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Market Structure Analysis Using Changes in the Number of Farms and Farm Income: In the Case of Korea

Won Sil Choi [1] and Sang Hyeon Lee [2,*]

[1] Institute of Ocean and Fisheries Policy, Seoul 06367, Republic of Korea; choiws3771@naver.com
[2] Department of Food and Resource Economics, Korea University, Seoul 02841, Republic of Korea
* Correspondence: lsh21c@korea.ac.kr; Tel.: +82-02-3290-4622

Abstract: This study proposes a method to analyze market structures using changes in the number of farms and amount of farm incomes, taking Korea as a case study. We discern the market structures in agriculture by scrutinizing the impact of variations in agricultural added-value and production costs on the count of farms and farm-type specific agricultural incomes using the method. We also explore the significant influence of policy changes on agricultural market structures. As a result, in response to the increase in agricultural value-added, most types of farm households are in a short-term equilibrium state with both the number of farm households and amount of agricultural incomes increasing. In response to the increase in agricultural management costs, results of the distribution of farm households and agricultural incomes depend on farm types.

Keywords: market structure; agricultural policy; entry and exit; number of farms; agricultural income despite

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1. Introduction

This study attempted to provide more effective research findings for the design and implementation of agricultural policies by proposing a method to analyze market structures using changes in the number of farms and amount of farm income, taking Korea as a case study. Structural characteristics of an industry can be differentiated by the count and size of suppliers within it [1]. This has prompted numerous studies aiming to comprehend the strategies of firms responding to demand by identifying changes in wages and the number of employees based on demands [2,3]. When applied to agriculture, the characteristics of the market structure can be discerned through the distribution of the number of farms and amount of agricultural incomes. In market structures, prices and costs act as mechanisms that influence demand and supply, a principle that also holds for agriculture. Thus, by recognizing the fluctuations in the number of farms and amount of agricultural incomes driven by changes in agricultural added-value and management costs, we can comprehend the market structure and its evolution.

Economics uses criteria like the number of suppliers and the distribution according to their scale to distinguish market structure characteristics [4]. In market structures, prices and costs play pivotal roles as drivers influencing demand and supply, a principle discussed at length by Marshall [5]. Similar dynamics are at play in agriculture, where by recognizing the fluctuations in the number of farms and agricultural incomes caused by changes in agricultural added-value and management costs, we can comprehend the intricacies of the market structure and its evolution. Research has been conducted to understand the strategies of companies responding to demand by identifying the variations in wages and the number of employees based on demands [2,3]. When applied to agriculture, the market structure features can be discerned through the distribution of the number of farms and amount of agricultural incomes. Prices and costs in market structures serve as mechanisms that drive changes in demand and supply. This is true for agriculture as well, where

variations in the number of farms and amount of agricultural incomes can be traced back to changes in agricultural added-value and management costs.

Understanding market structure is important in that market structure affects market performance and related policy making [6]. So, identifying the implications of the research on structural characteristics of agriculture and its changes can provide important information for policy decisions that improve market outcomes. But few studies have conducted changes in market structure in response to changes in agricultural demand-side and supply-side conditions from a macro perspective. Most of the studies to discover the characteristics of agricultural structure have been conducted with the focus on analyzing changes in major agricultural indicators or identifying factors that affect agricultural structure from a micro perspective [7–10]. Also, studies have been conducted to predict the structure of farm households using policy scenario analysis methods [11,12]. In this study, by attempting to apply a methodology that can identify the characteristics of the market structure using the number of farm households and amount of agricultural incomes according to changes in the agricultural demand-and-supply environment, it contributes to enabling researchers in other countries to derive more effective policy implications for agricultural structure.

The purposes of this study are presented in two ways. The first purpose is to propose a methodology to identify the structure of the agricultural market using changes in the number of farm households and amount of agricultural incomes. The second purpose is to apply the methodology to Korean agriculture and provide implications for making agricultural policy directions based on the results of analysis. In other words, this study aims to analyze the impacts of agricultural added-value and management costs on the number of farms and agricultural incomes, according to farm type. In addition, this study aims to analyze whether the impacts on the number of farm households and amount of agricultural incomes have had significant impacts on the agricultural market structure after 2000, when changes in agricultural structural policies became prominent in Korea.

The structure of this paper is as follows: Section 2 explains the theoretical background, Section 3 describes the analytical model and data, Section 4 presents the analysis results, and Section 5 summarizes the results and draws conclusions.

2. Background

2.1. Agricultural Structure Adjustment Policy in Korea

In the case of Korea, the expansion of agricultural market liberalization began in earnest with the FTA negotiation with Chile in December 1999 and its implementation in April 2004. Many studies that have analyzed the impact of the expansion of agricultural market liberalization on Korean agriculture have suggested negative effects such as decreases in producer surplus and agricultural income [13,14]. In Korea, agricultural value-added and productivity have increased, but agricultural incomes of farms have decreased or been stagnant. So, it is evaluated that there is the gap between the growth of Korean agriculture and the incomes of farms [1,15]. The Korean government recognized the need for structural improvement in the agricultural sector to enhance agricultural competitiveness in the context of expanding agricultural market liberalization. Hence, the goal of Korea's agricultural policy has significantly changed since the 2000s.

The primary goals of Korean agricultural policy in the 1990s were to enhance agricultural competitiveness through increasing farming scale, fostering agricultural manpower, and improving agricultural productivity. In other words, the Korean government aimed to increase agricultural competitiveness by promoting production-intensive agriculture, but it faced limitations in continuously increasing the incomes of farm households because the improvement in agricultural productivity under the opening of the agricultural market caused the treadmill effects [16]. Later, it was suggested that the main role of the government would be effective to make environments in which farmers could expand their investments in agriculture or decide to leave agriculture [17]. So, the direction of Korean agricultural policy has shifted to focus on implementing policies for market-oriented competition and farm-household income support since 2000 [18].

Korean agricultural structural policy began in earnest in the 1990s along with the two-merger plan after the UR Agreement was concluded [19]. The main goal of the agricultural policy implemented by the government in the 1990s was to enhance the competitiveness of agriculture, and policies were established to improve agricultural productivity, such as land scaling, agricultural technology development, and the promotion of large-scale agricultural management entities [20]. In particular, during this period, it focused on promoting the successor training project for farmers and fishermen and the full-time farmer training project to cultivate elite personnel who would lead agriculture. However, as the agricultural market liberalization gradually expanded, the strategy of securing the price competitiveness of agricultural products through cost reduction and the protective policy faced limitations, and as it entered the 2000s, the target of agricultural policy expanded from past agriculture-centric policies to include rural areas, and the principle of agricultural policy changed to strengthen market economic principles and professionalization and to enhance the public function of agriculture [20,21]. Therefore, this study aims to examine the changes in agricultural structure around 2000 when changes in Korean agricultural policy occurred in response to the expansion of agricultural market liberalization.

2.2. Entry and Exit of Farms

We apply the entry and exit of firms to identify changes in agricultural structure. The farms decide whether to enter or exit the market in consideration of economic fluctuations. In general, the farms choose to enter the market when total revenues are expected to be greater than total costs and, otherwise, choose to exit the market [22–25]. So, we can expect farmers will choose to enter the agricultural market when the expected profits from producing agricultural products are positive, while they will choose to exit the agricultural market when they are negative.

