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Modeling the Complexity of U.S. Rice Policies with Implicit Revenue Functions

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The implicit revenue function is quite powerful to cope with modeling difficulties such as multicollinearity, lack of degrees of freedom, and limitation of the number of explanatory variables in the regression analysis. The application of the implicit revenue function requires a thorough understanding of a set of policies to be statistically modeled. The U.S. rice policies are not only changing overtime but complex, and it is important to monitor closely a function of each policy. In this paper, each most recent policy related to rice production and marketing is described while the modeling procedure using the implicit revenue function is theoretically improved over a previous model.

Introduction

Rice policies in the U.S. are complex and have been changed every four to five years. Although rice farmers have to monitor the current policies closely and make a decision for planting, researchers often faces difficulty in modeling the policies appropriately. Since the beginning of the 1980's, three farm bills passed; the 1981, 1985, and 1990 farm bills (Johnson et al.[5]; Glaser[3]; and Pollack and Lynch[7]). New policies were introduced in each case. Particularly, the 1985 farm bill started a new era for the U.S. rice economies; the marketing loan. This new policy made the U.S. rice exports able to compete with other rice exporters despite the fact that U.S. rice production costs are higher than the competitors'. This substantially and directly influenced the revenue to rice producers as well. The 50/92 program was also introduced to provide inefficient producers with subsidy to divert the land to a certain extent.

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With the 1990 farm bill, which was passed and named "Food, Agriculture, Conservation, and Trade Act of 1990" and provides rice policies up to the 1995 crop, the planting flexibility provisions called "flex" were introduced. In these new provisions, the rice producers do not receive deficiency payment for 15% of their crop land although they are allowed to produce any crop except fruits and vegetables. An additional 10% can be added to the original 15%, so that rice growers can grow other crops on the additional 10% of land without losing their base acreage. U.S. rice policies have become even more complex under this new legislation.

While those new policies were being introduced, the traditional target price and loan rate system, acreage reduction program, paid land diversion program, etc. are still maintained as the major stream of the policies. Chen and Ito documented a new technique, implicit revenue functions (IRF) and employed it for analyses of the U.S. rice policies up to the 1985 farm bill[2]. In this research, the IRF is extended and applied to the 1990 farm bill focusing on rice to develop a theoretical model incorporating those detailed policy related variables.

Provisions of the Current Rice Policies

Modeling a set of complicated policies requires a thorough understanding of the mechanism of the entire policies. Table 1 shows the key policy variables, while Fig. 1 to 5 are to explain graphically the movements of prices and some policies.

Target prices and deficiency payments

Target price is a level that the government eventually subsidizes, namely, the government pays the producers the difference between the market price and the target price when the market prices is lower than the target price. The minimum target price for rice is set at $10.71 per 100 lbs. (cwt). Under the Food Security Act of 1985, the rice target price dropped from $11.90 per cwt for 1986 to $10.71 for 1990. Deficiency payments are determined by multiplying the payment rate times the payment acreage times the program payment yield. Eligible rice producers will receive a payment rate equal to the difference between the target price and the higher of either the national average market price during the first 5 month marketing year price for 1991-93. In 1994-95, the lower of either the 12-month national average calendar year price calculation, or the 5-month national average calendar price plus an appropriate amount that is fair and equitable in relation to wheat and feed grains (Fig. 2 and 3).

The payment acreage is the lesser of either the planted permitted acreage or 85 per-

Table 1 Policy related variables for the U.S. rice production.

