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The Pursuit of Efficiency and Its Unintended Consequences: Contract Withdrawals in the Environmental Quality Incentives Program

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This article analyzes why the USDA's Environmental Quality Incentives Program (EQIP) experiences contract withdrawals. Among approved contracts, 17% withdrew one or more conservation practices. After presenting a model of producers' behavior, a logit model is used to examine the withdrawal phenomenon. Withdrawals are linked to producers having an incentive to include low cost-share payments and practices in the conservation plan that increase the probability of approval, but may not be profitable These results are discussed in light of the changes to EQIP that have been introduced by the 2002 Farm Act.

Over the last 15 years, economic instruments have gained much ground relative to command-and-control mechanisms for the promotion of environmental policies. This shift is based on the view that incentive-based tools, directed towards voluntary means of reducing negative environmental externalities, are flexibl and economically more efficient Such was the reasoning behind the establishment by the 1996 Farm Act of the Environmental Quality Incentives Program (EQIP), a voluntary conservation program providing assistance to farmers facing threats to their natural resource base. EQIP's main efficiency-enhancin features were (i) a bidding mechanism where farm operators competed for funds based on their "bids" (proposals) for the provision of environmental services, and (ii) the targeting of funds to specifi resource concerns, such as soil erosion, nutrient management, water resource management, and wildlife habitat conservation, aimed at achieving the greatest possible environmental benefit per dollar of program expenditure. These are innovative features relative to previous programs,

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which allocated funds on a f rst-come, f rst-served basis, according to political jurisdiction. EQIP's innovative approach is of particular interest given the trend towards agri-environmental payments in the Farm Security and Rural Investment (FSRI) Act or "Farm Act" of 2002.

Cost-sharing and incentive payments are special cases of economic incentives for environmental policy and natural resource conservation (Cooper and Keim, Lichtenberg and Lessley, Madariaga). Cost-sharing covers some or all of the start-up and/or installation costs of implementing management practices that reduce natural resource degradation (Malik and Shoemaker). Monetary incentive payments are used to encourage farmers to initiate improved resource management practices.

The analysis of EQIP's performance enables us to assess some of the problems faced in the implementation phase of an incentive-based program. EQIP is particularly interesting because it deals with the diffuse environmental impacts of agricultural activities by (i) trying to elicit the farmers' willingness to accept payments for undertaking conservation practices, and (ii) allowing for funding of a broad set of conservation practices, thereby leaving f exibility to farmers to target natural resource concerns. A surprising feature of EQIP in its implementation phase has been the apparently high number of contracts (17% of total) involving postsigning withdrawal of one or more practices. The focus of this paper is to try to understand why cancellations of conservation practices in partially completed contracts occur, and, in the process, learn about how the incentive structure in an agri-environmental program can have unintended consequences.

How Has EQIP Been Implemented?

The Environmental Quality Incentives Program is administered by the Natural Resource Conservation Service (NRCS). It provides technical, f nancial, and educational assistance to farmers with working farmland used for agricultural production. While the 2002 FSRI Act will affect EQIP implementation, this section focuses on program functioning prior to such changes.

Since 1996, EQIP has offered 5- to 10-year contracts that provide cost-sharing and incentive payments for conservation practices called for in site-specif c conservation plans. Nationally, half of the funding for EQIP was targeted to natural resource concerns related to livestock and the remainder to other signif cant conservation priorities. The program is available nationwide, with an emphasis on locally identif ed priority areas or signif cant statewide resource concerns. Only persons engaged in agricultural production are eligible to participate.

As stated in the 1996 Federal Agriculture Improvement and Reform (FAIR) Act, EQIP's principal objective has been to achieve the greatest possible environmental benef ts per dollar of program expenditure. On the benef t side, EQIP requires activities to be carried out according to a conservation plan explaining how changes in farming practices will address primary natural resource concerns in the area. Natural resource concerns and the benef ts from addressing them were further prioritized according to geographic areas.

On the cost side, farm operators proposed a cost-share level (up to 75%) for each practice they intended to undertake as part of their conservation plan. An "offer index" was calculated by NRCS for each proposed conservation plan

by considering the environmental benef ts and the cost-share request for each practice.

Geographic environmental targeting was introduced to direct limited conservation funds to areas of greatest environmental concern. Prior to the reauthorization of EQIP in the 2002 Farm Act, the funding mechanism adopted by EQIP relied on the def nition of *priority areas* def ned at the watershed level, or around areas of special environmental sensitivity or presenting signif cant natural resource concerns.[1] Local conservation districts convened "work groups" to determine priority areas. The local work groups conducted a conservation needs assessment and developed proposals for priority areas.[2] These proposals were submitted to the NRCS State Conservationist, who selected the areas to be funded within the state based on the recommendations from the State Technical Committee. Ideally, understanding the problems and their causes within these priority areas provided focus to program strategies, as opposed to a more general, geographically broader targeting. An average of almost 73% of the total f nancial assistance available was allocated to priority areas during 1997–2001.

NRCS evaluated and ranked proposals from farm operators based on a point system. Ranking points were determined numerically according to the general guidelines provided at the state level, with each resource concern having an associated maximum point value in each priority area.[3] The rankings provided higher point values to practices or structures with greater expected benef ts.[4] The "offer index" was calculated for each proposal by dividing the total cost-share request by the number of ranking points. Proposals were most likely to be funded if they addressed crucial resource concerns identif ed by the local work groups. Proposals providing the same benef ts for the least amount of program expenditure were favored.

The EQIP program was authorized at $1.3 billion over FY 1996 through FY 2002, with annual amounts of $200 million per year.[5] Assuming the level of funding authorized by the 1996 Act, NRCS estimated 35.7 million acres of agricultural land would be enrolled by 2002, including 18.5 million acres of cropland, 3.7 million acres of pasture, and 13.5 million acres of rangeland (Federal Register). Table 1 presents the contractual obligations underwritten by the government and the farmland (including cropland, rangeland, and pasture) and cropland acreage covered by these contracts. With nearly 42.6 million acres of farmland already under contract by 2001, the goal of 35.7 million acres set out at the inception of the program was reached a year ahead of time.

