CHAPTER 3

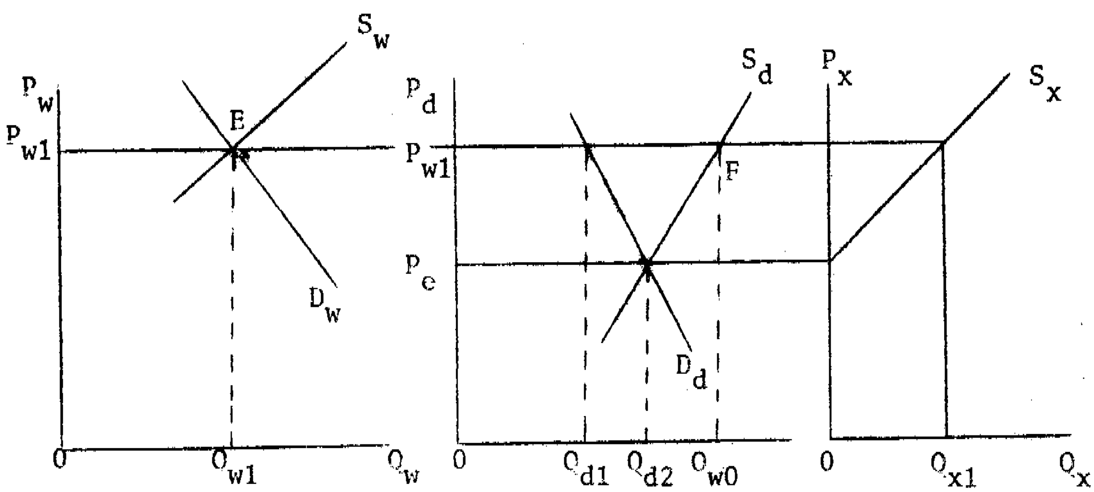
THEORETICAL FRAMEWORK, HYPOTHESES, METHODOLOGY AND DATA

A. Theoretical Framework

1. Linkage between world price and domestic price of exportable good.

From international economic theory, we have known that domestic price of an exportable good of a country which is integrated with the world economy, would be linked to the world price of that good.[1] This phenomenon could be shown by Figure 3.1.

FIGURE 3.1



A. World market for X B. Domestic market for X C. Export market for X

Assumptions: 1. Free trade, 2. Small Exporting Country

3. Zero transactions Cost

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[1] Jan S. Hogendorn and Wilson B.Brown, The New International Economics, (Mass.: Addison Wesley, 1979), p.148.

From Figure 3.1, the third assumption is asumed for simplicity. The first assumption may be true for all crops under study except rice.[2] But, some studies revealed that the export price of rice and its domestic price are linked together rather closely.[3] So, the Figure 1 above could be applied for all crops studied here.

We can see that the domestic price of a good follows its world price. Export supply is forthcoming as long as world price is greater than Pe. As the world price is equal to OP_{w1}, the domestic price could not be lower than OP_{w1}. If the domestic price is forced to be lower than OP_{w1}, there will be no domestic supply because the producer could sell his product to the world market with the higher price as long as there is no restriction on export, and the domestic supply becomes $P_{w1}FS_d$. So, the domestic price must be at OP_{w1}, (if transactions cost is considered, the domestic price would be OP_{w1} minus transactions cost), and the domestic demand coresponding to this price is OQ_{d1} leaving the amount of $O_{w0}\,Q_{d1}$ available for export. This domestic quantity demanded is lower than the quantity demanded in the case when there is no international trade, that is OQ_{d2}.

