Chapter VI

AGRICULTURAL PRODUCTION RESPONSE TO PRICING AND MARKETING SYSTEMS

It is the farmers in Hunan province who carry out the agricultural production job. The study of agricultural supply can be conducted through the analysis of farmers' decision making on the selection of crops to grow (*See Chapter 3*). The hypothesis is that farmers in Hunan province like farmers elsewhere make their decisions based on economic rationality under certain socioeconomic circumstances. Farmers respond to market information and government policies by adjusting their production. In this analysis, an econometric model is built with the *Utility Maximization Approach* to quantify the impacts of various socioeconomic and institutional factors on farmers production decision making on the planted areas of major crops.

6.1 Justification of The Dependent and Explanatory Variables

A number of factors have been identified that affect farmers decision making in various previous supply studies (*See Chapter 2*). Various researchers from different viewing angles and with different designations may analyze the topic in their own ways, therefore the variables justified vary in different conceptual models.

6.1.1 The Dependent Variable (A_{it})

The dependent variable is the planted area (*in Chinese Mu*) of the selected crop A_{it}. Many supply analyses use planted area rather than total output (*Morzuch et al., 1980; Babcock, 1990*) in order to reduce the disturbance effect of stochastic factors such as natural factor (*drought or flood*), technological factor (*crop productivity, variety improvement*) etc. Therefore, it can simplify the model as well as improve the estimation accuracy of the economic and institutional factors concerned. For this study, the main purpose is to reveal the acreage response through the simulation of the farmers' decision making process, whose direct action is the adjustment of their combination and proportion of the crops planted, therefore the planted areas of the selected crops (*Table 20*) are the dependent variables.

6.1.2 The Explanatory Variables

The model includes tangible variables considered to significantly affect farmers production decision making under the circumstance of Hunan province. They are the institutional variables, the price variables, the risk variables, the lagged planted area variable and regional dummy variables.

Table 20 The Planted Area of 4 Crops in Hunan Province
Unit: (mu)

Years	Rice	Cotton	Ramie	Tobacco
1976	69,489,100	2,752,900	119,200	543,200
1977	68,525,100	2,828,100	119,100	574,700
1978	67,866,600	2,734,600	125,800	685,300
1979	67,202,900	2,412,300	138,100	629,400
1980	66,184,800	2,694,300	176,900	404,500
1981	66,247,400	2,567,200	186,400	634,700
1982	65,850,900	2,518,500	183,300	981,100
1983	66,283,900	1,969,500	144,900	612,500
1984	66,016,100	1,989,600	135,900	743,200
1985	63,697,800	1,527,100	359,500	1,232,900
1986	64,913,800	1,291,400	1,107,600	884,100
1987	63,826,800	965,600	2,890,100	884,300
1988	64,405,800	1,370,800	1,173,300	1,226,600
1989	65,311,600	1,416,100	635,800	1,449,100
1990	65,555,600	1,778,200	282,300	1,167,100

Source: Hunan Agricultural Administration Bureau

6.1.2.1 Institutional Changes (D1, D2)

Institutional factors have a strong impact on farmers' ability to make independent decisions in Hunan. They also affect the rationality of decisions being made on the selection of crops, and the allocation and re-allocation of production resources. As institutional changes are discrete events, some are fundamental, some are complementary, and some are consequential. Therefore, it is convenient and practical to group institutional events into different phases which reflect the shifting or the adjustment of government policy in each time interval (*Table 21*). Therefore, the divided phases are included in econometric model as a set of 2 dummy variables *(D1, D2)*.

Table 21 Two Institutional Events and Their Dynamic Impacts on Agricultural Production

Years	Rice	Cotton	Ramie	Tobacco	
1979					
1980					
1981					
1982	**	**	**	**	Household responsi. prodn. poly. Farmers had their own farms *(D1)*.
1983					
1984					
1985	***	***	***	***	Price and market liberalization Most products are in free marketing system *(D2)*.
1986					
1987					
1988					
1989					
1990					

Source: Drawn by the author referring to book *Hunan Pricing 40 Years*.

D1 refers to the event of *Rural Reform* started in 1982, since then farmers in Hunan have been able to cultivate their own household farms individually, so the event has a dynamic impact to farmers' decision making. *D2* refers to the Market Reform Program started in 1985, since then farmers have gradually become able to sell their products in the free market and to private marketing sector *(see Chapter 4)*. This event has also had a lasting impact to the present.

Social and institutional changes may be based on government concern for regional agricultural productivity and/or production structure as a whole rather than based on any particular crop. Therefore, any P&M change may benefit some crops while at the same time depress the others, so the coefficients of dummy variables can be either positive or negative.

6.1.2.2 **The Expected Farm Prices (EPt)**

Farm price is the average price farmers received from buyers of their agricultural product on their farms. As all farmers in Hunan sell most of their agricultural products at the harvesting season to their nearby official procurement agencies such as the *Grain Marketing Agency*, the price they received from the agency (*Table A1*) is used as the farm price because the privately handled part and the amount handled by other marketing channels are still in very small volume.

As a result of government control, the official procurement price every farmer faced in the whole province used to be identical. This is quite convenient to the model building. Nevertheless, the items of government subsidies as incentives to crop production or marketing should be added to the farm prices as they directly affect the economic return of the crops in concern.

The expected farm price *(EPt)* of a crop is the farmers' anticipation of what price they will probably receive for the coming harvest. Farmers usually make their anticipation based on their experience ——that is the prices paid to their products in the former years. The expected price therefore can be expressed as:

$$EP_t = f(P_{t-1}, P_{t-2})$$

Where P_{t-1} and P_{t-2} are the one-year and two-year lagged output prices. In this analysis, two different ways have been adopted to

incorporate the EP_t in the model. Firstly, EP_t is represented by both P_{t-1} and P_{t-2}; secondly, the P_{t-1} is assumed as the farmers' expected output price according to the Nerlovain Naive Model (*Morzuch, 1980; Pongsrihadulchai, 1981*).

A high expected farm price of a certain crop will have a positive effect on farmers' decision on crop growing area, so the coefficient of EP_t is expected to be positive.

6.1.2.3 The Expected Farm Price of Alternative Crops (EPO_t)

The impact of the expected farm prices of alternative crops (EPO_t) on a particular crop reflects the competition among crops for limited farm resources such as land, physical inputs, labor and capital etc. in agricultural production. When a farmer wants to increase the benefit from the production of a particular crop, he has to sacrifice some benefit by reducing the production of other competing crops. For instance, in order to grow more tobacco, more paddy field need to be shifted from rice production. Therefore rice is justified as the alternative crop to tobacco, rice price affects the planted area of tobacco. But this does not mean vice versa will also be true as the huge rice growing area overwhelmingly suppresses the area of tobacco (*65,555,600 to 1,495,900 in 1990*). Tobacco growing area is only 1/50 of rice growing area, its changes should hardly cause significant impact to the rice growing as a whole. Therefore, it is not appropriate to include the tobacco price in the rice model. The justification for cotton and ramie are the same.

High prices of alternative crops will inversely affect the profit level of the given crop, so the coefficients of prices of competing crops are expected to be negative.

6.1.2.4 The Agricultural Input Prices (PF_t, PI_t)

In Hunan province, the justification of the most important inputs in crop production are chemical fertilizers and chemical insecticides (including fungicides). However, farmers could not make their own decisions on how much these inputs they should buy as they are sold to the farmers by the official *PIA* through the rationing system (*See Table 15*). As those inputs are subsidized by the government and are persistently in limited supply, farmers can do little to adjust their input level in agricultural production according to the low input prices *(Tables 22 and 23)* and output market situation. Therefore prices of these inputs may have little impact on the production decision, either in terms of planted area or output.

A high input price will raise the production cost of every crop, but its effect to certain crops which require large amount of input should be more significant. Therefore, the coefficients of the input variables (if estimatable) are expected to be negative.

Table 22 Agricultural Input and Output Price Indexes

Years	Input	Output	Years	Input	Output
1975	100.20	99.50	1983	102.70	104.10
1976	99.80	99.80	1984	103.40	107.50
1977	99.40	100.00	1985	111.90	108.00
1978	99.40	100.10	1986	105.40	102.50
1979	103.30	100.00	1987	111.30	114.60
1980	113.60	102.00	1988	125.70	128.30
1981	102.60	100.10	1989	130.30	135.06
1982	101.60	103.20	1990	138.60	145.91

Source: Hunan Agricultural Administration Bureau.

Note: The price in 1974 equals 100.

Table 23 Chemical Fertilizer and Pesticide Prices

Unit: yuan/50 kg

Years	Fertilizer	Pesticide	Years	Fertilizer	Pesticide
1975	22.5	315	1983	22.5	308
1976	22.5	315	1984	27.5	325
1977	22.5	315	1985	27.5	290
1978	22.5	315	1986	27.5	290
1979	22.5	315	1987	27.5	350
1980	22.5	315	1988	27.5	350
1981	22.5	315	1989	27.5	400
1982	22.5	308	1990	27.5	450

Source: Hunan Price Administration Bureau.

Note: Fertilizer price uses the official price of *Urea*, pesticide price uses the price of the most widely used brand.