Table 1. Overview of EQIP contractual obligations: The first 5 years

	1997	1998	1999	2000	2001	Total
Number of contracts	24,592	20,100	18,486	16,164	17,389	96,731
Contract obligations (millions $)	174	152	134	132	151	743
Farm acres (millions of acres)	8.633	9.278	8.730	7.460	8.544	42.646
Cropland acres (millions of acres)	2.602	2.259	2.043	1.824	1.919	10.647

Source: Natural Resource Conservation Service based on "FSA system 36 database—record 01". File can be found at: ftp://ftp.nhq.nrcs.usda.gov/pub/outgoing/eqip/quikfacts-4th01.xls.

The share of projects dealing explicitly with cropland, whether addressing soil erosion or other resource management issues, appears to be lower than initially anticipated. Of the 42.6 million acres under contract, only 10.6 million appear to be cropland. This factor is signif cant given that NRCS considers conservation practices on cropland to have signif cantly greater benef ts than on other types of land (Federal Register).

EQIP Contracts: Full Performance versus Withdrawal of Conservation Practices

The main objective of this paper is to provide insight into the practical implementation of EQIP, and to understand the reasons behind the apparently high rate of withdrawal of contracted conservation practices by participating farmers. By combining a bidding process with the prioritization among natural resource concerns, EQIP's framework would appear to be an eff cient mechanism for allocating the limited funds available for natural resource conservation. However, once proposals are approved and a contract signed, approximately 11% of the planned conservation practices never get implemented. Of the 215,000 conservation practices scheduled to be implemented in 1997–2000, 24,299 were withdrawn after a contract was signed (see f rst row in table 2).

From 0 to more than 10 practices were withdrawn from single contracts. One or more of the conservation practices approved were withdrawn in 10,497 of 62,734 contracts (17% of contracts). The resulting disconnect between the expected social benef ts and those arising from practices actually implemented can be highly relevant in the overall evaluation of EQIP as a program.

Nearly 3,700 contracts (6% of total) were withdrawn in full (ws = 1.0; table 2). This drop-out rate is puzzling given the voluntary nature of the program and the considerable transaction costs involved in preparing, bidding, and f nalizing a contract. Did farmers underestimate the contractual burden compared with business-as-usual f nancial assistance? If so, has this phenomenon decreased over time? Are some farmers bidding too low?

At the other extreme, there are a substantial number of contracts where most practices in the conservation plan are still performed. For example, 70% or more of the proposed practices were implemented (ws < 0.3) in 2,677 contracts involving withdrawals. This paper investigates the motivation behind these partial withdrawals, and whether, taking into account all other relevant factors, certain types of conservation practices are being dropped more than others. This would be consistent with rational behavior if some conservation practices increase the conservation plan's probability of being accepted. However, this has a negative impact on program performance considering that the funds allocated to withdrawn conservation practices are often lost to the program. Since 17% of contracts are not fully implemented, this raises the question of whether EQIP is achieving the stated objective of obtaining the greatest possible environmental benef t per dollar used.

A Model of Moral Hazard in EQIP Contracts with Limited Enforcement

The EQIP application procedure, with its relatively complex process of assessing benef ts and costs for each application, is characterized by information

Table 2. Number of conservation practices (CPs) by share of contract withdrawn (ws) and by number of withdrawn CPs

		Number of Practices Withdrawn in a Contract												
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**>10**	**Total**
Number of CPs withdrawn		0	5,201	4,616	3,396	2,892	1,910	1,578	959	848	603	580	1,716	24,299
Number of contracts linked to withdrawals														
Share of contract withdrawn	ws = 0	52,237												52,237
	0 < ws < 0.10		337	17	2									356
	0.10 < ws < 0.20		1,155	187	21	6	4	3						1,376
	0.20 < ws < 0.30		486	295	86	39	24	9	4		1		1	945
	0.30 < ws < 0.40		647	369	171	79	32	30	18	11	1	5	1	1,364
	0.40 < ws < 0.50		954	288	199	102	63	33	25	18	5	10	15	1,712
	0.50 < ws < 0.60					46	22	36	8	10	13	4	7	146
	0.60 < ws < 0.70			277	85	77	22	19	18	9	6	7	15	535
	0.70 < ws < 0.80				88	60	38	19	8	12	5	3	20	253
	0.80 < ws < 0.90						33	17	8	9	9	3	12	91
	0.90 < ws < 0.99											5	17	22
	ws = 1.0		1622	875	480	314	144	97	48	37	27	21	32	3,697
Total contracts by # of CPs withdrawn		52,237	5,201	2,308	1,132	723	382	263	137	106	67	58	120	62,734

Source: the author based on "FSA system 36 database—record 11."

asymmetries between the farmer and NRCS. This generates problems of adverse selection and moral hazard (Holt, Cox et al.). Adverse selection occurs ex ante to a farmer's decision to enter a contract, given that NRCS can observe the costs incurred by the farmer to install a practice, but not the *private* benef ts accruing to the farmer. Farmers have an incentive to try to be compensated in excess of the minimum amount necessary to induce them to enter in an agreement (the minimum cost-share would be the difference between the private benef ts and costs). Given that the program objective has been to maximize environmental benef ts per dollar of program expenditure, providing payments in excess of the farmers' willingness to accept represents a loss in program eff ciency.

The competitive bidding process is meant to limit adverse selection by decreasing the cost-share requested by farm operators, increasing the benef ts per dollar of program expenditure. However, after a farmer has entered into a contractual agreement, moral hazard may arise if the incentive to outbid other producers is combined with limited enforcement capabilities of the conservation authority (in this case, a joint task of NRCS and the Farm Service Agency).

The economic model adopted here focuses on two aspects of the EQIP implementation process: (i) each farm operator, when presenting a conservation plan for approval, tries to maximize the expected net private benef ts obtained, and (ii) once a contract is approved, it is assumed that the farm operator will compute private benef ts and costs and decide whether to implement every proposed conservation practice.

Given EQIP's selection criteria, the farm operator can control which conservation practices (CP) to propose and at what cost-share level. These two variables will determine the producer's expected benef ts. Neglecting the uncertainty surrounding the actual benef ts and costs of conservation practices, the problem is decomposed as follows: let the private $Net\ Benefit_{ij}$ for producer i and practice j be def ned as

$$(1) \qquad Net\ Benefit_{ij} = Gross\ Private\ Benefit_{ij} - (1 - offlvl_{ij}) \cdot Estimated\ Cost_{ij},$$

where $Net\ Benefit_{ij}$ is the private benef t to the farm operator after accounting for the practice's costs and $offlvl_{ij}$, which is the proposed cost-share rate.