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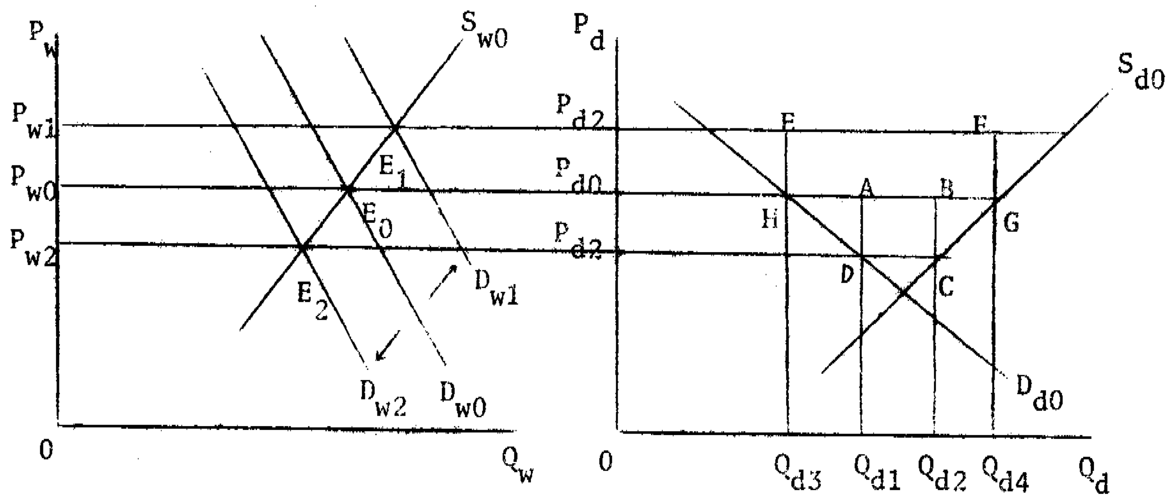
[2]Ammar Siamwalla, "Farmers and Middlemen : Aspects of Agricultural Marketing in Thailand", in Rungson Thanapornpan and Narongchai Akasanee (eds.), Rukmuangthai, (Bangkok : Social Science Association, 1976).

[3]Chaiyong Chuchart and Sopin Tongpan, The Determination and Analyses of Policies to Support and Stabilize Agricultural Prices and Incomes of the Thai Farmers, with Cooperation of Land Development, Ministry of National Development, Department of Agricultural Economics, Kasetsart University and South East Asia Treat Organization, 1965.

Thus, as long as domestic price of exportable good follows along its world price, an implication which could be derived is that fluctuations in world price of a good would also cause fluctuations in domestic price of that good.

When there is a tax on an export, the linkage between world price and domestic price of that export would be distorted. The situation could be shown in Figure 3.2 below.

FIGURE 3.2



Assumptions: 1. Small Exporting Country, 2. Zero Transactions Cost

3. Specific Export Tax, 4. Perfect competition

Case 1: Export tax rate is constant. Let $P_{d1}P_{d0} = P_{d0}P_{d2}$. At the initial world price of X at P_{w0}, the domestic price of X is P_{d2} which is lower than the world price P_{w0} due to the export tax imposed on X equal to $P_{d0}P_{d2}$ per unit of X. The export tax is assumed to be shifted to the producer of X. Then the domestic price of X is P_{d2}. The quantity exported is $Q_{d1}Q_{d2}$, the government export tax revenue is equal to ABCD. If the world price of X increases to P_{w1} (the change in the world price may be due to the shifts in world supply or demand or both) and with the fixed export tax rate, the domestic price of X increases to P_{d0} and the government export tax revenue is equal to EFGH. The cuantity exported is $Q_{d3}Q_{d4}$. And, if the world price of X decreases from PW_1 to initial price PW_0, the initial situation in domestic market occurs. Thus, the unit increase of decrease in world price of X is going to be the same as the unit increase or decrease in the domestic price. The variation of the domestic price of X is the same as the variation of its world price.

Case 2 : Export tax rate is adjusted according to the movement in the world price. The export tax rate is raised when the world price increases and decreased when the world price decreases. At the initial world price of X at P_{w0}, the domestic price of X is P_{d2}. The export tax rate is $P_{d0}P_{d2}$. If the world price increases to PW_1 and the export tax rate is raised, the domestic price increases from P_{d2} and will be some where below P_{d0}. If the world price decreases from PW_1 to the initial world price PW_0 and the export tax is decreased but less than initial tax $P_{d0}P_{d2}$, the domestic price will be some where above P_{d2}. Thus, the unit increase or decrease in the domestic price is going to be less than the unit increase or decrease in the world price. The variation of the domestic price of X, then, tends to be lower than the variation of its world price.