In addition, farmers can choose alternatives to change their agricultural management strategies to survive in the market before deciding to permanently exit. Ref. [26] suggested the agricultural management strategy as follows. First, how will farmers allocate the labor ratio between agriculture and non-farm activities to maintain household incomes? Second, what kind of crops will farmers choose when growing crops? Third, how many crops will farmers grow? The farmer's decisions on the above three questions, including entry and permanent exit, determine the number of farms according to the classification of farmers' full-time and part-time types, cultivation size, and major crop types that can identify the agricultural structure. Changes in the number of farms as a result of these farmers' choices can lead to increases or decreases in the average agricultural incomes of existing farms, depending on the level of the incomes of farms entering or exiting.

In order to understand the market structure of agriculture, we analyze how the number of farms and amount of agricultural incomes change because of fluctuations in agricultural added-value and the costs of agricultural production. In particular, we analyze whether there are differences in the degree of the effects of changes in the number of farms and amount of agricultural incomes after 2000, when the agricultural policy aims shifted significantly to respond to agricultural market liberalization in Korea. The results of changes in the number of farmers and average agricultural incomes can be divided into eight cases. We would like to present the case of the result by dividing it into two aspects: demand factors (agricultural value-added) and supply factors (production costs).

We classify the type of change in the number of farms and amount of agricultural incomes caused by growth in agricultural value-added into three cases (Table 1). Case 1 is when both the number of farms and the average agricultural income per farm household increase as agricultural value-added grows. If demand in the agricultural market grows, farmers' profits also increase through increased agricultural prices, and potential farmers attempt to enter to gain that profit. This is a short-term equilibrium.

Case 2 is as follows. When agricultural added-value grows, the number of farms increases, while there is no effect on the average agricultural income per farm. This case occurs in long-term equilibrium. The farms are the price taker in a perfectly competitive

market. The farms determine to produce a quantity of output (Q) where MR = MC. The supply curve is a horizontal line in long-run equilibrium. The number of farms entering the market is determined by the market demand. However, the number of farms allowed by the market is the total output of the market divided by the output of individual farms ($n^* = \frac{q_e}{q^*}$). The short-run supply curve by entering farmers is S′ (Figure 1). If market demand increases, the short-term equilibrium is p_0 and q_0 because the output is produced by the number of existing farms. However, as the minimum points of the LAC curves is below p_0, additional profits are generated, and eventually, new farms enter the market. The new farms enter until the price equals the minimum point of the LAC curve, and the equilibrium output increases to $q_e{}'$. As a result, the number of farms entering the market in the long-run equilibrium increases to $n^{**} = \frac{q_e{}'}{q^*}$. When n^{**} farms enter, the short-term market supply curve is S″. The short-run equilibrium that S″ and D′ encounter is consistent with the new long-term equilibrium.

Table 1. Cases on the number of farms and agricultural income fluctuations caused by the increase in agricultural value-added.

Case	The Number of Farms	Agricultural Income	Mechanism
Case 1	↑ (Increase)	↑ (Increase)	The short-run equilibrium · Increases in demand for agricultural products → The increases in price of agricultural products → The increases in farm profits → The increases in entry of potential farms
Case 2	↑ (Increase)	× (No significant change)	The long-term equilibrium in the completely competitive market · Increases in demand for agricultural products → Increases in price of agricultural products → Increases in farm profits → Increases in entry of potential farms → Decreases in price of agricultural products
Case 3	× (No significant change)	↑ (Increase)	Monopolistic competitive market Increases in demand for agricultural products → Increases in price of agricultural products → Increases in farm profits → The relative difficulties of entry because of barriers (Precondition) The production of differentiated agricultural products

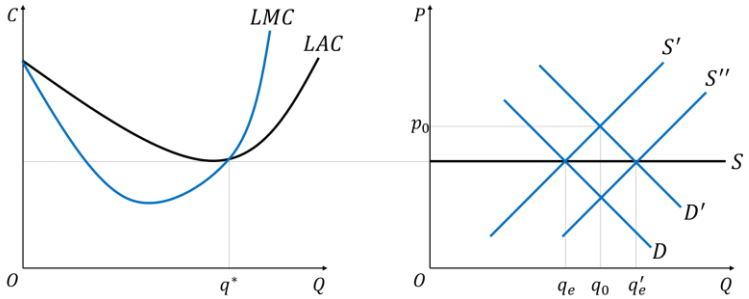

Figure 1. Long-term equilibrium in a perfectly competitive market. Source: figure created by author. (**a**) Individual farm; (**b**) market.

Case 3 is as follows. When agricultural added-value grows, the number of farms does not change significantly, while the average agricultural income increases. This case may arise in monopolistically competitive markets. Farms can act as price setters in a monopolistic competitive market. Each farmer can determine their price by selling products differentiated from other farmers' agricultural products. In this case, even if the

demand for the agricultural market grows, the effect of entry of the number of farms can be inelastic because the barriers to entry into the industry of farmers are higher than that of the completely competitive market.

We classify the number of farms and the types of changes in agricultural income caused by the increase in agricultural production costs into five cases (Table 2).

Table 2. Cases of the number of farmers and agricultural income fluctuations caused by the increase in agricultural production costs.

Case	The Number of Farms	Agricultural Income	Mechanism
Case 4	↓ (Decrease)	↑ (Increase)	·Increases in production cost→ Increases of break-even point → Exit of farms in low-income groups → Increases of the proportion of high-income farms
Case 5	↓ (Decrease)	↓ (Decrease)	·Increases in production cost→ Increases in break-even point → Exit of farms and decreases in agricultural income ·Increases in production cost → Changing its management strategy of high-income groups → Exit of farms → Increases in the proportion of low-income farms
Case 6	↑ (Increase)	↓ (Decrease)	·Increases in production cost→ Increases in break-even point → Exit of farms and decreases in agricultural income ·Increases in production cost → Changing its management strategy → Entry to low-income groups → Increases in the proportion of low-income farms
Case 7	↑ (Increase)	↑ (Decrease)	·Increases in production cost → Changing its management strategy → Entry to high-income groups → Increases in the proportion of high-income farms
Case 8	× (No significant change)	↓ (Decrease)	·Increases in production cost → Decreases in average agricultural income per farm

Case 4 is as follows. As agricultural production costs increase, the number of farms decreases, and the average agricultural income per farm increases. As agricultural production costs increase, the marginal cost and average total cost curve for agricultural production increase, and then the break-even point and the point of discontinuation of operation also increase. As a result, farmers in relatively low-income groups are more likely to decide to leave, and thus, the number of farms decreases and the proportion of high-income farmers increases.

