ANALYSIS OF SOCIAL WELFARE EFFECTS OF CROP REVENUE INSURANCE*

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Keywords
consumer welfare, cost-benefit analysis, crop revenue insurance, crop yield insurance, producer welfare, simulation, social welfare effect

Abstract
This study examines the need to introduce crop revenue insurance through analyzing its social welfare effects for the five target crops of the 2013 tabletop exercise. Based on the 5,000 simulated crop prices and revenues, producer welfare and consumer surplus resulting from the introduction of revenue insurance were estimated for each of the five crops. In addition, the cost-benefit of introducing revenue insurance was analyzed and compared with that of operating current crop yield insurance from the standpoint of the country as a whole. We found that the increase in producer and consumer welfare due to subscribing revenue insurance is 5.9 billion won and 3.0 billion won, respectively, for the five crops in total. The results of cost-benefit analysis show that net benefit of introducing revenue insurance is estimated to increase by 5.1 billion won, which is 3.4 billion won more than the net benefit increase of 1.7 billion won which could be attained through the implementation of current crop yield insurance. Although revenue insurance has many benefits, it needs to be dealt with carefully through considering various operating issues such as finding of additional data, complex evaluation of loss, and prevention of moral hazard.

* This work was supported by KREI Research Grant and Pusan National University Research Grant, 2014.
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I. Introduction

Unlike other industries, agriculture is an industry of big risks and uncertainty since it is inseparably related with nature. The biggest risks faced by farmers can be said to be production risk and price or market risk arising from natural disasters. In order to compensate farmers for their loss due to natural disasters, Korea has introduced crop yield insurance in 2001 for two agricultural items: apples and pears. The crop yield insurance has expanded rapidly every year to cover 43 agricultural items as of 2014, and the participation rate, too, is increasing rapidly. Having compensated until now one trillion 11.2 billion won to farmers who have suffered big damages from natural disasters such as big typhoons and hail, the crop yield insurance is evaluated to have contributed greatly to stabilizing farm management by providing them with opportunities to recover. Since various disasters are expected to increase due to unusual changes in climate, the importance of crop yield insurance is expected to grow even further.

However, farmers are equally sensitive to the risk of falling prices and they regard price risk as more of a threat in recent years. The production risk due to unusual changes in weather has an effect on price volatility, too, so it is true that the two risks are closely related with each other. In addition, rapid expansion of the domestic market to foreign agricultural products due to free trade agreements acts as factors that reduce the acreage of crops and their prices, thus acting as a big risk factor to domestic farm management. Therefore, domestic farmers recognize the need for crop revenue insurance that compensates the loss of revenue due to either falling prices or production reduction in addition to the crop yield insurance that compensates the loss of production due to natural disasters.

The Korean government began to consider crop revenue insurance as an alternative policy while reviewing various farm income stabilization policies after the conclusion of the Korea-US FTA in 2007. The current policy on price risk in the case of rice compensates 85% of the price difference between the target price and the actual market price in the form of a direct payment. In the case of some horticultural crops, the policy compensates within the 20% range of the target price only for farmers who have signed a shipment contract with a local distributor in production regions. Therefore, many farmers do not enjoy

much benefit from the policy. Thus, the government is considering adopting a policy that would compensate price risk or income loss in the form of price insurance or revenue insurance by using the infrastructure of crop yield insurance which is being established as a major means of stabilizing farm management.

In the case of the United States, revenue insurance purchases increased rapidly since 1996 when it was introduced, but the transactions of APH, which is a yield insurance, decreased and were overtaken by revenue insurance in 2002. Especially since 2005, revenue insurance has posted a rapid growth and today it accounts for about 80% of the total insured amount, thus becoming the mainstay of crop insurance. On the contrary, other developed countries such as Europe and Japan have not introduced revenue insurance and this signifies that revenue insurance requires more considerations of various types and an implementation base than yield insurance. As this is the case, when introducing revenue insurance or price insurance, there is a need for Korea to take a careful approach and examine various considerations such as selection of product items, insurance design, and conditions of insurance through sufficient tabletop exercises and trial projects. In 2013, a tabletop exercise for revenue insurance was conducted for five crops: revenue insurance for onion, grape, soybean and greenhouse cucumber, and price insurance for Chinese cabbage. In the 2014 tabletop exercise, rice, garlic, sweet potato, greenhouse tomato and tangerine were included in addition to the five crops conducted in 2013.

Previous researches on revenue insurance in Korea were mostly focused on the need to introduce the insurance and presentation of overseas cases. Chu (1998) suggested the role of revenue insurance for farm management stabilization using the examples of the United States and Canada. Hwang (1999) explained Canada's revenue insurance GRIP and emphasized Korea's need to introduce revenue insurance. Choi (2011) comprehensively examined the overall state of revenue insurance in the U.S. and derived policy implications. As for studies on the expected effects of revenue insurance, Hennessy et al. (1997) showed that implementing revenue insurance is more beneficial to producer welfare and efficient use of government budget in the United States than implementing both the Deficiency Payment Program and the crop yield insurance. Kim (2001) compared certainty equivalent revenue and efficiency ratio of revenue insurance and crop yield insurance and confirmed that revenue insurance is more effective and its policy efficiency is higher than crop yield insurance.