	Target price	Loan rate	Markey price	5 month price	Deficiency payment	USDA world price	Loan def. payment	Basy acreage	Planted acreage	ARP rate	ARP prtpn. rate	50/92 prtpn. rate
	$/cwt, roughrice							1000acre		%		
1978	8.53	6.40	8.16	7.75	0.78	None	None	1800	2933	No ARP	...	None
1979	9.05	6.79	10.50	9.87	0.00	None	None	1800	2890	No ARP	...	None
1980	9.49	7.12	12.80	11.30	0.00	None	None	1800	3380	No ARP	...	None
1981	10.68	8.01	9.05	10.40	0.28	None	None	1800	3827	No ARP	...	None
1982	10.85	8.14	7.91	7.69	2.71	None	None	3969	3295	15	78	None
1983	11.40	8.14	8.57	8.63	2.77	None	None	3946	2190	50	99	None
1984	11.90	8.00	8.04	8.14	3.76	None	None	4160	2830	25	85	None
1985	11.90	8.00	6.53	7.73	3.90	3.16	1/	4234	2512	35	90	None
1986	11.90	7.20	3.75	3.87	4.70	3.50	3.70	4199	2381	35	94	18.0
1987	11.66	6.84	7.27	5.71	4.82	6.15	0.69	4183	2356	35	96	23.2
1988	11.15	6.63	6.83	6.84	4.31	6.50	0.13	4155	2933	25	94	15.5
1989	10.80	6.50	7.35	7.24	3.56	6.00	0.50	4168	2731	25	94	23.4
1990	10.71	6.50	6.70	6.25	4.16	5.40	1.10	4154	2897	20	94	27.3
1991	10.71	6.50	7.58	7.64	3.07	5.85	0.65	4155	2878	5	95	37.2
1992	10.71	6.50	5.90	6.44	4.21	5.50	1.00	4148	3174	0	96	
1993	10.71	6.50						4145	3015	5	95	
1994	10.71	6.50								0		
1995	10.71	6.50										

1/Loan deficiency payments were paid to a portion of the 1985 crop.
Source: U.S. Department of Agriculture, Economic Research Service.