Case 5 is when both the number of farms and the average agricultural incomes per farm decrease as the cost of agricultural production increases. In this case, we can consider two cases. One is when farmers decide to permanently leave, and another is when farmers change their agricultural management strategies. In the former case, it can be expected that the increase in agricultural production costs will increase the number of farmers who permanently stop growing crops, and the decrease in agricultural income of most farmers will occur. In the latter case, instead of farmers choosing to permanently leave, farmers change their management strategies, such as increasing the proportion of out-of-farm activities or changing crops, as described above. These farms are likely to belong to the high-income farm group in the type of farmhouse where they were located. In other words, the number of farms in that type may decrease, and the proportion of low-income farmers may increase as high-income farmers enter other types of new farms as agricultural production costs increase. As a result, the average agricultural income can be reduced.

Case 6 is as follows. When the cost of agricultural operation increases, the number of farms increases, while the average agricultural income per farm decreases. The increase in the number of farms can occur in some types of farms because of changes in their management strategies, even if the total number of farms in Korea decreases because of the increase in agricultural production costs. For example, the increases in the number of farms engaged in agriculture and other industries at the same time and the change in the number

of farms by major crop cultivation because of crop changes. These farmhouse management strategic behaviors are also affected by changes in agricultural policy. Farms that change their management strategies are more likely to move from the high-income group of the existing farms type to the low-income group of the new farms type. So, the incomes of the farms decrease.

Case 7 is as follows. When agricultural production costs increase, both the number of farms and the average agricultural income per farm increase. In this case, a farmhouse changing its management strategy enters a new farmhouse-type high-income group from a low-income group of the existing farmhouse type. There are two examples in this case. In the first case, existing full-time farm households engage in agriculture and non-agriculture at the same time when agricultural operating costs increase. The second is a case in which a farmhouse with a relatively large cultivation scale enters a small farm by reducing the cultivation scale. In this case, the number of farms increases as the low-income farmhouses of the existing farmhouse type enter the new high-income farmhouses of the farm type, and the proportion of high-income farmhouses increases, leading to an increase in average agricultural income.

Case 8 is a case in which the number of farms does not change as the agricultural operating cost increases, while the average agricultural income per farm decreases. This is a case in which the high-income group of the farmer moves to the low-income group when the agricultural operating cost increases. As a result, the overall agricultural income of the farmhouse decreases.

3. Methods and Data

3.1. Methods

We set up estimation equations to analyze changes in the number of farms (FARM) and agricultural income (INCOME) according to changes in agricultural value-added (AGRIVA) and farm production costs (COST) per farm and, then, include dummy variables (P) in the analysis model, meaning before and after 2000.

As suggested in Section 2, agricultural structures (G) can be classified based on the degree of agricultural dependence of farmers, the scale of cultivation, and the types of major cultivated crops, as shown in Table 3. Agricultural dependence can be determined through the proportion of agriculture among the total income of farmers, and farmers are classified into three types according to the degree of proportion. The full-time farms refer to farmhouses composed only of agricultural workers. The side farms refer to farmhouses with household members who have been engaged in fields other than agriculture for more than 30 days a year, and they are divided into type 1 and type 2 according to the proportion of agricultural income. The type 1 side-job farms mean farmhouses whose incomes earned by engaging in agriculture are greater than the incomes earned through other fields than agriculture, and the type 2 side-job farms mean the opposite.

Table 3. Classification of farm types.

Farm Types	Categories
Farm types by dependence on agriculture (3)	The full-time farms, the side-job farms (Type 1), the side-job farms (Type 2)
Farm type by major crop (6)	Rice paddies, fruits, vegetables, specialty crops, flowers, and livestock.
Cultivation scale (4)	Small farms, middle farms, regular farms, large farms

We classify farmhouse types into four categories by farmland size. Farmers with cultivation scales of less than 0.5 ha are referred to as small farms, farms with cultivation scales of more than 0.5 ha and less than 1.0 ha are referred to as middle farms, farms with cultivation scales of more than 1.0 ha and less than 2.0 ha are referred to as regular farms, and farms with cultivation scales of more than 2.0 ha are referred to as large farms.

Also, we classify major crop types into six types: rice paddies, fruit trees, vegetables, special crops, flowers, and livestock.

Estimation equations to identify whether the difference in influence exists before and after 2000 are divided into agricultural added-value and agricultural production cost variables. Equations (1) and (2) estimate the effect of changes in agricultural value-added (AGRIVA), reflecting the timing of changes in agricultural policy (P) on changes in the number of farms (FARM) and agricultural income (INCOME).

$$lnFARM_{Gt} = \beta_1 lnAGRIVA_t + \gamma(lnAGRIVA_t \times P) + \beta_2 lnCOST_{Gt} + \varepsilon_{Gt} \quad (1)$$

$$lnINCOME_{Gt} = \beta_1 lnAGRIVA_t + \gamma(lnAGRIVA_t \times P) + \beta_2 lnCOST_{Gt} + \varepsilon_{Gt} \quad (2)$$

$$G = Farm\ type, t = 1993, 1994, 1995, \cdots, 2019$$

Equations (3) and (4) estimate the effect of changes in agricultural production costs (COST) reflecting changes in agricultural policy (P) on changes in the number of farms (FARM) and agricultural income (INCOME).

$$lnFARM_{Gt} = \beta_1 lnAGRIVA_t + \beta_2 lnCOST_{Gt} + \gamma(lnCOST_{Gt} \times P) + \varepsilon_{Gt} \quad (3)$$

$$lnINCOME_{Gt} = \beta_1 lnAGRIVA_t + \beta_2 lnCOST_{Gt} + \gamma(lnCOST_{Gt} \times P) + \varepsilon_{Gt} \quad (4)$$

$$G = Farm\ type, t = 1993, 1994, 1995, \cdots, 2019$$

We used the log of each variable to facilitate the interpretation of the estimation results because variables in this model, such as agricultural income, agricultural production costs, and agricultural added-value, have large unit differences between them. In addition, we constructed estimation equations that remove the constant term, assuming that the number of farms and amount of agricultural income may appear to be '0' if agricultural production costs and agricultural added-value are '0' [27].

We did not consider the parallax between the dependent variable and the independent variable of the estimation equation. Depending on changes in agricultural added-value and agricultural production costs, the impact on farmers' entry and exit behaviors may occur at intervals of time. The purpose of this study is to understand the changes and characteristics of the market structure by analyzing the effects of agricultural value-added and increased agricultural production costs on the number of farms and agricultural income, respectively.

We use the SUR model that can be analyzed by combining two or more estimation equations. The SUR model is a concept that extends the GLS estimation method to a system of equations with G dependent variables.

When correlations between error terms are suspected, the SUR model is used because using a combined estimation procedure rather than a separate least-squares estimation method can represent an efficient estimator. In this analysis model, we use the number of farms by farm type and changes in agricultural income as dependent variables to understand the agricultural structure. Therefore, there may be correlations between the error terms of each estimation formula because of the common characteristics of farm households. We conducted the Breusch–Pagan (BP) test on the hypothesis that there is a correlation between error terms of group characteristics ($H_0 : corr(\varepsilon_{1t}, \varepsilon_{Gt}) = 0$) to check whether the estimation result of the SUR model is more efficient than the estimation result of the OLS model. As a result, the hypotheses were rejected in all estimation equations.

