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Farmer Participation in the Dairy Termination Program in North Carolina and Virginia

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INTRODUCTION

The Dairy Termination Program (DTP) was introduced as part of the 1985 Food Security Act in an effort to curb mounting surplus production of milk. Participants contracted to sell all dairy cattle for slaughter or export during one of three disposal periods during 1986-87 and to remain out of the dairy business for a period of five years in exchange for a payment from the U.S. government. Thus, the goal of the program was to achieve a long-term reduction in U.S. milk supply by removing resources from production.

The size of the payment was determined by a competitive bidding process. Producers who wished to do so submitted bids in dollars per hundredweight of base period milk production. A separate bid could be submitted for each of the three disposal periods. After all bids had been submitted, it was announced that all bids less than or equal to $22.50 per cwt. had been accepted. The payment was equal to the amount of the bid multiplied by hundredweight of base production.

The DTP differs from most previous programs in several respects. Participation involved a complete cessation of milk production for a relatively long five-year period, whereas most programs require partial, and temporary, cutbacks. Participation thus involved exit from the industry. The payment received by the participant was determined by a competitive bidding process, rather than simply signing up for a clearly-specified payment per unit of output reduction.

The research reported here examines the relationship between characteristics of the farm and of the farm operator and the decision to participate in the DTP in a sample of North Carolina and Virginia dairymen. Such a study may allow an evaluation of the program, and of the incentives

provided by it. It may be possible to determine what the impact of the buyout has been on industry structure and on current and future milk supplies. Authorization is given to the Secretary of Agriculture to implement future buyouts if necessary, so information about participation in the 1986 DTP will be valuable in predicting the possible effects of future rounds. A farm operator's willingness to participate in the DTP is also an indication of how willing he is to exit the industry normally. An understanding of the factors influencing this decision may be useful in designing new policies to deal with excess capacity in agriculture.

MODEL

Participation in the DTP reduces the farm operator's utility in at least three ways:

(1) He must switch to an alternative work activity (job or farm enterprise) which presumably has lower earnings.

(2) A capital loss on the value of assets may be experienced due to the restrictions placed on their use by the program provisions.

(3) Direct (transactions) costs of participation may be experienced.

I begin by defining the breakeven payment--the after-tax payment which leaves the operator equally well off whether he participates or not.[1] The corresponding breakeven bid, equal to the payment divided by base marketings, is expressed as being proportional to the difference between annual earnings in dairy and in the alternative work activity, plus a compensation for the capital loss and direct cost of participation. Lacking data to measure the latter two

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[1] Obviously the participant will submit a bid that will make him better off if accepted. A more complex model capturing strategic bidding behavior does not add to the empirical model, and is not attempted here. The "breakeven bid" will place a lower bound on the bid.

effects across producers, I incorporate them into a scale effect and concentrate on the earnings difference:

(1) $BID_i = g[E^d_i - E^a_i] + bQ_i$,

where E^j_i represents the earnings individual i can expect to earn in activity j, d=dairy, a=best alternative, and Q_i represents scale of the dairy enterprise. Now express E^j_i in terms of observable operator characteristics:

(2.1) $E^d_i = d_o + d_1 GHC_i + d_2 SHC^d_i + d_3 Z_i + e^d_i$,

(2.2) $E^a_i = a^o + a_1 GHC_i + d_2 SHC^a_i + e^a_i$,

where GHC_i is general human capital which contributes to earnings in all activities, SHC^j_i is human capital specific to activity j, Z^d_i is farm characteristics influencing farm profitability, e^j_i are error terms, and d_i, a_i are parameters, representing the contribution to profitability of the relevant characteristic or factor. The relations (2.1) and (2.2) may be interpreted as indirect profit functions, the explanatory variables as fixed factors when the work activity is farm production.