The benef t from each conservation practice, however, is conditional on the approval of the entire conservation plan. Assume that the probability of approval, P, will depend on the type of practices proposed (CP_{ij}, a dichotomous variable representing whether practice j is present in the conservation plan), on the cost-share requested ($offlvl_{ij}$), and on factors outside of the farmer's control (EXT). Then the private total expected benef ts can be written as

$$(2) \qquad E[Total\ Benefit_i] = P[CP_{ij}, offlvl_{ij}, EXT] \cdot \left[\sum_j Net\ Benefit_{ij} \right].$$

Once a contract has been approved and signed, the farm operator's decision problem enters the practice implementation phase. The farmer has to decide whether to comply fully with the contractual agreement or face the chance of a penalty if some practices of the conservation plan are not installed.[6]

EQIP contracts contain a "liquidated damages" provision, providing for payment from the producer to the government of a certain f xed amount in the event of a breach (actual damages from the breach being extremely diff cult to ascertain). However, the author is unaware of the application of this clause by the Farm Service Agency (FSA). In the analysis that follows, it is assumed that the expected penalty of a breach is negligible. This may be an economically rational course of action on the part of FSA if it is costly to determine liquidated damages and enforce them. The literature on principal–agent theory applied to procurement contracting (Dunne and Lowenstein) and to agri-environmental policies (Ozanne, Hogan, and Colman) supports this possibility.[7]

If there is no penalty for opting out of implementing a specif c conservation practice, the two decision stages are effectively decoupled. In the second stage, the farmer analyzes each conservation practice separately and decides based on private benef ts and cost associated with that practice. This implies that a practice that may have been attractive because it increased the probability of approval of the conservation plan, either by its very nature or because of a low cost-share request for the practice, may be withdrawn.

In this second stage, let w_{ij} be the decision by farmer i to withdraw from conservation practice j.[8] Since w_{ij} can take on only two possible values, the stochastic behavior of w_{ij} is described by the probability of a positive response, $P(w_{ij} = 1|\mathbf{X})$, which is here taken to depend on a vector-valued variable **X,** representing the benef ts and cost components of implementing a practice, the expected penalty of withdrawing the practice, and socioeconomic characteristics of the farmer. Assuming farmers weigh benef ts and costs for each practice, the decision process can be represented by

$$w_{ij} = \begin{cases} 1 & \text{if} \quad \textit{Net Benefit}_{ij} < 0 \\ 0 & \text{if} \quad \textit{Net Benefit}_{ij} \geq 0 \end{cases},$$

where negative net benef ts lead to withdrawal. In what follows, assume that $\textit{Net Benefit}_{ij}$ is related to $\mathbf{X}$ linearly (as in equation (1)) with an additive random component,

$$\textit{Net Benefit}_{ij} = \alpha + \boldsymbol{\beta} \cdot \mathbf{X}_{ij} + \varepsilon;$$

then outcome probabilities are determined by

$$P(w_{ij} = 1|\mathbf{X}) = P(\alpha + \boldsymbol{\beta} \cdot \mathbf{X}_{ij} + \varepsilon < 0). \tag{3}$$

Three common specif cations of the probability model are the linear probability model, the probit model, and the logit model. The logit specif cation was employed in this study (Amemiya, Theil).[9] Specif cally, the logit is def ned as the natural logarithmic value of the odds in favor of a positive response (in this case withdrawal from a contracted practice).

$$L_{ij} = \log\left[\frac{P_{ij}}{1 - P_{ij}}\right] = \alpha + \boldsymbol{\beta} \cdot \mathbf{X}_{ij}, \tag{4}$$

where:

Farmers $i = 1, 2, \ldots, n$
Conservation practices $j = 1, 2, \ldots, m$
P_{ij} is the conditional probability of a conservation practice being withdrawn given the knowledge of $\mathbf{X}_{ij}$,
$\mathbf{X}_{ij}$ are a set of farmer characteristics, contracted conservation practices, cost-share level and other factors inf uencing the benef t-cost considerations,
$\boldsymbol{\beta}$ is a vector of parameters to be estimated.

Data Description and Empirical Analysis

Data for the analysis, which spans from 1997 to the end of f scal year 2000, were provided by the Natural Resource Conservation Service (NRCS), the USDA agency in charge of administering EQIP. As part of administering the program, NRCS collects data on the conservation plans submitted by producers, on the cost-share requested in the bids, and, for approved contracts, the implementation of practices, total costs, and the dollar amount disbursed by EQIP. The data comprising 224,000 observations for approved conservation practices were taken from an electronic database maintained by FSA. After accounting for inconsistencies and missing values, 215,136 usable observations remained. An observation is constituted by a conservation practice associated with a specif c contract and farm operator and includes the cost of the practice, the offer level, and the code identifying the farm location by county. Variables are also available identifying the extent of the practice to be performed according to the appropriate units of measurement, the amount of farmland and cropland, whether the contract is linked to livestock production, and if there are multiple farm operators associated with a contract.

Ideally, both the expected total benef ts from presenting a conservation plan (phase 1) and the net benef ts stemming from implementing a single conservation practice (phase 2) could be quantif ed. Unfortunately the *expected* total benef ts could not be computed because detailed data are kept only for approved contracts. Therefore, the probability of accepting a conservation plan cannot be estimated since no data are available concerning practices proposed, total cost, and offer level for rejected conservation plans. The analysis presented here will not be able to test directly whether including certain proposed conservation practices will increase the expected total benef ts. However, it will be possible to test this hypothesis indirectly by seeing if certain types of practices are consistently dropped after approval.