3.2. Data

We used agricultural added-value and agricultural production cost variables as dependent variables, and the number of farms and agricultural income were used as independent variables. Data on the agricultural value added are obtained from the Bank of Korea's national account data [28]. Data on agricultural production costs per farmhouse and agricultural income per farm household are obtained from the farm household economic survey of the National Statistical Office [29]. The subjects of the farmhouse economic survey are

about 3000 sample farms, and the selection of sample farms is changed every five years. Therefore, there is a problem that a time-series fault may occur because of sample replacement. Nevertheless, we use these data because the Farmhouse Economic Survey is the only survey that provides time-series data on agricultural income in Korea. Data on the number of farms are obtained from the Agriculture, Forestry and Fisheries Survey of the National Statistical Office [30].

As suggested above, this study estimates changes in the number of farms and amount of agricultural income by farm type to understand the agricultural structure. Since agricultural data by farm type in Korea have been provided since 1993, this study uses 27 years of data from 1993 to 2019.

Agricultural value-added, agricultural income, and agricultural production costs, which are variables of the monetary unit, need to remove the effect of price fluctuations when used as time-series data. Agricultural added-value is used as the current added-value proposed by the Bank of Korea, and agricultural production costs and agricultural income are calculated using the GDP deflator (2015 = 100). The descriptive statistics of data used in this study are shown in Table 4.

Table 4. Descriptive statistics.

Variable		Average	S.D	Minimum	Maximum
Agricultural value-added (AGRIVA) (KRW 1 billion)		23,903	2654	19,258	27,827
Agricultural production costs (COST) (KRW 1000)					
Types of farm households by dependence on agriculture	The full-time farms	20,062	5919	11,715	29,622
	The side-job farms (Type 1)	24,881	9034	10,224	41,041
	The side-job farms (Type 2)	6667	1528	4421	8596
Major crop types	Rice paddies	13,259	2860	8796	18,432
	Fruits	21,144	4437	14,730	28,524
	Vegetables	20,009	4009	12,231	26,291
	Special crops	20,253	9109	6970	41,785
	Flowers	46,972	15,142	19,139	78,919
	Livestock	68,440	32,762	28,054	121,560
Cultivation scale	Small farms	6950	1240	5111	9409
	Middle farms	11,278	4283	5706	18,985
	Regular farms	16,321	5067	9710	24,878
	Large farms	31,140	11,039	15,120	55,029
The number of farm households (FARM)					
Types of farm households by dependence on agriculture	The full-time farms	749,360	129,591	580,224	985,115
	The side-job farms (Type 1)	172,517	42,010	106,476	277,214
	The side-job farms (Type 2)	338,293	33,582	256,677	399,991
Major crop types	Rice paddies	637,292	176,867	386,739	1013,288
	Fruits	154,796	16,840	129,068	181,973
	Vegetables	246,959	17,751	198,138	271,845
	Special crops	40,696	7389	27,883	57,990
	Flowers	11,888	3043	8091	19,099
	Livestock	77,640	23,557	52,870	155,923
Cultivation scale	Small farms	482,283	16,595	452,720	507,866
	Middle farms	328,396	70,507	226,500	472,001
	Regular farms	279,599	88,762	161,332	459,774
	Large farms	169,893	17,814	132,210	198,504
Agricultural income per farm households (INCOME) (KRW 1000)					
Types of farm households by dependence on agriculture	The full-time farms	16,264	2963	12,090	23,163
	The side-job farms (Type 1)	20,571	2617	15,771	25,269
	The side-job farms (Type 2)	3794	2171	592	6841

Table 4. *Cont.*

Variable		Average	S.D	Minimum	Maximum
Major crop types	Rice paddies	12,492	4758	5691	22,612
	Fruits	23,600	7150	13,955	39,360
	Vegetables	17,487	5373	11,087	28,517
	Special crops	22,936	1,2910	2499	41,602
	Flowers	19,951	10,276	1527	44,785
	Livestock	38,464	10,423	17,486	58,353
Cultivation scale	Small farms	4125	2052	1311	7953
	Middle farms	6549	1044	4760	8862
	Regular farms	14,360	3372	10,468	21,626
	Large farms	25,902	5038	18,244	34,274

4. Results and Discussion

4.1. Types of Farm by Dependence on Agriculture

In Section 4.1, the results of estimating changes in agricultural structure in terms of their dependence on agriculture were presented. The effects of the increase in agricultural added-value and agricultural production costs per farm on the number of farms were estimated as shown in Table 5. The estimated results showed that the number of farms in all farm types classified by agricultural dependence had a positive (+) relationship with the agricultural value-added variable. On the other hand, it was found that the number of farms in all farm types except for the side-job farms (type 2) had a negative (-) relationship with the agricultural production costs variable. In other words, the increases in agricultural added-value induce the entry effects of the number of farms, and the increases in agricultural production costs bring the exit effects of the number of farms. Also, the estimation results show that the estimated coefficients for the entry effects are larger than the estimated coefficients for the exit effects. These results support the results of previous studies that exit decisions are more prudent than entry decisions in management's actions to economic conditions [31].

Table 5. The results of analysis of structural changes in the number of farm types by dependence on agriculture.

ln*Farm*	The Full-Time Farms		The Side-Job Farms (Type 1)		The Side-Job Farms (Type 2)	
ln *AGRIVA*	2.1304 *** (0.22)	2.1160 *** (0.23)	1.7339 *** (0.18)	1.7163 *** (0.19)	1.0925 *** (0.09)	1.0567 *** (0.10)
ln *AGRIVA* ×after 2000	−0.0141 (0.01)		−0.0223 (0.01)		−0.0383 *** (0.00)	
ln *COST*	−0.7960 *** (0.23)	−0.7808 *** (0.24)	−0.5248 *** (0.19)	−0.5063 ** (0.20)	0.2284 ** (0.11)	0.2705 ** (0.11)
ln *COST* ×after 2000		−0.0149 (0.01)		−0.0232 (0.01)		−0.0449 *** (0.01)
Observations	27					
BP test	$p < 0.01$					

Note: Numbers in parentheses indicate standard errors. **, ***—significant at 5% and 1%, respectively.

The estimated coefficients for the effect of the increase in agricultural added-value and agricultural production costs on the number of farms are large, in the order of full-time farms, side-job farms (type 1), and side-job farms (type 2). These results suggest that the higher the dependence on agriculture, the greater the influence of changes in agricultural value-added and agricultural production costs when farms decide whether to enter or exit from agriculture.

We can comprehend the characteristics of changes in the agricultural structure in Korea through the difference in the effect of the change in the number of farm households among farm types by dependence on agriculture. The agricultural structure of Korea has been changing from the state with a large proportion of farms with a high dependence on agriculture to the structure with a large proportion of farm households with a low dependence on agriculture. In the case of full-time farm households and the side-job farms (type 1), which are highly dependent on agriculture, the estimated coefficients of farm entry by the increases in agricultural added-value are larger than the estimated coefficients of exit by the production costs. However, the actual costs of agricultural production in Korea have increased two to four times faster than the added value of agriculture. As a result, it is presumed that the number of full-time farms and side-job farms (type 1) is decreasing.