6.1.2.5 The Lagged Planted Area ($A_{i,t-1}$)

The lagged planted acreage $A_{i,t-1}$ (i = 1, 2, 3, 4 represent rice, cotton, ramie and tobacco respectively), which can be viewed as

the support/resistance to production variations, reflects farmers' preferences and persistence on the production of the crop. Farmers naturally have the tendency to keep on growing the crops they used to plant for several reasons. Firstly, by shifting from one crop to another one not only raises shifting cost such as new spending on seeds, farm tools, field re-preparation, technological consultation and etc., but one also get into risks of production failure for technical and/or technological reasons. Secondly, farmers keep on growing rice to insure food security for their families under incomplete market situation. Thirdly, some government policies and interventions may keep the farmers on growing official crops. For example, the government invested a lot of money to the farmers in some regions to establish industrial crop (Cotton, Sugarcane, tobacco etc.) production bases in recent years, once a farmer becomes part of a production base, he has to follow the government instruction and continue growing the crop.

The lagged planting acreage $A_{i,t-1}$ also shows the dynamic effect of the trend *(Pyndick and Robinfeld, 1972)*, its coefficient is expected to be positive, its value will be less than one, but a high value will tell that the crop production is rigid and market-insensitive.

6.1.2.6 The Price and Yield Risk Variables (RKP, RKY)

According to *Lin* (1990) farmers in Hunan are utility maximizers and risk-averse. In this analysis two measures will be employed to address the risk factor. Firstly, the standard deviation ——

σ is widely used in many econometric analyses (*Chavas, 1990*). In this analysis, the standard deviations of both yield and price (*Tables 24 and 25*) are employed to reveal farmers' income risks caused by market and production uncertainties. The σ is calculated with the data of the each previous five years.

$$RKP=\delta_y=STD(yield)$$

$$RKY=\delta_p=STD(price)$$

Where *RKY* is the yield risk variable, *RKP* is the farm price risk variable. The risk factors reflect the degree of income risk to the

Table 24 The Standard Deviations of Farm Price of the Four Crops in Hunan Province

Years	Rice	Cotton	Ramie	Tobacco
1979	0.90	8.16	12.00	0
1980	3.44	18.53	15.30	1.68
1981	4.79	41.94	25.97	8.58
1982	5.03	44.31	25.72	33.89
1983	4.09	36.63	16.51	32.88
1984	1.61	24.64	15.58	31.07
1985	0.72	17.05	27.31	27.14
1986	0.52	25.50	283.60	26.86
1987	0.72	25.76	456.83	9.70
1988	2.02	37.75	416.42	33.99
1989	5.40	77.89	418.26	77.81
1990	9.32	108.37	418.26	80.98

Source: Calculated by the author with the data of prices from *The Price Bureau of Hunan*.

Table 25 The Standard Deviations of Yield of the Four Crops in Hunan Province

Years	Rice	Cotton	Ramie	Tobacco
1979	31.10	2.92	7.92	6.52
1980	33.39	3.72	11.70	9.45
1981	32.14	3.76	11.70	9.74
1982	25.35	3.76	12.02	17.40
1983	16.46	4.06	10.92	16.74
1984	29.76	5.03	10.92	13.27
1985	31.45	10.64	12.40	9.96
1986	24.94	12.12	11.08	6.05
1987	13.34	10.64	11.23	5.31
1988	5.67	6.08	10.99	4.31
1989	6.08	12.79	10.82	4.31
1990	6.49	12.69	9.97	3.00

Source: Calculated by the author with the data of crop yields from *The Agricultural Bureau of Hunan.*

farmers, so the higher the variation, the less likely the assumed risk-averse farmers will choose to grow the crop, thus their coefficients are expected to be negative.

An alternative measure to address the risk variable is to use the percentage changes of price and yield in the previous two years (*Tables 26 and 27*). The proposed risk measure can be expressed as:

$$RKP = (P_{t-1} - P_{t-2}) / (P_{t-1} + P_{t-2})$$

$$RKY = (Y_{t-1} - Y_{t-1} / (Y_{t-1} + Y_{t-2})$$

Where *RKP* and *RKY* represent the price risk and the yield risk respectively. As a positive change of either price or yield of a certain

Table 26 The Percentage Changes of Farm Prices of the Four Crops in Hunan Province

Years	Rice	Cotton	Ramie	Tobacco
1979	2.81	2.32	4.27	0
1980	6.74	2.73	2.18	-0.82
1981	2.31	5.65	3.57	4.39
1982	0.77	-0.79	-4.30	9.02
1983	0.92	0.09	1.57	-10.61
1984	-1.19	0.70	2.53	1.66
1985	0.59	-3.85	4.23	1.30
1986	-0.28	-1.91	26.92	-0.76
1987	1.21	5.12	8.77	2.57
1988	2.58	3.69	-19.82	8.66
1989	5.63	6.55	-21.84	9.40
1990	5.09	3.94	5.15	-1.66

Source: Calculated by the author with the data of prices from The Price Bureau of Hunan.

Table 27 The Percentage Changes of Crop Yields of the Four Crops in Hunan Province

Years	Rice	Cotton	Ramie	Tobacco
1979	12.61	-9.67	14.70	6.20
1980	-1.65	16.41	8.77	4.34
1981	-0.84	-4.00	-12.72	4.54
1982	2.00	1.36	8.86	12.79
1983	5.42	2.63	8.99	-1.70
1984	4.36	12.35	-1.98	-5.50
1985	-0.67	12.28	2.94	5.50
1986	0.13	1.53	-16.02	-4.07
1987	1.74	-0.76	5.59	-0.95
1988	-0.26	-6.55	-2.40	2.34
1989	-1.47	-28.08	9.49	-2.83
1990	2.00	18.98	2.00	-1.47

Source: Calculated by the author with the data of crop yields from The Agricultural Bureau of Hunan.

crop in the previous years can encourage the risk-averse farmers, the coefficients of *RKP* and *RKY* should be positive.

6.1.2.7 Regional Variables (R1, R2, ... R6)

This analysis uses the cross-sectional and time series data. The time period is from 1979 to 1990. Hunan province is divided into 11 regions *(see Figure 2)*. Those sub-regions are geographically prefectures, they are: (1)Yiyang, (2)Reyang, (3)Zhangde, (4)Changsha, (5)Huihua, (6)Shaoyang, (7)Lingling, (8)Chengzhou, (9)Hengyang, (10)Zichizhou, and (11)the rest of Hunan province. Each region has the population size of 3 to 6 millions. Since each region has its own production characteristics, the regions with very small cultivated areas of the certain crop are excluded from that crop model. Therefore, each crop model includes only 7 regions *(Table 28)*. 6 dummy variables *(R1, R2, ...R6)* are used to represent the selected region 1 to region 6 in each crop model in order to incorporate with region 7 to form the cross-sectional data base.

6.1.3 The Specification of the Seemingly Unrelated Regression Model

It is assumed that the areas of the selected crops are correlated to each other as they are substitutable crops in same areas in the same season. The *Seemingly Unrelated Regression (SURE)* model

Table 28 The Divided Eleven Regions in Hunan Province and the Seven Regions in Each Crop Model

Region	Code	Selected Region in The Crop Models			
		Rice	Cotton	Ramie	Tobacco
Yiyang	1	1	1	1	-
Reyang	2	2	2	2	-
Zhangde	3	3	3	3	1
Changsha	4	4	-	-	2
Huihua	5	5	4	-	3
Shaoyang	6	6	5	-	4
Lingling	7	7	6	4	5
Chengzhou	8	-	-	5	6
Hengyang	9	-	7	6	-
Zichizhou	10	-	-	7	7
Other Area	11	-	-	-	-

Note: "-" means not included in the model for reason of very small growing area of the crop in that region.

which take into account of the correlations among the crop models should be employed (Empirical OLS regression applied to each crop model reveals it is less efficient than SURE model in estimation (See Appendix *Table A8*). This analysis assumes that the planted area is related to the lagged planted area and crop prices in a Cobb-Douglas form, which has been widely adopted in agricultural analyses. The adopted empirical SURE model is:

$$logA_{it} = \beta_{0i} + \beta_{1i} logA_{i,t-1} + \beta_{2i} D1_t + \beta_{3i} D2_t + \beta_{4i} logEP_{it} + \beta_{5i} logEPO_{it}$$

$$+ \beta_{6i} logPF_t + \beta_{7i} logPI_t + \beta_{8i} logRKP_{it} + \beta_{9i} logRKY_{it}$$

$$+ \beta_{10i} R1_{it} + \beta_{11i} R2_{it} + \ldots\ldots + \beta_{15i} R6_{it}$$

$$(i=1,2,3,4)$$

Where A_{it} is the planted area of the ith analyzed crop, i varies from 1 to 4 represent rice, cotton, ramie and tobacco respectively, β_{ji} (j from 1 to 15) is the variable coefficient (other variables have been defined earlier).

6.2 Empirical Results

The empirical results include the basic statistics of the original data of all variables, Correlations among the variables and the estimation results of alternative regression models.