The purpose of this study lies in analyzing the need to introduce revenue insurance through evaluating its expected effects. Since the study by Kim (2001), research on revenue insurance in Korea has been stalled and under such an environment, significant importance can be attached to analyzing the social welfare effect of revenue insurance by comparing it with crop yield insurance while conducting revenue insurance tabletop exercises for 2013 and 2014. In addition, unlike previous studies that focused on producer welfare, this study is expected to contribute greatly to formulating a government policy by showing the extent of benefits revenue insurance can have on the society as a whole by comparing the costs and benefits of revenue insurance with those of crop yield insurance.

II. Structure of Crop Revenue Insurance

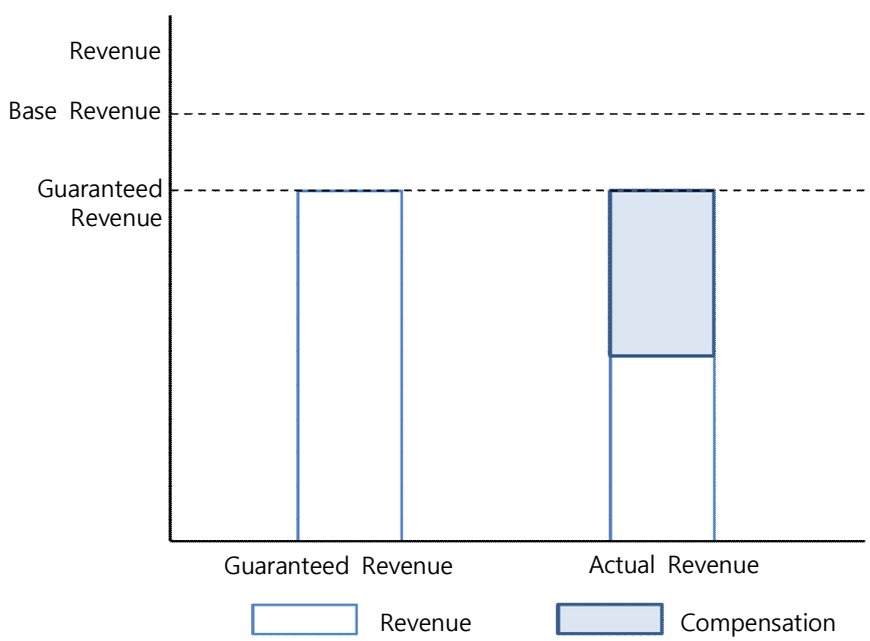
Revenue insurance is an insurance which ensures that producer revenue does not fall below a certain level due to either production reduction or price drop. Because revenue insurance compensates changes in both quantity and price, it is advantageous in that its effect on stabilizing farmer's income is bigger than yield insurance or price insurance that compensates changes in one variable only. But, in order to reflect changes in both production volume and price, it requires additional statistical data at the farm level and it has a weakness in that evaluation of loss for insurance payment is more complicated than yield insurance.

The mechanism of revenue insurance is based on giving priority to adding a special pricing arrangement to existing crop yield insurance and, additionally, various arrangements can be designed to suit the domestic situation. As for how admission is decided, individual farmers can voluntarily sign up for the insurance on an individual crop basis as in the case of crop yield insurance. When signing a revenue insurance policy, individual farmers must consult with an insurance company about base production amount, base price and compensation rate to determine the amount of guaranteed revenue. As for the base production amount, the average production amount from past data is typically applied and, in this study, the Olympic average (the average calculated after eliminating highest and lowest values) of previous five years of individual farmers' production is used. In the case of base price, the most objective option would

be to use futures price if the futures market is advanced as in the United States. But, since there is no crop futures market developed in Korea, the Olympic average of wholesale prices in the previous five years is used as the base price. The compensation rate of insurance is determined to compensate a certain percentage of base revenue which is the multiplication of base production amount and base price. In this study the compensation rate is assumed to be 85%. Note that the current crop yield insurance is offered with three compensation rates (70%, 80%, and 85%) and most participating farmers choose 85% of compensation rate.

When the maturity date approaches, actual production amount and actual wholesale price are confirmed and thus actual revenue can be determined by multiplying the two. The actual revenue is then compared with the guaranteed revenue, which was predetermined at the time of signing the insurance contract, to calculate the shortfall. The difference is compensated and, thus, participating farmers are guaranteed 85% of their normal years' average revenue. Figure 1 shows the basic structure of the revenue insurance.