Although the cost data are available, the private benef t to the farmer is not observable. While private benef ts must exist since EQIP does not allow for full refunds, the question is what variables can be used as proxies. Following from the USDA cost–benef t analysis procedure for assessing EQIP performance, it is assumed that the amount of farmland and cropland involved in a contract are directly related to benef ts. It is further assumed that different practices provide benef ts of different magnitude to the farm operator. Incorporating these changes, a logit estimation is carried out of the form

$$P_{ij} = F(\boldsymbol{\beta}'\mathbf{X}) = \frac{1}{1 + e^{-(\alpha + \beta'\mathbf{X}_{ij})}}, \tag{5}$$

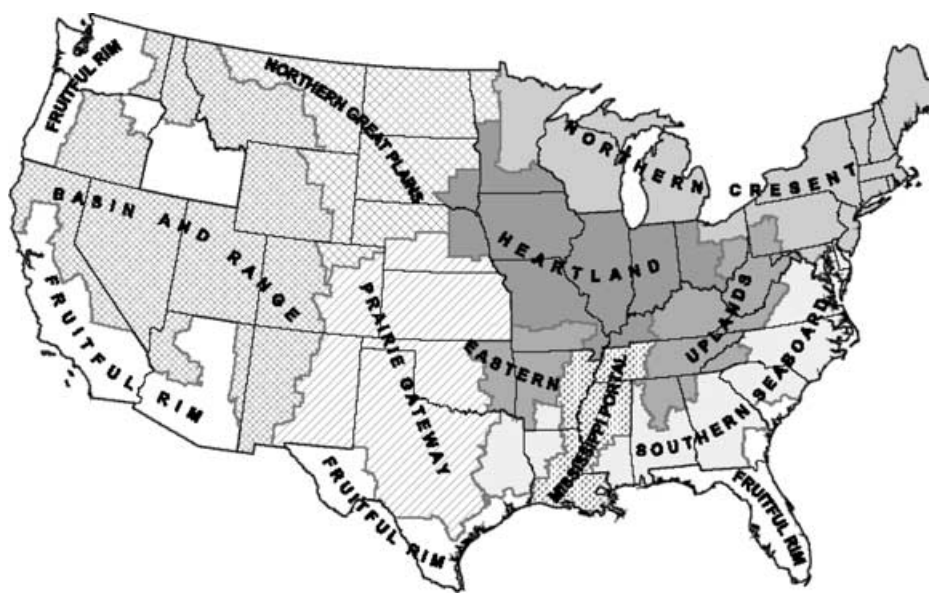
and the basic equation used in the logistic regression is

$$(6) \qquad \textit{Net Benefit} = \beta_0 + \beta_1 \cdot PRACTYPE + \beta_2 \cdot FMLD + \beta_3 CRPSHR + \beta_4 \cdot OFFLVL + \beta_5 \cdot ESTCOST + \beta_6 \cdot SCHEDYR + \varepsilon,$$

where *PRACTYPE* is a categorical variable indicating the type of technical practice involved, *FMLD* is the amount of farmland (in hundreds of acres), and *CRPSHR* is the portion of farmland in crops covered by the contract (in percentage terms).[10] This equation is a bare bones formulation that considers only the variables in equation (1). Three alternative formulations were also estimated to test the hypotheses that conservation practice withdrawals may be linked also to contract characteristics and to regional socioeconomic conditions.

Characteristics that may matter are the number of practices and farm operators in the contract. Dummy variables were introduced for farm location based on the ERS Farm Resource Regions classif cation (f gure 1), to take into account the regional variation in the type of commodities produced, natural resource constraints faced, and general economic conditions of farmers involved in the contracts (http://www.ers.usda.gov/emphases/harmony/issues/resourceregions.htm). So, for example, the Fruitful Rim region has the greatest share of large farms, with 10% of the farms and 22% of the production value (producing mainly fruit, vegetables, nursery, and cotton). The Eastern Uplands region, in contrast, has the most small farms, with 15% of the country's farms accounting for 5% of production value (focusing on tobacco and poultry and part-time cattle farms). Natural resource concerns, too, will differ regionally: Soil erosion will generally

Figure 1. ERS Farm Resource Regions: Accounting for geographic distribution of U.S. farm production and natural resource constraints



be more of an issue in the Heartland, Mississippi Portal, Prairie Gateway, and Southern Seaboard.

Table 3 presents the full set of independent variables hypothesized to affect the probability of withdrawal of a conservation practice. The inclusion of *SCHEDYR* among benef ts and costs is meant to capture how the farm operators' perception of benef ts and costs may change over the life of the program, representing in some way the learning curve associated with participating in a new program.[11] With this interpretation, a decrease in the probability of withdrawal over time is expected.

Table 4 presents the results for the basic logistic regression, and alternative formulations that consider the characteristics of a contract and the socioeconomic conditions of farmers. The results are presented as $e^{\boldsymbol{\beta}}$ because the exponentiated form conveys the change in odds (as a multiplicative effect) that each independent variable has on the chances of withdrawal from a conservation practice.

Column (1) of table 4 presents the results for the basic regression. The categorical variable *PRACTYPE* proved to be signif cant at the 1% level, and when it is decomposed into $k - 1$ dummy variables (*SOIL & LAND MANAGEMENT* was dropped), the only coeff cient that was not signif cantly different from zero was that for "*LIVESTOCK NUTRIENT MANAGEMENT*." The coeff cient for *WATER MANAGEMENT* is 1.0461, meaning that if a conservation practice is classif ed as a water management practice, the odds of withdrawal increase by 4.6% relative to the unweighted average odds of the sample. The striking result from this basic regression, conf rmed by the alternative formulations (as discussed later), is the 26% higher odds of *HABITAT* conservation practices being withdrawn (1% signif cance level). This result appears to conf rm the hypothesis that some practices may be attractive in the proposal stage but not in the implementation phase because of low private benef ts.

Continuing with the basic regression, substantially lower odds of withdrawal for *CROP NUTRIENT MANAGEMENT* (−18%) indicate higher private returns in those practices that also are considered to have the highest social returns in USDA's benef t-cost analysis. Farmland (*FMLND*) and the share of cropland (*CRPSHR*) are both highly signif cant and with the expected sign. However, even though they do ref ect greater benef ts, it appears from the limited impact on the odds of withdrawal (less than 1%) that the extent of the practice is less important to farmers than the type of practice in determining implementation. The odds of withdrawal decrease by 2% for every additional 1,000 acres involved in a conservation practice, and similarly for the share of land in crops; a 2% decrease in odds is encountered for an increase of 10 percentage points, implying greater private benef ts associated with practices linked to cropland.