On the other hand, the estimation results of the side-job farms (type 2) were analyzed in opposite directions. It was estimated that the effect of an increase in agricultural production costs on the number of farms had a positive (+) relationship. These results suggest that farm households with high agricultural dependence, such as full-time farms and side-job farms (type 1), have taken management strategies to lower their dependence on agriculture in response to the increase in agricultural production costs. However, it is estimated that the effects of increasing the number of side-job farms (type 2) after 2000 have decreased. The reason can be interpreted from two aspects. The first reason is the change in the structure of agriculture. The side-job farms (type 2) are defined as households whose non-farm income share is higher than that of agricultural income among farm households that have more than 30 non-farm household members a year. So, the farms with a large number of household members who can work outside the farm are more likely to become side-job farms (type 2). However, the average number of household members in Korean farms has been declining. In particular, the number of members per farm reached about two people after 2000. It is expected that this decrease in the average number of household members in non-farm households who can work outside of farming has caused the slowdown in the effect of increasing the number of side-job farms (type 2).

The second reason is the effects of the expansion of the direct payment system. According to the Farm Economic Survey published by the Korea Statistical Office [29], the agricultural production costs of full-time and side-job farms (type 1) have increased rapidly since the 2000s. Farm households could be more likely to choose to leave agriculture because of the increase in agricultural production costs. Meanwhile, the Korean government has been expanding public direct payments to farmers since 2000. The expansion of public subsidies changes the income structure of agriculture with a large proportion of transfer income. The increases in the share of transfer income of farms through the expansion of public subsidies contributes to the stabilization and recovery of farm household incomes [32,33]. So, it is expected that the expansion of public subsidies prevented the further increase in the exit effect of full-time and side-job farms (type 1).

The effects of the increase in agricultural added-value and agricultural production costs per farmer on agricultural income were estimated as shown in Table 6. The estimated results show that agricultural income of all farm types had a positive (+) relationship with agricultural value-added variables, so there were effects of increasing agricultural income. It was estimated that the effect of increasing agricultural income decreased after 2000. The reduction in the increase effects of agricultural income of full-time farmers and side-job farms (type 1) after 2000 may be the result of decreases in the dependence on agricultural income because of increases in the share of transfer income by implementing the expansion of direct agricultural payments.

On the other hand, it was found that only the agricultural income of the side-job farms (type 2) had a significant negative relationship with the variable of agricultural production costs. Since the agricultural production cost of full-time farmers and side-job farms (type 1) increased rapidly in the 2000s, it is expected to have a negative relationship only during that period.

Table 6. The results of analysis of structural changes in income of farm type by dependence on agriculture.

lnINCOME	The Full-Time Farms		The Side-Job Farms (Type 1)		The Side-Job Farms (Type 2)	
ln *AGRIVA*	1.0747 *** (0.19)	1.0418 *** (0.19)	1.1757 *** (0.13)	1.1590 *** (0.14)	2.3519 *** (0.60)	2.3012 *** (0.61)
ln *AGRIVA* ×after 2000	−0.0375 *** (0.01)		−0.0188 * (0.01)		−0.0618 ** (0.03)	
ln *COST*	−0.0879 (0.20)	−0.0532 (0.20)	−0.1774 (0.14)	−0.1599 (0.14)	−1.7324 ** (0.70)	−1.6729 ** (0.72)
ln *COST* ×after 2000		−0.0393 *** (0.01)		−0.0196 * (0.01)		−0.0722 ** (0.04)
Observations	27					
BP test	$p < 0.01$					

Note: Numbers in parentheses indicate standard errors. *, **, ***—significant at 10%, 5% and 1%, respectively.

The decrease in the effects of increasing agricultural income of the side-job farms (type 2) after 2000 can be expected to suggest that farmers adopt a strategy to increase their dependence on economic activities in other fields while reducing their agricultural activities. The study by Rhew et al. analyzed the agricultural strategies of farmers by analyzing the changes in agricultural income from 2013 to 2017 [34]. As a result, the study found that farmers belonging to the low agricultural income group had taken strategies to increase their dependence on economic activities other than agriculture. In fact, examining the income change of the side-job farms (type 2) in the early 2000s in Korea, the agricultural incomes have decreased from about KRW 5 million to KRW 3 million per year, and the non-farm incomes have increased from about KRW 21 million to KRW 29 million per year compared to before the 2000s.

Although the effects of agricultural income of the side-job farms (type 2) worsened by increasing agricultural added-value and production costs, the decline in agricultural income is not expected to have a significant impact on household maintenance because the main source of income for household expenses for their living is non-farm income.

The above analysis results are interpreted as the analysis method presented in this study, as shown in Table 7. All farm types classified by agricultural dependence were found to have the characteristics <Case 1>, in which both the number of farms and agricultural income increased with the increase in agricultural added value. In other words, in terms of agricultural dependence, Korean agriculture appears to be in a short-term equilibrium state.

Table 7. The results of case classification of structural changes in farm types by agricultural dependence.

Case	The Full-Time Farms		The Side-Job Farms (Type 1)		The Side-Job Farms (Type 2)	
	FARM	**INCOME**	**FARM**	**INCOME**	**FARM**	**INCOME**
AGRIVA	2.1304	1.0372	1.7339	1.1569	1.0542	2.2901
	Case1					
COST	−0.7808	−0.0925	−0.5063	-	0.2256	−1.7451
	Case 5		-		Case 6	

In the case of full-time farms, it was analyzed as <Case 5>, in which the number of farms and agricultural income both decreased because of the increase in agricultural production costs. On the other hand, in the case of the side-job farms (type 2), the number of farms increased and agricultural income decreased with the increase in agricultural production costs, which was analyzed as <Case 6>. Through these results, we identified the

structure in which the exit of the full-time farmer and the side-job farms (type 1) entered side-job farms (type 2).

4.2. Types of Farm by Cultivation Scale

In Section 4.2, the results of estimating the change in farm structure in terms of cultivation scale are presented. The impact of agricultural added-value and agricultural production costs per farm on the number of farms is estimated as shown in Table 8. It was found that there was a positive (+) relationship between the increase in agricultural added-value and the number of farms of all types of cultivation scale. This means that the increase in agricultural demand affects the entry of farmers in all types of cultivation size.

Table 8. The results of analysis of structural changes in the number of types by cultivation scale.

lnFarm	**Small Farm (Less than 0.5 ha)**		**Middle Farm (0.5~1.0 ha)**		**Regular Farm (1.0~2.0 ha)**		**Large Farm (More than 2.0 ha)**	
ln *AGRIVA*	1.2538 *** (0.06)	1.2376 *** (0.06)	1.7779 *** (0.12)	1.7510 *** (0.12)	2.2516 *** (0.15)	2.2169 *** (0.15)	1.9252 *** (0.08)	1.9298 *** (0.09)
ln *AGRIVA* ×after 2000	−0.0179 *** (0.00)		−0.0272 *** (0.01)		−0.0371 *** (0.01)		0.0052 (0.01)	
ln *COST*	0.0663 (0.07)	0.0845 (0.07)	−0.5434 *** (0.13)	−0.5128 *** (0.14)	−1.0273 *** (0.16)	−0.9902 *** (0.16)	−0.7195 *** (0.09)	−0.7242 *** (0.09)
ln *COST* ×after 2000		−0.0201 *** (0.00)		−0.0309 *** (0.01)		−0.0395 *** (0.01)		0.0052 (0.01)
Observations	27							
BP test	$p < 0.01$							

Note: Numbers in parentheses indicate standard errors. ***—significant at 1%.