2. Influerce of Risk on Production Decision

We usually assume that producer would have had profit maximization objective in mind in order to offer any product to a market. The profit maximizing condition occurs when a producer employs factors of production until the marginal value product is equal to the price for each factor hired. While the product price is randomly fluctuating, there is no single marginal product for each factor. There occurs a probability range of marginal product in a given year. Given the prices of factors, so the profit maximization under uncertainty condition could happen when the marginal expected value product is equal to the price of each factor. For farmers, they are considered as risk-averters because they have no accumulated wealth in order to cushion the impact of bad crop years.[4] Consequently, in order to avoid risk, they would try to invest more on crops with a low variance of prices comparing to an investment on those with high variance of prices.[5] On the other hand, the reduction in risk of a crop leads to an increase in investment on that crop and, then, its production. This phenomenon could be shown by applying to a price stabilizing programme on a crop as follows.

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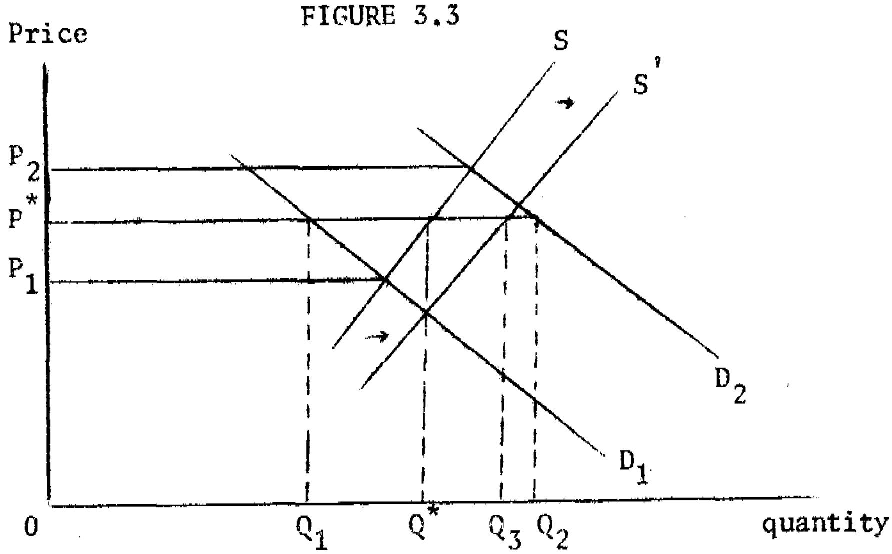
[4] John Weeks, "Uncertainty, Risk, and Wealth and Income Distribution in Peasant Agriculture," Journal of Development Studies 7 (Oct 1970) : 29.

[5] Howard Kunreuther, "Risk Taking and Farmers' Crop Growing Decisions", Center Discussion Paper No.1156 (Newhaven : Yale University, 1971).

FIGURE 3.3



In Figure 3.3 let D_1 and D_2 be demands for a crop each having a probability 0.5 and supply under uncertainty is represented by S. Suppose the programme sets a price $P^* = (P_1+P_2)/2$ at which it will either purchase excess supply or support excess demand. Without response to risk, this programme would make the expected change in buffer stocks equal to zero. If farmers are risk responsive, the result is that the price stability will induce a shift in supply to S' as producers become more certain about price. Hence, exess supply, Q_1Q_3, will generally be larger than excess demand, Q_2Q_3, at the imposed price (P*). So, in this situation, the expected change in the buffer stocks would not be zero and there would be the excess supply left in the stock all the time.

B. Hypothesis

Two hypotheses will be tested in this study:

1. World price instability causes domestic price instability

2. World price instability causes a fluctuation and substitution in production, i.e., the world price stability would lead to an increase in production, and world price instability would lead to a diversification in production.

C. Methodology

In order to test the hypotheses mentioned above, two steps will be involved in the methodology.

Step 1: Test the Linkage Between Instability of World Price and Instability of Domestic Prices.

This test would show how strong the instability of world price of each crop has influenced the instability of domestic prices of that crop. And, the strength of influence of the instability of world price on the instability of farmgate price of each crop would provide a basis for the analysis in the next step.

Step 2: The Effect of Instability of World Price on The Domestic Production.