At f rst glance, it would appear the cost-share requested (*OFFLVL*), which is also highly signif cant but with an impact of only 1%, would not greatly affect the odds of withdrawal. However, considering the range of variation in the cost-share requests found in the data (from 20% to 75%), a one-to-one relationship on the withdrawal odds would have a considerable impact (e.g., an increase in the *OFFLVL* from 50% to 70% would decrease the odds of withdrawal by 20%). On the cost side, the result is quite surprising to the extent that COST is signif cant at the 1% level but with an opposite sign from that expected. This may indicate that given the heterogeneity of practices inside our broad classif cation,

Table 3. Independent variables for logistic regression

Variable	Definition	Units	Expected Sign
Benef ts			
PRACTYPE	Categorical variable specifying		
Soil & Land Mng	broad types of conservation		?
Water Management	practices based on the NRCS		?
Livestock Nutrients	def nition for each practice		?
Crop Nutrients			?
Habitat			–
Other Practices			?
FMLND	Amount of farmland under contract for a conservation practice	10^2 Acres	–
CRPSHR	Share of *FMLND* that is in crops	%	–
Costs			
OFFLVL	Cost-share requested for practice	%	–
COST	Total estimated cost per practice	10^3 $	+
SCHEDYR	Year of program in which practice is to be performed (values = 1, 2, 3, 4)		–
Contract characteristics			
PRNUM	Categorical variable indicating total		
Practice number = 1	number of practices specif ed in a		
Practice number: 2–3	contract		+
Practice number: 4–7			+
Practice number >8			+
HABT_G3	Dummy variable for habitat conservation practices included in contracts that contain more than three practices		+
PRIORITY	Dummy variable for farms in priority areas (affects the application procedure through fund availability)		?
MULTPRD	Multiple Producers (= 1 if more than one producer is listed in the contract)		?
Producer characteristics			
LIVSTPRD	Livestock Producers (= 1 if livestock producer)		?
REGION	Location of producer according to		
Northern Crescent	ERS Farm Resource Regions used		?
Northern Plains	to capture the socio-economic		?
Prairie Gateway	variation in the sample.		?
Eastern Uplands			?
Southern Seabord			?
Fruitful Rim			?
Basin & Range			?
Mississippi Portal			?

Table 4. Parameters estimates of factors affecting conservation practice withdrawal

Variable Name	Basic (1)	With Contract Characteristics (2)	With Contract Characteristics (3)	All Regressors (4)
PRACTYPE	(0.000)**	(0.000)**	(0.000)**	(0.000)**
Water Management	1.0461	1.0437	1.0633	1.0926
	(0.001)**	(0.002)**	(0.009)**	(0.000)**
Livestock Nutrients	0.9751	0.9940	1.0198	1.0579
	(0.321)	(0.813)	(0.455)	(0.040)*
Crop Nutrients	0.8227	0.8074	0.8187	0.7971
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
Habitat	1.2645	1.2721	1.1674	1.1076
	(0.000)**	(0.000)**	(0.000)**	(0.009)**
Other	0.9506	0.9346	0.9462	0.9572
	(0.002)**	(0.000)**	(0.002)**	(0.015)*
FMLND	0.9989	0.9987	0.9987	0.9983
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
CROPSH	0.9969	0.9973	0.9974	0.9981
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
OFFLVL	0.9911	0.9907	0.9909	0.9913
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
COST	0.9836	0.9884	0.9893	0.9897
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
SCHEDYR	0.8128	0.8153	0.8182	0.8102
	(0.000)**	(0.000)**	(0.000)**	(0.000)**
PRNUM		(0.000)**	(0.000)**	(0.000)**
Practice number: 2–3		1.2634	1.2811	1.3022
		(0.000)**	(0.000)**	(0.000)**
Practice number: 4–7		1.2960	1.3041	1.3195
		(0.000)**	(0.000)**	(0.000)**
Practice number > 8		1.6107	1.6340	1.6396
		(0.000)**	(0.000)**	(0.000)**
HABT_G3			1.1426	1.1362
			(0.013)*	(0.018)*
PRIORITY			0.8655	0.8805
			(0.000)**	(0.000)**
MULTPRD			0.9337	0.9473
			(0.008)*	(0.041)*
LIVSTPRD				0.9150
				(0.000)**
REGION				(0.000)**
Northern Crescent				0.9036
				(0.000)**
Northern Plains				0.8868
				(0.000)**
Prairie Gateway				1.4117
				(0.000)**

Continued

Table 4. Continued

Variable Name	Basic (1)	With Contract Characteristics (2)	With Contract Characteristics (3)	All Regressors (4)
Eastern Uplands				0.8873 (0.000)**
Southern Seabord				1.1685 (0.000)**
Fruitful Rim				1.0349 (0.138)
Basin & Range				0.9300 (0.006)**
Mississippi Portal				1.0855 (0.001)**
Model χ^2	2,087	2,472	2,579	3,314
Probability	0.0000 (df 10)	0.0000 (df 13)	0.0000 (df 16)	0.0000 (df 25)
Nagelkerke R^2	0.019	0.023	0.024	0.031

Numbers in parentheses are signif cance levels: single and double asterisks indicate statistical signif cance at 5% and 1%, respectively.

the more costly practices may be the ones with higher returns and therefore preferred.

The f nal consideration concerning the basic regression in column (1) of table 4 is that the scheduled year of implementation (*SCHEDYR*) is highly signif cant and shows a 19% decrease in the odds of withdrawal for every additional year since the inception of the program. This indicates that a greater number of contracts were cancelled at the beginning of EQIP as part of a learning curve associated with the innovations introduced by the program.

In the second regression, the total number of conservation practices in a single contract (*PRNUM*) was added in the equation. The rationale behind the inclusion of this variable is that practices may be added to increase the probability of acceptance of the conservation plan and dropped in the implementation phase. This should be ref ected as a higher probability of withdrawal if a practice is part of a contract with many other practices.[12] The results for *PRNUM* are presented as the impact on the odds relative to contracts with only one practice.[13] The f ndings indicate a very large and signif cant impact with the expected sign: If a practice belongs to a contract with a total of two to three practices, the odds of withdrawal increase by 26% relative to one practice in the contract. This rises to 61% if the contract has eight or more practices. Adding *PRNUM* as an additional independent variable does not affect the signif cance or the magnitude of the other coeff cients, indicating that the results of the basic regression are robust.