FIGURE 1. Basic Structure of Revenue insurance



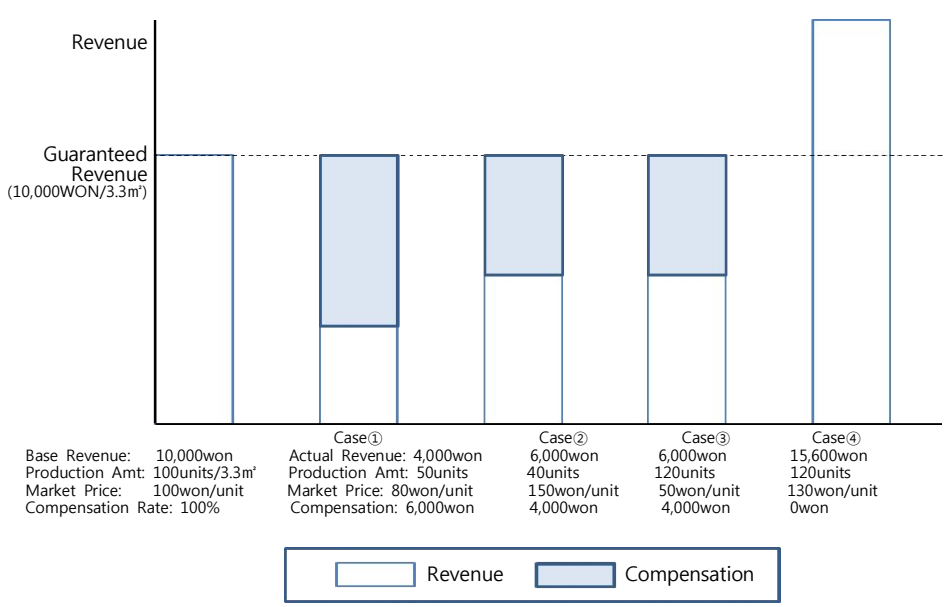
Note: Guaranteed revenue is determined by base revenue multiplied by compensation rate.

Ⅲ. Farm Income Stabilization Effect of Crop Revenue Insurance

The purpose of introducing revenue insurance lies in stabilizing the income of farmers by compensating the loss of their revenue due to fluctuations in either production amount or price on a crop basis regardless of the cause of the shortfall. As the likelihood of natural disasters increases due to unusual patterns in the climate, it is feared that crop production would fall, and it has become difficult to predict domestic crop prices due to further opening of the domestic market. Under such circumstances, stabilizing the income of farmers has become a major policy goal.

Figure 2 shows an insurance model in which an insured farmer (e.g., apple farmer) can maintain the guaranteed revenue of 10,000 won per 3.3 square meters under various situations during the harvest season. In the case of examples ① ~ ③, the insured farmer can maintain the insured level with the compensation payment, whereas in the case of example ④, the insured farmer is not eligible to receive the compensation since the actual revenue exceeds the guaranteed revenue. Thus, the apple farmer who signed the revenue insurance policy is guaranteed under any circumstances with the level of guaranteed revenue (for simplicity of explanation, compensation rate is 100% and premiums are not taken into account).

FIGURE 2. Income Stabilization Effect of Revenue Insurance



In Table 1, the effects of subscribing revenue insurance on total revenue, as well as revenue variation coefficient, of sample farmers of four crops, who are insured every year for eight years from 2005 to 2012, are compared with the total revenue and revenue variation coefficient of uninsured farmers. The results show that farmers can have stable revenue through a revenue insurance. The total revenue accumulated during the 8-year period increased and revenue variation coefficients decreased (income stabilized) for all four crops.

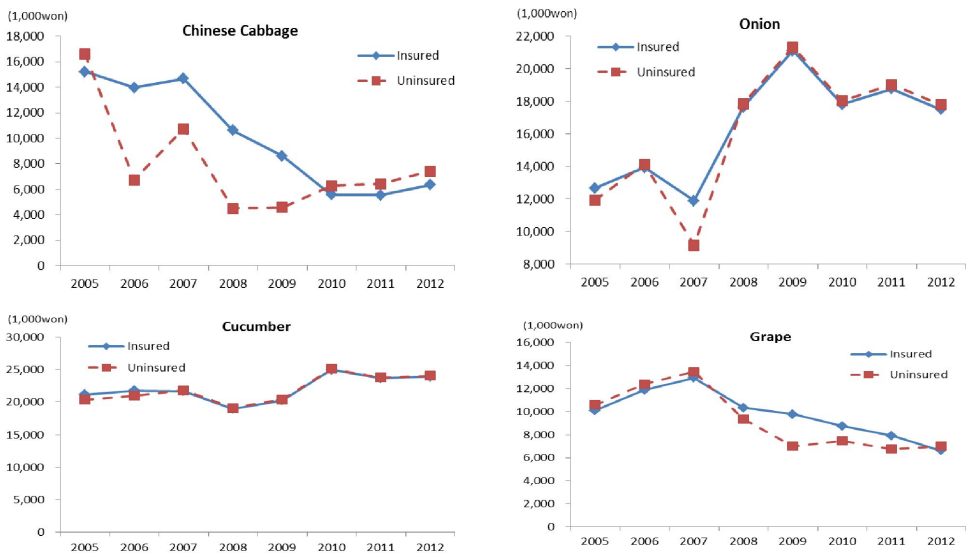
TABLE 1. Comparison of Total Revenue and Variation Coefficient of Insured and Uninsured Sample Farmers (In the Case of Revenue Insurance)

Crop	Acreage (㎡)	8-Year Total Revenue (1,000won, %)			8-Year Revenue Variation Coefficient (%)[1)]		
		Uninsured	Insured	Rate of Increase	Uninsured	Insured	Rate of Decrease
Chinese Cabbage	5,500	63,201	80,512	27.4	50.8	41.2	18.9
Onion	3,891	129,235	131,328	1.6	25.1	19.7	21.6
Cucumber	2,225	175,481	176,271	0.5	9.6	9.0	6.1
Grape	3,110	73,925	78,231	5.8	28.6	20.9	27.0

Note: 1) The variation coefficient is the standard deviation/average of revenue earned during the 8-year period from 2005 to 2012.
2) The government subsidy for insurance premium is assumed to be 50% as in the case of crop yield insurance.

