IMPLEMENTING THE CONSERVATION RESERVE PROVISIONS: POTENTIAL RISKS FACING FARMERS

by

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The 1985 Farm Bill introduced sweeping new conservation provisions including: the conservation reserve, sodbuster, swampbuster, and conservation compliance. These provisions have the potential to transform both the Nation's approach toward soil conservation and supply control and the government policy environment within which farmers must operate. The conservation reserve program (CRP) is perhaps the most innovative and potentially may have the greatest impact of any of the new conservation provisions. The ultimate impact of the CRP will depend upon how the government decides to implement the CRP in relation to commodity programs and how farmers respond to this new, untried, untested program.

The specifics of the conservation reserve program (CRP) legislation and first year rules and regulations for implementing the CRP were outlined by Boggess et. al. Reichelderfer developed a conceptual model of the government's decisionmaking process in implementing the CRP. The objective of this paper is to focus on the other half of the equation by developing a model of an individual farmer's decision to participate in the bidding and then point out the areas of risk and uncertainty impinging on that decision. The intent is to frame the problem and define the issues. Further analysis awaits the collection of data from the first round of bidding.

A farmer's general decision problem can be conceptualized as a stochastic adaptive control model. The farmer attempts to maximize his or her expected utility over time. Expected utility is hypothesized to be a function of annual income, wealth accumulation, risk, and other personal objectives. The attainment of utility is governed by the equations of motions reflecting the resource constraints, government policy environment, and operational processes within which the farmer operates. The farmer manipulates the control variables (crop selection, acreages planted, program participation, etc.) in a manner designed to maximize his or her well being. Clearly however, ultimate attainment of the farmer's objectives depends upon both stochastic variables (yields, prices, interest rates, etc.) over which the farmer has limited control and uncertain variables (commodity program variables, budget deficit policy, tax reform, etc.) over which the farmer has no direct control.

For the purposes of this paper, the farmer's decision problem is restricted to determining what combination of commodity program participation, CRP participation, and general farm operation will maximize his or her expected utility over time. There are three key time periods to consider: (1) the CRP bidding period, (2) the CRP reserve period, and (3) the post CRP period. The CRP bidding period presents an interesting study in strategy formation and gaming when the rules of the game are subject to considerable change. Furthermore the mere determination of an expected utility maximizing bid is fraught with considerable risk due to the inherent uncertainty surrounding most of the key variables both during the CRP and post CRP periods.

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In order to make the decision problem cognitively manageable the problem is simplified by breaking it down into two parts. The first part is a conceptual model of CRP bid calculation based on Phipps' purchase of development rights model and Kramer and Pope's model of participation in commodity programs. The second part explores the gaming aspect of participation in the CRP and points out some of the linkages between the government's strategy and the producer's strategy.

Conceptual Model of Bid Calculation

Two basic approaches can be used to determine break-even rental rates (bids) for participation. Both revolve around the calculation of the net present value of the eligible highly erodible land. One approach is to determine the investment opportunity return on the land if sold and the proceeds invested and then use this return to establish the minimum bid for participation in the CRP. The second approach is to calculate a net present "use" value assuming that the land continues to be farmed and base the CRP bid on the expected net returns. This study focuses on the second approach under the assumption that the majority of potential CRP participants plan to continue farming making the "use value" the more relevant option.

The use value approach in this study is similar to Phipps' purchase of development rights (PDR) model except in this case the government is merely renting the "development" rights for a period of ten years. The "development" rights being rented in the CRP are the rights to cultivate, graze, harvest hay, or grow fruit, nut or Christmas trees on the land. The lease value of these rights is calculated as the difference between the net present value of the farm with the rights and the net present value of the farm without the rights. Four cases are considered: (1) the farmer doesn't participate in either commodity programs or the CRP; (2) the farmer participates in commodity programs, but not the CRP; (3) the farmer participates in the CRP, but not commodity programs; and (4) the farmer participates in both commodity programs and the CRP. Before tax net present value (NPV) equations were developed for each of these four possibilities.