6.2.1 Basic Statistics of the Original Variable Data

The descriptive statistics of the variables are presented in *Table 29* to show the ranges and variations of the original data, and to view the data characteristics which may help to judge the significance level of the estimation.

Table 29 Descriptive Statistics of the Original Data

Variable	Mean	Std.Dev.	Minimum	Maximum
A_1	608.66	149.99	375.80	980.10
A_2	25.09	35.15	0.92	137.10
A_3	8.42	17.97	0.22	111.90
A_4	11.53	12.58	0.82	54.51
$A_{1,t-1}$	613.57	151.61	375.80	980.10
$A_{2,t-1}$	25.81	35.42	0.92	137.10
$A_{3,t-1}$	8.22	18.01	0.22	111.90
$A_{4,t-1}$	10.90	11.78	0.82	54.51
D1	0.26	0.44	0.00	1.00
D2	0.50	0.50	0.00	1.00
$P_{1,t-1}$	30.07	9.29	19.00	52.24
$P_{2,t-1}$	343.47	99.44	230.00	577.00
$P_{3,t-1}$	423.68	314.81	190.60	1161.00
$P_{4,t-1}$	205.32	88.59	90.02	440.00
PI	324.67	33.40	290.00	400.00
PF	18.30	2.50	15.64	22.48
RKP_1	2.16	1.71	0.24	6.26
RKP_2	35.49	15.98	9.62	70.68
RKP_3	132.00	135.68	1.00	364.30
RKP_4	23.64	42.30	1.00	122.90
RKY_1	18.16	12.36	0.82	70.82
RKY_2	5.62	4.12	0.15	19.91
RKY_3	9.58	10.56	0.82	56.86
RKY_4	11.53	11.45	0.47	69.07

Source: Result obtained from statistic analysis.

Note: $P_{i,t-1}$ is the one-year lagged farm price of the ith crop; 84 observations were used in this analysis.

6.2.2 Correlations Among Variables

The input prices were manipulated by the government to keep it moving proportionally with the agricultural output prices, so there are high correlations between the input and output prices (*Table 30*) which causes a serious multicollinearity problem. Under this situation,

Table 30 Correlations Among Variables

	ONE	*logA1,t-1*	*logA2,t-1*	*logA3,t-1*	*logA4,t-1*	*logP1,t-1*
ONE	0					
logA1,t-1	0	1				
logA2,t-1	0	0.608	1			
logA3,t-1	0	-0.069	0.032	1		
logA4,t-1	0	-0.167	-0.525	-0.278	1	
logP1,t-1	0	-0.077	-0.275	0.384	0.046	1
logP2,t-1	0	-0.049	-0.172	0.280	0.018	**0.790**
logP3,t-1	0	-0.059	-0.198	0.227	0.018	0.356
logP4,t-1	0	-0.057	-0.177	0.183	0.009	0.555
D1	0	-0.046	-0.235	0.388	0.029	**0.831**
D2	0	-0.077	-0.279	0.344	0.045	**0.794**
logA1	0	**0.981**	**0.721**	0.208	0.687	-0.098
logA2	0	**0.754**	**0.968**	0.429	**-0.844**	-0.181
logA3	0	0.246	0.447	**0.919**	-0.337	0.272
logA4	0	0.688	**-0.822**	-0.331	**0.915**	0.168
logPF	0	-0.141	-0.252	0.377	0.233	**0.900**
logPI	0	-0.050	-0.129	0.290	0.092	**0.715**
logRKP1	0	-0.078	-0.163	0.311	0.133	0.699
logRKP2	0	-0.121	-0.181	0.319	0.179	**0.847**
logRKP3	0	-0.104	-0.218	0.319	0.184	0.632
logRKP4	0	-0.044	-0.051	0.213	0.069	0.590
logRKY1	0	0.027	0.198	-0.101	-0.023	-0.229
logRKY2	0	0.052	0.152	0.154	-0.160	0.362
logRKY3	0	0.228	0.510	0.184	-0.371	-0.125
logRKY4	0	-0.048	0.232	0.183	-0.173	-0.246

	logP2,t-1	*logP3,t-1*	*logP4,t-1*	*D1*	*D2*	*logA1*	*logA2*
logP2,t-1	1						
logP3,t-1	-0.221	1					
logP4,t-1	0.608	0.113	1				
D1	**0.817**	0.024	0.497	1			
D2	0.353	**0.732**	0.560	0.590	1		
logA1	-0.054	-0.105	-0.094	-0.048	-0.120	1	
logA2	-0.060	-0.224	-0.140	-0.121	-0.224	**0.746**	1
logA3	0.023	0.442	0.108	0.150	0.391	0.231	0.435
logA4	0.132	0.120	0.270	0.125	0.227	-0.690	**-0.844**
logPF	**0.700**	0.374	**0.743**	**0.784**	**0.843**	-0.104	-0.201
logPI	**0.891**	-0.342	0.420	**0.867**	0.284	-0.010	-0.023
logRKP1	0.373	0.320	0.039	0.569	0.505	-0.018	-0.113
logRKP2	**0.703**	0.399	0.573	0.636	**0.746**	-0.107	-0.147
logRKP3	0.187	0.648	0.358	0.505	0.848	-0.072	-0.183
logRKP4	0.835	-0.333	0.480	0.668	0.174	-0.023	-0.007

(Table 30 Continued)

	$logP_{2,t-1}$	$logP_{3,t-1}$	$logP_{4,t-1}$	$D1$	$D2$	$logA_1$	$logA_2$
logRKY1	-0.163	-0.217	-0.137	-0.231	-0.264	0.027	-0.203
logRKY2	0.375	-0.008	0.511	0.305	0.322	0.110	0.205
logRKY3	0.223	0.162	-0.059	-0.243	-0.015	0.214	0.497
logRKY4	0.262	0.112	-0.146	-0.301	-0.144	-0.048	0.204

	$logA_3$	$logA_4$	$logPF$	$logPI$	$logRKP_1$	$logRKP_2$
logA3	1					
logA4	-0.362	1				
logPF	0.279	0.233	1			
logPI	0.005	0.078	0.647	1		
logRKP1	0.254	0.022	0.564	0.545	1	
logRKP2	0.249	0.179	**0.748**	0.486	0.433	1
logRKP3	0.369	0.170	**0.756**	0.269	0.675	0.571
logRKP4	-0.043	0.073	0.390	**0.770**	0.260	0.530
logRKY1	-0.120	-0.079	-0.175	-0.103	-0.091	-0.335
logRKY2	0.116	-0.139	0.444	0.287	0.144	0.391
logRKY3	0.256	-0.397	-0.091	-0.259	-0.087	-0.146
logRKY4	0.267	-0.194	-0.228	-0.349	-0.246	-0.199

	$logRKP_3$	$logRKP_4$	$logRKY_1$	$logRKY_2$	$logRKY_3$	$logRKY_4$
logRKP3	1					
logRKP4	-0.078	1				
logRKY1	-0.173	-0.208	1			
logRKY2	0.299	0.231	0.065	1		
logRKY3	-0.032	-0.229	0.409	0.006	1	
logRKY4	-0.184	-0.266	0.239	-0.119	0.340	1

Source: Result obtained from statistic analysis.

Note: Number of observation is 84; data of all variables has been logarithm treated except variables D1 and D2.

the fertilizer and insecticide price variables have to be dropped from the regression model to avoid estimation problems. As farmers obtain agro-inputs from the rigid rationing system, the impact of input price is limited. Therefore, dropping those variables should not be harmful to the results.

6.2.3 The Appropriateness of The SURE Model

Before making interpretation of the empirical results, it is necessary to verify the estimation technique. For the seemingly unrelated regression model proposed in chapter 3, Two questions arise: (1) is there a serious autocorrelation problem, and (2) does the SURE model yields more efficient estimates than ordinary least squares (OLS) estimation to each equation separately?

Since the model consists of time series observations and cross sectional units (7 regions and 4 crops). The error vector of each crop equation represents a time series and cross section, and so these vectors are likely to exhibit serial correlation. Therefore it is necessary to test the hypothesis for autocorrelation.

The first order autocorrelation is assumed. Since the model contains a lagged endogenous variable, the Durbin-Watson test is not appropriate. The h-test is thus employed (Judge et al, 1980; Jonhnston, 1984). The hypothesis is:

H0: $r = 0$

H1: $r > 0$ for positive correlation

or H1: $r < 0$ for negative correlation

Where r indicates correlation of error terms of period t and t-1. The h-test is applied to OLS estimate of each equation. The results show that the null hypothesis can not be rejected for all crop equations *(Appendix A8)*. Therefore contemporaneously correlated disturbances can be assumed for this model.

For the second question, the variance of the estimates (of coefficients) obtained from SURE and OLS are compared. Those of the formers are smaller than the latters *(Table 31 and appendix Table A8)*. The predicted values obtained from SURE are very close to the actual planted areas as shown in *Figure 14 to Figure 17*. Thus the empirical results of the SURE model will be used in the discussion from here onward.

