IIv}\frac{\phi(W_i\alpha)}{1-\Phi(W_i\alpha)} + \xi_{IIi} \qquad (15)$$

The log likelihood model becomes equation (16).

$$\ln L = \sum_{i=0}^{N}\left\{I_i\left[\ln\frac{1}{\sigma_I}\psi\left(\frac{\ln y_{Ii} - X_{Ii}\beta_1}{\sigma_I}\right) + \ln\Phi(\eta_{Ii})\right] + (1+I_i)\left[\ln\frac{1}{\sigma_{II}}\psi\left(\frac{\ln y_{IIi} - X_{IIi}\beta_2}{\sigma_{II}}\right) + \ln[1-\Phi(\eta_{IIi})]\right]\right\} \qquad (16)$$

,where $\eta_{ji} = \left[\frac{W_i a - \rho_j(\ln y_{ji} - X_{ji}\beta_j)/\sigma_j}{\sqrt{1-\rho_j^2}}\right]$, $j = I, II$, and ρ_j is the correlation coefficient between u_{ji} and v_i.

Now we have following expected incomes contingent on the zone.

$$E[\ln y_{Ii} \mid I_i = 1, X_I] = X_{Ii}\beta_1 + \sigma_{Iv}\frac{\phi(W_i\alpha)}{\Phi(W_i\alpha)} \qquad (17)$$

$$E[\ln y_{Ii} \mid I_i = 0, X_I] = X_{Ii}\beta_1 - \sigma_{IIv}\frac{\phi(W_i\alpha)}{1-\Phi(W_i\alpha)} \qquad (18)$$

$$E[\ln y_{IIi} \mid I_i = 1, X_{II}] = X_{IIi}\beta_2 + \sigma_{IIv}\frac{\phi(W_i\alpha)}{\Phi(W_i\alpha)} \qquad (19)$$

$$E[\ln y_{1i} \mid I_i = 0, X_{1i}] = X_{1i}\beta_2 - \sigma_{1v}\frac{\phi(W_i\alpha)}{1-\Phi(W_i\alpha)} \qquad (20)$$

3.4 Estimation of Income and Indicator Functions

3.4.1 Variables and Data

In order to get adjustment cost, we need to estimate equations (7) ~ (9). Variables and data construction for the estimation are summarized in Table 2.

Table 2 Data Statistics (2003~2007, Average) Sample Size = 12,263 farm households

Les			Average	Definition
Dependent Variable: Farm Household Income (₩)			19,754,730.58	Farm Household Income =Farm Income + Non-Farm Income + Transfer Income
Explanatory Variables	Human Factors	Operator's Gender	0.96	Male=1 Female=0
		Operator's Age(Years)	62.62	
		Operator's Education	7.62	Schooling Year
		Full-time Farming	0.86	Yes = 1, No = 0
		Part-time Farming	0.14	Yes = 1, No = 0
		Family Member(Person)	3.12	
		Highest schooling Year	9.64	Highest Educated Family Member's schooling Year
		Farm Working Family Members	2.34	Permanent Farm Workers + Temporary Farm Workers
		Full-time Farm Workers	1.84	Family Number of Full-time Farm Workers
		Ratio of Full-time Farm Workers	0.58	Full-time Farm Workers / Family Member
		Part-time Farm Workers	0.51	Family Number of Part-time Farm Workers
		Ratio of Part-time Farm Workers	0.15	Part-time Farm Workers / Family Member
		Non-Farming Family Members	0.48	
	Fixed Assets	Cultivated Area(ha)	0.53	
		Ratio of Rented Area	0.38	
		Large Plants(₩)	4,030,730.28	Fruit Trees
		Large & Small Animals(₩)	4,638,479.19	Livestocks
		Real Estates (₩)	235,953,077.45	Land Value + Buildings Value
	Machinery and Implements(₩)		10,686,645.78	Average of Beginning and End of the Year
	Intangible Assets(₩)		1.267,583.95	Average of Beginning and End of the Year