On the other hand, it was analyzed that the increase in the agricultural production cost per farm and the number of farms had a negative (-) relationship in the middle, regular, and large farm types, whereas in the small farm type were not found significant effects. These results suggest middle, regular, and large farms can reduce the size of their cultivation scale or take actions to give up agriculture when the production cost of agriculture increases. Also, small farms do not take management strategy behaviors such as adjustment of cultivation scale or abandonment of agricultural in that situation. We can consider the reason for the result that middle, regular, and large farm types have entered small farm type by reducing the cultivation scale. In fact, Korean agriculture has a structural characteristic that the proportion of small farms continues to increase in terms of the size of arable land. The proportion of small farmers in Korea increased from 29.4% in 1991 to 48.4% in 2019 [30]. Also, the demographic structure of small farm households in Korea has a high proportion of the elderly population. The Korean government has implemented a management transfer policy focused on targeting aged farmers to leave farming, and the results of the implementation of the policy have been evaluated as ineffective [35]. In addition, the larger the cultivated area, the easier it is to choose farming successors, so the possibility of transferring agricultural management is high. Therefore, we can assume that small-scale farmers are less likely to leave aged farmers [35].

In terms of the added value of agriculture, the effect of increasing the number of farms was found to decrease after 2000. The degree of decrease in these effects was in the order of regular, middle, and small farms. On the other hand, it was analyzed that the effects of decreasing the number of farms in terms of agricultural production costs were more severe in regular and middle farms after 2000. Small farms did not show significant influence relationships, but the number of farms increased despite the increase in agricultural production costs, and the effects of these increases have decreased after 2000.

Since the 2000s, the Korean government has implemented policies to promote the circulation of agricultural land to expand the farming scale in response to the expansion of the opening of the agricultural market. Specifically, the direct payment on the aged farmers' retirement has been implemented since 1997. Also, farmland pension policies have been implemented since the 2000s. In addition, the projects to expand the farming scale have been continuously carried out. Due to the influence of these policies, it is possible that the effects of increasing the number of small, middle, and regular farmers tended to decrease after 2000 as small farms chose a strategy to exit from agriculture, and middle and regular farms took a strategy to expand the size of the farmland.

The impacts of agricultural added-value and agricultural production costs per farm on agricultural income were estimated as shown in Table 9. The effects of fluctuations in agricultural incomes per farm caused by the increases in agricultural added-value and agricultural production costs were found in the order of regular farms, large farms, and middle farms. As explained above, the regular farms are composed of a high proportion of full-time farmers, so there is a possibility that their fluctuation effects can be large, similar to the characteristics of full-time farms. On the other hand, the fluctuation effects of income in large farm types because of the increases in agricultural production costs through economies of scale can appear relatively small. When the cultivation scale per farm increases, even if the farms' income per unit area does not increase, the total area increases, so the total farm income can increase, and it also has the effect of reducing the production cost per unit area [26].

Table 9. The results of analysis of structural changes in income of type by cultivation scale.

lnINCOME	**Small Farm (Less than 0.5 ha)**		**Middle Farm (0.5~1.0 ha)**		**Regular Farm (1.0~2.0 ha)**		**Large Farm (More than 2.0 ha)**	
ln *AGRIVA*	0.4187 * (0.24)	0.3330 (0.23)	0.9639 *** (0.13)	0.9547 *** (0.14)	1.5169 *** (0.16)	1.4885 *** (0.17)	1.0112 *** (0.17)	0.9743 *** (0.18)
ln *AGRIVA* ×after 2000	−0.0907 *** (0.02)		−0.0057 (0.01)		−0.0322 *** (0.01)		−0.0427 *** (0.01)	
ln *COST*	0.5273 ** (0.27)	0.6242 ** (0.26)	−0.0967 (0.15)	−0.0862 (0.16)	−0.5694 *** (0.18)	−0.5389 *** (0.18)	0.0266 (0.17)	0.0640 (0.18)
ln *COST* ×after 2000		−0.1026 *** (0.02)		−0.0068 (0.01)		−0.0344 *** (0.01)		−0.0430 *** (0.01)
Observations	27							
BP test	$p < 0.01$							

Note: Numbers in parentheses indicate standard errors. *, **, ***—significant at 10%, 5% and 1%, respectively.

It was found that there is a positive (+) relationship between agricultural production costs and agricultural incomes of small farms. The effects of increasing agricultural incomes per farm were found to have changed in most types of farms, except for small farmers, since 2000. The effects of increasing agricultural income because of the increase in agricultural added-value were found to decrease after 2000, and the effects were the largest for small-scale farms, followed by large farms and middle farms.

In terms of the increases in agricultural operating costs, the effects of the largest decrease in agricultural income of the regular farms were found, and the effects of the decrease were further increased after 2000. On the other hand, the agricultural income of small farms was shown to have a positive (+) relationship with agricultural production costs, and the agricultural income of large farms was also shown to have a positive (+) relationship, although not significant.

It was found that the effects of increasing agricultural income because of the increase in agricultural operating expenses also decreased after 2000. In the case of small-scale farms, the effects of decreasing agricultural income were relatively large after 2000. We

can consider that the effects of increasing agricultural income decreases as the super-aged farmers are concentrated on the small-scale farm type.

In addition, the effects of decreasing the agricultural incomes of the regular farm type because of the increase in agricultural production costs were larger than of the other types, and the decrease effect was found to be more severe after 2000. As for the major crops cultivated by middle, regular, and large farms, the proportion of rice farms is relatively high. However, because the full-time farms fostering project has been centered on large farms among rice farms since 2000, it is possible that the effects of reducing the agricultural income of the middle farms excluded from the support of government has been further intensified after 2000. These results suggest that the effects of reducing agricultural income for farmers who are excluded from government policy support by limiting the items and the size of arable land as the target criteria for the full-time farmer development project can be further intensified.

Table 10 summarizes the effects of agricultural value-added and agricultural production costs per farm on the number of farms and agricultural income. All farm types classified by cultivation scale were found to have <Case 1>, in which both the number of farms and agricultural income increased with the increase in agricultural added-value. In other words, Korean agriculture appears to be in a short-term equilibrium state in terms of cultivation scale.

Table 10. The results of case classification of structural changes in farm types by cultivation scale.

Case	Small Farm		Middle Farm		Regular Farm		Large Farm	
	FARM	**INCOME**	**FARM**	**INCOME**	**FARM**	**INCOME**	**FARM**	**INCOME**
AGRIVA	1.2359	0.3280	1.7507	0.9639	2.2145	1.4847	1.9252	0.9685
	Case 1							
COST	-	0.5216	−0.5437	-	−1.0297	−0.5733	−0.7242	-
	-		-		Case 5		-	

Regular farms were found to have <Case 5>, in which both the number of farms and agricultural income decreased. On the other hand, middle and large farms decreased the number of farms, while small farms increased only the income. In fact, the trend of increasing agricultural production costs is steeper for middle, regular, and large farms compared to small farms in Korea [29]. Based on these results, we can infer that the behaviors of the farms, excluding small farms, chose a strategy of reducing the farmland size to minimize losses in response to the increase in agricultural production costs.