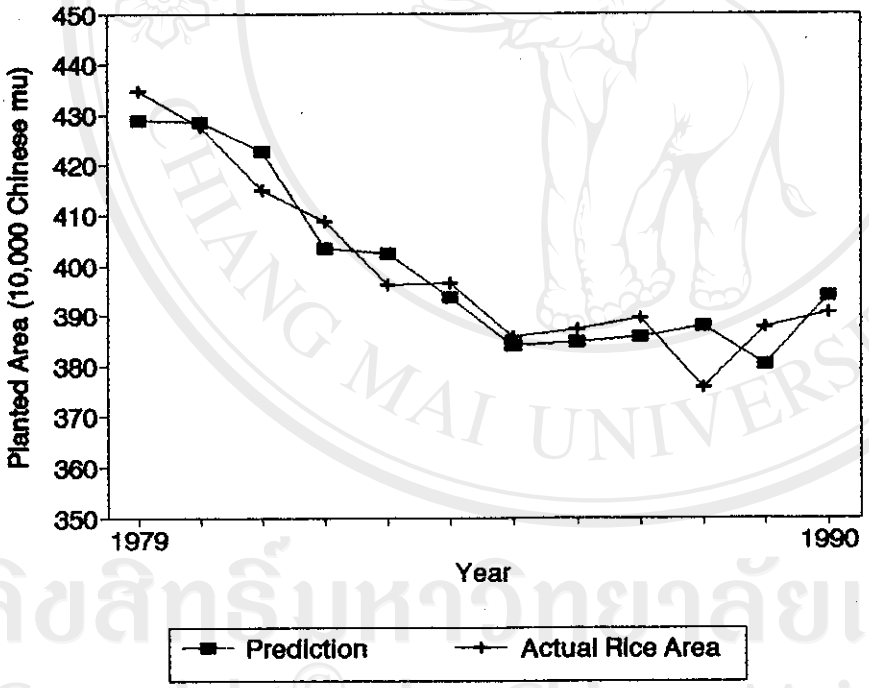

Figure 14 The Predicted and Actual Area of Rice of Huihua Prefecture

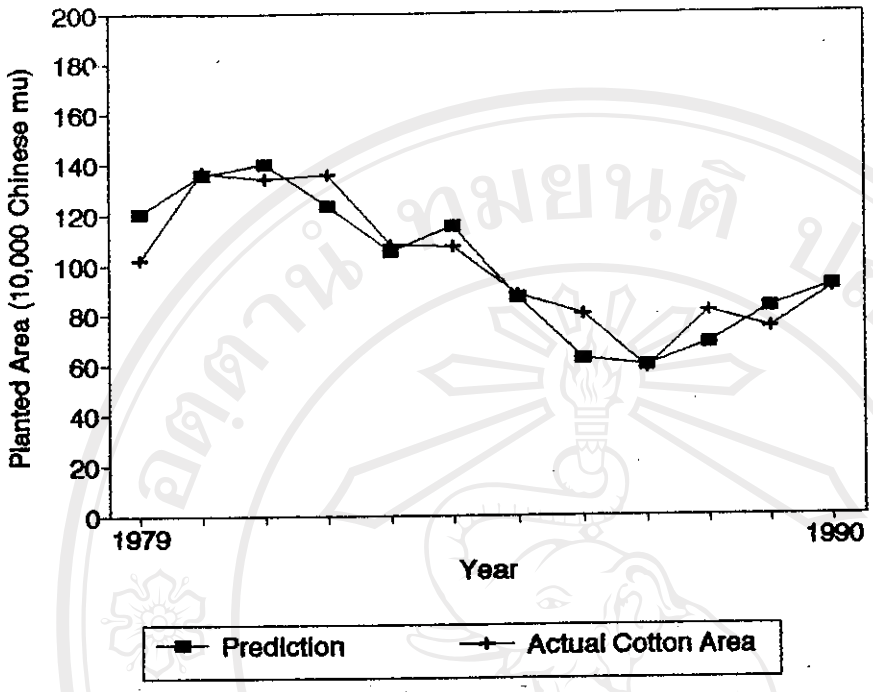

Figure 15 The Predicted and Actual Area of Cotton of Changde Prefecture

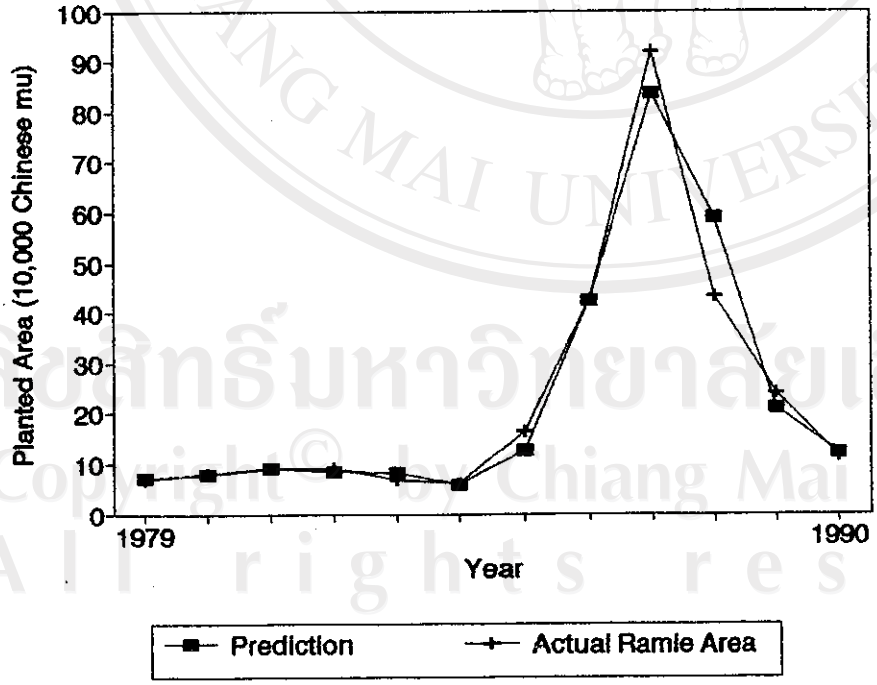

Figure 16 The Predicted and Actual Area of Ramie of Yiyang Prefecture

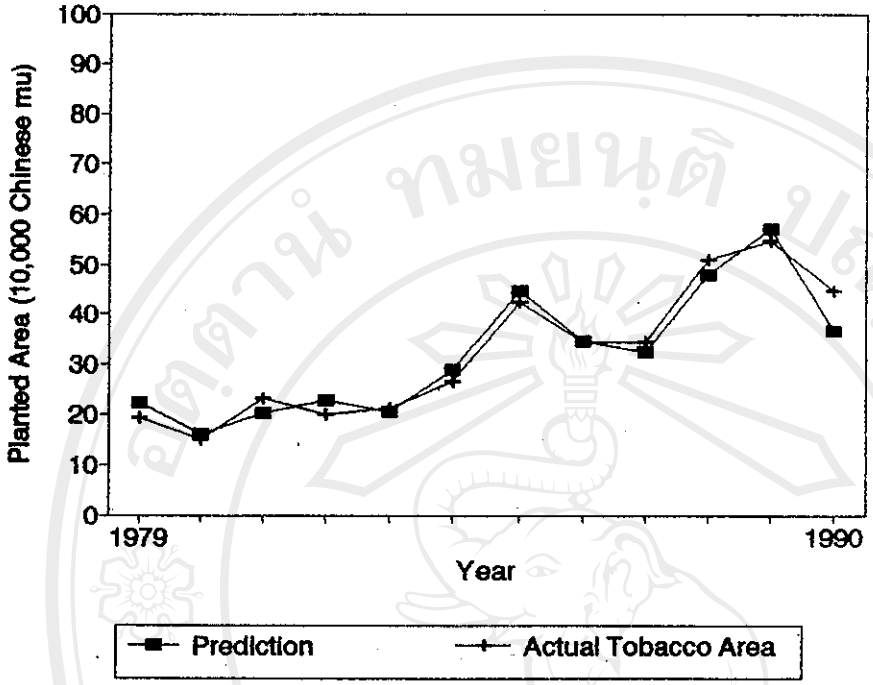

Figure 17 The Predicted and Actual Area of Tobacco of Lingling Prefecture

6.2.4 The Estimation Results of Alternative Regression Models

The empirical results of a set of alternative models with different assumption of the expected price and the risk variables, as well as alternative variable combinations, are presented in *Table 31*. These models were run on the computer software of *LIMDEP*. In this software the *SURE* model has the limitation of maximum 55 variables, and there are 24 rigid regional dummy variables in all the models (6 in each crop model), the variables that could be included in each model are limited and have to be carefully selected.

The result of model 1 shows the strong effects of alternative crop prices on farmers' crop selection. There is no indication that risk factors have played a significant role in farmers' decision making. Model 2 excludes the risk variables, the omission of risk variables does not alter the estimates of parameters significantly. The result of model 3 shows that ramie and tobacco should not be considered as the competing crops of rice (*See section 6.1.2.3*). Model 4 uses another risk variable proxies, the result of this model yields some evidence to the assumption that farmers in Hunan are risk-averse (*See section 6.1.2.6*). In model 5, the expected prices are assumed to be a function of both the 1-year and 2-year lagged farm prices. The result of this model shows that the 2-year lagged price variables are much less significant than the 1-year lagged price variables. The risk variable can not be included because of limited program capacity.