Now substitute (2.1) and (2.2) into (1) to express BE_i in terms of observable characteristics:

(3) $BID_i = g(d_o - a_o) + g(d_1 - a_1)GHC_i + gd_2 SHC^d_i - ga_2 SHC^a_i$
$+ g_{d3} Z^d_i + bQ_i$.

General human capital has an ambiguous effect on the bid since it contributes to earnings in both the dairy and the alternative activities, while dairy-specific human capital should raise the bid, and human capital specific to an alternative activity should reduce the bid.

In addition to the variables identified above, I will examine the effect of several other important characteristics:

(1) Family transfer of the farm planned. A farm operator who plans to pass on his farm to a younger family member will be less inclined to participate.
(2) Off-farm work may encourage or discourage movement out of farming (Findeis, Hallberg and Lass (1987)). Off-farm work may represent a transition out of farming into full-time non-farm work, or it may be a means by which farmers supplement low farm incomes with off-farm earnings. The effect on the bid will be negative if off-farm work encourages movement out of farming.
(3) Diversification of the dairy. Specialized dairies tend to be more profitable than diversified dairy farms. It may also be easier for a diversified farmer to switch to an alternative enterprise. The DTP should be more attractive to diversified farmers.
(4) Age of operator. The DTP is expected to be attractive to farmers nearing retirement, thus older farmers should be more inclined to participate.
(5) Non-labor income/retirement benefits. Farmers with such an income source will face less risk by participating and should be more willing to participate.

DATA

Utilizing ASCS and N.C. and VA milk commission records, the 377 accepted participants in the two states were identified, along with a randomly chosen sample of 400 continuing producers. Among continuing producers it was not possible to distinguish between producers who had submitted rejected bids and those who did not bid. A questionnaire was mailed to the sample in September 1987, with a reminder letter ten days later. Of the 777 mailings, 359 responses were received from 131 accepted bidders, 34 rejected bidders, and 193 who did not bid (see Table 1).

Table 2A lists the variable names used in this study, while Table 2B presents means and standard deviations. The variables SUBMIT and BID are

biased upward due to the over-representation of accepted bidders in the sample. ED represents general human capital, TRAIN, DAIRYEXP, and MANAGE represent human capital specific to dairy, and NFEXP and HLTHLIM represent non-dairy specific human capital.

Table 3 shows that accepted producers were smaller than continuing producers with lower milk per cow. They were older, used slightly fewer management techniques, were less likely to be planning a family transfer, and were more likely to be eligible for retirement benefits within the next five years, and less likely to be a specialized dairy. These numbers indicate that the DTP was attractive primarily to older farmers using less sophisticated management techniques who do not have a family member interested in the dairy.

STATISTICAL ANALYSIS

Simple OLS estimation of a bid equation may result in biased parameter estimates due to self-selection in the decision of whether or not to bid. The oversampling of accepted bidders may also result in biased estimates. Heckman's two-stage procedure for dealing with censored dependent variables was used (Heckman; Fomby, Hill, and Johnson), and the second stage bid equation was estimated with a type of weighted least squares to correct for the oversampling of accepted bidders. The two stages of estimation included:

(1) estimation of probit equations explaining the probability of submitting a bid (SUBMIT) and the probability of being accepted into the program (ACCEPT). These equations are estimated using observations on both bidders and non-bidders.

(2) estimating an equation explaining the bid level with a correction for possible self-selection bias. The correction consists of inclusion of Heckman's lambda calculated from the first-stage probit equation for the

probability of bidding (that the bid is observed) in the bid equation. The observations are weighted a transformation of the predicted probability that the individual would be accepted into the program to correct for the oversampling of accepted bidders. This estimation is carried out using only data on bidders.

Probability of Bidding

Table 4 presents the result of a probit equation with dependent variable SUBMIT. Schooling and participation in training classes had positive but non-significant effects. Experience in dairying, holding age constant, reduced the probability of bidding. Increased use of management techniques also had a negative effect, but it was non-significant. Older farmers were more likely to bid, as were those not planning a family transfer of the dairy, and those who were eligible for retirement benefits within five years.