These two steps are discussed in order, as follows :

Step 1: Test The Linkage Between Instability of World Price and Instability of Domestic Prices

The relation between export price and domestic price of some food crops were tested by some studies. The results for rice, maize and cassava from these studies are reviewed as follows,

1. The result for rice appearing in Renaud and Suphaphiphat's study[6]

rice : (1955-1968)

$$P_d = -391.82520 + \underset{(9.72031)}{1.27409\, P_w} - \underset{(-6.04686)}{1.48320\, T}, \quad R^2 = 0.9494$$

The figures in the parentheses are t-ratios

P_d = the domestic rice price

P_w = the world rice price (export rice price)

T = the rice export tax

2. The result for maize appearing in Konjing's study[7]

maize : (1970-1974)

$$PB_t = \underset{(0.90)}{61.00} + \underset{(24.2)}{857.72}\, PE_{t+1}, \quad R^2 = 0.97$$

The figures in the parentheses are t-ratios

PB_t = the Bangkok wholesale maize price in month t in Baht per metric ton

PE_{t+1} = the average export prices of Thai maize in $month_{t+1}$ in Baht per metric ton

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[6]Bertrand M. Renaud and Phiphit Suphaphiphat, "The Effect of The Rice Export Tax on The Domestic Rice Price Level in Thailand," The Malayan Economic Review 26 (April 1971) : 97.

[7]Chaiwat Konjing, Thailand's Maize Export Agreement Policy : An Economic Analysis, Ph.D.Thesis, The Faculty of The Graduate School, University of Minnesota, 1977, p.62.

3. The result for cassava appearing in Atikul's study[8]

Cassava : (1957-1974)

$$PR = \underset{(-0.31683)}{-1199.08931} + \underset{(2.46694)}{1.02516}\ PXF + \underset{(2.65393)}{0.69423}\ PR_{-1}, \quad R^2 = 0.86608$$

The figures in the parentheses are t-ratios

PR = price of cassava roots at present period

PR_{-1} = price of cassava roots at last period

PXF = export price of cassava products for human consumption

From the above results, it is clear that the domestic prices of rice, maize and cassava are highly related with their export prices. Thus, in our study here, the relation between the export prices (world prices) and domestic prices of the crops studied would not be tested again. The relationship between variations of world price and variations of domestic prices will be tested instead.

The method of testing those relationships is as follows:

If variations of world price and variations of domestic price are related, we can write,

$$VDP_t = f(VWP_t)$$

Suppose that these two variables are linearly related, thus we get,

$$VDP_t = C_0 + C_1 VWP_t + \varepsilon_t$$

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[8] Jamlong Atikul, An Econometric Model of Thai Cassava, School of Development Economics, National Institute of Development Administration, October, 1978, p.138.

where, VDP_t = the variance of domestic price (Bangkok wholesale and farmgate prices, respectively), of the crops concerned over the moving three years' period.

$$= \sum_{t=1}^{3} \frac{(DP_t - \bar{DP}_t)^2}{n-1}$$

DP_t = domestic price (Bangkok wholesale, farmgate prices) of the crops concerned in year t

$\bar{DP}_t$ = mean of domestic price (Bangkok wholesale, farmgate prices) of the crops concerned over the moving three years' period

n = 3

VWP_t = the variance of world price (export price) of the crops concerned over the moving three years' period

$$= \sum_{t=1}^{3} \frac{(WP_t - \bar{WP}_t)^2}{n-1}$$

WP_t = world price (export price) of the crops concerned in year t

$\bar{WP}_t$ = mean of world price (export price) of the crops concerned over the moving three years' period

n = 3

ε_t = error term

t = time trend

In addition to the above method, the relationship between instability of world price and domestic prices could be tested by comparing the variances of each price. The variance of world price should be larger than the variances of Bangkok wholesale and farmgate prices as domestic prices follow the world price, but with the fluctuations toned down by certain domestic factors. So, if the world price is the main determinant of the domestic prices, the variance of the world price and the variances of the domestic prices would not be different, given that there is no obstacle to prevent the linkage between the world price and the domestic prices.

The results from this step can be used to support the influence of the instability of world price of each crop on its domestic prices and hence on its production as will be discussed in the next section.

Step 2: The Effect of Instability of World Price on The Production

The effect of instability of world price of food crops studied on their productions could be estimated by supply response model. This could be done, if the instabilities of world price and domestic prices are related as we are going to prove them in step 1. So, the farmer's response to farmgate price fluctuation could be interpreted as the influence of world price fluctuation on the farmer's decision to produce.