Generally, the estimates of coefficients of the prices and the lagged planted area are rather consistent across the models except model 3, Since models 2 and 5 omit risk variables and the 2-year lagged price is not a significant variable, model 1 and model 4 should be more preferable for further analysis. However, the estimates of price variables *(Table 31)* of all models are presented to confirm the ranges of estimates.

Table 31 The Estimated Co-efficients of the Explanatory Variables from Five Seemingly Unrelated Regression Models

(*Crop*)	Variable Coefficients				
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Rice					
Intercept	2.1490	2.1827	2.0915	2.1854	2.2316
	(5.16)	(5.28)	(3.86)	(5.34)	(5.39)
Lagged acreage	0.6472	0.6420	0.6435	0.6415	0.6343
	(10.37)	(10.37)	(10.73)	(10.47)	(10.24)
Rice price(t-1)	0.0784	0.0781	0.2162	0.0777	0.0812
	(1.42)	(1.41)	(2.75)	(1.40)	(1.67)
Rice price(t-2)					-0.0443
					(-0.75)
Cotton price(t-1)	-0.0224	-0.0223	-0.1392	-0.0221	
	(-0.56)	(-0.56)	(-1.84)	(-0.55)	
Ramie price(t-1)			0.0028		
			(0.12)		
Tobacco price(t-1)			0.0617		
			(2.95)		
Dummy 1982	-0.0255	-0.0257	-0.0436	-0.0258	-0.0251
	(-1.94)	(-1.96)	(-2.39)	(-1.97)	(-1.91)
Dummy 1985	-0.0318	-0.0319	-0.0923	-0.0318	-0.0215
	(-1.47)	(-1.48)	(-2.96)	(-1.47)	(-1.53)
Regional Dummy 1	-0.0416	-0.0418	-0.0424	-0.0418	-0.0421
	(-2.66)	(-2.67)	(-2.69)	(-2.66)	(-2.69)
Regional Dummy 2	0.0053	0.0054	0.0053	0.0054	0.0056
	(0.34)	(0.35)	(0.34)	(0.34)	(0.36)
Regional Dummy 3	0.1550	0.1574	0.1567	0.1576	0.1609
	(4.73)	(4.84)	(4.93)	(4.89)	(4.95)
Regional Dummy 4	0.0133	0.0135	0.0135	0.0135	0.0138
	(0.85)	(0.86)	(0.86)	(0.864)	(0.88)
Regional Dummy 5	-0.1412	-0.1431	-0.1426	-0.1433	-0.1459
	(-5.08)	(-5.18)	(-5.26)	(-5.22)	(-5.28)
Regional Dummy 6	0.0052	0.0053	0.0053	0.0053	0.0055
	(0.33)	(0.34)	(0.34)	(0.341)	(0.36)

Table 31 (Continued)

Cotton					
Intercept	-1.2278	-1.1437	-0.8171	-1.5855	-0.7232
	(-0.60)	(-0.56)	(-0.38)	(-0.78)	(-0.28)
Lagged acreage	0.4601	0.4652	0.4685	0.4504	0.4703
	(7.27)	(7.36)	(7.65)	(7.15)	(7.29)
Rice price$_{(t-1)}$	-0.4785	-0.5036	-0.4556	-0.6666	-0.186
	(-1.34)	(-1.19)	(-1.047)	(-1.54)	(-0.45)
Rice price$_{(t-2)}$					-1.179
					(-2.21)
Cotton price$_{(t-1)}$	0.7289	0.7499	0.6860	0.8939	1.512
	(1.72)	(1.76)	(1.53)	(2.07)	(3.08)
Cotton price$_{(t-2)}$					-0.391
					(-0.87)
Ramie price$_{(t-1)}$	-0.0402	-0.5904	-0.0822	-0.0291	0.049
	(-0.30)	(-0.45)	(-0.58)	(-0.22)	(0.27)
Ramie price$_{(t-2)}$					-0.108
					(-0.64)
Yield risk	0.0299			0.0067	
	(0.846)			(1.62)	
Dummy 1982	-0.3737	-0.3669	-0.3557	-0.4001	-0.2682
	(-3.72)	(-3.64)	(-3.44)	(-3.91)	(-1.99)
Dummy 1985	-0.0694	-0.0288	-0.0216	0.0139	0.1686
	(-0.46)	(-0.20)	(-0.15)	(0.095)	(1.12)
Regional Dummy 1	0.5206	0.5152	0.5123	0.5297	0.5107
	(4.64)	(4.55)	(4.56)	(4.69)	(4.73)
Regional Dummy 2	1.1065	1.1016	1.0953	1.1316	1.0920
	(7.26)	(7.17)	(7.26)	(7.38)	(7.22)
Regional Dummy 3	1.5665	1.1579	1.5487	1.6103	1.5438
	(7.91)	(7.82)	(7.96)	(8.07)	(7.76)
Regional Dummy 4	-0.2000	-0.1991	-0.1966	-0.2127	-0.1953
	(-1.85)	(-1.82)	(-1.80)	(-1.94)	(-1.88)
Regional Dummy 5	-0.6203	-0.6218	-0.6177	-0.6420	-0.6155
	(-5.01)	(-4.97)	(-4.99)	(-5.14)	(-5.09)
Regional Dummy 6	-0.3142	-0.3348	-0.3329	-0.3439	-0.3320
	(-2.96)	(-3.19)	(-3.19)	(-3.29)	(-3.36)

Table 31 (Continued)

Ramie					
Intercept	0.1245	-2.0289	-2.1134	-1.5003	-4.8142
	(0.37)	(-0.62)	(-0.64)	(-0.44)	(-1.55)
Lagged acreage	0.6552	0.6524	0.6563	0.6841	0.7258
	(12.02)	(11.77)	(11.95)	(10.31)	(10.51)
Rice price($t-1$)	-0.0429	-0.2780	-0.2978	-0.5116	
	(-0.07)	(-0.46)	(-0.49)	(-0.68)	
Cotton price($t-1$)	-0.6649	-0.2309	-0.2123	-0.1191	-0.5478
	(-0.97)	(-0.35)	(-0.32)	(-0.16)	(-1.06)
Cotton price($t-2$)					0.5882
					(1.12)
Ramie price($t-1$)	0.7440	0.8553	0.8625	0.7710	1.0533
	(3.45)	(4.09)	(4.10)	(3.68)	(4.15)
Ramie price($t-2$)					-0.1199
					(-0.55)
Market risk	0.0697			0.0040	
	(1.37)			(0.72)	
Yield risk	-0.0943			0.0017	
	(-1.27)			(1.52)	
Dummy 1982	0.1534	-0.1019	-0.1047	-0.0702	-0.2415
	(0.72)	(-0.67)	(-0.69)	(-0.45)	(-1.43)
Dummy 1985	-0.3236	-0.0234	-0.0273	0.0724	-0.2837
	(-1.15)	(-0.12)	(-0.13)	(0.32)	(-1.40)
Regional Dummy 1	0.4977	0.3693	0.3644	0.3195	0.2741
	(2.68)	(2.36)	(2.33)	(1.98)	(1.69)
Regional Dummy 2	0.0128	-0.1856	-0.1837	-0.1728	-0.1513
	(0.06)	(-1.31)	(-1.30)	(-1.23)	(-1.09)
Regional Dummy 3	0.3182	0.1747	0.1725	0.1505	0.1327
	(1.76)	(1.22)	(1.21)	(1.06)	(0.94)
Regional Dummy 4	-0.8822	-0.9403	-0.9313	-0.8769	-0.7662
	(-4.59)	(-4.91)	(-4.89)	(-4.19)	(-3.61)
Regional Dummy 5	-0.6709	-0.7517	-0.7458	-0.7191	-0.6383
	(-3.92)	(-4.60)	(-4.58)	(-4.18)	(-3.71)
Regional Dummy 6	-0.7441	-0.8177	-0.8101	-0.7655	-0.6733
	(-4.10)	(-4.63)	(-4.60)	(-4.03)	(-3.52)

Table 31 (Continued)