Table 5 presents the results of a probit equation with the dependent variable equal to one if the individual was accepted into the program and zero if the individual bid and was rejected or did not bid. Here we find that participation in training classes has a positive effect, while dairy experience and use of management techniques have significant negative effects. A planned family transfer again has a strong negative effect, while age and eligibility for retirement benefits have positive effects. Specialized dairy farms were less likely to be accepted than more diversified farms. There is no significant effect of either non-farm experience, health, or farm size in Tables 4 and 5.

The program appears to have been attractive to farmers nearing retirement age who did not have a family member interested in the farm. More experienced

farmers and those who used better management techniques seem to have been less inclined to participate.

Bid level equations

Table 6 presents the second-stage estimates of a bid-level equation using OLS including LAMBDA, a correction for possible sample selection bias resulting from self-selection of bidders. Specifications including and excluding the LAMBDA variable are presented to evaluate the extent of the bias. Comparison of the two specifications shows that the coefficients on several variables are sensitive to the inclusion of the LAMBDAs. The model is able to explain a reasonable 40% of the variation in the data.

The coefficients on most explanatory variables are consistent with expectations. Schooling (general human capital) does not have a significant effect on the bid. Experience managing the current farm raises the bid, holding age constant, but the coefficient is statistically significant only in the uncorrected specification (without LAMBDA). Use of management techniques raises the bid. There appears to be some evidence that farmers who have invested in dairy-specific human capital are less inclined to quit dairying.

Non-farm work experience has a positive effect, contrary to expectations, but it is not significant. A health limitation that affects non-farm work has an extremely large partial effect, raising the bid between 40 and 80 percent. These results should be considered in light of the fact that very few respondents reported significant amounts of non-farm experience or a non-farm health limitation.

A family transfer was associated with a higher bid, and age with a lower bid, but these effects are non-significant in the presence of the LAMBDAs.

The positive effect of a specialized dairy was also non-signifcant in the presence of the LAMBDAs. The negative scale effect (Q) was not statistically significant.

Table 7 presents some additional effects which were expected to be important, but were never significant in any specification. Surprisingly, participation in training classes and eligibility for retirement benefits, which were important in the probit equation, were not significant in the bid equation. County wages and land values were included to proxy for factor prices and to explain regional differences. Neither performed well in explaining bid levels. Measures of facilities and use of mechanized equipment did not explain bids either.

SUMMARY

Farmers of differing characteristics differ in their willingness to leave farming, and consequently in their willingness to participate in supply control programs. A recognition of this heterogeneity among farm operators could lead to design of more effective policies. Farm programs could be targeted at particular groups of farmers to better achieve policy objectives.

The results presented here suggest that better, more experienced managers are less inclined to quit dairying. While schooling and training classes make individuals more likely to sign up for the DTP, such general human capital did not affect the bid level. Similarly, eligibility for retirement benefits affected the sign up decision, but did not affect the bid level. A planned transfer of the dairy to a family member was an important deterrent to participation. These results, however, may be limited in generality since they were obtained using data from only two southeastern states.

The program appears to have removed the older operators who use outmoded management techniques. This result may be desirable from the point of view that these individuals have poor alternatives to dairying, and might justifiably be compensated to leave dairying to enter early retirement (Tolley). This participation pattern, however, implies that many of the farmers removed would have exited soon anyway, thus the DTP may not have been very effective in achieving a long-term reduction in milk supplies.

The results do not reveal any major deletorious effects of the program on industry structure. The main effects appear to be a reduction in the average age of operator and an increase in average enterprise size. The dominant explanatory variables in this analysis were characteristics of individual operators, rather than farm or regional characteristics. Thus, the participation decision appears to depend primarily on the type of operator rather than on the type or location of the farm.