The Nerlovian Dynamic Supply Response Model is employed here. This model is frequently followed by agricultural economists in studying farmer's output adjustment decision due to various relevant variable changes. It takes account of output changes caused by expected relevant variable changes with some lag. At the same time, this study will follow krishna[9] in considering expected variables in order to avoid estimation problems, and Behrman[10] in selecting relevant variables in the case study of Thailand. The model is as follows.

On the study of supply response to price, Nerlove specified the relationship between price and output as,[11]

$$X_t^* = f(P_t^*) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 1$$

where, X_t^* = the level of long-run equilibrium output or desired output at time t

P_t^* = the expected long-run normal price or expected price at time t.

If the other or "shifter" variables are also concerned, they can be added into the equation 1. So, we get,

$$X_t^* = f(P_t^*, S_{1t}, S_{2t} \text{ and } S_{3t}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 2$$

where S_{it} = "shifter" variable, i = 1, 2, 3

= expected yield (Y_t^*), price risk variable (X_t) and farm population (N_t)

The actual output depends on the level of desired output. When the desired output increases, the actual output increases and vice versa.

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9 Raj Krishna, "Farm Supply Response in India-Pakistan : A Case Study of The Punjab Region", The Economic Journal (1963): 477-487.

10 J.R.Behrman, Supply Response in Underdeveloped Agriculture, 1968.

11 Mar Nerlove, The Dynamics of Supply : Estimation of Farmers Response to Price, (Baltimore : Johns Hapkins PRESS, 1958.

Then, the desired output is assumed to follow the adjustment model which stresses that in each period the actual output is adjusted in proportion to the difference between the desired output and the actual output last period.

The model is expressed by,

$$(X_t - X_{t-1}) = \gamma(X_t^* - X_{t-1}) + e_t, \quad 0 < \gamma \leq 1$$

$$X_t = \gamma X_t^* + (1 - \gamma) X_{t-1} + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3$$

Where, X_t = actual output at time t

X_{t-1} = actual output at previous time t-1

γ = adjustment coefficient

e_t = error term at time t

Expected price is presumed to depend on past price. And the relationship between these prices is assumed as the adaptive expectation model which shows that expected price in each period is equal to last period's expected price plus the proportion of the difference between last year's actual price and last year's expected price. This is,

$$P_t^* = P_{t-1}^* + \delta(P_{t-1} - P_{t-1}^*), \quad 0 < \delta \leq 1$$

Where, δ = coefficient of expectation

If the adaptive expectation is added to the equations above, the number of explanatory variables would double and, then, a lot of degrees of freedom would be lost. Thus, for simplicity of the estimation, the expectation coefficient (δ) is assumed to be unity. So, the adaptive expectation equation above becomes,

$$P_t^* = P_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4$$

This implies that farmer expects future price by judging from only previous one year price. This assumption may not be totally accurate, but it might be approximately true as Nerlove stressed that"....past values of prices, then, affect people's notions of the "normal" level of prices (expected prices), individual past price do not exert their influence equally, however, more recent prices are a partial result of forces expected to continue to operate in the future, the more recent the price, the more it is likely to express the operation of forces relevant to "normal" price"[12]

Equations (2) - (4) could be rearranged and specified into linear functional form as follows,

$$X_t^* = \beta_0 + \beta_1 P_{t-1} + \beta_2 S_{1t} + \beta_3 S_{2t} + \beta_4 S_{3t} + U_t \quad \ldots\ldots\ldots\ldots \quad 5$$

Put equation (3) into (5), we get,

$$X_t = \gamma\beta_0 + \gamma\beta_1 P_{t-1} + \gamma\beta_2 S_{1t} + \gamma\beta_3 S_{2t} + \gamma\beta_4 S_{3t} + (1-\gamma)X_{t-1}$$
$$+ \gamma U_t + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 6$$

where, U_t = error term

The functional form used is linear since we do not know what is the true form of the relation between the dependent variable and the independent variables specified above. So, the linear form is used as an approximation of the true relation of the variables studied.

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[12] Ibid., p.52.