4.3. Types of Farm by Major Crops

Section 4.3 presents the results of estimating changes in the agricultural structure in terms of farm households' cultivated crops. The effects of the increase in agricultural added-value and agricultural production cost per farm on the number of farms were estimated as shown in Table 11. The estimated results showed that the increase in agricultural added-value had the effect on the number of farms entering. On the other hand, it was analyzed to have exit effects in rice, specialty crops, and livestock farms, but to have entry effects in fruit trees and flower farms when agricultural production costs increase.

We expect the reason for this result is that farm families have shifted their farming items in consideration of changes in the demand for agricultural products as the total number of farms continues to decline. Annual per capita consumption of each agricultural product in Korea had decreased by about 48.35% in 2019 compared to 1990, but had increased by 15.23% for vegetables, 35.41% for fruits, and 174.37% for livestock products [36,37]. In the case of livestock farms, despite the increase in demand, farmers' exit effects occurred. Since 1990, the number of livestock farms has decreased and the total number of livestock animals have increased, so the number of livestock per farm has continued to increase [26].

In particular, small livestock farms have been exiting, and then, the way to raise livestock has been in intensification systems [38].

Table 11. The results of analysis of structural changes in the number of types by major crops.

lnFARM	Rice Paddies		Fruits		Vegetables		Specialty Crops		Flowers		Livestock	
ln *AGRIVA*	2.6631 ***	2.6338 ***	1.0539 ***	1.0423 ***	1.0358 ***	1.0193 ***	1.2599 ***	1.2462 ***	0.5956 ***	0.5981 ***	1.4614 ***	1.4277 ***
	(0.31)	(0.31)	(0.08)	(0.08)	(0.16)	(0.16)	(0.05)	(0.05)	(0.14)	(0.15)	(0.10)	(0.11)
ln *AGRIVA* ×after 2000	−0.0376 ***		−0.0129 ***		−0.0203 ***		−0.0163 **		−0.0033		−0.0401***	
	(0.01)		(0.00)		(0.01)		(0.01)		(0.01)		(0.01)	
ln *COST*	−1.3967 ***	−1.3653 ***	0.1431 *	0.1551 *	0.2154	0.2324	−0.201 ***	−0.1872 ***	0.3157 **	0.3133 **	−0.2908 ***	−0.2592 ***
	(0.33)	(0.34)	(0.08)	(0.08)	(0.16)	(0.17)	(0.05)	(0.05)	(0.14)	(0.14)	(0.10)	(0.10)
ln *COST* ×after 2000		−0.0401 ***		−0.0133 ***		−0.0208 ***		−0.0163 **		−0.0029		−0.0373 ***
		(0.01)		(0.00)		(0.01)		(0.01)		(0.01)		(0.01)
Observations	27											
BP test	$p < 0.01$											

Note: Numbers in parentheses indicate standard errors. *, **, ***—significant at 10%, 5% and 1%, respectively.

The effects of changes in the number of farms were greatest in rice paddy farms. The reason for this is that the share of Korean farmers in Korea was about 39.1% in 2019, which had a large market share and continuously decreased grain consumption. In addition, our analysis results support the results of previous studies of the high proportion of agricultural production costs among the total revenues of farms, which are relatively influenced by the change in agricultural production costs [39].

The effects of increasing the number of farms were found to have significant changes in all types of farms except for flower farms since 2000. The degree of increase in the effects of reducing the number of farms was found to be large in rice and livestock farms. Also, despite the increase in agricultural production costs in fruit trees, vegetables, and flower farms, the increase in the number of farms has been reduced since 2000.

The effects of the increase in agricultural added-value and agricultural production cost per farm on agricultural income were estimated as shown in Table 12. The estimated results showed that the agricultural income of most farm types except for specialty crop farms had a positive (+) relationship with agricultural value-added variables, which had the effect of increasing agricultural income. The effects of increasing agricultural income were estimated to decrease in the case of farm types except for flower farms after 2000.

On the other hand, it was found to have significant negative relationships with agricultural income in the case of rice, specialty crops, and flower farms with the variable of agricultural production costs. On the other hand, it was found to have positive (+) relationships with agricultural income in the case of livestock farms. The effects of increasing the agricultural income of livestock farms are considered to be phenomena that occur when livestock farms adopt intensive or scale-up strategies to respond to the increase in production costs [26]. According to the profitability data per head of Korean beef feeder published by the National Statistical Office, the larger the breeding scale, the higher the income by reducing production costs. It was found that the effects of decreasing agricultural income because of the increase in the agricultural production costs of rice farms increased further after 2000. These results may be the result of the oversupply of rice, the expansion of the volatility of rice prices, and the deepening income instability caused by the fact that the rice income compensation payment program paid in proportion to the cultivation scale, which was implemented after 2000 [40–42].

Table 12. The result of analysis of structural changes in income by type of major crops.

lnINCOME	Rice Paddies		Fruits		Vegetables		Specialty Crops		Flowers		Livestock	
ln *AGRIVA*	1.8421 *** (0.36)	1.7919 *** (0.36)	1.3712 *** (0.29)	1.3193 *** (0.29)	1.0261 *** (0.24)	0.9699 *** (0.25)	0.0845 (0.17)	−0.0049 (0.18)	2.3789 *** (0.48)	2.3582 *** (0.50)	0.7029 *** (0.11)	0.6859 *** (0.12)
ln *AGRIVA* ×after 2000	−0.0546 *** (0.01)		−0.0556 *** (0.01)		−0.0616 *** (0.01)		−0.1036 *** (0.02)		−0.0224 (0.03)		−0.0233 ** (0.01)	
ln *COST*	−0.9281 ** (0.39)	−0.8738 ** (0.39)	−0.3395 (0.30)	−0.2862 (0.30)	−0.0152 (0.25)	0.0429 (0.26)	0.9872 *** (0.18)	1.0789 *** (0.18)	−1.3146 *** (0.47)	−1.295 *** (0.48)	0.3280 *** (0.11)	0.3440 *** (0.11)
ln *COST* ×after 2000		−0.0588 *** (0.02)		−0.0570 *** (0.01)		−0.0636 *** (0.01)		−0.1059 *** (0.02)		−0.0210 (0.03)		−0.0216 ** (0.01)
Observations	27											
BP test	$p < 0.01$											

Note: Numbers in parentheses indicate standard errors. **, ***—significant at 5% and 1%, respectively.

The above analysis results are interpreted as the analysis method presented in this study, as shown Table 13. All farm types classified by main cultivated crops excluding flower farms were found to be in <Case 1>, excluding specialty crops farms, in which both the number of farms and agricultural income increased with the growth in agricultural added-value. In terms of major crops, Korean agriculture also appears to be in short-term equilibrium. On the other hand, it was found that the farmhouse type for special crops corresponds to <Case 2>.