Tobacco					
Intercept	-1.0867	-0.7513	-0.7543	-0.4576	-1.6982
	(-0.75)	(-0.88)	(-0.88)	(-0.52)	(-1.96)
Lagged acreage	0.4821	0.4658	0.4654	0.4847	0.5980
	(5.31)	(5.38)	(5.38)	(5.62)	(6.78)
Rice price($_{t-1}$)	-0.2150	-0.5040	-0.5040	-0.5327	-1.2014
	(-1.27)	(-2.40)	(-2.40)	(-2.24)	(-2.19)
Rice price($_{t-2}$)					1.3887
					(2.14)
Tobacco price($_{t-1}$)	0.6979	0.6780	0.6788	0.6280	0.5428
	(4.70)	(5.37)	(5.37)	(4.79)	(3.75)
Tobacco price($_{t-2}$)					-0.1362
					(-0.84)
Market risk	-0.0097			0.0097	
	(-0.28)			(1.34)	
Yield risk	0.0051			0.0048	
	(0.11)			(-0.55)	
Dummy 1982	-0.1021	-0.0925	-0.0928	-0.0589	-0.0750
	(-0.80)	(-0.78)	(-0.78)	(-0.49)	(-0.58)
Dummy 1985	0.1939	0.2238	0.2239	0.1969	
	(1.18)	(1.84)	(1.84)	(1.62)	
Regional Dummy 1	-0.3384	-0.3346	-0.3347	-0.3274	-0.2984
	(-2.54)	(-2.56)	(-2.6)	(-2.53)	(-2.32)
Regional Dummy 2	-0.6953	-0.6893	-0.6898	-0.6634	-0.5415
	(-4.27)	(-4.28)	(-4.28)	(-4.13)	(-3.38)
Regional Dummy 3	-0.9125	-0.9055	-0.9061	-0.8788	-0.7192
	(-5.09)	(-5.11)	(-5.11)	(-4.99)	(-4.06)
Regional Dummy 4	-0.2398	-0.2404	-0.2405	-0.2366	-0.2177
	(-1.85)	(-1.86)	(-1.86)	(-1.84)	(-1.71)
Regional Dummy 5	0.6979	0.6935	0.6941	0.6695	0.5101
	(3.96)	(3.94)	(3.94)	(3.83)	(2.90)
Regional Dummy 6	0.5090	0.5031	0.5036	0.4874	0.3676
	(3.21)	(3.22)	(3.22)	(3.14)	(2.37)
Variable Number	55	50	52	55	55
Observation Number	4*84	4*84	4*84	4*84	4*84

Source: Result of the SURE model estimation

Note: Data in parentheses are *t*-test values of coefficient estimates.

6.3 Discussion

The presented alternative models reveal that most coefficients of the variables are significant with correct signs as expected. It also shows the expected differences among the four different crops in terms of responses to variable changes. The estimation of key variables are quite stable in five alternative models.

This section will interpret the regression results which will focus on the characteristics of the own-price elasticities, the cross-price elasticities, the impact of institutional changes, the risk factors, the lagged planted area variable, and the explanation of the regional dummy variables.

6.3.1 The Own-price Elasticities

This analysis uses the annual data. The period of twelve months should be sufficient for certain production adjustment. Farmers were expected to adjust their crop production according to their expected price. The area response model *(Table 31)* reveals that the expected price model of Hunan farmers is a function of one-year lagged price (models 1 and 4) as compared to a combination of one and two year lagged prices (model 5). This implies that farmers' crop decision is basically based on the price they received in the previous year in Hunan, the price of two previous years was not significant for their decision making.

The coefficients of one-year-lagged price are significant for all crops and rather stable in all models *(Table 32)*. However, the values in model 5 and some in model 3 are the extremes. Regardless of model specification, the estimates of price elasticities are robust and reveal that the price elasticity of area response is inelastic. Nevertheless, further interpretation will base on *models 1* as discussed earlier.

Table 32 The Own Price Elasticities of the Four Crops

Crops	Own-price elasticity
Rice	0.0784*
Cotton	0.7289***
Ramie	0.7440***
Tobacco	0.6979***

Source: Table 31.

Note: Triple (single) asterisk indicates 5% (20%) significance level.

The own-price elasticity of rice (0.0784) is the lowest and is very inelastic. The elasticities of other crops are about the same that is 0.6979 for tobacco, 0.744 for ramie and 0.7289 for cotton. These estimates are reasonable as compared to some of the past studies *(Table 33)*. The similarity of price elasticities of those three crops, which were under different government marketing control, reveals that farmers' responses to price signals are in the same pattern no matter they were official or free market prices. It also illustrates that government

marketing controls did not obstruct product prices from playing a role in farmers' crop decision.

Table 33 The Supply Elasticities of Rice, Cotton and Tobacco Obtained by Several Authors in Early Researches

CROP Region	Period	Author	Long-Run Elasticity
RICE			
Punjab	1950-66	Cummings	0.05
Thailand	1937-63	Behrman	0.19 to 0.43
Egypt	1953-72	Askari, etc.	0.08
COTTON			
Punjab	1960-69	Kaul & Sidhu	0.79 to 1.17
U.S.A.(10 states)	1883-14	DeCanio	0.23 to 0.85
India	1948-61	Raj Krishna	1.33
TOBACCO			
Nigeria	1945-64	Adesimi	0.82
Bangladesh	1950-66	Cummings	0.53
Madras(Tamil Nadu)	1949-67	Cummings	0.25
China	1978-87	Ho	1.96(1.39)*
JUTE AND RAMIE			
China	1978-87	Ho	1.38(0.41)*

Source: *Askari* and *Cummings* (1977); and *Ho* (1990).

Note: Data in parentheses are area-response elasticities.

That rice production has the lowest own-price elasticity can be explained by the rigidity of the production. This rigidity shows that farmers do not grow rice based on its market price, farmers grow rice mainly for household consumption and to meet government grain procurement requirement. Another explanation is that rice price may be so low that some potential commercial rice growers can hardly earn profit. Therefore, to increase rice production effectively may need a

big price hike (its side-effect is discussed later in the cross-price elasticity section), but its effectiveness of is still doubtful.

Cotton and ramie have the highest own-price elasticities among the four crops. This illustrates that cotton and ramie are quite sensitive to their output market prices, and proves that farmers grow these two crops for income generation.

The own-price elasticity of tobacco is slightly lower than cotton and ramie, it is probably that the production regions are in the remote southern and western parts of Hunan province where the land and climate are not so favorable for the production of other cash crops. So farmers kept on growing this crop as long as it is comparatively more profitable than cereal crops like rice, corn or wheat.

Table 34 shows the extent of own-price changes affecting crop planted areas. For example, an increase of rice price by one yuan/100 kg (base on 53.5 yuan/100 kg in 1990), the planted area of rice could increase by 96,067 mu in Hunan province providing other factors remain unchanged.

Table 34 The Prediction of the Changes of Crop Planted Areas in Hunan Province Providing the Crop Own-price Increase by 1 Yuan on the Base of Year 1990

Crop	A_i (1990)	P_i (1990)	E_i	dA_i/dP_i
Rice	65,555,600	55.7	0.0784	92,305
Cotton	1,778,200	716.9	0.7289	1,808
Ramie	282,300	211.2	0.7440	994
Tobacco	1,167,100	239.4	0.6979	3,402

Source: Calculated by the author.

Note: A_i is the planted area of the ith crop (mu), P_i is the farm price (yuan/100 kg), E_i is the own-price elasticity, dA_i/dP_i is the prediction of the change of crop planted area provided the crop price change 1 yuan/100 kg. $dA_i/dP_i = A_i*E_i/P_i$.

6.3.2 Cross-Price Elasticities

The cross-price elasticities shows the degree of farmers' production response to the price of substitute crops. As rice has been justified as the effective competing crop to the production of all other cash crops analyzed, the cross-price elasticities of the other three crops with respect to the change in rice price are estimated. Other cross price elasticities include: cotton is considered as an effective competing crop to rice, and cotton and ramie are considered as competing each other.

This analysis shows that the estimates of these variables are not significant except rice to tobacco (*Table 35*). This is probably because farm land in Hunan is very limited and the production of each

crop is Table 35 The Cross Price Elasticities of the Four Crops

Area of Price Crop$_i$ / of Crop$_j$	Cross Price Elasticity
Cotton/Rice	-0.4785
Ramie/Rice	-0.0429
Tobacco/Rice	-0.2150*
Rice/Cotton	-0.0224
Ramie/Cotton	-0.6649
Cotton/Ramie	-0.0402

Note: The crop$_i$ is the affected crop by the price of crop$_j$; asterisk indicates 20% significance level.

Source: Table 31.

quite rigid as a result of the strong influence of the implementation of government self-sufficiency policy. On the other hand, crop prices were found moving simultaneously in the same direction, therefore the high correlations among those output prices prevented significant estimation of the cross-price elasticities.

To a certain extent, rice price has very low cross price effect to ramie, because ramie production does not require good irrigation. Therefore, most ramie fields were originally arid land, only a small proportion were directly converted from paddy fields.

Cotton is found to have strong cross-price effect to ramie, the cross-price elasticities are considerably high. The cross-price effect of cotton to ramie is found greater than that of ramie to cotton. This is because these two crops are both fiber crops and they are grow mostly in the same area around the Dongting-Lake Plain. Farmers can easily convert their cotton fields to ramie when ramie price is in

favor, but vis versa is not so easy as ramie is a semi-perennial crop with deep tubes and roots in the soil which are difficult to remove. This somewhat explains that when ramie production increased in the late 1980s, cotton production decreased in the opposite path.

Even though there was conversion between cotton and rice, the growing area of cotton was too small to have a significant impact on rice production, this is why the cross-price elasticity of cotton to rice is considerably small and not significant.

Table 36 shows the extent of crop price changes affecting the planted area of competing crops. For instance, an increase of rice price by one yuan/100 kg (base on 53.5 yuan/100 kg in 1990) could decrease the planted area of cotton by 15,904 mu providing cotton price and other factors remain unchanged.