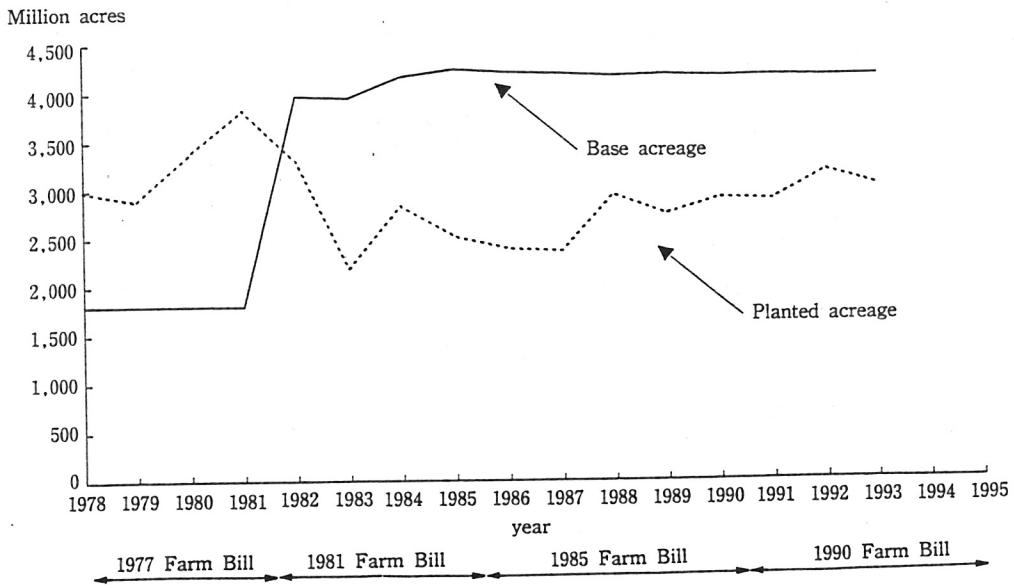

Fig. 1 U.S. rice acreage, 1978-'93

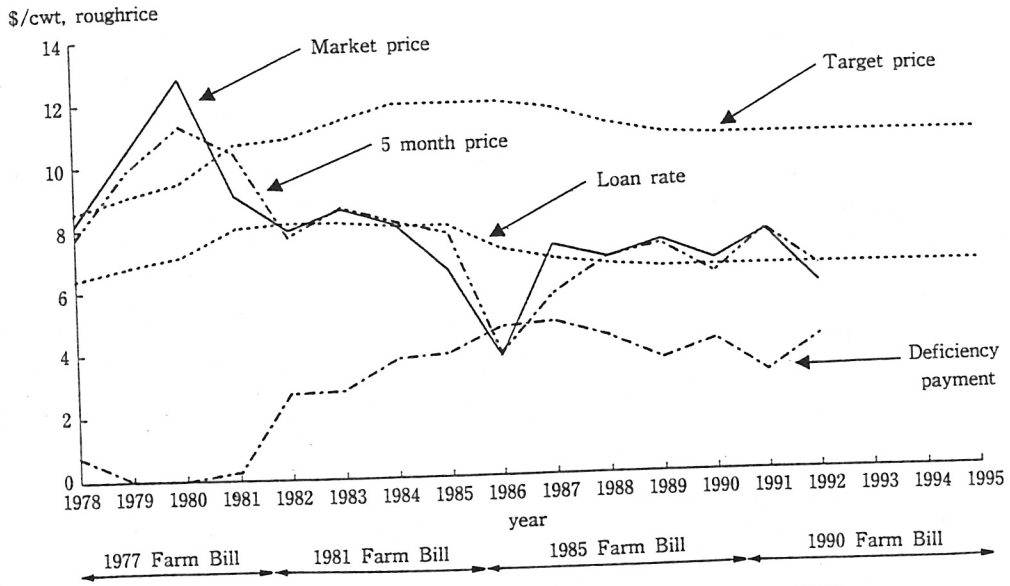

Fig. 2 Prices for deficiency payment rates, 1978-1995

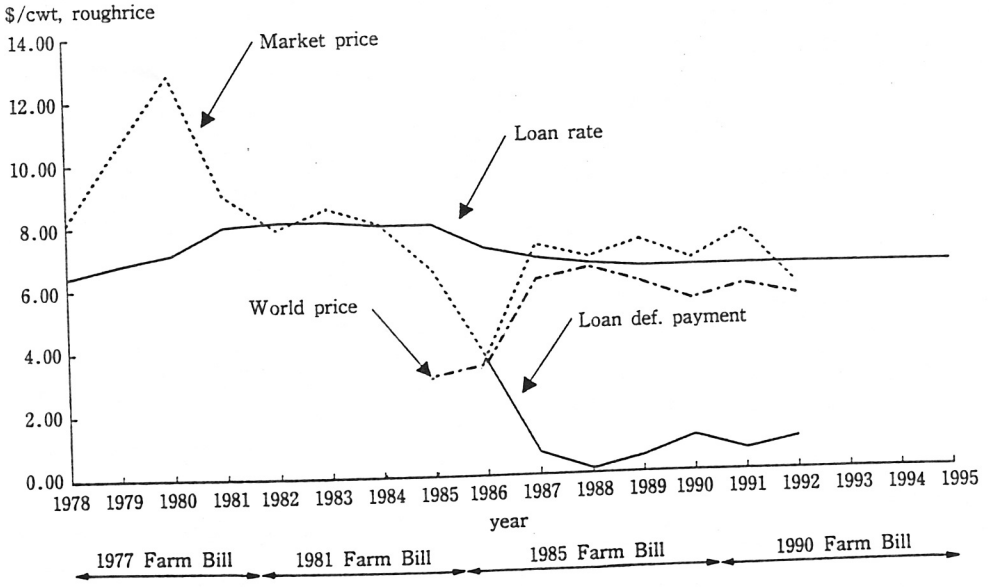

Fig. 3 Prices for loan deficiency payment rates, 1978-1995

cent of the crop acreage base minus any Acreage Reduction Program (ARP) acres. Maximum payment acreage is 85 percent under flex. (See the planting flexibility provisions.)

Loan rates and loan repayments

The basic price support rate is set at 85 percent of the simple average price during the marketing year of the preceding 5 years, excluding high and low years. However, the loan rate cannot be reduced more than 5 percent from the level of the previous year. The minimum loan rate will continue at $6.50 per cwt until 1995. Loan periods are for up to 9 months. The producer has to decide at the end of the period whether he pay back the loan and receive the rice or turn the rice over to the government and keep the loan. The loan period begins in the month after the application is made. The loan and purchase level and the target price must be announced by January 31 of the calendar year during which the crop is harvested.

Marketing loan repayment

Rice producers will have the option to repay price support loans at a rate lower than the price support level. Producers can use these marketing loans whenever the adjusted world market price for rice falls below the price support rate. The repayment rate is the lesser of either the announced loan rate for rice, or the higher of either 70 percent of the announced loan rate or the prevailing world market price for rice. As a condition for repaying the loan at lower than the announced loan rate, the Secretary of Agriculture may require a producer to purchase marketing certificates for up to 50 percent of the difference between the announced rate and the repayment rate. These marketing certificates may be exchanged for rice owned by the Commodity Credit Corporation (CCC) or for cash. The use of certificates is described more in detail below.