Table 13. The results of case classification of structural changes in farm types by major crops.

Case	Rice Paddies		Fruits		Vegetables	
	FARM	**INCOME**	**FARM**	**INCOME**	**FARM**	**INCOME**
AGRIVA	2.6255	1.7875	1.0410	1.3156	1.0155	0.9645
			Case 1			
COST	−1.4054	−0.9326	0.1418	-	-	-
	Case 5		-		-	
Case	Specialty crops		Flowers		Livestock	
	FARM	INCOME	FARM	INCOME	FARM	INCOME
AGRIVA	1.2436	−0.0191	0.5956	2.3789	1.4213	0.6796
	Case 2			Case 1		
COST	−0.2035	0.9730	0.3133	−1.316	−0.2965	0.3224
	Case 4		Case 6		Case 4	

In other words, when agricultural added-value increases, the number of farm households increases, but it does not have significant effects on agricultural income. We found that specialty crops, despite being high-income crops, have the characteristics of the long-run equilibrium state of a perfectly competitive market. We can conclude that because of these structural features, farmers are in a difficult situation to make profits. This may be the result of the small cultivation area per farm of specialty crops [43].

As for the rice farm type, both the number of farms and the agricultural income per farm decreased according to the increase in agricultural production costs, which was analyzed as <Case 5>. In the case of livestock and specialty crop farms, the number of farms decreased, and agricultural income increased with the growth in agricultural production costs, which was analyzed as <Case 4>. These results show that the proportion of low-income farms decreased as the number of farms decreased because of the exit of small-scale livestock farms because of the promotion of scale expansion of livestock farms.

The flower-farm type was analyzed as <Case 6>, in which the number of farms increased and the agricultural income per farm decreased according to the increase in agricultural production costs. Although there are difficulties in entering the flower industry, it is possible that new farmers have entered the industry because of the Korean government's policy to modernize agricultural facilities [44]. Also, the increase in the number of farms may have been affected by the increase in consumer demand for flowers. In other words, as the number of farms increased and the proportion of low-income farms increased, as the number of new farms increased because of the flower farms support project and the increase in consumer demand, the number of farms increased.

However, only the number of farms decreased according to the increase in agricultural production costs in the case of fruit farms, and there were no significant effects on both the number of farms and the agricultural income in the case of vegetable farms. The Korean government has continuously expanded the policy of budget support to strengthen the competitiveness of field farming to respond to the expansion of agricultural market opening. Korea's budget for strengthening field farming competitiveness had increased from KRW 118,315 million in 2001 to KRW 567,162 million in 2014 [45]. We can consider that the number of farms and agricultural income of fruit and vegetable farms affected by these government policies do not decrease significantly compared to farms for other crops, despite the increase in agricultural production costs.

5. Conclusions

This study proposed a methodology to identify the structural characteristics of agriculture using changes in the number of farm households and agricultural income in order to provide more effective research implications for agricultural policy design. Specifically, this study analyzed the effects of agricultural value-added and agricultural management costs on the number of farm households and amount of farm household income, taking Korea as a case study. Also, we analyzed whether these effects on the number of farm households and amount of agricultural income had significant changes in the agricultural market structure from 2000, when the agricultural structure policy greatly changed in Korea. Then, we analyzed the market structure and its changes in Korean agriculture and suggested implications based on the results of categorizing the results of the distribution of the number of farm households and amount of agricultural income into three types according to the increase in agricultural value-added and five types according to the increase in agricultural management costs.

The results of this study showed that the effects of changes in agricultural value-added and agricultural management costs per farm household on the number of farm households and amount of agricultural income were significant. We found entry effects of farms in response to an increase in agricultural value-added and exit effects in response to an increase in agricultural operating costs in most types of farm households. Also, it was analyzed that the size of the effect of entry into agriculture was greater than the effect of exit. However, the rate of increase in agricultural management costs was higher than the rate of increase in agricultural value-added in Korea after 1990. As a result, the effect of exiting farms would have been greater than the effect of entry. It is possible that this situation has affected the state that the number of farm households in Korea has been decreasing and agricultural income has been stagnant. These results suggest that it is necessary for the government to take measures to overcome the increasing agricultural management costs of farm households and to establish policies to increase agricultural demand in the long term.

As a result of analyzing the impact of Korean agricultural policy on changes in agricultural structure after 2000, the effect of the exit of full-time farms and side-job farms (Type 1) did not increase despite the increase in agricultural management costs. In addition, the effect of entry into the side-job farms (Type 2) was found, but the effect decreased after 2000. Also, only small farms did not find an exit effect among the classifications by farmland size. On the other hand, the effect of decreasing agricultural income was expanded because of the increase in agricultural management costs of rice paddy farmers after 2000.

These results imply that the Korean government has expanded the implementation of the direct payment system to farm households since 2000. In other words, the direct payment expansion of the government could have prevented the expansion of the effect of farms' exit. Nevertheless, the oversupply of rice caused by the implementation of the direct payment system designed as a system in which rice farmers are paid in proportion to their cultivated area could have affected the expansion of the effect of reducing the agricultural income of rice paddy farms. So, the government needs to strengthen the decoupled direct payment system.

Using the methodology for analyzing the agricultural structure proposed in this study, the results of analyzing the changes in the number of farm households and amount of agricultural income according to changes in agricultural value-added and agricultural management costs are as follows. In response to the increase in agricultural value-added, most types of farm households were included as Case 1, which is shown as a short-term equilibrium state with both the number of farm households and amount of agricultural income increasing. Exceptionally, special crop farms were classified as Case 2, which increased the number of farms but had no significant effect on agricultural income and was shown to be in the long-run equilibrium state of a perfectly competitive market. Special crops are classified as high-income crops, but the scale of farms is small in Korea. These results support the fact that even farmhouses that grow high-income crops may have structural characteristics that make it difficult to generate profits in agricultural income if the farming scale is small.

In response to the increase in agricultural management costs, the distribution of farm households and agricultural income showed different results by farm household type. Livestock and special crop farms were classified as Case 4, in which the number of farms decreased and agricultural income increased, indicating that it is an intensive agricultural structural feature. On the other hand, full-time farms, middle farms, and rice paddy farms were classified as Case 5, in which both the number of farm households and agricultural income decreased. The side-job farms (Type 2) and flower farms were classified as Case 6, in which the number of farms increased and agricultural income decreased. So, the government should take measures that can respond to the increase in agricultural management costs targeting the farmhouse type included in Case 5.

The primary objective of this study was to propose a method to examine changes in market structure according to changes in agricultural conditions and apply this to the South Korean case. This study may contribute to the analysis of agricultural structures and the extraction of policy implications in various countries. This study still has several limitations. This study did not consider variables related to factors representing various supply environments, such as prices of agricultural products and agricultural raw materials, other than variables of agricultural added-value and agricultural operating costs. As a result, some types of farm households did not find significant results in changes in the number of farm households and agricultural income and could not be included in the types presented in the methodology of this study. We used value-added data for agriculture as a whole, since agricultural value-added data cannot be classified by farm type. Future research needs to be able to apply more improved agricultural demand-and-supply conditions.

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