Table 36 The Prediction of the Changes of Crop Planted Areas in Hunan Province Providing the Competing Crop price Increases by 1 Yuan on the Base of Year 1990

Area of Crop$_i$ / Price of Crop$_j$	A_i (1990)	P_j (1990)	E_{ij}	dA_i/dP_j
Cotton / Rice	1,778,200	55.7	-0.4785	-15,281
Ramie / Rice	282,300	55.7	-0.0429	-219
Tobacco / Rice	1,167,100	55.7	-0.2150	-4,507
Rice / Cotton	65,555,600	716.9	-0.0224	-2,048
Ramie / Cotton	282,300	716.9	-0.6649	-262
Cotton / Ramie	1,778,200	211.2	-0.0402	-338

Note: A_i is the planted area of the ith crop (mu), P_j is the farm price of crop j (yuan/100 kg), E_{ij} is the cross-price elasticity of crop i to crop j, dA_i/dP_j is the prediction of the change of planted area of crop i provided the price for crop j by 1 yuan/100 kg. $dA_i/dP_j = A_i * E_{ij}/P_j$.

As the government can use price control and manipulation as levers to adjust agricultural production, it is useful to simulate and evaluate the implementation outcomes of possible packages of government price policies. *Tables 37 (1-4)* assumes that there are adjustment upon both crop own-price and its competing crop price (other factors are assumed unchanged), the result of possible price movements is presented.

According to past experiences, most agricultural prices vary within 30% range, this figure is adopted to set the price boundary in the simulation. It is quite convenient to check how crop prices should be adjusted if the government set a production target for the particular crop that requires the planted area increasing/decreasing a certain amount. For example, if tobacco growing area in this year is set at the same level of year 1990, assume rice price has increased from 55.7 yuan/100 kg in 1990 to 65 yuan/100 kg at present, from table 37-(4) we can observe that the tobacco price should be adjusted to 250-255 yuan/100 kg level (provide other factors are not significantly changed).

Table 37-(1) Prediction of Changes of Rice Area Assume Rice and Cotton Prices Were Adjusted

Rice Price Level	Cotton Price Level (Competing Crop)						
	500	600	700	716.9	750	850	950
42	-862300	-1067100	-1271900	-1306511	-1374300	-1579100	-1783900
44	-670166	-874966	-1079766	-1114377	-1182166	-1386966	-1591766
46	-478032	-682832	-887632	-922243	-990032	-1194832	-1399632
48	-285898	-490698	-695498	-730109	-797898	-1002698	-1207498
50	-93764	-298564	-503364	-537975	-605764	-810564	-1015364
51	2303	-202497	-407297	-441908	-509697	-714497	-919297
52	98370	-106430	-311230	-345841	-413630	-618430	-823230
53	194437	-10363	-215163	-249774	-317563	-522363	-727163
54	290504	85704	-119096	-153707	-221496	-426296	-631096
55	386571	181771	-23029	-57640.2	-125429	-330229	-535029
55.6	444211	239411.2	34611.2	0	-67788.8	-272589	-477389
56	482638	277838	73038	38426.8	-29362	-234162	-438962
57	578705	373905	169105	134493.8	66705	-138095	-342895
58	674772	469972	265172	230560.8	162772	-42028	-246828
59	770839	566039	361239	326627.8	258839	54039	-150761
60	866906	662106	457306	422694.8	354906	150106	-54694
62	1059040	854240	649440	614828.8	547040	342240	137440
64	1251174	1046374	841574	806962.8	739174	534374	329574
66	1443308	1238508	1033708	999096.8	931308	726508	521708
68	1635442	1430642	1225842	1191231	1123442	918642	713842
70	1827576	1622776	1417976	1383365	1315576	1110776	905976

Note: Price unit = yuan/100 kg, unit of rice area = mu.
Prediction is based on crop area and price in 1990

Table 37-(2) Prediction of Changes of Cotton Area Assume Cotton and Rice Prices Were Adjusted

Cotton Price Level	Rice Price Level (Competing Crop)						
	40	45	50	55.7	60	65	70
530	-337675	-337752	-337828	-337915	-337981	-338057	-338134
550	-301515	-301592	-301668	-301755	-301821	-301897	-301974
570	-265355	-265432	-265508	-265595	-265661	-265737	-265814
590	-229195	-229272	-229348	-229435	-229501	-229577	-229654
610	-193035	-193112	-193188	-193275	-193341	-193417	-193494
630	-156875	-156952	-157028	-157115	-157181	-157257	-157334
650	-120715	-120792	-120868	-120955	-121021	-121097	-121174
670	-84555.3	-84631.7	-84708.1	-84795.2	-84860.9	-84937.3	-85013.7
690	-48395.3	-48471.7	-48548.1	-48635.2	-48700.9	-48777.3	-48853.7
710	-12235.3	-12311.7	-12388.1	-12475.2	-12540.9	-12617.3	-12693.7
716.9	239.9117	163.5067	87.1017	0	-65.7083	-142.113	-218.518
720	5844.712	5768.307	5691.902	5604.8	5539.092	5462.687	5386.282
740	42004.71	41928.31	41851.9	41764.8	41699.09	41622.69	41546.28
760	78164.71	78088.31	78011.9	77924.8	77859.09	77782.69	77706.28
780	114324.7	114248.3	114171.9	114084.8	114019.1	113942.7	113866.3
800	150484.7	150408.3	150331.9	150244.8	150179.1	150102.7	150026.3
820	186644.7	186568.3	186491.9	186404.8	186339.1	186262.7	186186.3
840	222804.7	222728.3	222651.9	222564.8	222499.1	222422.7	222346.3
860	258964.7	258888.3	258811.9	258724.8	258659.1	258582.7	258506.3
880	295124.7	295048.3	294971.9	294884.8	294819.1	294742.7	294666.3
900	331284.7	331208.3	331131.9	331044.8	330979.1	330902.7	330826.3

Note: Price unit = yuan/100 kg; unit of cotton area = mu.
Prediction is based on crop area and price in 1990.

Table 37-(3) Prediction of Changes of Ramie Area Assume Ramie and Rice Prices Were Adjusted

Ramie Price Level	Rice Price Level (Competing Crop)						
	40	45	50	55.7	60	65	70
150	-57394.5	-58489.5	-59584.5	-60832.8	-61774.5	-62869.5	-63964.5
160	-47454.5	-48549.5	-49644.5	-50892.8	-51834.5	-52929.5	-54024.5
170	-37514.5	-38609.5	-39704.5	-40952.8	-41894.5	-42989.5	-44084.5
180	-27574.5	-28669.5	-29764.5	-31012.8	-31954.5	-33049.5	-34144.5
185	-22604.5	-23699.5	-24794.5	-26042.8	-26984.5	-28079.5	-29174.5
190	-17634.5	-18729.5	-19824.5	-21072.8	-22014.5	-23109.5	-24204.5
195	-12664.5	-13759.5	-14854.5	-16102.8	-17044.5	-18139.5	-19234.5
200	-7694.5	-8789.5	-9884.5	-11132.8	-12074.5	-13169.5	-14264.5
205	-2724.5	-3819.5	-4914.5	-6162.8	-7104.5	-8199.5	-9294.5
210	2245.5	1150.5	55.5	-1192.8	-2134.5	-3229.5	-4324.5
211.2	3438.3	2343.3	1248.3	0	-941.7	-2036.7	-3131.7
215	7215.5	6120.5	5025.5	3777.2	2835.5	1740.5	645.5
220	12185.5	11090.5	9995.5	8747.2	7805.5	6710.5	5615.5
225	17155.5	16060.5	14965.5	13717.2	12775.5	11680.5	10585.5
230	22125.5	21030.5	19935.5	18687.2	17745.5	16650.5	15555.5
235	27095.5	26000.5	24905.5	23657.2	22715.5	21620.5	20525.5
240	32065.5	30970.5	29875.5	28627.2	27685.5	26590.5	25495.5
245	37035.5	35940.5	34845.5	33597.2	32655.5	31560.5	30465.5
255	46975.5	45880.5	44785.5	43537.2	42595.5	41500.5	40405.5
265	56915.5	55820.5	54725.5	53477.2	52535.5	51440.5	50345.5
275	66855.5	65760.5	64665.5	63417.2	62475.5	61380.5	60285.5

Note: Price unit = yuan/100 kg; unit of ramie area = mu.
Prediction is based on crop area and price in 1990.