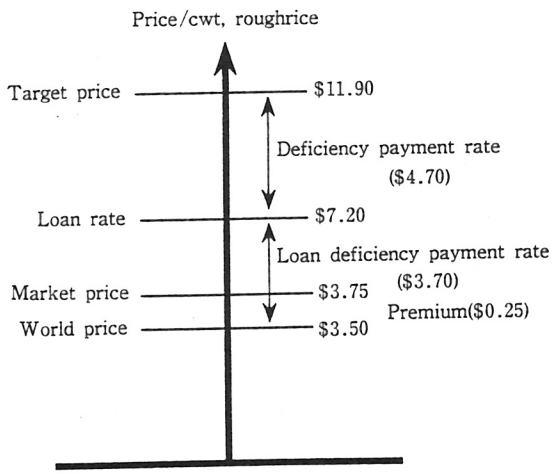

Fig. 4 Situation of U.S. rice prices in 1986

Loan deficiency payments are made to producers who are eligible to receive price support loans (loan rate) or purchase agreements but who agree to forgo obtaining such a loan or agreement. Loan deficiency payments are calculated

by multiplying the loan payment rate times the quantity of rice eligible for, but not put under, loan. The loan payment rate is the announced loan level minus the allowed repayment rate. The Secretary may use marketing certificates to pay up to half of this payment (Fig. 4).

Marketing certificates

If the adjusted prevailing world price for a class of rice falls below the loan repayment rate for that class of rice, the Secretary must issue negotiable marketing certificates to any person who participates in the certificate program. The value of these certificates is the difference between the loan repayment rate for the class of rice and the adjusted prevailing world market price. A person receiving marketing certificates can redeem them for CCC-owned rice or cash, at such times, in such manner, and at such price levels that best make rice competitive in world markets.

Acreage reduction program (ARP)

To be eligible for loans, purchases, and payments, producers must comply with any acreage reduction program announced by the Secretary. The Secretary is authorized to implement the ARP and the Paid Land Diversion Program (PLD) if total supplies of rice are projected to be excessive. The Secretary may establish an ARP of 0 to 35 percent for rice with the objective of achieving an ending stocks-to-use ratio of 16.5 to 20 percent. The "use" for rice is the simple average of all rice utilization, including total domestic, total export, and total residual disappearance for the 3 marketing years preceding the year the ARP announcement is made. The Secretary must make an announcement by January 31 of the calendar year in which the crop will be harvested.

The Secretary may also implement a PLD whether or not an ARP is in effect if a PLD assists in adjusting the total national acreage to desirable goals. PLD payments may be set by bids submitted by producers or by any other means that the Secretary deems appropriate. The Secretary must limit the total acreage to be diverted under agreements in any county or local community so that the PLD does not adversely affect the economy of the county or local community. Land under PLD must be devoted to conserving use.

The Secretary may offer targeted option payments (TOP) to producers who increase (or decrease) their ARP in return for an increase (or decrease) in their target price if the ARP is 20 percent or less. For each voluntary 1-percent increase (decrease) in ARP above (below) the announced level, producers may receive an increase (decrease) in target price between 0.5 to 1 percent. The increase in the total ARP cannot be more

than 5 percentage points.

Acreage conservation reserve

The Acreage Conservation Reserve (ACR) or reduced acres refers to the acreage which must be devoted to conserving uses under an ARP. The quantity required is determined by multiplying the crop acreage base times the percentage reduction required. Producers must plant an annual or perennial cover crop on 50 percent or more of the ACR (not to exceed 5 percent of the base) except in designated arid and summer fallow areas.

On 50 percent of the ACR, the CCC will pay 25 percent of the cost if a producer plants and maintains for 3 years permanent cover that is capable of improving water quality or wildlife habitats. If the ARP is reduced below the portion of the crop base planted to cost-share perennial cover, the Secretary must pay deficiency payments on this acreage.