	Financial Assets(₩)		37,399,545.73	Deposits + Saving Insurance + Mutual Savings + Loans to Individual + Securities
	Others	Debt(₩)	24,966,511.10	Average of Beginning and End of the Year
		Debt Ratio	0.10	Ratio of Debt to Total Assets
		Expenditures(₩)	22,351,420.20	Household Consumption Expenditures
		Subsidies(₩)	908,564.61	

We need three kinds of data sets; i) farm household income data (y) for dependent variable, ii) income-determining household's characteristics data(x) for independent variables, and iii) data of household's other characteristics affecting choice of zone(Z) for independent variables. The income-determining household's characteristics data(x) include endowed assets which go through income-creating economic activities such as human assets, natural assets, real estates, physical assets, intangible assets, financial assets while the data of household's other characteristics affecting choice of zone(Z) include subsidies and liabilities irrelevant to income creating activities. Final estimation includes regional dummy and time trend are included.

3.4.2 Estimation Results[*]

All six possible adjustment paths are considered here; i) moving from Zone II to Zone I (Model II-I), ii) from Zone III to Zone IV (Model III-IV), iii) from Zone I to Zone IV (Model I-IV), iv) from Zone II to Zone III (Model II-III), v) from Zone II to Zone IV (Model II-IV), vi) from Zone III to Zone I (Model III-I). For each path, we estimate income functions in each zone and switching indicator function. All models have passed Wald fitness test and Wald test of independent equations by rejecting the null hypothesis of equal estimated coefficient between different zones, which means that the switching points have been chosen properly so that the differences between two zones may be reflected sufficiently.

Table 3 Estimation Results of II-I Model

Variables	Zone 1		Zone 2		Indicator Function	
	coefficient	t-vale	Coefficient	t-vale	coefficient	t-vale
Operator's Gender	-0.1223	-1.19	0.2984	6.04 ***	0.0801	1.23

[*] Due to the space limit, the results for adjustment moving from Zone II to Zone I are reported in this paper. Other results will be available on request.

Operator's Age	-0.0096	-3.13	***	-0.0155	-9.46	***	-0.0063	-2.68	**
Operator's Education	-0.0045	-0.46		-0.0164	-3.30	***	0.0038	0.50	
Family Member	0.0138	0.58		0.0679	5.13	***	0.0412	1.72	
Highest schooling Year	0.0141	1.75		0.0128	2.80	***	-0.0014	-0.20	
Cultivated Area	0.0525	1.80		0.2261	9.18	***	0.0914	4.83	***
Ratio of Rented Area	0.1010	1.17		-0.0394	-0.79		-0.0188	-0.26	
Fixed Assets(in log)	0.1580	4.63	***	0.1351	8.93	***	0.0673	2.88	***
Natural Assets(in log)	0.0315	4.46	***	0.0176	4.84	***	-0.0151	-3.23	***
Financial Assets(in log)	0.1912	2.95	***	0.2609	16.68	***	0.1551	5.26	***
Intangible Asset(dummy)	0.1869	1.61		0.1026	1.66		0.0880	0.98	
Rice	0.3847	2.57	**	0.4342	6.48	***	-0.5976	-8.92	***
Barley	0.3114	2.61	**	0.0588	1.54		-0.3272	-4.49	***
Miscellaneous Grain	0.0524	1.09		-0.0535	-1.97	*	-0.1150	-2.97	***
Pulse	0.1543	2.15	*	-0.0192	-0.40		-0.2254	-3.82	***
Potato	0.1419	1.45		-0.0056	-0.17		-0.2464	-5.23	***
Vegetable	0.0585	0.42		0.1142	0.79		-0.4148	-2.90	***
Oilseeds and Specialty Crops	0.2288	2.34	**	-0.0185	-0.46		-0.2944	-5.43	***
Fruit	0.0628	1.17		-0.0197	-0.70		0.0147	0.33	
Flower	0.3583	1.85		0.3043	2.11	*	0.0980	0.65	
Other Crops	0.3239	3.46	***	0.1130	3.36	***	-0.1908	-3.16	***
Large Animal	-0.0368	-0.82		-0.0135	-0.55		-0.0385	-1.03	
Small Animal	0.3505	4.43	***	0.1509	4.84	***	-0.2327	-5.15	***
Other Livestock	-0.0858	-1.54		-0.0515	-1.95		0.0379	0.82	
Forestry and Fishery	0.0812	1.13		-0.0693	-2.91	***	-0.1824	-4.50	***
Manufacture	0.2501	2.93	***	0.1262	3.99	***	-0.1819	-2.93	***
Construction	0.3021	1.20		0.1935	1.17		-0.1164	-0.43	
Other Non-Farm Business	0.3741	3.91	***	0.1309	4.52	***	-0.3206	-5.81	***
Non-Farm Employment	0.5238	4.39	***	0.2259	8.65	***	-0.4854	-11.41	***
Farm Employment	0.2528	3.67	***	0.0831	3.37	***	-0.2410	-6.09	***
Interests and Dividends	-0.0463	-0.94		0.0997	3.79	***	0.0106	0.28	
Securities	0.7289	1.83		-0.0899	-0.61		-0.3033	-0.86	
Rent for Farmland	0.3335	4.01	***	-0.0540	-1.39		-0.2009	-3.38	***
Other Rents	0.5129	3.36	***	0.0906	1.79		-0.4198	-4.77	***
Gyeonggi	-0.3689	-2.47	**	-0.3831	-3.80	***	0.4109	3.39	***