In the study here, variables in equation (5) and (6) are rearranged and respecified as equations (7), (8) and (9) below.

$$A_t^* = \beta_0 + \beta_1 P_{t-1} + \beta_2 Y_t^* + \beta_3 X_t + \beta_4 N_t + U_t \quad \ldots\ldots\ldots\ldots\ldots \; 7$$

$$A_t = \gamma\beta_0 + \gamma\beta_1 P_{-1} + \gamma\beta_2 Y_t^* + \gamma\beta_3 X_t + \gamma\beta_4 N_t$$

$$+ (1-\gamma)\, A_{t-1} + \gamma U_t + e_t \quad \ldots\ldots\ldots\ldots\ldots \; 8$$

$$A_t = a_0 + b_1 P_{t-1} + b_2 Y_t^* + b_3 X_t + b_4 N_t + b_5 A_{t-1} + v_t \quad \ldots\ldots\ldots \; 9$$

where, $a_0 = \gamma\beta_0$, $b_1 = \gamma\beta_1$, $b_2 = \gamma\beta_2$, $b_3 = \gamma\beta_3$, $b_4 = \gamma\beta_4$, $b_5 = (1-\gamma)$

$v_t = \gamma u_t + e_t$

A_t^* = desired planted area

A_t = actual planted area (Rai)

A_{t-1} = actual planted area last period (Rai)

P_{t-1} = actual farmgate price lagged one year of the crops concerned, deflated by an actual farmgate price lagged one year of the alternative crop

Y_t^* = expected yield, where Y_{t-1} is used as the proxy

X_t = price risk variable

N_t = farm population in the region concerned

γ = adjustment coefficient

a_0, b_i, β_i = parameter

v_t = error term

The equation (9) will be the estimated equation and the supply response in this equation would be the actual planted area responding to the changes in the relevant variables. The equation (7) provides another aspect. It shows the desired planted area of the farmers in responding to the changes in the relevant variables. In the equation (9), if the lag planted area (A_{t-1}) is dropped out and each coefficient is divided by adjustment coefficient (γ), the equations (9) and (7) would be the same. So, the coefficients in the equation (7) could be derived from the coefficients in the equation (9).

The influence of instability of farmgate price of a crop on its planted area could be shown by the influence of X_t on A_t in equation (9). The influence of instability of world price of a crop on its production, then, could be inferred from the influence of X_t on A_t in equation (9) also, if the instabilities of world and farmgate prices of a crop are related. Thus, steps 1 and 2 would be jointly considered in order to see the influence of instability of world price of a crop on its production.

Specification of Variable

Planted Area (A_t) is used as dependent variable instead of output because in the model used in this study, expected output is important in influencing actual output. While output is less under control of farmer than planted area due to environment nature, the actual output may not well reflect the adjustment of output to changes in expected output like the planted area reflects the expected planted area and, also, expected output. So, the planted area might be appropriate here.

Lagged Planted Area (A_{t-1}) appears as explanatory variable because of the adjustment model used. This adjustment model shows that lagged output would influence actual output this period. And, as the adjustment equation (3) shows, the lagged output (X_{t-1}) has positive relationship with actual output (X_t), then, the lagged planted area (A_{t-1}) also has positive relationship with actual planted area (A_t). So, the coefficient of the lagged planted area is expected to have a positive sign.

Relative Price (P_{t-1}): Price of a crop relative to price of the alternative crop is the important factor influencing farmers' decisions on the production of a crop as it reflects the profitability of growing a crop. The alternative crop differs from region to region. Here, the alternative of a crop is determined by looking in terms of area and output of the crops in the region as well as the similarity of technique of production. So, all upland crops could be the alternative crop of each other. Rice and upland crops could be the alternative crop of each other to some extent. The relative price has positive relationship with planted area, as the relative price increases, farmers want to supply more and vice versa. So, the coefficient of the relative price is expected to have a positive sign.

The relative price could be separated into increasing and decreasing segments, as some economists have suggested that the supply response to different segment of price is different.[13] This idea is based on the fixed asset theory which stresses that under conditions of rising price, firm may be induced to adopt new technique at a somewhat faster rate comparing to the adoption of new technique under conditions of constant or declining price and, then, output increases at higher rate too. Once new technique is adopted, it is retained although the price of product subsequently declines and, then, the output may not drop at the same speed as the increase in output due to the rising price. However, this idea was tested in this study using the Wolffram's method of separating price variable,[14] but it is not so successful. This is because of the problem that the two segments of price are related to a high degree.