The Secretary may permit the planting of designated crops on up to 50 percent of the ACR in return for a specified reduction in deficiency payment acreage. If producers plant these crops on the ACR, their deficiency payments will be reduced for each acre they plant by the amount the Secretary considers appropriate. If the producer plants more than one program crop, this reduction is prorated across all program crops. This program must be implemented in a manner which results in no additional cost to the CCC.

Haying and grazing of ACR and conserving use acreage are permitted except for the 5-month period designated by the State Agricultural Stabilization and Conservation (ASC) committee. This haying and grazing period must run between April 1 and October 31 each year. During a natural disaster, the Secretary may permit unlimited haying and grazing and may not exclude any irrigated acreage, except irrigated alfalfa

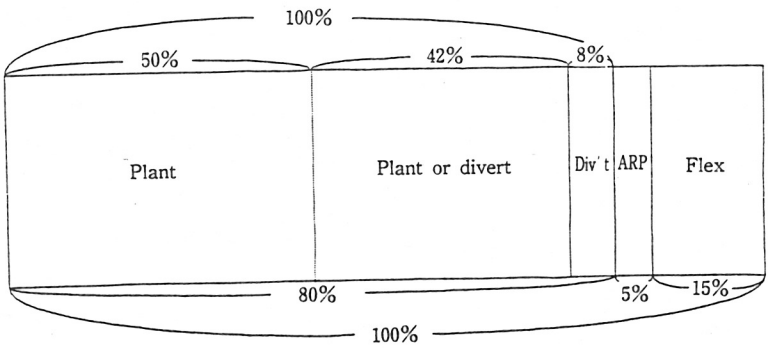

Fig. 5 A situation of the 50/92 option in 1993

acreage.

50/92 provisions

The general 50/92 provisions remain the same as those in effect for 1988 through 1990 except the number of permitted acres has been altered by the triple base provision. If producers plant between 50 and 92 percent of the crop's permitted acreage when an ARP is in effect and devote the rest to conserving uses or approved nonprogram crops, then they are eligible to receive deficiency payments on 92 percent of maximum payment acreage. These payments on conserving use acreage are guaranteed to be at least the projected deficiency payment rate. In case of prevented planting or quarantines, deficiency payments may be available on up to 92 percent of permitted acreage even though planted acreage is less than 50 percent of the permitted acreage (Fig. 5).

The Secretary may permit planting of alternative crops on all or part of acreage designated as conserving use under the 50/92 provisions. Under the 50/92 provisions, rice crop acreage base and farm program payment yield history are maintained. The 50/92 acreage cannot be used to fulfill ARP or PLD requirements.

Planting flexibility provisions

Producers may plant any eligible commodity, except fruits and vegetables, on up to 25 percent of the crop acreage base. Producers will not receive deficiency payments on 15 percent of the crop base. On the remaining 10 percent of the flexible acreage, producers will receive deficiency payments only if they plant the original program crop. Producers' base history is preserved regardless of the eligible crop planted on flexible areas if they comply with the provisions of the programs.

Disaster payments

Similar to the Food Security Act of 1985, prevented planting and reduced yield disaster payments are authorized in the case of natural disasters. If the Secretary determines that any producers have been prevented from planting any portion of their base due to natural disaster, the Secretary must make a prevented planting disaster payment. This payment is calculated by multiplying the number of permitted acres affected times 75 percent of the program payment yield times a payment rate at one-third of the target price. If, due to natural disaster, a producer's total yield is less than 75 percent of payment yield times acreage planted, the Secretary will make reduced yield disaster payments equal to one-third of the target price for a production loss below 75 percent. However, if prevented planting and reduced yield crop insurance were available to

producers under the Federal Crop Insurance Act, they are ineligible for disaster payments.

Table 2 Variables of U.S. rice policies for implicit revenue functions during 1982 through 1995.