Table 1
The Sampling Process

Bid	(1) NC & VA population	(2) Mailed	(3) Received	(4) [as pct. of pop.]	(5) Response Rate
none	2350 (76%)		193 (53.8%)	[8.2%]	
		400			56.8%
rejected	367 (12%)		34 (9.5%)	[9.3%]	
accepted	377 (12%)	377	131 (36.5%)	[34.7%]	34.7%
all	3094 (100%)	777	359		46.2%

Numbers in parentheses () are percentages of column totals.
column (4) = (3)/(1), (5) = (2)/(1).

Table 2A
Description of Variables Used in the Study

Variable Name	Description
SUBMIT	=1 if a bid was submitted for the 1986 DTP
BID	The lowest bid submitted for the 1986 DTP
ED	Years of schooling of farm operator
TRAIN	=1 if operator attended classes related to managing the dairy farm in the last 5 years
DAIRYEXP	Years experience since age 18 in dairy farming
FARMEXP	Years experience operating the current dairy
NONFEXP	Years experience in non-farm work
HLTHLIM	=1 if a health limitation limits non-farm work
MANAGE	Number of management techniques used (out of six possible): e.g. DHIA, use of AI, record keeping
COWS86	Average number of cows in the dairy herd 1986
MILK/COW	Average annual milk production per cow 1986
BASE	Predicted output obtained by multiplying predicted herd size by predicted milk per cow
NLINC	=1 if non-labor income exceeded $5000 1986
FAMILY	=1 if a family transfer of the dairy is planned
ELIGIBLE	=1 if operator eligible for retirement benefits within 5 years
AGE	Age of principal operator
DAIRY90	=1 if 90-100% of farm income derived from dairy enterprise
OFFHRS	Average hours per week worked off the farm by farm operator

Table 2B
Means and Standard Deviations
of Variables Used in the Study

Variable Name	Mean	Standard Deviation
SUBMIT	0.51	0.50
BID	18.91	10.26
LN(BID)	2.82	0.47
ED	12.46	2.64
TRAIN	0.53	0.50
DAIRYEXP	30.85	12.24
FARMEXP	23.27	12.83
NONFEXP	6.20	8.67
HLTHLIM	0.02	0.15
MANAGE	3.64	1.55
COWS86	97.68	63.55
MILK/COW	15,575	2454
NLINC	0.38	0.49
FAMILY	0.52	0.50
ELIGIBLE	0.40	0.49
AGE	52.22	11.83
DAIRY90	0.71	0.45
OFFHRS	5.01	12.64

222 Observations remain after deleting observations with missing values from the original 359 questionnaires received. See Table 6.1 for response rates to survey).

Table 3

Means For Bidding and Non-bidding Producers

VARIABLE	NO BID	BID
COWS 1986	97.0	98.3
	(6.14)	(7.15)
MILK/COW	16,103.8*	15,047.0*
	(223.1)	(241.0)
MANAGEMENT INDEX	3.86*	3.41*
	(0.15)	(0.14)
PERFORMANCE TESTING[d] (e.g. DHIA)	0.69*	0.58*
	(0.04)	(0.05)
ARTIFICIAL INSEMINATION[d]	0.86	0.87
	(0.03)	(0.03)
FORAGE QUALITY[d] TESTING	0.68	0.60
	(0.04)	(0.05)
FEED RATION FORMULATION[d]	0.71*	0.57*
	(0.04)	(0.05)
GROUP ANIMALS BY[d] PRODUCTION LEVELS	0.22*	0.14*
	(.04)	(0.03)
KEEP INDIVIDUAL[d] ANIMAL RECORDS	0.71	0.64
	(.04)	(0.04)
AGE OF OPERATOR	49.2*	55.3*
	(1.06)	(1.10)
FAMILY TRANSFER[d] PLANNED	0.64*	0.40*
	(0.05)	(.05)
ELIG. FOR RETIREMENT[d] BEN. WITHIN 5 YRS	0.25*	0.55*
	(0.04)	(0.05)
SPECIALIZED DAIRY[d]	0.75*	0.67*
	(.04)	(0.04)
Number of Observations	112	110

Numbers in parentheses () are standard errors of the mean.
Numbers in brackets [] are number of missing values for the variable.
* denotes a significant difference between means at .05 level.
d denotes dummy variable.