The net present value for a nonparticipant in both commodity and CR programs is given by

$$(1)\quad NPV_{n,n} = \sum_{t=1}^{10} \sum_{i=1}^{k} \left\{ \left[\left[(P_{it} - HC_{it}) \cdot Y_{it} \right] - PHC_{it} \right] \cdot A_{it} - FC_t \right\} \frac{1}{(1+r)^t}$$

$$\text{s.t.} \quad \sum_{i=1}^{k} A_{it} \leq TC_t$$

Equation 1 reflects the value of the land based solely on expected market returns. (Table 1 provides a complete list of variable definitions.)

Table 1: Variable Definitions for Equations 1 through 4

Variable		Description
$NPV_{a,b}$	=	Net present value of income. a = program participation, n = non, p = participates b = CRP participation, n= non, p = participates
P_{it}	=	Actual market price received per bushel.
HC_{it}	=	Harvest cost per bushel.
Y_{it}	=	Harvested yield per acre.
PHC_{it}	=	Pre harvest costs per acre.
A_{it}	=	Acres planted.
r	=	Rate of discount.
TC_t	=	Total cropland in acres.
FC_t	=	Fixed costs of production.
BL_{it}	=	Basic loan level per bushel.
AB_{it}	=	Acreage base in acres for program crops and actual acres planted for nonprogram crops.
S^m_{it}	=	Mandatory percent acreage reduction.
S^o_{it}	=	Optional percent acreage reduction.
DFP_{it}	=	Deficiency payments.
PDP_{it}	=	Paid diversion payments.
NDP_{it}	=	Net disaster payments (corrected for decrease in deficiency payments.)
NFCIP	=	Net federal crop insurance payments (net of premiums).
$GRHD_t$	=	Gramm-Rudman-Hollings discount rate.
TP_{it}	=	Target price per bushel.
NP_{it}	=	National average market price per bushel.
PY_{it}	=	Program yield per acre.
DPR_{it}	=	Paid diversion payment rate per bushel.
RLM_t	=	Residual labor and management released from the reserve acreage.
OFW_t	=	Off-farm wage rate.
CS	=	CRP cost share rate.
CEC	=	CRP cover establishment costs.
CRA	=	CRP acres.
CRR	=	CRP rental rate per acre.
CMR_t	=	Market returns from hunting or other wildlife activities.
CMC_t	=	CRP cover maintenance costs.
TV_T	=	CRP terminal value.
CCS_t	=	Conservation compliance cost savings per acre.

Subscripts; t refers to years 1 through 10, i refers to crops 1 through k.

The net present value for a participant in the commodity programs, but not in the CRP is given by

$$(2)\quad NPV_{p,n} = \sum_{t=1}^{10} \sum_{i=1}^{k} \Big\{ \Big[\big[(\max (P_{it}, BL_{it}) - HC_{it}) \cdot Y_{it} \big] - PHC_{it} \Big] \cdot AB_{it} \cdot (1-S^{m}_{it} - S^{o}_{it}) - FC_{t} + \Big[DFP_{it} + PDP_{it} + NDP_{it} + NFCIP_{it} \Big] \cdot (1-GRHD_{t}) \Big\} \frac{1}{(1+r)^{t}}$$

$$\text{s.t.} \quad \sum_{i=1}^{k} DFP_{it} + PDP_{it} \leq 50{,}000$$

$$\sum_{i=1}^{k} AB_{it} \leq TC_{t}$$

where $DFP_{it} = \max [(TP_{it} - \max (NP_{it}, BL_{it})), 0] \cdot PY_{it} \cdot AB_{it}$

$$PDP_{it} = DPR_{it} \cdot PY_{it} \cdot AB_{it} \cdot S^{o}_{it}$$

Equation 2 modifies equation 1 to reflect the additional value of participation in commodity programs. The modifications appear in two primary ways. First, the market returns term is modified to reflect the price support effects of the loan rate and the acreage reduction effects of the acreage limitation. Second, additional terms are added to reflect revenue from deficiency payments, paid diversion payments, net disaster payments, and net federal crop insurance proceeds.