Although the separation of price in the model used increases power of explanation of the model, the relation between explanatory variables create bias on the estimates. So, the idea of separating price into two segments is dropped from the study here.

Relative Expected Yield (Y_t^*) might be important for farmers in making decision in favour of any crop. It is not only the price per unit of product that is relating to farmer's income, but also the number of units of product per unit area cropped. So, the increase in expected yield of a crop would make production of that crop more desirable.

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[13] See Luther G.Tween and C.Leroy Qunce, "Positivistic Measures of Aggregate Supply Elasticities : Some New Approaches," American Journal of Agricultural Economics 51 (Ma6 1969) : 342-352, and Rudolf Wolffram," Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches : Some Critical Notes," American Journal of Agricultural Economics 53 (May 1971) : 356-359.

[14] Ibid.

That is expected yield has a positive relationship with the planted area. Then, the coefficient of the expected yield is expected to have a positive sign. However, because expected yield is not known, one possible proxy for it is yield at last period (Y_{t-1}). This means that the farmer is assumed to expect the yield at time t being equal to the yield at time t-1 (Y_{t-1}).

Relative Price Risk Variable (X_t) is interesting to be tested in order to see whether farmer is a risk averter. A high degree of fluctuation in price of a crop means that probability of getting high profit or loss for a farmer is high. As most Thai farmers are supposed to be poor, to make a loss on growing a crop would greatly affect their living condition. Thus, the Thai farmers are supposed to be risk averters. And, the price risk variable is thus expected to have a negative sign.

Moving standard deviation around mean is used as measurement of price risk. The standard deviation around mean of price is expressed as a formula below.

$$X_t = \hat{\sigma}_P = \frac{\sqrt{\sum_{j=1}^{3} (P_j - \bar{P}_j)^2}}{\sqrt{\sum_{j=1}^{3} (P_{ja} - \bar{P}_{ja})^2}}$$

where, X_t = relative price risk variable

σ_P = the standard deviation around mean of the farmgate price of the crop over the last three preceding periods relative to the standard deviation around mean of the farmgate price of the alternative crop over the last three preceding periods

P_j = farmgate price of the crop

$\bar{P}_j$ = mean of farmgate price of the crop over the moving three years' period

P_{ja} = farmgate price of the alternative crop

$\bar{P}_{ja}$ = mean of farmgate price of the alternative crop over the moving three years' period

j = 1, 2, 3

Population (N_t) is included in testing production response for rice which is also consumed whthin farm. But, for the other four crops concerned, which are considered as cash crops,the population (N_t) is unimportant and excluded. An increase in population would lead to an increase in rice production in order to meet the on-farm consumption. Thus, the population (N_t) positively relates to planted area. The coefficient of the population is expected to have a positive sign.

D. Source of Data

The data used in this study will be the time series data covering the period during 1967 to 1980. They are obtained from the following sources.

1. Planted Area (A_t) and Yield for Rice : Data of Production and agricultural Prices, Data Bank Project, Faculty of Economics, Thammasat University, 1980.

2. Planted Area (A_t) and Yield for maize, cassava mungbean and sorghum : Annual Statistics of Upland crops and Vegetable, Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, various issues.

3. Farmgate Prices : Statistics of Farmgate Prices of Some Crops, Agricultural Economic Analysia Section, Division of Agricultural Economics, Office of The Undersecretary, Ministry of Agriculture and Cooperatives, various issues.

4. Bangkok Wholesale Prices : (1) Statistics of Agricultural Products, Division of Agricultural Economics, Office of The Undersecretary, Ministry of Agriculture and Cooperatives, various issues, (2) Monthly Bulletin, Bank of Thailand, various issues.

5. Export Prices : Monthly Bulletin Bank of Thailand, various issues.

6. Farm Population : Agricultural Statistics of Thailand, The Center for Agricultural Statistics, Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, 1981.

In this chapter, the theoretical framework, hypotheses and methodologies are formed and discussed. The results of empirical tests of the hypotheses on the basis of the models formed above will be presented and discussed in the next chapter.