Gangwon	-0.1700	-1.18	-0.3242	-3.62 ***	0.2057	1.60	
Chungcheongbuk	-0.0309	-0.20	-0.2396	-2.75 **	0.2624	2.03 *	
Chungcheongnam	-0.3812	-2.28 **	-0.3201	-3.49 ***	0.5882	4.98 ***	
Jeollabuk	-0.3533	-2.15 *	-0.1765	-1.97 *	0.4521	3.79 ***	
Jeollanam	-0.0694	-0.53	-0.2421	-2.81 ***	0.2830	2.40 **	
Gyeongsangbuk	-0.2480	-1.62	-0.2128	-2.46 **	0.4745	4.14 ***	
Gyeongsangnam	-0.0887	-0.64	-0.2895	-3.27 ***	0.3017	2.59 **	
Time trend	-0.0668	-3.18 ***	-0.0993	-10.27 ***	-0.0248	-1.75	
Constant	10.3611	7.39 ***	9.1888	22.02 ***	-2.2878	-3.68 ***	
Debt Ratio					0.4601	4.07 ***	
Ratio of Full-time Farm Workers					0.2615	2.47 **	
Ratio of Part-time Farm Workers					-0.1918	-1.68	
/lns1	0.1826	0.93					
/lns2	-0.2759	-9.99 ***					
/r1	-1.6306	-2.15 *					
/r2	0.0074	0.27					
sigma_1	1.2004	5.08 ***					
sigma_2	0.7589	36.20 ***					
rho_1	-0.9261	-8.59 ***					
rho_2	0.0074	0.27					
No. of Observatons	8801						
Log pseudolikelihood	-14691.71						
Wald chi2(43)		699.7 ***					
Wald tetss of Indep. Eqns.							
chi2(1)	4.64						
Pro(>chi2(1))	0.0312						

3.5 Estimation of Adjustment Costs

3.5.1 Expected Incomes (or Opportunity Costs) of Farm Households

Based on the estimation results of income and indicator functions, matrix of expected income increase $\{ \Delta y = E(y_{ji}/I_i, x_{ji}) - E(y_{ki}/I_i, x_i); j, k = I, II, III, IV\}$ by zone can be constructed as in Table 4. The matrix shows the expected income increase for each zone when they change to another zone. The second column on the left shows

the average income in thousand Korean Won (₩) for each zone. The following columns show the expected income increases, and the ratios of the income increase to the previous one.