The net present value for a commodity program nonparticipant but CRP participant is given by

$$(3)\quad NPV_{n,p} = \sum_{t=1}^{10} \sum_{i=1}^{k} \Big\{ \big[(P_{it} - HC_{it}) \cdot Y_{it} \big] - PHC_{it} \big] \cdot A_{it} - FC_{t} \Big\} \frac{1}{(1+R)^{t}}$$

$$\sum_{t=1}^{10} RLM_{t} \cdot OFW_{t} \cdot 1/(1+r)^{t} - (1-CS) \cdot CEC \cdot CRA$$

$$+ \sum_{t=1}^{10} (CRR + CMR_{t} - CMC_{t}) \cdot CRA \cdot \frac{1}{(1+r)^{t}} + TV_{T} \cdot \frac{1}{(1+r)^{T}}$$

$$\text{s.t.} \quad CRR \cdot CRA \leq 50{,}000$$

$$\sum_{i=1}^{k} A_{it} + CRA < TC_{t}$$

Equation 3 builds on equation 1 by adding four components to reflect the effects of CRP participation and by requiring the acreages planted in the market returns term to be reduced by the amount of acreage placed in the reserve. The four CRP components reflect the present value of additional off-farm income, the original outlay to establish the conservation cover (minus the cost share), the discounted value of the net rental payments including additional rental payments from hunting or other wildlife activities, and the discounted terminal value of the CRP program.[1]

The last case represents a participant in both the commodity and the CR programs.

$$(4)\quad NPV_{p,p} = \sum_{t=1}^{10} \sum_{i=1}^{k} \Big\{ \Big[[\max (P_{it}, BL_{it}) - HC_{it}) \cdot Y_{it}] - PHC_{it} \Big] \cdot AB_{it} \cdot \left(1 - \frac{CRA}{TC^1}\right) \cdot (1 - S^m_{it} - S^o_{it}) - FC_t + [DFP'_{it} + PDP'_{it} + NDP_{it} + NFCIP_{it}] \cdot (1 - GRHD_t) \Big\} \cdot \frac{1}{(1+r)^t} + \sum_{t=1}^{10} RLM_t \cdot OFW_t \cdot \frac{1}{(1+r)^t} - (1-CS) \cdot CEC \cdot CRA + \sum_{t=1}^{10} (CRR + CMR_t - CMC_t) \cdot CRA \cdot \frac{1}{(1+r)^t} + TV_T \cdot \frac{1}{(1+r)^T} + \sum_{t=6}^{10} CCS_t \cdot CRA \cdot \frac{1}{(1+r)^t}$$

$$\text{s.t.} \quad \sum_{i=1}^{k} DFP'_{it} + PDP_{it} \leq 50{,}000$$

$$CRR \cdot CRA \leq 50{,}000$$

$$\sum_{i=1}^{k} AB_{it} + CRA \leq TC_t$$

$$\text{where } DFP'_{it} = \max [(TP_{it} - \max (NP_{it}, BL_{it})), 0] \cdot PY_{it} \cdot AB_{it} \cdot \left(1 - \frac{CRA}{TC^1}\right)$$

$$PDP'_{it} = DPR_{it} \cdot PY_{it} \cdot AB_{it} \cdot \left(1 - \frac{CRA}{TC^1}\right) \cdot S^o_{it}$$

1/ The terminal value could be either positive or negative depending upon specific cases. Examples of positive terminal effects include the value of a 10 year old stand of timber or the increased market value of the land as a result of the conservation measures employed under the CRP. Examples of negative terminal values include the cost of breaking the CRP contract prior to expiration or the cost of clearing the land in order to return it to cropland.

Equation 4 in effect is a modified combination of equations 2 and 3 reflecting the interactions between the commodity and CR programs. The primary modification is that the acreage bases are reduced in proportion to the CRP acreage which results in reduced market returns, reduced deficiency payments and reduced paid diversion payments.[2] The second important modification is that a fifth component has been added to the CRP term to reflect the conservation compliance opportunity cost of not placing highly erodible land in the CR.[3]

The break-even CRP lease rate (bid) for a commodity program participant can be determined by equating equations 2 and 4 and solving for CRR. A comparison of equations 2 and 4 indicates that this value is a function of (1) CRP induced changes in the market returns term, (2) reductions in the commodity program payments term as a result of participation in the CRP, and (3) the addition of the five CRP cost and return components.