In the third regression, three dummy variables were added relating to contract characteristics: (i) *HABT_G3* tests for the relevance towards withdrawal of habitat practices in contracts with four or more conservation practices, (ii) *PRIORITY* indicates the farmer is located in a conservation priority area, and (iii) *MULTPRD*

indicates whether a conservation practice belongs to a contract involving multiple farm operators. Given the very big impact of *HABITAT* in the previous two regressions, *HABT_G3* is introduced to further ref ne our hypothesis that some conservation practices are simply add-ons to improve the probability of acceptance. Since the impact on withdrawal of habitat and of the number of practices in a contract is already being controlled for, the presence of *HABT_G3* tests the possibility that the habitat practices being withdrawn have a stronger presence in contracts with a large number of practices. This is indeed the case: *HABT_G3* is signif cant at the 5% level and indicates that the odds of withdrawal for habitat practices in large contracts are 14% above those for other habitat practices. Introducing *HABT_G3* as an additional variable has an impact, as would be expected, on the coeff cient of *HABITAT*, which is reduced from 27% to 17%.

The fact that a practice is to be installed in a conservation priority area (*PRIORITY*) reduces the odds of withdrawal by 13%. This is important from the policy perspective, since two-thirds of EQIP funds were meant to be targeted towards priority areas. The smaller withdrawal probability occurring inside priority areas may be attributable to higher private returns from conservation practices addressing pressing local natural resource concerns. More eff cient screening of applications by NRCS may also be a factor, thanks to the ranking procedures based on local criteria as opposed to comparing applications from widely divergent areas within a state.

The impact of *MULTPRD* in regression (3) indicates a statistically signif cant 7% decrease in the odds of withdrawal. The logic behind the possible impact of *MULTPRD* was that organizational complications stemming from multiple farm operator contracts might increase the odds of withdrawal. Since it appears not to be the case, this can be interpreted to mean that higher transaction costs associated with putting together multifarm operator contracts leads to lower withdrawal rates if the contract is approved.

The f nal regression is an attempt to include farm operators' socioeconomic characteristics that are independent of EQIP procedures but that may affect the probability of withdrawal. These were whether the farm operator contracting a practice is a livestock producer (*LIVSTPRD*) and the location of the farm according to the Economic Research Service's Farm Resource Region classif cation. The Farm Resource Regions are used here as a proxy for a set of variables encompassing type of commodities produced, natural resource constraints, and general economic conditions that may differ among areas.

An important f nding is that *LIVSTPRD* is highly signif cant, indicating that if a practice is contracted by livestock producers, the odds of withdrawal are 8% lower relative to a practice being contracted to non-livestock producers. EQIP had to explicitly channel at least 50% of funds to livestock-related practices. The reliability, in contractual terms, of livestock producers is therefore good news for EQIP and for environmental issues arising from livestock production.

The location of farm operators in different regions is highly signif cant for all regions except the Fruitful Rim. Relative to the unweighted average odds of the sample, the location of the farmer has a considerable impact on the odds of withdrawing a practice. The impact ranges from a 41% increase for farmers in the Prairie Gateway to a 10%–11% decrease for those in the Northern Crescent, Northern Plains, and Eastern Uplands. Interestingly, introducing this additional

information alters only slightly the coeff cients of the independent variables. The robustness of the results conf rm our hypotheses about the characteristics of EQIP that may be leading to high withdrawal rates.

In all four regressions, the likelihood ratio test indicates that the amount of variation explained by the model was signif cantly different from zero beyond the 1% level. As an indication of the goodness-of-f t, the measure of association between the predicted and the observed withdrawals (assuming a cut-off point of 0.11, equal to the relative share of withdrawals) showed 55% and 58% of the sample being correctly predicted in, respectively, the basic regression and regression (4).[14]

Program Incentives and Structural Issues: EQIP's New Rules and Their Implications for Program Performance

The results suggest that multiple factors contributed to the considerable withdrawal rate of approved conservation practices. Some factors, such as socioeconomic conditions of the farm operator participants are external to the administration of EQIP; however, others relate directly to the EQIP's f nancing mechanism and the incentives that the program creates. A greater number of contracts were cancelled at the beginning of EQIP as part of a learning curve associated with the innovations introduced by the program. This effect has decreased over time, but is important given the relatively short authorization intervals of government programs (4–6 years).

Now that EQIP has been reauthorized with greatly increased funding, this section tries to infer how the program will function in the near future based on the structural components that led to the cancellation of contracted conservation practices and the changes that have been introduced by the 2002 FSRI Act. In other words, will the withdrawal of conservation practices continue or will the new program rules eliminate to some degree the incentives for producers to enter into a contract without carrying it out in full? Furthermore, what other impacts will program changes have in terms of the ratio of environmental benef ts to program cost?

The 2002 FSRI Act introduced some major changes in EQIP, ranging from increased funding to greater program f exibility. These modif cations can be grouped by theme into three distinct categories: changes pertaining to application evaluation procedures, modif cations to contract structure, and program-wide funding allocation. These changes and their implications are discussed below.

Application Evaluation Procedures

The 2002 Farm Act modif es the EQIP application process by eliminating (i) the bidding procedure where farm operators could improve the offer index of their applications by reducing the amount of cost-share funds they would accept, and (ii) the requirement to allocate 65% of funds to established priority areas. Both these changes will likely have a large impact on the costs and environmental benef ts of future EQIP contracts.

The analysis presented here suggests that conservation practices with low cost-share requests tend to have a higher withdrawal rate. Removal of the bidding provision therefore eliminates a structural component of the program that likely played a considerable role in the high withdrawal rates. Because the provision

was perceived as discriminating against limited resource farmers who were less able to bid down their applications, elimination of the bidding mechanism should make the program more equitable. However, these positive aspects may be counterbalanced by a decrease in eff ciency in terms of benef ts per dollar of program expenditure associated with the full cost-share rates.[15]

Eliminating the requirement for priority areas will allow greater f exibility to the states. However, it may be in the states' best interest to maintain spatially specif c environmental targeting. Under the existing program, at least 65% of the total funds were required to be allocated to specially targeted priority areas. This generated an a priori disparity in fund distribution that led to some dissatisfaction among farm operators who were not located within the geographic priority areas. Nonetheless, NRCS reported that the priority areas were a useful tool because, in practice, establishing ranking criteria that addressed statewide concerns in an equitable manner proved diff cult. Since priority areas were smaller geographic units, the ranking criteria proved more useful. Ranking procedures using these techniques are likely to be much less useful when trying to compare applications from widely divergent areas within a state. As a result of the new rule (if the states decide to abandon prioritizing by area), the percent of program funds targeted to special areas will likely decrease and the resulting environmental improvements will presumably be more scattered.