Farm households currently in Zone II keeping an agricultural diversification strategy are expected to earn about ₩10.2 million by remaining still in Zone II, but ₩22.6 million more, 2.2 times current income, by moving to Zone I through concentration of endowed assets to a smaller number of agricultural economic activities. Likewise, households also expect income increase(₩19.7 million, 1.93 times) by moving to Zone III through transferring their farm assets to more non-agricultural activities, and also(₩12.1 million, 1.18 times) by moving to Zone IV through more specialization into non-agricultural activities. But they expect highest income when they move to Zone I by concentrating endowed assets to much smaller number of agricultural economic activities.

Farm households currently in Zone III keeping an non-agricultural diversification strategy are expected to earn about ₩14.7 million by remaining still in Zone III, but ₩14.3 million which is 0.97 times and ₩26.8 million which is 1.82 times current average income by moving to Zone I and Zone IV through concentration of endowed assets to a much smaller number of agricultural or non-agricultural economic activities respectively. However, farm households in Zone III that diversify in non-agriculture will benefit highest if they specialize in non-agriculture.

As seen before, for farm households located in Zone II and III that diversify in agriculture and non-agriculture, specialization strategy seems to be better than diversification strategy.

On the other hand, farm households already in agricultural or non- agricultural specialization zone (Zone I or Zone IV) are expected to suffer from income reduction by moving to Zone II. However, for the farm households in Zone I, non-agricultural strategic options (Zone III and IV) seem to be beneficial while those in Zone IV with already non-agricultural strategy do not have such a significantly beneficial other non-agricultural option.

Actually, farm households in Zone IV with non-agricultural specialization strategy show the highest average income. For this reason, we can see that any movement from

Zone IV to other Zone results in expected income reduction if we ignore a minor increase in income for the case of movements to Zone I.

The results for farm households in Zone I and IV imply that off-farm income and specialization would be an important strategic option for Korean farm households. In this income context, farm households in the Zone II and Zone III seem to be the most urgent target group of structural adjustment. As we have discovered, farms that move from quadrant I to quadrant III or IV(toward non-agriculture), from quadrant II to other quadrants(toward non-agriculture or specialization), and from quadrant III to IV(toward specialization) will see significant jumps in incomes, the outcomes that rational farm owners will pursue. These directions imply the movements toward non-agriculture, and specialization. Considering that almost 50% of farms are located in Zone II, and over 60% in Zone II and Zone III together in Korea, it is important for government policies and measures to target these farms for efficiency and effectiveness.

Table 4 Matrix of Expected Income Increase by Zone (₩1000)

		Average Income (₩1000) (A)	To Zone							
			I		II		III		IV	
			Exp. Inc. (B)	(B/A)	Exp. Inc. (C)	(C/A)	Exp. Inc. (D)	(D/A)	Exp. Inc. (E)	(E/A)
From Zone	I	15,482	0		-7,626	(-0.49)	**11,534**	**(0.74)**	**11,392**	**(0.73)**
	II	10,184	**22,651**	**(2.2)**	0		19,686	(1.93)	12,093	(1.18)
	III	14,705	**14,356**	**(0.97)**	8,254	(0.56)	0		**26,845**	**(1.82)**
	IV	23,962	2,671	(0.11)	-28,524	(-1.19)	-19,993	(-0.83)	0	

3.5.2 Actual Transition of Farm Households

Now we will check whether farm households follow the above mentioned adjustment directions in reality. Table 5 and Table 6 construct a matrix to show the real transition pattern between 2003 and 2007. From Table 4, we see that a farm household in Zone II expects the highest income increase when it moves to Zone I. Let's see the real transition pattern for this case. In Table 5, we can see that 9% of farm households in Zone I came from Zone II except for the farm households which move around boundary area of adjoining zones defined by 0.4~0.6 in vertical or horizontal axis value. Table 6 shows that 5% of farm households in Zone II changed to Zone I. As a next case, a farm

household in Zone III expects the highest income increase when it moves to Zone IV in Table 4. However, real transition indicates that more farms move to Zone II (13%) than to Zone IV(7%).