In order to examine the income stabilization effect on insured farmers graphically, Figure 3 compares the revenue trends of the insured and uninsured during the 8-year period (2005~2012) as described in the simulation above. It shows that revenue insurance contributes to stabilizing income by reducing the loss of revenue when revenue drops.

FIGURE 3. Comparison of Revenue of Insured and Uninsured



IV. Social Welfare Effects of Crop Revenue Insurance

Table 1 showed that, in the case of sample farmers of each crop who had subscribed to a revenue insurance for eight years, total income has increased by 0.5~27.4% compared to the total income of uninsured farmers. Such an increase in income is derived from the government's subsidy on insurance premium (which is assumed to be 50% of net premium as in the case of crop yield insurance). The government subsidy represents tax, which is a social cost. Therefore, there is a need to examine the benefits and costs of revenue insurance from the standpoint of the society as a whole. The social benefits of operating a revenue insurance represent an increase in social welfare, which can be classified into producer welfare and consumer welfare.

Producer welfare

The increase in producer welfare as a result of introducing a revenue insurance can be said to be an effect of stabilizing income owing to the reduc-

tion of risks on the part of producers who subscribed to the revenue insurance. In order to calculate the increase in producer welfare, it is necessary to convert the reduced risk into a monetary value. The economic value of risk is measured by employing the concept of Certainty Equivalent, which is often used as a risk management indicator. Certainty Equivalent means a guaranteed return which refers to a least monetary amount one is willing to pay in exchange for unequivocal attainment of a revenue, even if it is of a lesser amount than what could be achieved with a higher risk. Since Certainty Equivalent (CE) is related to the degree of risk avoided, it is needed to first define a utility function that can reflect the risk appetite of the producer.

The producer's utility function uses the power utility function which is most commonly used in risk analysis. In the utility function, utility increases as income increases, but the rate of the increase decreases gradually. It has the advantage of reflecting the risk appetite of the producer since the effect of risk reduction on utility increase varies depending on the degree of risk avoided by the producer.

$$U(Y) = \frac{Y^{1-\gamma}}{1-\gamma} \tag{1}$$

Here, U(Y) is the power utility function of income (Y) and γ is the degree of risk avoided. If γ=0, then it signifies that risk is neutral or the producer is indifferent to risk, and if γ=1, then it means 'very sensitive to risk.' Considering that farmers who subscribe to a revenue insurance are reluctant to be exposed to risks, as they are relatively sensitive to risks, the degree of risk evasion (γ) in this study is assumed to be 0.5 without loss of generality.

If the producer utility function is assumed to be a power utility function, then the CE can be expressed by taking the expected value of equation (1) and arranging with regard to Y as follows;

$$CB(Y) = ((1-\gamma)B[U(Y)])^{1/(1-\gamma)} \tag{2}$$

In the case of the situation where the producer does not subscribe to a revenue insurance, a bigger risk should be deducted than the case for subscribed producers when calculating CE, because the producer will be exposed to a bigger risk than when the producer does subscribe to the insurance. Thus,

the CE of the producer who dose not subscribe to the revenue insurance will be smaller than that of the producer who subscribes to it. Consequently, the increase in producer welfare owing to the reduced risk resulting from the subscription to the insurance can be calculated by subtracting the CE of the uninsured from the CE of the insured.

To measure the increase in CE due to subscribing revenue insurance in year 2013, 5,000 revenues for subscribed farmers are simulated using @Risk software based on the estimated distribution function of historical revenues during the period from 1990 to 2012. For Chinese cabbage, which is a target crop for price insurance, 5,000 producer prices are simulated based on the estimated distribution function of historical prices during the period from 1990 to 2012[1]. Table 2 shows the estimation results of revenue (price for Chinese cabbage) distribution functions and the basic statistics of simulated revenues for subscribed farmers for five crops.

TABLE 2. Estimated Distribution Functions and Basic Statistics of Revenues

Unit: billion won(revenue), won(price)

Crop	Distribution	Parameters	K-S Statistic	Mean	Standard Dev.
Chinese Cabbage	Triangular Distribution	a(min)=15.16 b(max)=580.03 c(mode)=15.16	0.0008*** (0.0000)	203	133
Onion	Uniform Distribution	a(min)=8.79 b(max)=44.0	0.0004*** (0.0000)	26.4	10.2
Cucumber	Pareto Distribution	=2.35 xm(mode)=4.31	0.0003*** (0.0000)	7.48	6.34
Grape	Exponential Distribution	λ=1.26	0.0004*** (0.0000)	19.5	12.6
Soybean	Extreme Value Distribution	λ=24.5 =6.71	0.0003*** (0.0000)	28.4	8.63

Note: Distribution function and basic statistics of Chinese cabbage is for producer prices, not revenues.

*** 1% statistically significant, ** 5% statistically significant, * 10% statistically significant

[1] 5,000 simulated revenues for year 2013 are generated following the three steps. First, calculate the ratios of actual revenue to its previous five years Olympic average of revenue for each of the 23 years from 1990 to 2012 and estimate the distribution function of revenue ratios. Second, generate 5,000 ratios of revenue based on the estimated distribution function of ratios. Third, multiply the 2013 expected revenue, which is the Olympic average of revenues from 2008 to 2012, by each of the generated 5,000 ratios of revenues.