Looking at these changes in more detail suggests that market returns will be reduced due to reductions in planted acreage. However, there may also be some offsetting reductions in fixed production costs (in addition to the direct acreage-related reductions in variable costs) and an offsetting increase in average yields based on shifts in the acreage used for setaside and more intensive management of the remaining cropland. However average yields of some crops also might decrease if the CRP acreage is more productive than the farm average or if removal of the CRP acreage requires more productive land to be setaside (e.g. the opportunity cost of the setaside). Deficiency and paid diversion payments will be reduced in direct proportion to the ratio of CR acres to total cropland adjusted for any change in program yields over time (see footnote 2).

The five CRP components reflect (1) the present value of additional off-farm income; (2) fifty percent of the cost of establishing appropriate conservation cover (grass or trees), (3) the present value of the annual rental and wildlife payments net of cover maintenance costs (clipping, fertilizing, etc.), (4) the terminal value of the CRP (see footnote 1), and (5) the opportunity cost of satisfying the conservation compliance requirements beginning in 1990 if the highly erodible acres are not placed in the CR.

Obviously, the next step is to operationalize this conceptual model by calculating break-even bids for a variety of situations. Analysis of the sensitivity of the break-even bids to factors such as crop type, land and

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2/ In cases where a producer's acreage base is large enough that payments are constrained by the $50,000 commodity program payment limitation, the bidding of land into the CRP may not reduce deficiency or paid diversion payments.

3/ The conservation (cross) compliance provisions of the 1985 farm bill specify that beginning in 1990, farmers who produce agricultural commodities on highly erodible land without employing appropriate conservation practices will be ineligible for government program benefits including price supports, storage facility loans, federal crop insurance, disaster payments, FHA loans, and CCC commodity storage payments. These provisions have two possible consequences for CRP participants. First, producers need to consider what it will cost to comply with the provisions if the CRP acreage is left in production. Second, producers should realize that beginning in 1990, they must comply with the conservation (cross) compliance provisions on all highly erodible cropland not in the CRP or else they will be in violation of their CRP contract.

existing legislation or known mechanism governing specification of the variables. Unknown variables include changes in farm legislation in 1990 or before, the potential cutoff of funds to the CRP in 1988 under pressure from G-R-H (Becker), and tax reforms such as proposed changes in the treatment of capital gains, timber production costs, and soil and water conservation expenses (Durst). This is a particularly difficult area of research. In some cases it may be possible to evaluate the expected impacts of potential changes and factor these impacts into the evaluation of the CRP bid.

One final question of interest is "Do risk preferences matter in the decision to enter a CRP bid?" One hypotheses is that risk averse producers are more likely to participate in the CRP bidding due to (1) the fixed CRP rent; (2) the subsidized opportunity to comply with the conservation compliance provisions; (3) the reduction in yield risk if marginal land is placed in reserve; and (4) the opportunity to earn greater off-farm income. Additional research is needed on the effects of the CRP on the distributions of income and net present values and ultimately on expected utility for various classes of farmers.

Gaming Considerations in Bidding and Linkages to the Government's Decision Problem

Several characteristics of the CRP suggest that a gaming approach may be relevant. First, the CR is a new program and no one is quite sure how it will work. Second, the legislation specifies five years of bidding which allows participants to play more than one round. Third, there are opportunities for the government and farmers to learn, to form strategies, and to change strategies. Finally, at the simplest level the CRP can be construed as a competitive game; farmers want to maximize the rental rates and the government wants to minimize the rental rates.

Conceptually the farmer's situation is not unlike trying to make a living in Las Vegas; overall the odds are against you, but there are several interesting ways of losing and some probability of winning. In this make believe Las Vegas there are three games: (1) the CRP, (2) government commodity programs, and (3) the marketplace. Farmers can play various combinations of the games. The government controls who can play the CRP and commodity programs and sets the rules of the games, but like in all true games the outcomes are uncertain. However, the government doesn't have a monopoly on the games in town. The market game is outside direct control of the government although the government can influence it through the rules established for the CRP and commodity programs.