Revenue/Cost Component	Price, Cost, or Payment Rate (P)	Yield Unit (Y)	Acreage Unit (Q)	Policy Option Operators (S)
Participants				
Cash receipts	PF	SY	1-KARP-KPLD-KPIK-KFLX*(1-C2)	C2+C3*(1-C2)*0.50
Def. payments	PT-MAX(PL, PF5)	SYG	1-KARP-KPLD-KPIK-KFLX	(1-C1){C2+C3*(1-C2)*0.50}
Loan payments	MAX(PL, PF)-PF	SY	1-KARP-KPLD-KPIK-KFLX*(1-C2)	C2+C3*(1-C2)*0.50
Mrktng. loan prem.	PL-PAW	SY	1-KARP-KPLD-KPIK-KFLX*(1-C2)	C2+C3*(1-C2)*0.50
Diversion payments	PDVG	SYG	KPLD	1
PIK payments	PF	SYG*0.8	KPIK	1
Disaster payments	k*PT*0.33	SYG*0.75	1-KARP-KPLD-KPIK-KFLX*(1-C2)	1-C4
Variable costs	PVC	-1	1-KARP-KPLD-KPIK-KFLX*(1-C2)	C1+(1-C1){C2+C3*(1-C2)*0.50}
Maintenance costs for diverted land	PMC	-1	KARP-KPLD-KPIK-KFLX*(1-C2)	1
Maintenance costs for the 50/92	PMC	-1	1-KARP-KPLD-KPIK-KFLX*(1-C2)	C2*(1-C2)*0.50
Revenue from grazing on diverted land	PGZ	1	KARP+KPLD+KPIK+KFLX*(1-C2)	1
Non-Participants				
Cash receipts	PF	SY	1	1
Variable costs	PVC	-1	1	1

Definition of Variables

Note: Each item under (P), (Y), (Q), and (S) in the table is a variable to calculate operating returns over variable costs per one base acre under the current farm programs during 1982 through 1995. The definitions of the variables are:

PF= U.S. average producer price, crop year average ($/cwt);

PF5= U.S. average producer price during the first five months, August - December, for calculation of the deficiency payment rate ($/cwt);

PT= U.S. average target price ($/cwt);

PL= U.S. average loan rate ($/cwt);

PAW= USDA-announced world adjusted price (U.S. annual average, $/cwt);

PDVG= U.S. average paid land diversion payment rate ($/cwt);

k= insurance value coefficient;

PVC= U.S. average variable cost ($/acre);

PMC= maintenance cost ($/acre);

PGZ= revenue from grazing on diverted land ($/cwt);

SY= U.S. average yield (cwt/acre);

SYG= U.S. average program payment yield (cwt/acre);

KARP= rate of acreage reduction;

KPLD= rate of paid land diversion;

KPIK=0.3 in 1983 indicating the PIK program in 1983, otherwise 0 (assuming producers cut back anadditional 30% under the PIK program);

KFLX=0.15 indicating a 15% of diversion under the planting flexibility provisions which were introduced by the 1990 Farm Bill starting with the 1991 crop;

C1=1 if PF5≧PT, otherwise 0, indicating no deficiency payment;

C2=1 if PF5≧PVC/SY indicating no participation in the 50/92 option and in planting flexibility provisions, otherwise 0;

C3, participation coefficient for the 50/92 option; and

C4=0 if disaster payments are declared, otherwise 1.

If PL≦PAW, the PL-PAW=0. Prior to 1986, PAW=PL. The PIK program was implemented in 1983. The features were to encourage producers to cut production acreage by another 10% to 30% (or whole base under bidding) in addition to the regular 15% of ARP and 5% of paid land diversion. The acreage diverted due to the PIK was paid in-kind with 80% of the established program yield.

Modeling Approach

The implicit revenue function (IRF) facilitates estimation of producer's operating returns over variable costs (OROVC) for each of the simulation periods (Chen et al.[1]). A major benefit of using the IRF is that it is possible to avoid multicollinearity problems that frequently occur among the explanatory variables. That is, the IRF reduces the number of independent variables in each equation by incorporating important factors such as farm prices, target prices, loan rates, loan repayment rate, and acreage reduction rates into one variable, the OROVC. These elements are categorized under P, Y, Q, and S, and the general formulation of IRF in terms of OROVC can be written as follows:

$$R = \sum_{i=1}^{n} P_i Y_i Q_i S_i,$$

where R is operating returns over variable costs per acre, namely OROVC; P is a series of prices, implicit revenues, and costs per unit; Y is yield and program payment yield per unit, and other scale units; Q is planted area for program payments; and S is operating function for the government program provisions (Chen and Ito).