Table 3 shows the estimated increments in producer welfare in 2013 resulting from the subscription to the revenue insurance for five crops. It is assumed that the revenue insurance guarantees 85% of the base revenue (Olympic average of actual revenues for 2008~2012) and the subscription rate of the revenue insurance is same as the rate of the crop yield insurance for 2013. In the case of Chinese cabbage, which is the target crop for price insurance, it is assumed that the estimated price (Olympic average of actual prices for 2008~2012) is guaranteed 85%.

The increased amount of producer welfare resulting from the subscription to the revenue (price) insurance by the producers of five crops is 5.9 billion won in total. In the case of Chinese cabbage, in particular, which is expected to have a high subscription rate due to its wide fluctuations in price, the increased amount of producer welfare reaches 4.6 billion won. In the case of grape, too, the fluctuation in revenue is thought to be high given that its insurance premium rate is estimated at 14.92% in the simulation model. As a result, the actual rate of its subscription to the revenue insurance is expected to be much higher than 4.8% assumed in the simulation model, and the increased amount of producer welfare, therefore, is expected to surpass the model estimate.

TABLE 3. Welfare Increase Estimates for 2013 due to Revenue (Price) Insurance

Unit: million won, %

Crop	Expected Revenue of Insured Producers	Premium Rate[2)]	Insurance Subscription Rate	Producer Welfare Increments[4)]
Chinese Cabbage[1)]	66,618	14.05	19.1[3)]	4,551
Onion	21,980	6.33	2.2	409
Cucumber	6,629	5.37	1.4	50
Grape	19,390	14.92	4.8	599
Soybean	31,954	8.29	7.7	305
Total				5,914

Note: 1) Chinese cabbage is covered item of price insurance.
2) Premium Rate is calculated using the simulated 5,000 revenues based on the distribution estimated with historical revenues during the period from 1990 to 2012.
3) Since Chinese cabbage is not covered by existing crop yield insurance, the subscription rate of the price insurance for the crop is assumed to be 19.1%, which is the overall subscription rate of the crop yield insurance in 2013.
4) The degree of producer's risk evasion (γ) to calculate CE is assumed to be 0.5.

Examination of how much more the revenue insurance contributes to stabilizing farmer's income than the crop yield insurance by comparing the

monetary value of the increment in producer welfare through the subscription of revenue insurance with that through the subscription of the current crop yield insurance forms an important basis for introducing a revenue insurance. The monetary value of the increase in producer welfare through the subscription of a crop yield insurance by the farmers of five crops totals 1.1 billion won, which is less than 5.9 billion won which could be achieved by subscribing to the revenue insurance. In the case of revenue insurance, it is reasonable that the increase in producer welfare is bigger because the revenue insurance guarantees not only the production amount but also the price. In addition, in the case of Chinese cabbage, which is a target crop of price insurance, the reason that the increase in producer welfare of price insurance is much larger than that of crop yield insurance, signifies that the price fluctuation of Chinese cabbage is much bigger than the fluctuation in production amount.

TABLE 4. Producer Welfare Increase Estimates of Crop yield insurance for 2013

Unit: 1,000 ton, million won, %

Crop	Expected Production Amount of Insured	Premium Rate	Insurance Subscription Rate	Producer Welfare Increments[2)]
Chinese Cabbage	441.2	3.26	19.1[1)]	433
Onion	29.2	3.59	2.2	274
Cucumber	4.5	2.98	1.4	21
Grape	14.7	12.80	4.8	209
Soybean	9.9	6.60	7.7	141
Total				1,078

Note: 1) The insurance subscription rate of Chinese cabbage is assumed to be 19.1%, the total subscription rate of crop yield insurance in 2013.

2) The degree of producer's risk evasion (γ) is assumed to be 0.5.

Consumer Welfare

If revenue insurance is introduced, the risk of revenue falling will decrease and, as a result, producer welfare will increase. In that case, the production amount of the crop on which the producer is insured will increase. In particular, the effect of stimulating production will be bigger if the drop in the risk of an insured crop is bigger (Turvey, 1992). Since the increase in production will cause price to drop if other conditions remain same, the consumer welfare effect of the pertinent crop is expected to increase.

To measure the increase in consumer welfare caused by introducing

revenue insurance, it is needed to estimate the effect of production increase on consumer price for five crops. Using the data from the 1980~2013, consumer price of each crop is estimated on several explanatory variables: production amount, consumer price of substitute crops, per capita disposable income, year as a trend variable, year dummy variables if necessary. All of the price and income variables are "real" by adjusting for inflation using GDP deflator (2010=100). All data are collected from Korean Statistical Information Service (KOSIS). A log-linear model is estimated for all five crops.