The government ostensibly is trying to reach its CRP acreage targets (with the associated erosion reduction and supply control benefits) with a minimum level of budget exposure. The government's decision problem is how to set the rules of the CRP and commodity program games in order to jointly achieve the erosion and supply control objectives, given the increasingly stringent budget constraints. Several questions are relevant to this process. First, are the targeted levels of erosion versus supply control likely to change over the CRP bidding period? Second, how many resources will enter each game given a particular set of rules? Third, how much budget exposure will each game generate? Finally, what effects will changes in the rules of the government's games have on market returns and ultimately on the cost of government programs.

As discussed earlier in this paper, farmers wish to maximize utility. As they look around this make believe Las Vegas they have to decide what combination of games to play. In addition to needing to understand the basic rules of the games, several questions are likely to arise with respect to

productivity types, whole farm versus partial bid situations, off-farm employment, government commodity program payments, conservation compliance costs, etc. would help identify which factors or under what conditions certain factors are important. This information in turn would provide insights into likely participation patterns and costs of the CRP program.

Potential Risks and Uncertainties

It is obvious from a comparison of equations 2 and 4 that the calculation of the break-even CR bid is complicated and subject to a great deal of risk and uncertainty. The risk and uncertainty arise from a number of characteristics of the program. First, the CR is a ten year program with significant penalties for breaking the contract. Second, participation in the CRP directly affects participation in the commodity programs under current legislation and there is considerable uncertainty about key program variables in coming years. Finally, probable but uncertain changes in tax laws, commodity program legislation, and Gramm-Rudman-Hollings provisions cloud the crystal ball over the next ten years. All of these factors are in addition to "normal" risks associated with stochastic prices and yields.

The nature of these risks and uncertainties can be brought into sharper focus by classifying the variables involved into four categories: (1) control variables, (2) stochastic variables, (3) uncertain variables, and (4) unknown variables. The processes involved in determining the various categories can then be examined to ascertain what is known and to outline potential areas of research.

Given the simplified model of farmer decision-making implied by equations 2 and 4, the farmer has a limited set of control variables. These include choice of production practices and levels of input use, acreages devoted to each crop, commodity program participation, acreage to include in a CR bid, CR bid level and total cropland. Topics for research in this area include correctly specifying the objective function, determining farmer's risk preference levels, and identifying the appropriate set of constraints.

Stochastic variables are defined as variables that lie outside the control of any single actor and that can be represented by probability distributions reflecting the underlying stochastic processes involved in their determination. Stochastic variables in the model include yields, output prices, input prices, and interest rates. This set of variables is common to many problems in agricultural economics and considerable literature exploring the underlying processes and the nature of the probability distributions already exists. This knowledge needs to be considered in the context of projecting over the ten year time frame of the CRP in a fashion similar to other long term investments.

Uncertain variables are defined as variables whose values are determined by specific actors (e.g. USDA) but the realization of these variables is unknown to the decisionmaker at the time a decision must be made. In the case of CRP participation, uncertain variables consist of government program variables to be determined in the future under existing legislation. These include loan rates, acreage limitations, target prices, paid diversion rates, conservation compliance requirements, program yields, and G-R-H discount rates. Useful research in this area would include sensitivity analyses to determine the relative importance of the variables and macro analyses such as the FAPRI study (Womack et al.) which shed some light on likely outcomes or scenarios.

The final category of variables are the unknown variables. These variables are characterized by the attributes that (1) they may have important effects on the outcome of the decision to participate in the CRP, and (2) there is no

playing the CRP. First, will CRP odds improve over time? Second, will the government change the rules of the CRP relative to commodity programs over time? Finally, how will the payoffs and odds of the market change over time?