The diff culties in def ning statewide criteria to rank proposals are likely to cause an increase in the proportion of conservation practices withdrawn (as is indicated by the econometric analysis). One option that states may take is to rank applications based on spatially targeted natural resource concerns, without necessarily earmarking a share of funds for priority areas. Applicants who are located strategically for one or more of the resource concerns would be assigned more points. An example of this approach might be, for surface water concerns, to target land that is in the proximity of water bodies not meeting water quality standards (as listed according to Section 303(d) of the Clean Water Act (CWA)). Such an approach would have the advantage that farmers' applications would be evaluated solely on local environmental criteria. Furthermore, the natural resource concern areas could overlap spatially in a more f exible manner than when using priority areas with one boundary for all concerns.

Contract Structure

The new program introduces greater contract f exibility by allowing more than one contract per tract of land and shorter contracts. This increased f exibility regarding contract length will be attractive to farm operators, since many were uncomfortable signing contracts with a minimum length of 5 years. Because technology changes rapidly and commodity prices f uctuate, farm operators have a diff cult time projecting 5 years into the future. Having multiple contracts allows the farm operator to prioritize and address the most signif cant concerns f rst, without the fear that the land will be tied up contractually and ineligible for additional practices for a minimum of 5 years.

Multiple smaller contracts will also decrease the risk to farm operators and reduce the likelihood of contract cancellation. From the econometric results presented here, decreasing the incentive for the farmer to submit conservation plans with many practices would contribute to limiting the withdrawal phenomenon. Multiple contracts will promote the use of progressive planning for natural

resource management so as to allow farmers to gradually work towards a full resource management system (RMS). The previous structure of the program was geared more heavily towards achieving an RMS through one EQIP contract. The added f exibility of multiple contracts per tract will, however, result in an increase in administrative costs.

Payment Limitations, Eligibility, and Overall Funding

New rules will increase the contract payment limitation to from $50,000 to $450,000 for all contracts held by a farm operator through 2007. This change may allow for more environmental concerns to be addressed on an individual contract. It may also remove a barrier to participation for large-scale farmers who felt the payment limits did not offer enough incentive to participate. This may increase the program's use by producers who control a large proportion of sector resources and potential resource needs, making the program more eff cient in terms of environmental benef ts per dollar of program expenditure. This is most likely the case for large conf ned livestock operations (def ned as those operations with more than 1,000 animal units) that were not previously eligible for cost sharing on waste management facilities. They are no longer excluded under the EQIP program.

Another major change was the nearly f vefold increase in funding from $200 million annually to $5.8 billion from 2002 through 2007. Increased funding will have considerable indirect impact on program implementation enabling states and counties to treat resource problems that require more expensive conservation treatments. This factor, combined with the higher payment limitations, should also have a limiting effect on withdrawal of conservation practices since more expensive practices are less likely to be withdrawn.

The new law increased EQIP funds allocated to livestock-related practices from 50 to 60%. Since 62% of the contracted practices were livestock related, this should have a negligible effect on the distribution of funds or program eff ciency.

Conclusions

In broad policy terms, the EQIP program is a f exible, voluntary program popular with farmers because it does not require them to take land out of production as is done by other USDA programs (CRP, WRP, and WHIP). However, the f exibility that makes EQIP successful creates the shortcomings that have been analyzed in this paper. The problem is essentially one of moral hazard that introduces considerable uncertainty on the benef t side due to cancellation by farmers of conservation practices to be implemented under the program.

In a policy environment where it is costly to determine liquidated damages and enforce them, the government may prefer not to pursue action against farmers who do not complete the conservation plan laid out in an EQIP contract. This implies that a practice that may have been attractive because it increased the probability of approval of the conservation plan may be withdrawn.

If increasing enforcement is not viable, the government may modify the incentives that led to withdrawing practices proposed voluntarily. This is a particularly timely issue because EQIP has just been reauthorized with new application and contract structure provisions. From the analysis presented, it appears that the majority of modif cations introduced will reduce the incentive to withdraw practices. Shorter contracts, removal of the limitation of one contract per tract of land, and

elimination of the bidding procedure will contribute to reducing withdrawals, making the benef ts from the program less uncertain (although probably at a higher unit cost). The progressive approach of the new program, by allowing the addition of practices at a later stage, should limit the incentive to propose a broad conservation plan with as many practices as possible, which has led to higher chances of practice withdrawal (especially among the habitat-related practices).

Under the new program, the maximum payment was increased, making it more likely that larger contracts with more expensive practices will be contracted. These practices are less likely to be withdrawn. Large farms will also be more willing to participate in the program, which may provide environmental benef ts that are more cost effective (counterbalancing the loss in program savings arising from the elimination of the bid process).

The potential removal of priority areas is one exception to the overall benef cial effects of the changes introduced by the 2002 FSRI Act. Environmental targeting through priority areas was an effective tool that facilitated the ranking process and was less prone to practice withdrawal compared with contracts approved outside of priority areas on the basis of statewide natural resource concerns. Although NRCS is no longer required to prioritize by area, program performance would benef t from maintaining local ranking criteria.

In conclusion, although in the past there has been considerable withdrawal of contracted conservation practices, EQIP is likely to function more smoothly after the modif cations introduced in the 2002 farm bill. Although the legislative debate was far removed from the technicalities underlying the withdrawals, the greater program f exibility introduced by the 2002 FSRI Act is likely to reduce the ineff ciencies and distortions that were present in the implementation of EQIP in its f rst few years.