TABLE 5. Basic Statistics of Consumer Price and Production Amount for 1980-2013

	Consumer Price Index(2010=100)				Production Amount(million ton)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Chinese Cabbage	34.3	21.9	8.6	100.0	1.80	0.54	1.08	2.93
Onion	57.2	30.5	16.4	146.9	0.78	0.35	0.17	1.52
Cucumber	44.4	30.1	7.1	108.9	0.28	0.12	0.08	0.46
Grape	65.9	30.4	19.5	115.9	0.26	0.12	0.06	0.48
Soybean	54.7	39.2	9.4	143.7	0.17	0.05	0.11	0.26

Source: Korean Statistical Information Service (KOSIS)

Prior to estimating the five OLS models, several tests were conducted to verify the models satisfy the hypotheses for OLS model and have any model specification problem. To test for multicollinearity, VIF (Variance Inflation Factor) is calculated. If VIFs of all explanatory variables are less than 10, then there is no multicollinearity problem. To test for heteroskedasticity, Breusch-Pagan statistic is used with null hypothesis of constant variance. To test for autocorrelation, Durbin-Watson test is conducted. If there is not any autocorrelation problem, DW statistic is close to 2. Finally, we take Ramsey Reset test with null hypothesis of no omitted variables to verify the model does not have any omitted variables problem. Table 6 shows that all five models satisfy the OLS hypotheses without any omitted variables problem.

TABLE 6. Hypothesis Test Results for OLS model

	Chinese Cabbage	Onion	Cucumber	Grape	Soybean
All VIF<10	Yes	Yes	Yes	Yes	Yes
B-P	0.74(0.3882)	0.13(0.7236)	0.46(0.4990)	2.02(0.1549)	1.44(0.2304)
D-W	1.5213	2.1345	1.7569	1.6632	1.74
Ramsey	0.69(0.5668)	1.49(0.2397)	0.82(0.4997)	1.33(0.2864)	1.20(0.3054)

Note: Numbers in parenthesis are p-values.

Table 7 shows estimated results of variables that have effect on consumer prices of the five crops. For all five crops, production amount has a negative effect on consumer price and is statistically significant. In the case of soybean, the effect of increase in production amount on price is relatively high, as a 1% increase in production amount causes price to drop by 0.91%. For Chinese cabbage, onion, grape and cucumber, a 1% increase in production amount decreases price by 0.74%, 0.64%, 0.25% and 0.14%, respectively. Consumer price of substitute crop has a positive effect on consumer price of its corresponding crop as expected. For example, 1% increase in consumer price of cabbage will increase the demand for Chinese cabbage as a substitute crop for cabbage and, thus, increase the consumer price of Chinese cabbage by 0.52%.

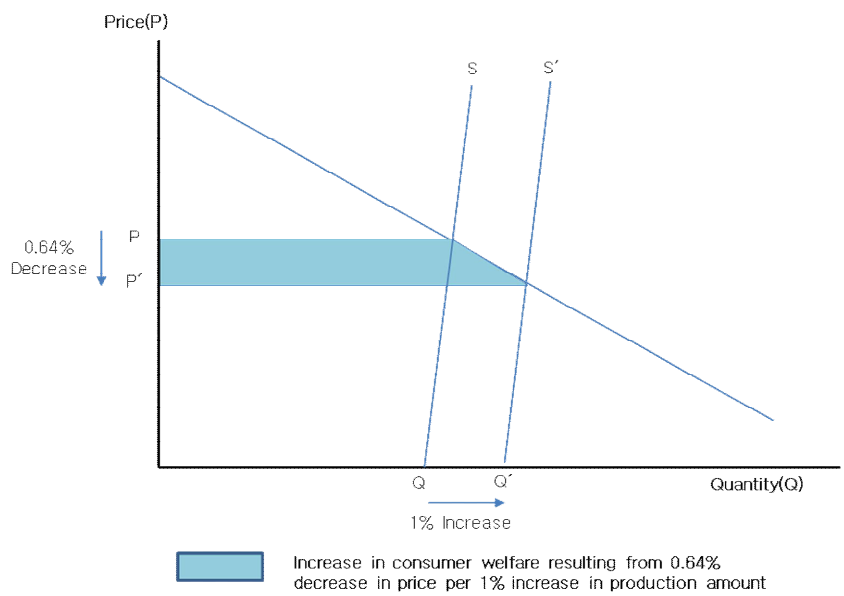
TABLE 7. Estimation Results of Consumer Price Function

	Consumer price(Index: 2010=100)				
	Chinese Cabbage	Onion	Cucumber	Grape	Soybean
Constant term	15.54***	-60.01***	-94.4***	62.7*	19.85***
Production amount of Chinese cabbage	-0.74***				
Production amount of onion		-0.64***			
Production amount of cucumber			-0.14**		
Production amount of grape				-0.25**	
Production amount of soybean					-0.91***
Consumer price of cabbage (Index: 2010=100)	0.52***				
Consumer price of garlic (Index: 2010=100)		0.39***			
Consumer price of barley (Index: 2010=100)					0.33
Per capita disposable income	-0.46***		-0.31	0.94**	
Trend(Year)		0.04***	0.05***	-0.03*	
Year Dummy (2004~2005=1)					0.48**
R-squared	0.63	0.60	0.95	0.29	0.60
F-statistic	16.72***	14.81***	138.6***	4.02**	14.91***

Note: A log-linear model was used for estimation.
*** 1% statistically significant, ** 5% statistically significant, * 10% statistically significant

Based on the estimation results of consumer price functions in Table 7, the increase in consumer welfare is calculated as shown in Figure 4. For example, if the supply of onions increases by 1% from Q to Q' in 2013 as a result of introducing revenue insurance and the price falls by 0.64% from P to P' as a result, then increase in consumer welfare (surplus) will be measured as the shaded area. The price (P) and quantity (Q) prior to subscribing revenue insurance is assumed to be expected price and production amount for 2013 which are Olympic averages of actual data during the previous five years.