Rice has always been included in the major agricultural protection acts throughout the history of agricultural legislation including the Agricultural Adjustment Act of 1933 (Holder and Grant[4]; Rasmussen and Baker[8]; and Tweeten[9]). And the target price/loan rate concept was introduced to rice in 1976, two years after other crops such as wheat and corn. However, the set of policies has become increasingly more complex since the 1980's.

Table 2 shows modeling mechanism for the period between 1982 and 1995 under the most recent three legislatures; 1981, 1985, and 1990 agricultural acts. The first row indicates cash receipt per one base acre for the program participants when PF (farm price) under the P column is multiplied by SY (yield per acre) of Y column, 1-KARP-KPLD-KPIK-KFLX * (1-C2) of Q column, and C2+C3 * (1-C2) * 0.50 of S column for cash receipts per one base acre: Cash receipts = PF * SY * {1-KARP-KPLD-KPIK-KFLX * (1-C2)} * {C2+C3 * (1-C2) * 0.50}.

For example, in 1983 during which implementation of policies was dramatically different from the past due to the PIK (payment-in-kind) program, a 15% acreage reduction (ARP) was imposed on the participants. In addition, a 5% paid land diversion (PLD) and the PIK program were optional participation choices after the ARP. In the PIK program, an additional 10% to 30% reduction was required. Planting flexibility

provisions (FLX) were introduced with the 1990 farm bill starting with the 1991 crop; therefore, FLX was 0 in 1983.

Meanwhile, the equation under the S column indicates whether or not the producers participated in the 50/92 option. Using the switching mechanism, if farm price is smaller than variable costs per cwt, then producers may be participating the 50/92 option. However, not all of the producers necessarily participate in it due to the fact that each producer has his own level of variable costs per cwt. Then, the C3, the 50/92 participation coefficient, is employed.

In the case of the 1993 program, by the way, the situation was different due to the FLX. ARP was imposed at only 5%, and there were no paid land diversion or payment-in-kind program. The FLX was in effect, however. Because there are no deficiency payment on the FLX acreage, a 15% of the base acreage, producers may divert the area when market prices are expected to be lower than their variable costs per cwt. Accordingly, there is a switch, 1-C2, where C2=1 if market price is expected to be higher than variable costs per cwt, otherwise 0. If the market prices were expected to be higher than the variable cost, there would be no diversion on the 15% of the base acreage. (The situation of the 1994 crop may be the case reflecting high market prices caused by Japanese emergency rice imports.)

The second row is for calculating the deficiency payments. First, the deficiency payment rate is defined under the P column. The deficiency payment rate is the difference between the target price and the higher of either the loan rate or the five-month (August-December) average farm price, except the most current two years, 1994 and 1995, during which the lesser of five-month or twelve-month average farm price plus appropriate amount is applied instead of only the five-month price:

> However, the five-month average price is generally lower than the 12 month price because it is set right after harvest. Therefore, it is assumed that this new provision should not affect the producers' decision making on planted acreage. Accordingly, this provision is neglected in the calculation of the OROVC.

Deficiency payments are paid on government program yield (SYG). Planted acreage under the Q column is the same as that for cash receipts. The value of C1 for the policy option operator under the S matrix will be 0 if PF5<PT indicating deficiency payments are paid, or 1 if PF5>PT indicating no deficiency payments. C2 and C3 are policy option operators for the 50/92 option. Accordingly, the deficiency payments per one base acre would result by multiplying each item in P, Y, Q, and S columns, namely: Def. payment = {PT-MAX(PL, PF5)} * SYG * (1-KARP-KPLD-KPIK) * {C2+C3 * (1-C2) * 0.92}. Following the same manner, a value in each row is calculated, then

added (or subtracted for the cost items) and estimated for the OROVC per one base acre for the program participants.

For nonparticipants in the program, the calculation of OROVC is straightforward. The corresponding unit values under individual P, Y, Q, and S columns for cash receipts would be PF, SY, 1, and 1, respectively. Because nonparticipants do not have to set aside any area, their planted acreage would be the whole base acre with a unit of 1. Variable costs are also applied for the whole one base acre while no government payments are applied for nonparticipants.