Appendix

Table A1 shows conservation practice classif cations in each category for variable *PRACTYPE.*

Table A1. The conservation practice classification: Main practices in each category

Category	Example of Practices by Category	Approved Funds	Contracted	Withdrawn (%)
Habitat conservation	Brush management	11,825,658	6,680	14.0
	Upland wildlife habitat management	1,272,219	2,716	13.6
	Range planting	2,201,942	2,008	19.8
	Windbreak/shelterbelt establishment	1,699,067	1,957	9.8
	Filter strip	661,063	869	14.0
	Forest site preparation	602,056	642	17.9
	Prescribed burning	482,324	640	22.0
	Subtotal for whole data set	20,781,135	17,165	14.6

Continued

Table A1. Continued

Category	Example of Practices by Category	Approved Funds	Contracted	Withdrawn (%)
Crop nutrient manag.	Nutrient management	12,742,347	26,912	8.6
	Pest management1	6,311,656	14,679	8.7
	Residue management, seasonal	814,528	2,896	6.5
	Integrated crop management system	497,543	829	6.3
	Agrochemical mixing facility	311,097	21	28.6
	Subtotal for whole data set	20,697,677	45,347	8.5
Livestock nutrient manag.	Waste utilization	3,780,521	4,451	7.7
	Waste storage facility	45,903,452	4,439	10.2
	Composting facility	8,326,369	1,621	13.3
	Roof runoff management	1,797,670	1,101	13.1
	Waste management system	14,029,715	1,038	12.8
	Animal trails and walkways	1,045,970	602	11.5
	Interim closure of abandoned waste treatment lagoons	2,258,319	279	11.1
	Waste treatment lagoon	1,812,978	215	14.9
	Manure transfer	1,158,632	202	4.0
	Subtotal for whole data set	81,766,440	15,286	10.1
Soil erosion & land management	Prescribed grazing	6,972,158	11,131	7.2
	Critical area planting1	3,963,152	7,062	15.8
	Grade stabilization structure	12,274,104	5,634	11.5
	Grassed waterway	8,698,599	5,542	11.8
	Residue manag., no-till and strip till	6,450,427	5,271	8.2
	Terrace1	9,248,545	3,696	8.3
	Underground outlet	3,807,828	2,310	8.0
	Conservation crop rotation	1,562,143	2,250	8.4
	Subtotal for whole data set	74,934,441	57,504	10.2
Water resources manag.	Trough or tank	8,743,072	11,203	11.6
	Pipeline	13,735,392	8,511	12.6
	Pond	13,166,963	5,889	13.2
	Irrigation pipeline, high-pressure	15,599,463	4,196	10.9
	Structure for water control	6,803,273	3,906	13.0
	Irrigation system sprinkler	19,501,828	2,861	9.2
	Water well	5,862,687	2,741	11.6
	Subtotal for whole data set	131,968,358	57,478	11.8
Other	Fence	24,269,909	15,832	12.7
	Pasture and hay planting	18,479,250	15,085	13.2
	Heavy use area protection	7,669,448	2,881	9.6
	Record keeping	40,470	1,406	5.0
	Animal use area protection	492,640	228	4.8
	Subtotal for whole data set	52,299,576	36,155	12.4

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Endnotes

[1]Although some rules have changed since EQIP was reauthorized, the data used were all gathered before 2002. Therefore, the paper f rst describes the impact of the old rules on withdrawals and then discusses how the 2002 Farm Act changes are likely to affect program performance.

[2]Membership in the local work groups could be made up of federal, state, and local conservation agencies, environmental groups, agricultural producers, and agribusiness representatives. The natural resource concerns considered could include soil erosion, decline in water quality and availability, loss of wildlife habitat, and degradation of wetlands, and forest and grazing lands.

[3]An application by a farmer outside a priority area was ranked according to the point system developed for statewide concerns.

[4]Conceptually, this is similar to the Environmental Benef ts Index (EBI) used to rank the proposals for the Conservation Reserve Program (CRP). The main difference is that the EBI is more structured and transparent, while the EQIP ranking methods favor locally driven criteria under the oversight of the NRCS State Conservationist.

[5]The funding for the initial interim year was $130 million. During the interim administration period in FY 1996, the $130 million was used to continue implementation of the terms and conditions of the superseded programs to the extent that such terms and conditions were consistent with the statutory provisions of EQIP.

[6]The cost-share or incentive payments for a practice are typically disbursed upon completion of the practice, independently of completion of other practices in the conservation plan. A farmer can receive payment for the practices installed even if the contract is breached by not performing some practices.

[7]Formally, the problem considered could be modeled more accurately as a two-period contract procurement game between government and farmer. However, this is diff cult to do in practice given that the good that is being transacted is not fully observable and depends on the combination of conservation practices that a farmer decides to propose in the conservation plan. Since no penalties are observed in practice, it is legitimate to assume that the parameters in the game are such that a pooling equilibrium is reached in which the government never enforces full implementation of the contracts. The reason this system works in practice is that NRCS informally oversees the conservation plan proposal phase, thereby limiting the moral hazard stemming from a zero expected penalty.

[8]Due to data limitations, only this second stage of the farmers' decision to participate in EQIP is considered in the empirical analysis.

[9]The logit model was selected primarily because the majority of the independent variables in our model are dichotomous, which results in data being concentrated in the tails and in the probability distribution resembling a logistic function.

[10]Table A1 in the Appendix presents a description of the main practices in each category for variable *PRACTYPE*.

[11]The variable *SCHEDYR* may also pick up variation over time of the economic condition of producers. However, this is unlikely because change in producer income was not monotonic in 1997 to 2000.

[12]This is not to be confused with the fact that contracts with more practices will have, by default, a higher probability of having at least one withdrawal.

[13]Indicator contrasts were used for *PRNUM* which compare each group of the categorical variable to a reference category that is excluded (in our case Practice Number = 1).

[14]The overall goodness-of-f t for the model is not very good with a Nagelkerke-R^2 of only 2 to 3%. Hosmer and Lemeshow's goodness-of-f t test rejects the hypothesis that the models f tted generated the data. The poor f t is probably attributable to the unbalanced nature of the sample shares of the two outcomes: Although 24,300 conservation practices were withdrawn, this represents only 11% of the sample.

[15]In the broader context of program implementation mechanisms, equity considerations could probably have been addressed by introducing safeguards for small producers rather than eliminating the bidding process. However, it would still have to be determined whether the cost savings that the bidding generated was more than offsetting the foregone environmental benef ts associated with withdrawals. Research on this topic would require a measure of the discrepancy between the expected social benef ts when the contracts were approved and realized social benef ts after accounting for withdrawals.

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