FIGURE 4. Consumer Welfare Increase Due to Production Rise and Price Drop of Onions



The rate of increase in production amount resulting from introducing revenue insurance comes from the farm survey result conducted in 2013 (Chung, et al.).

The 2013 survey asked about whether and how much he or she is willing to increase production amount if he or she participates in revenue (price) insurance program. Table 8 summarizes the survey result. To estimate the rate of increase in production amount for Chinese cabbage after subscribing revenue insurance, for example, we multiply the subscription rate (19.1% in Table 5) by rate of willingness to increase (7.3%) times average rate of increase (30.3%) to result in 0.4%. By the same logic, the rate of increase in production amount for onion, cucumber, grape and soybean is estimated to be 0.1%, 0.1%, 0.1%, 0.3%, respectively.

TABLE 8. Survey Results on Intention of Production Increase due to Revenue Insurance

Unit: %

	Chinese cabbage	Onion	Cucumber	Grape	Soybean
Willingness to increase	7.3	11.3	9.1	7.4	13.1
Average rate of increase	30.3	19.5	17.2	18.4	34.3

Table 9 shows that consumer welfare increases owing to a price drop resulting from an increase in production amount if revenue (price) insurance is introduced for five crops. It is estimated that consumer welfare would increase by a total of 3 billion won. Chinese cabbage and soybean show relatively larger increases in consumer welfare mainly due to larger effect of production increase on price drop (Table 7) and higher average rate of production increase (Table 8). In practice, it is highly likely that the actual subscription rates of revenue insurance will be higher than the rates assumed in this study based on yield insurance, and revenue insurance participants will increase production more than they answered in the survey since there is no concern over decrease in income. Therefore, it is expected that the rise in consumer welfare would be larger than the rise estimated in this study.

TABLE 9. Consumer Welfare Increase Estimates for 2013: Revenue Insurance

	Expected Production Amount (1,000 tons)	Expected Price (won/kg)	Change in Production Amount (1,000 tons)	Change in Price (won/kg)	Consumer Welfare Increase (million won)
Chinese Cabbage	2,310	150.99	9.2	-0.45	1,034
Onion	1,327	734.74	1.3	-0.47	624
Cucumber	321	1,480.42	0.3	-0.21	66
Grape	305	1,392.00	0.3	-0.35	106
Soybean	128	3.405.48	0.4	-9.30	1,194
Total					3,024

Note: Expected production amounts and expected prices are found by calculating the Olympic average of actual production amount and prices in the period from 2008 to 2012.

This study does not estimate the decrease in producer welfare due to price decrease because the price drop is caused by production increase resulting from introducing revenue insurance. As reported in Table 7, 1% increase in production amount decreases consumer price by less than 1% for all five crops.

This implies that the decrease in producer welfare due to price drop will be minimal because of offsetting the price drop by production increase. However, it is necessary to estimate producer selling price, not consumer price, on production amount in order to calculate the change in producer welfare due to subscribing revenue insurance more accurately, which would be a good future study.

Cost-Benefit Analysis of Revenue Insurance

So far we have estimated the increase in producer and consumer welfare resulting from the introduction of a revenue insurance. Now we can calculate to what extent a revenue insurance can contribute to the country as a whole in addition to insured farmers by analyzing the costs and benefits of the insurance from the standpoint of the country as a whole. There is also a need to confirm how necessary it is to introduce a revenue insurance for the country as a whole, in addition to farmers, by showing how big an increase of social welfare can the revenue insurance achieve compared to the crop yield insurance currently operated.

Table 10 shows the results of a cost-benefit analysis of a tabletop exercise under the assumption that a revenue insurance is introduced in 2013 for five crops. The results show that the countrywide benefits of introducing the insurance for the crops exceed the costs. The sum of the benefits, which is 25.6 billion won, is about 5.1 billion won more than the sum of the costs, which is 20.5 billion won. The net benefit (benefit minus cost) of the country will increase as the number of crops covered increases. Given the fact that the production amount of the five crops (2.9 trillion won) accounts for 14.5% of the total agricultural production in 2012 (20.1 trillion won excluding rice and livestock), it is expected that if insurance coverage expands to include all agricultural crops, then the increase in net benefit would amount to approximately 35.2 billion won (It is assumed that revenue volatility is same as the one for the five crops).

TABLE 10. Cost-Benefit Analysis[1] of Introducing Revenue Insurance in 2013

Unit: million won

	Cost				Benefit			
	Premium	Government Subsidy		Total Cost	Compensation Amount	Social Welfare		Total Benefit
		Premium Support[2]	Operating Cost Support[3]			Producer Welfare[4]	Consumer Welfare[5]	
Chinese Cabbage	4,678	4,678	1,651	11,008	9,357	4,551	1,034	14,942
Onion	767	767	271	1,805	1,391	409	624	2,424
Cucumber	196	196	69	462	356	50	66	473
Grape	1,596	1,596	563	3,754	2,893	559	106	3,598
Soybean	1,461	1,461	516	3,439	2,650	305	1,194	4,149
Total				20,468				25,586

Note: 1) Cost-Benefit analysis is conducted under the assumption that farmers choose the compensation rate of 85% without loss of generality. Assumption on the level of compensation rate does not affect the main result of analysis because higher(lower) level of compensation rate will increase(decrease) both benefit and cost due to higher(lower) premium rate.