Table 37-(4) Prediction of Changes of Tobacco Area Assume Tobacco and Rice Prices Were Adjusted

Tobacco Price Level	Rice Price Level (Competing Crop)						
	40	45	50	55.7	60	65	70
140	-267433	-289968	-312503	-338193	-357573	-380108	-402643
150	-233409	-255944	-278479	-304169	-323549	-346084	-368619
160	-199386	-221921	-244456	-270146	-289526	-312061	-334596
170	-165362	-187897	-210432	-236122	-255502	-278037	-300572
180	-131339	-153874	-176409	-202099	-221479	-244014	-266549
190	-97315.7	-119851	-142386	-168076	-187456	-209991	-232526
200	-63292.3	-85827.3	-108362	-134052	-153432	-175967	-198502
210	-29268.9	-51803.9	-74338.9	-100029	-119409	-141944	-164479
220	4754.504	-17780.5	-40315.5	-66005.4	-85385.5	-107920	-130455
230	38777.9	16242.9	-6292.1	-31982	-51362.1	-73897.1	-96432.1
239.4	70759.9	48224.9	25689.9	0	-19380.1	-41915.1	-64450.1
240	72801.3	50266.3	27731.3	2041.404	-17338.7	-39873.7	-62408.7
250	106824.7	84289.7	61754.7	36064.8	16684.7	-5850.3	-28385.3
260	140848.1	118313.1	95778.1	70088.2	50708.1	28173.1	5638.104
270	174871.5	152336.5	129801.5	104111.6	84731.5	62196.5	39661.5
280	208894.9	186359.9	163824.9	138135	118754.9	96219.9	73684.9
290	242918.3	220383.3	197848.3	172158.4	152778.3	130243.3	107708.3
300	276941.7	254406.7	231871.7	206181.8	186801.7	164266.7	141731.7
310	310965.1	288430.1	265895.1	240205.2	220825.1	198290.1	175755.1
320	344988.5	322453.5	299918.5	274228.6	254848.5	232313.5	209778.5
330	379011.9	356476.9	333941.9	308252	288871.9	266336.9	243801.9

Note: Price unit = yuan/100 kg, unit of tobacco area = mu.
Prediction is based on crop area and price in 1990

6.3.3 Impacts of Institutional Changes

This analysis shows that or demonstrates that previous institutional changes had significant impacts on farmers' decision making on the selection of some crops in Hunan province during the 1979 to 1990 period. With the estimated coefficients of the institutional variables in *Table 38*, we can obtain the changes of crop planted areas due to the institutional changes in 1982 and in 1985 of the four major crops by substituting the coefficients into the Cobb-Douglas production function *(Table 39)*. Rice planted area decreased more than 1 million mu after both of the 1982 and 1985 events.

Table 38 Coefficient Table of the Institutional Variables

Event	Crops	Coefficient
(1982)	Rice	-0.0255***
	Cotton	-0.3737***
Rural	Ramie	0.1534
Reform	Tobacco	-0.1021
(1985)	Rice	-0.0318*
	Cotton	-0.0694
Market	Ramie	-0.3236
Reform	Tobacco	0.1939*

Note: Triple (single) asterisk indicates 5% (20%) significance level.

Source: Table 31.

Table 39 Prediction of Crop Planted Area Changes Resulted by Institutional Changes in 1982 and 1985

Event	Crops	Changes of Areas (mu)	Percentage(%)
(1982)	Rice	-1,669,435	-2.52
	Cotton	-800,453	-31.18
Rural	Ramie	30,905	16.58
Reform	Tobacco	-61,629	-9.71
(1985)	Rice	-2,066,304	-3.13
	Cotton	-133,303	-6.70
Market	Ramie	-37,563	-27.64
Reform	Tobacco	159,045	21.40

Source: Calculated by the author with the data of table 37.

The estimates of *D1* for ramie and tobacco are all insignificant. *Rural Reform* was found have negative impact to the planted areas of all the 4 crops except ramie, it dramatically depressed the planted area of cotton by 31.18%, rice by 2.52%. Therefore, cotton production was influenced the most by rural reform.

Market Reform was found to negatively affect the production of all the crops except tobacco. The estimates of *D2* for cotton and ramie are not significant. For rice and tobacco it is only significant at 20% level, therefore the market reform did not affect the production of cotton and ramie significantly during the 1985 to 1990 period. Therefore, we can conclude that the market reform probably reduced rice growing area by 3.13% and boosted tobacco growing by 21.40%.

Before the implementation of the *Rural Reform* in 1982 which allow the farmers to make their own production decisions, the production of the four crops were under the control of the Central Planning System.

Market price did not play a significant role in agricultural production. After rural communes were dismantled, the government released most of its control (it may also be viewed as help) on agricultural production. Therefore, many farmers diversified their crops to many of their preferred crops rather than the staple crops like rice and cotton.

The agricultural *Market Reform* in 1985 enabled farmers to make their own marketing decision, and at the same time the government gradually weakened its control on agricultural marketing. For instance, the government reduced the official procurement quotas and allowed the farmers to sell their products in free markets. Because of this farmers were not only able to select their crops to grow in their fields according to the product market conditions, but were also able to choose where to sell their products. Therefore, the production of rice, cotton and ramie were affected by several competing crops such as vegetables, water melons, fruits etc. Tobacco is positively affected because the government in 1985 changed its marketing policy by dramatically raising the price of high grade tobacco while reduced the low grade price, at the same time more government supported production bases were set up, and more government services were provided to the growers for production, initial processing and marketing *(Xiao, 1989)*.

The impact of institutional factors on agricultural production has been widely analyzed by many economists, some found institutional factors to have a positive impact in China (*Fan, 1989*). This seems to differ from the result of this study. Fan analyzed the agricultural sector in terms of the aggregated gross value of outputs, but this study analyzes the planted areas of four specific crops only in

Hunan. If the institutional changes increased the production specialization and the efficiency of resource utilization in overall production, eventhough the planted areas of some crops decrease the overall output still increased. This is found to be true in the case of rice and sometimes cotton *(Appendix Table A5)*. The second reason is probably that most government efforts to promote agricultural production in Hunan province in recent years were implemented by means of actions of economic measures like price hike, and those economic changes used to be put in the category of institutional changes. For example, the implementation of the *Household Contract Responsibility Policy* around year 1982 was accompanied by price increases of most agricultural products, all the agricultural achievements in the following years can easily be attributed to institutional changes. It is really difficult to find any institutional change that is not accompanied by government economic policy changes in Hunan province. As the price variables and the institutional variables in table 6.11 are highly correlated, the impact of institutional changes may be partly embodied in the estimates of the price variables as well.

6.3.4 Impact of Price and Yield Risks

The price and yield risks contribute to farmers income risk. Farmers are assumed to maximize their profit and minimize their income risk in their production activities. As rice production is comparatively associated with little yield and price risk *(Appendix tables A1 and A5)*, and cotton is under the official contract-marketing system, there are no

rice price and yield risk variables, nor any cotton price risk variable included in this analysis. The *standard deviation* of the farm prices and the crop yields is used as a proxy to incorporate the risk factors in regression model 1 *(Table 40)*. It yields no significant estimation of the impact of the risk variables with some coefficients carrying unexpected positive sign, this may be because the analyzed period is too short. In addition farmers may take little of the risk factors into their crop production decision. The impact of the risk factors is limited as the coefficients is very small and not quite significant.

Table 40 The Coefficients of the Market and the Production Risk Proxy Variables in Model 1

	Cotton Yield	Ramie Yield	Ramie Market	Tobacco Yield	Tobacco Market
Coefficient	0.0299	-0.0943*	0.0697*	0.0051	-0.0097*

Note: Asterisk indicates 20% significance level.

Source: Table 31.

6.3.5 The Lagged Planted Area Variable

This variable *(LA_1)* is very significant that it is within 1% significance level for the four crops in all models. This shows that trend plays an important role in farmers' crop decision making.

The elasticity of the lagged planted area of ramie is the highest among the four crops *(Table 41)*, because ramie is a semi-perennial crop, this characteristics forces farmers keep growing the crop once they start growing it.

Rice has the second highest elasticity for the lagged planted area variable, because most farmers grow rice for their self-consumption and for the official procurement quota which are two quite rigid factors, farmers keep a fixed proportion of their farm land for rice production.

Cotton and tobacco are typical cash crops and are relatively easer to be converted to other crops, this is why their coefficients are smaller. Tobacco production requires some once-for-all capital investment. For example, the flue-curing facility. It is difficult to alter this facility to other activities. Some farmers prefer grow tobacco for several years in order to fully utilize their facilities. This may be reflected by the higher coefficient of the lagged planted area of tobacco than that of cotton.

Table 41 The Coefficients of the Lagged Planted Area Variable

Crops	Coefficient
Rice	0.6472***
Cotton	0.4601***
Ramie	0.6552***
Tobacco	0.4821***

Note: Triple asterisk indicates 5% significance level.

Source: Table 31

6.3.6 The Regional Dummy Variables

In this analysis, six dummy variables have been used for the seven selected regions in the model (the dummy variable for the seventh region is dropped to avoid absolute autocorrelation). The regional dummy variables reveal the regional differences in terms of production scale and model simulation significance. To view the regional production scale, if the coefficient of R_i is equal to 0, it means region i has the same production scale of region 7 (See Table 28 for the specific region assigned as region 7).

In rice model, it is found that only the production scale of region 5 (which represent Yiyang and Changde respectively) are smaller than Lingling (region 7), Changde (region 3) is found to be the largest rice producer in terms of planted area. The coefficients of regions 2,4 and 6 are not significant. As for cotton the coefficients of the six regional dummy variables are all significant. Changde and Reyang (regions 2 and 3) are found to be the largest cotton growers. Four regions are significant in the ramie model except Reyang and Changde (regions 2 and 3), Yiyang (region 1) and Changde is found to have the largest ramie planted areas. All regions in the tobacco model are significant, regions 5 and 6 (Lingling and Chengzhou) are the largest tobacco growers.