Discussion of a potential bidding strategy may help clarify some of the issues. Five assumptions underlie the strategy: (1) commodity programs will become less attractive over time as a result of G-R-H and changes in the program variables; (2) there will be a slow improvement in market returns; (3) the government will learn from the first round of CRP bidding and may broaden the eligibility and reweight the decision criteria toward supply control; (4) producers will learn form the first round of bidding and many who sat out the first round will participate in the second round; and (5) G-R-H poses a major threat to 1988 funding of CRP bids. Given these assumptions, an early adopter strategy might payoff. The first year bid would be calculated to cover break-even costs and a suitable risk premium that still has a chance of being selected. The bid should be high enough that the farmer would be happy if it was accepted. If the bid was not selected then the situation would have to be reviewed in preparation for the second round. Here is where the learning takes place. The farmer would have to reevaluate the probability of 1988 funding, review changes in the rules and regulations to determine the government's strategy, and recalculate the bid based on current information.

Where do we go from here? First, some additional observations are in order. This is not a purely competitive game. The government is much better equipped to learn and compete and the government controls the rules. Producers not only have to compete with the government, they also have to compete with each other.

Possible empirical research includes analyzing data from the first round of bidding. Revealed preference approaches could be used to infer information about producer's strategies (e.g. participation, bid levels) and about the government's evaluation criteria. Futher information about the government's strategy may be provided by analyzing changes made in eligibility and rules for the second round of bidding this summer.

Concluding Comments

This paper presented a "use value rental of development rights" model to represent a farmer's calculation of a CRP bid. For a commodity program participant, the model suggests that the CRP bid will be a function of (1) reductions in market returns due to reduced acreages and the opportunity cost of the setaside, partially offset by potential reductions in fixed costs and increased yields; (2) reductions in commodity program payments resulting from reduced base acreages; (3) additional off-farm income; (4) fifty percent of the cost of establishing conservation cover on the CRP acreage; (5) annual rental returns net of cover maintenance costs; (6) the terminal value of the CRP program; and (7) the conservation compliance opportunity cost of the CRP acreage. The calculation of the CRP break-even bid was shown to be subject to a great deal of risk and uncertainty arising from the effects of stochastic prices and yields, uncertain government program parameters, and unknown developments in future government legislation.

The paper also briefly discussed the CRP bidding process as a gaming model. Characteristics of the bidding process that suggest a gaming approach include (1) the CRP is a new program and no one knows quite how it will operate; (2) the legislation specifies five years of bidding allowing more than one round of play; (3) multiple rounds allow for learning and strategy formation; and (4) the process can be viewed as a competition over bids between government and farmers.

The CRP is one of the most risky and uncertain farm programs ever enacted. Furthermore, it is being implemented during one of the most uncertain political and economic environments in decades. Together these conditions provide fertile ground for research into the effects of risk and uncertainty on government programs and farmers.

References

1. Becker, Geoffrey S. Agriculture and the Gramm-Rudman-Holdings Deficit Control Act. Congressional Research Service Report 86-547ENR, February 1986.

2. Boggess, W. G., Michael Dicks, and Katherine Reichelderfer. Questions and Answers on the Conservation Reserve Component of the 1985 Farm Bill. Paper presented at the 1986 Southern Regional Project S-180 "An Economic Analysis of Risk Management Strategies for Agricultural Production Firms". Tampa, Florida, March 1986.

3. Durst, R. L. Summary of the Administration's and the Ways and Means Proposals for Tax Reform. Mimeograph paper, USDA/ERS/ARED/FTB, Washington, D.C. 1986.

4. Kramer, Randall A. and Rulon D. Pope. "Participation in Farm Commodity Programs: A Stochastic Dominance Analysis". Am. J. Ag. Econ. 63(1981):119-128.

5. Phipps, Tim. "Landowner Incentives to Participate in a Purchase of Development Rights Program with Application to Maryland". J. Northeastern Agr. Econ. Council. 12(1983):61-65.

6. Reichelderfer, Katherine. Risk in Government Program Decisionmaking: The Case of the Conservation Reserve. Paper presented at the 1986 Meeting of Southern Regional Project S-180 "An Economic Analysis of Risk Management Stategies for Agricultural Production Firms", Tampa, Florida. March 1986.

7. Womack, Abner W., Robert E. Young II, William H. Meyers, and S. R. Johnson. An Analysis of the Food and Security Act of 1985. FAPRI Staff Report #1-86, University of Missouri, Columbia. February 1986.