2) The amount of government subsidy on insurance premium is assumed to be 50% of the net premium.

3) The government subsidy on operating cost is assumed to be 15% of gross premium which is the sum of net premium and operating cost.

4) Producer welfare is an estimation derived by assuming that the degree of risk evasion (γ) is 0.5.

5) Consumer welfare is an estimation derived by assuming that production amount increases by 0.1~0.4% based on the farm survey results.

According to a cost-benefit analysis of introducing a crop yield insurance for the five items, net benefit turned out to be 1.7 billion won (Table 11), as the total benefit of 12.2 billion won exceeds the total cost of 10.5 billion won. When only producer welfare is compared in Table 3 and Table 4, producer welfare is higher in revenue insurance than in crop yield insurance by 4.8 billion won. From the standpoint of the whole society, too, the net benefit from introducing a revenue insurance is higher than the net benefit from the crop yield insurance by 3.4 billion won. Therefore, this confirms that revenue insurance is beneficial to not only farmers but the country as a whole, too. In 2012, the output value of 5 items accounted for 14.5% of the total output value of all agricultural crops. If crop yield insurance is expanded to cover all agricultural products, it is anticipated that the net benefit will increase by about

11.7 billion won. However, it is estimated that the net benefit will be lower by about 23.5 billion won than the net benefit from revenue insurance.

Since it was assumed that introduction of either revenue insurance or crop yield insurance will equally increase production amount by 0.1~0.4% based on the farm survey results, it was revealed that the increase in consumer welfare resulting from price drop will be identical. However, if farmers' income is guaranteed under any circumstances by the introduction of revenue insurance, then farmers will try to increase their income by increasing production amount more than they would do when they are covered with crop yield insurance only. Thus, it is evaluated that the increase in consumer welfare, which is expected to occur when revenue insurance is introduced, will be bigger than in the case of crop yield insurance. As a result, it is highly likely that the difference between revenue insurance and crop yield insurance with respect to the increase in social net benefit, too, will be bigger than the economic value estimated in this study.

TABLE 11. Cost-Benefit Analysis[1] of Introducing Crop yield insurance for 2013

Unit: million won

	Cost				Benefit			
	Premium	Government Subsidy		Total Cost	Compensation Amount	Social Welfare		Total Benefit
		Premium Support[2]	Operating Cost Support[3]			Producer Welfare[4]	Consumer Welfare[5]	
Chinese Cabbage	1,197	1,197	423	2,817	2,171	433	1,034	3,638
Onion	424	424	150	998	769	279	624	1,672
Cucumber	109	109	39	257	198	21	66	286
Grape	1,528	1,528	539	3,594	2,770	209	106	3,085
Soybean	1,224	1,224	432	2,881	2,220	160	1,194	3,573
Total				10,547				12,254

Note: 1) Cost-Benefit analysis is conducted under the assumption that farmers choose the compensation rate of 85% without loss of generality. Assumption on the level of compensation rate does not affect the main result of analysis because higher(lower) level of compensation rate will increase(decrease) both benefit and cost due to higher(lower) premium rate.

2) The amount of government subsidy on insurance premium is assumed to be 50% of the net premium.

3) The government subsidy on operating cost is assumed to be 15% of gross premium which is the sum of net premium and operating cost.

4) Producer welfare is an estimation derived by assuming that the degree of risk evasion (γ) is 0.5.

5) Consumer welfare is an estimation derived by assuming that production amount increases by 0.1~0.4% based on the farm survey results.

Ⅴ. Summary and Conclusion

As natural disasters are expected to increase alongside the acceleration of domestic market liberalization due to free trade agreements, the South Korean government is reviewing the idea of introducing the crop revenue insurance, which compensates changes in both production amount and price, as a major farm management stabilization tool. The tabletop exercise results of comparing the total income and income variation coefficient of insured and uninsured farmers of Chinese cabbage, onion, cucumber and grape have confirmed that the total income of insured farmers during an eight-year study period has increased stably through the subscription of a revenue insurance.

A cost-benefit analysis from the standpoint of the country as a whole was conducted to analyze the cost and benefit of introducing a revenue insurance for the five target crops of an experimental revenue insurance scheme for 2013. The results show that net benefit is estimated to increase by 5.1 billion won, which is 3.4 billion won more than the net benefit increase of 1.7 billion won which could be attained through the implementation of a crop yield insurance. If the target crops are expanded to include all agricultural crops, the increase in net benefit as a result of introducing a revenue insurance is estimated to be higher than in the case of a crop yield insurance by about 23.5 billion won. What this means is that a revenue insurance, which compensates changes in both production amount and price, contributes significantly more to the welfare increase of producers as well as the society as a whole than a crop yield insurance that compensates the change in production amount only.

Although revenue insurance has the benefit of being used as a comprehensive tool for stabilizing farm management under any circumstances, it is true that it entails more considerations to take into account in operating the insurance than a crop yield insurance, such as finding of additional data, complex evaluation of loss, and prevention of moral hazard. Therefore, maximum results from implementing a revenue insurance can only be attained when the issue is dealt with carefully after conducting sufficient tabletop exercises and trial projects under a variety of scenarios reflecting insurance practices of developed countries.

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Date Submitted: Aug. 13, 2014
Period of Review: Aug. 26, 2014～Dec. 18, 2014