Table 4

Variables Affecting the Probability of Submitting a Bid

Variable	(1)	(2)
CONSTANT	-1.16	-1.28
	(0.950)	(0.874)
ED	0.043	0.046
	(0.042)	(0.041)
		[0.018]
TRAIN^D	0.312	0.308
	(0.206)	(0.201)
		[0.122]
DAIRYEXP	-0.042*	-0.041*
	(0.014)	(0.013)
		[-0.016]
MANAGE	-0.149	-0.087
	(0.132)	(0.072)
		[-0.035]
NONFEXP	-0.010	—
	(0.014)	
HLTHLIM^D	2.00	—
	(2.17)	
FAMILY^D	-0.673*	-0.622*
	(0.211)	(0.197)
		[-0.244]
NLINC^D	0.042	—
	(0.222)	
AGE	0.044*	0.041*
	(0.019)	(0.016)
		[0.016]
DAIRY90^D	-0.362	-0.275
	(0.240)	(0.219)
		[-0.109]
Q	$3\ E^{-5}$	—
	$(5.0\ E^{-5})$	
ELIGIBLE^D	0.697*	0.744*
	(0.285)	(0.276)
		[0.288]

Table 4 (continued)

SOUTHWEST VA.[D]	0.576**	0.627**
	(0.330)	(0.326)
		[0.239]
SHENANDOAH VA.[D]	0.069	0.084
	(0.352)	(0.349)
		[0.033]
NORTHERN VA.[D]	0.707**	0.638**
	(0.406)	(0.399)
		[0.240]
WESTERN NC [D]	-0.499	-0.480
	(0.377)	(0.365)
		[-0.188]
PIEDMONT NC [D]	0.201	0.317
	(0.326)	(0.277)
		[0.125]
EASTERN NC [D]	0.459	0.613
	(0.589)	(0.556)
		[0.228]
-2lnL	70.7	66.4
df	18	14

Number of usable observations = 222
Dependent variable SUBMIT proportion =1 is .51
Maximum likelihood estimates shown
Standard errors reported in parentheses
Derivative evaluated at the means for all variables reported in brackets [] for specification 2.
* Denotes significantly different from zero at .05 level of significance.
**Denotes significantly different from zero at .10 level
D denotes dummy variable. Derivative evaluated for a change from 0 to 1, with all other variables held constant at mean value.

Estimation procedure used = Probit

Table 5

Variables Affecting the
Probability of Acceptance into the DTP

VARIABLE	(1)	(2)
CONSTANT	-1.22	-1.13
	(1.06)	(0.761)
ED	0.027	—
	(0.045)	
TRAIN^D	0.513*	0.567*
	(0.237)	(0.230)
		[0.204]
DAIRYEXP	-0.073*	-0.070*
	(0.017)	(0.016)
		[-0.026]
MANAGE	-0.312*	-0.195*
	(0.146)	(0.081)
		[-0.072]
NONFEXP	-0.020	-0.020
	(0.015)	(0.014)
		[-0.007]
HLTHLIM^D	-0.259	—
	(0.776)	
FAMILY^D	-1.03*	-0.994*
	(0.240)	(0.221)
		[-0.339]
NLINC^D	0.198	—
	(0.244)	
AGE	0.060*	0.066*
	(0.020)	(0.019)
		[0.024]
DAIRY90	-0.656*	-0.676*
	(0.259)	(0.247)
		[-0.256]
Q	$5.0\ E^{-5}$	—
	($5.0\ E^{-5}$)	
ELIGIBLE^D	0.786*	0.741*
	(0.320)	(0.316)
		[0.274]