Once the OROVC per one base acre for both program participants and nonparticipants are calculated, it is possible to estimate the participation rate for the rice program using the regression analysis. The more OROVC for the participants, are the higher the rate of participation in the program becomes. Because program participation rate is ranged between 1 and 0, it is important to employ a logistic transformation of the function for estimation. The logit model may be appropriate (Pindyck and Rubinfeld). The model would be specified as follows:

$$LOGITR=f(E(OROVCAD-OROVCNO)/OROVCAD) \quad (1)$$

where LOGITR=log(RPRM/(1-RPRM)), RPRM is the participation rate in the program, and OROVCAD and OROVCNO are the operating returns over variable costs for the program participants and nonparticipants, respectively. Once the LOGITR is estimated, the real participation rate is calculated as follows:

$$RPRM=Exp(LOGITR)/\{1+Exp(LOGITR)\} \quad (2)$$

Once the participation rate is determined, the base acreage for both participants and nonparticipants can be derived:

$$SBPRM=RPRM * SB \quad (3)$$

$$SBNO=(1-RPRM) * SB \quad (4)$$

where SBPRM is base acreage for the participants, SBNO is base acreage for nonparticipants, and SB is exogenously determined total base acreage. Finally, planted acreage for both participants and nonparticipants are regressed taking the key program variables into consideration for the participants:

$$SAAD=f(SBPRM, KARP+KPLD+KFLX, KPIK) \quad (5)$$

$$SANO=f\{SBNO, E(OROVCNO/OROVCOT)\} \quad (6)$$

where SAAD is acreage planted by the participants, KARP, KPLD, KFLX, and KPIK are the percentages of acreage set aside under ARP, PLD, FLX and PIK programs, respectively, SANO is planted acreage of the nonparticipants, and OROVCOT is the operating returns over variable costs of competitive crops. Nonparticipants have the flexibility to allot a portion of rice land to other crops that may be more profitable than

rice. Generally, soybeans are the most common competitive crop. The total planted area in the U.S. would be the summation of SAAD and SANO.

The main rice producing states in the U.S. are Arkansas, California, Louisiana, Mississippi, and Texas. The estimation of planted acreage can be performed for individual state as well as the aggregate. California experienced a severe drought problem for the six years from 1987 through 1992. An individual state estimate would incorporate those exceptional situations more precisely. An example of implicit revenue function modeling for the U.S. rice policies regarding acreage during 1982 and 1988 demonstrated by Chen and Ito is shown in the appendix.

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Appendix

Chen and Ito's results indicates that applying the IRF method for modeling the complex of the U.S. rice policies is quite promising. Employing data between 1982 and 1988, 7 observations, their results for planted acreage are as follows:

$$\begin{aligned} LOGITR &= 7.853(6.47)KPIK + 1.734(15.8)((OROVCAD-OROVCNO)/OROVCAD \\ &\quad + (OROVCAD_{-1}-OROVCNO_{-1})/OROVCAD_{-1}) \end{aligned} \tag{1'}$$

$R^2=0.850$ $R^2adj.=0.819$ $DW=2.15$

$$\begin{aligned} SAAD &= 104(0.344) + 1.04(9.25)(SBPRM) - 4806(10.1)(KARP+KPLD) \\ &\quad - 3560(15.6)KPIK \end{aligned} \tag{5'}$$

$R^2=0.989$ $R^2adj.=0.978$ $DW=1.68$

$$\begin{aligned} SANO &= -325(2.97) + 0.640(3.53)SBNO + 394(3.38)(OROVCNO+OROVCNO_{-1}) \\ &\quad /(OROVCSY+OROVCSY_{-1}) \end{aligned} \tag{6'}$$

$R^2=0.941$ $R^2adj.=0.902$ $DW=1.53$

The numbers in parentheses are t-values. The equation numbers with primes correspond to the original theoretical equations. The estimated coefficients for independent variables are all significantly different from zero at the 5% significance level. The Durbin-Watson statistic indicates no serious serial correlations in an error term. These results for program participation rates, LOGITR, and planted acreage for both program participants and nonparticipants suggest that employing the IRF for modeling policies is quite promising. Because the IRF includes most of the factors affecting producer decision making, it may be useful for analyzing individual policies in detail. The equation for SANO employing an operating returns over variable costs for soybeans, OROVCSY, appear to be quite realistic and meaningful although it requires a tremendous amount of efforts to develop the OROVC for soybeans.