Similar analysis using Table 5 and Table 6 reveals no evident adjustment patterns following suggested directions before. In sum, we can see that there is no significant change in farm household distribution across zones between 2003 and 2007. In 2003, total distribution was 41%, 17%, 29%, 4%, 9% while in 2007, 40%, 15%, 30%, 4%, 10% for boundary, Zone I, II, III, IV, respectively.

Even with higher expected incomes, farm households seem to have not gone through significant structural adjustment. What factors caused farm households not to be able to realize their income potentials through structural adjustment? We argue that it's the adjustment.

Table5 Distribution of Farm Households by Source Zone (%, between 2003 and 2007)

		To (2007)					
		(0.4~0.6)	I(2007)	II(2007)	III(2007)	IV(2007)	TOTAL
From (2003)	Boundary(0.4~0.6)	50	29	34	47	37	41
	I (2003)	15	59	5	3	3	17
	II (2003)	23	9	57	10	4	29
	III (2003)	5	1	2	29	3	4
	IV (2003)	7	1	2	11	53	9
	Total	100	100	100	100	100	100

Table6 Distribution of Farm Households by Destination Zone (%, between 2003 and 2007)

		To (2007)					TOTAL
		(0.4~0.6)	I(2007)	II(2007)	III(2007)	IV(2007)	
From (2003)	Boundary(0.4~0.6)	50	11	25	5	9	100
	I (2003)	34	54	9	1	2	100
	II(2003)	32	5	60	1	1	100
	III (2003)	47	4	13	28	7	100
	IV (2003)	32	2	6	5	55	100
	TOTAL	40	15	30	4	10	100

3.5.3 Adjustment Costs for Farm Households

Now we can estimate the adjustment costs using the estimated expected income increase or opportunity cost in Table 4 and the definition of adjustment cost in equation (6) where the interest rate (r) is assumed to be 7.5%. As mentioned before, equation (6) defines an opportunity cost which sets a low limit of the adjustment cost. A farm household would take status quo when the adjustment cost exceeds the opportunity cost, a discounted value of additional income a farm household would receive with adjustment. Table 7 shows Matrix of Adjustment Cost by Zone.

A farm household in Zone II (agricultural diversification strategy) is facing adjustment cost of at least about ₩302 million for adjusting toward more agricultural specialized zone (Zone I). In this case we argue that it cannot move to Zone I because its adjustment cost is larger than ₩302 million. In this context, the estimated adjustment costs in Table7 need to be interpreted as low limits of actual adjustment cost.

Table 7 Matrix of Adjustment Cost by Zone(₩)

	Zone I	Zone II	Zone III	Zone IV
Zone I	0	-	153,798,360	151,895,027
Zone II	302,015,846	0	262,484,728	161,246,497
Zone III	191,421,973	110,063,813	0	357,942,187
Zone IV	35,618,549	-	-	0

4. CONCLUSION

Structural adjustment is defined as the farm household's behavior of changing the existing farm asset distribution over more specialized, or diversified directions toward agricultural or non-agricultural activities. Estimated expected income increase through switching regression model reveals significant income increases are expected when specialization or non-agricultural strategies are chosen for some farms. However, we cannot see significant adjustment in reality. This simply implies that high adjustment

costs are involved and some farm households suffer from large opportunity cost, by not adjusting toward more beneficial zones. Analysis on the factors of adjustment cost will be a topic of further study.

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