Table 5 (continued)

SOUTHWEST VA.[D]	0.932*	0.940*
	(0.380)	(0.377)
		[0.360]
SHENANDOAH VA.[D]	0.371	0.401
	(0.418)	(0.410)
		[0.154]
NORTHERN VA.[D]	1.44*	1.46*
	(0.45)	(0.44)
		[0.528]
WESTERN NC [D]	0.005	0.086
	(0.430)	(0.420)
		[0.032]
PIEDMONT NC [D]	0.586	0.798*
	(0.377)	(0.328)
		[0.301]
EASTERN NC [D]	1.08**	1.17*
	(0.619)	(0.600)
		[0.438]
-2lnL	103.6	101.4
df	18	14

Number of usable observations = 222
Maximum likelihood estimates shown
Standard errors reported in parentheses
Derivative evaluated at the means for all variables reported in brackets [] for specification 2.
Dependent variable ACCEPT proportion=1 is .39
* Denotes significantly different from zero at .05 level of significance.
**Denotes significantly different from zero at .10 level
D denotes dummy variable. Derivative evaluated for a change from 0 to 1, with all other variables held constant at mean value.

Derivatives are evaluated at the means

Estimation procedure used = Probit

Table 6

Estimated Bid Equations
Whole Sample

VARIABLE	(1)	(2)
INTERCEPT	2.86*	1.81*
	(0.020)	(0.430)
ED	-0.005	0.013
	(0.020)	(0.021)
DAIRYEXP	0.022*	0.012
	(0.008)	(0.010)
MANAGE	0.124*	0.120*
	(0.038)	(0.038)
NONFEXP	0.011	0.009
	(0.007)	(0.007)
HLTHLIM[d]	0.490*	0.810*
	(0.227)	(0.278)
FAMILY[d]	0.350*	0.150
	(0.101)	(0.144)
NLINC[d]	-0.062	-0.055
	(0.101)	(0.100)
AGE	-0.021*	-0.005
	(0.008)	(0.012)
DAIRY90[d]	0.209**	0.143
	(0.119)	(0.122)
Q	-4.5 E-6	-3.0 E-6
	(3.2 E-6)	(3.2 E-6)
LAMBDA	—	0.410*
		(0.213)
R^2	0.41	0.43

Dependent Variable = ln(BID)
Six regional dummy variables were also included (see Table 7.11)
E-5 represents x 10^{-5}
* Denotes significant at .05
**Denotes significant at .10
d Denotes a dummy variable
Standard errors in parentheses

107 observations after deleting observations with missing values

Table 7

Estimated Partial Effects of Additional Variables on Bid Levels

Variable	Partial Effect
TRAIN	-0.036 (0.107)
Eligible for Retirement Benefits within 5 years	-0.118 (0.208)
Average Hours per Week Worked Off the Farm	0.007# (0.005)
Average Weekly Wage in County (All Industries, mean=292.85,s.d.=44.35)	-0.0012 (0.0013)
Average Value per Acre of Farmland and Buildings in County (mean=1258.2, s.d.=443.9)	0.00007 (0.00016)
Stanchion Barn with Pipeline or Bucket milking system (mean=0.24,s.d.=0.43)	-0.034 (0.130)
Mechanized Equipment index (range:0-6,mean=1.61,s.d.=1.27)	0.031 (0.041)
Uses no mechanized equipment in milking parlor (mean=.24,s.d.=.48)	-0.106 (0.139)

Parameter estimate shown with standard error in paretheses.
Specification is same as in Table 6, col. 2, with each of the above variables entered separately as an additional explanatory variable.
#The coefficient on off-farm work was obtained using two-stage least squares with instruments for off-farm work, including age, experience, herd size, diversification, schooling and number of school-age children.