Assessing Participation in the Milk Income Loss Contract Program and its Impact on Milk Production

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Abstract

The MILC program, a counter-cyclical income support program, was designed to provide price support to dairy farmers. Since the inception of the MILC program it has been argued that the program is inefficient and rewards inefficiency by keeping high cost, small dairy farms in business. Large dairy producers have expressed concerns that the MILC payments have negatively affected their farming income. Using farm-level, ARMS data from 2005, this study investigated the factors that affect farmer's decision to participate in MILC program and if participation in MILC has an impact on milk production. The results show that participation in MILC program is positively correlated with farmer's educational attainment, organic certification subsidy, milk price, off-farm work by spouses, and financial record keeping. Further, medium sized dairy farms are more likely to participate in MILC program. Finally, results indicate that participation in MILC program has a positive impact on milk production.

Keywords: dairy farms, agricultural policy, Milk Income Loss Contract Program, two-step probit estimation

JEL codes: H20, Q13, Q18

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During the 20th century, financial stress in the dairy industry has led to the creation and dismantling of various dairy programs (Shields, 2010). The most prominent dairy policy instrument, instituted in the early 1930's, has been the Dairy Price Support Program (DPSP). Under the DPSP, the Commodity Credit Corporation (CCC) stands ready to purchase excess nonfat dry milk, butter, and cheese to support market prices of milk.[2] The 1996 Farm bill provided decoupled payments to dairy farmers. Billions of dollars were spent to make up for low prices; however, these payments only caused low market prices for milk to persist. The 2002 Farm Security and Rural Investment Act (2002 Farm Bill) initiated the counter-cyclical dairy income support program known as Milk Income Loss Contract (MILC) program. The MILC program was designed to provide price support to dairy farmers when milk prices fell below a target level for the Boston Federal Milk Marketing Order Class I price. In order to receive program payments, a dairy farmer must earn a nonfarm, adjusted gross income less than $500,000. Payments are only eligible for up to 2.985 million pounds of milk produced within the fiscal year.[3] Unless they otherwise fail to enroll in the program, dairy farmers receive MILC payments if the market price of milk falls below the target level. From inception through 2010, the program has made payments of about $3.5 billion to U.S. dairy farmers (figure 1).

The MILC program is unique in its design by imposing a limit on milk eligible for payment during a fiscal year (Oct-Sept). It has been argued that given a chance to participate in federal programs like MILC almost every dairy producer will participate. However, data from

[2] The 2002 Farm Bill included temporary continuation of DPSP, but also encouraged use of futures markets.
[3] This limit was about 2.4 million pounds until the 2008 Farm Bill, when the MILC program was renewed with new production limit.

the 2005 Agricultural Resource Management Survey (ARMS)[4] shows that 58 percent of the producers—with an average of 7,815,427 pounds of milk production—did not participate in the MILC program. Since the inception of the MILC program it has been argued that the program is inefficient and rewards inefficiency by keeping high cost, small dairy farms in business. Large dairy producers have expressed concerns that the MILC payments have negatively affected their farming income. The MILC program has also been criticized for extending the length of low price periods and shifting the responsibilities of supply adjustment to large dairy farmers.

With more than half of dairy operations not participating in MILC program (ARMS, 2005) and average production of over two times the production limit for payments, some curious possibilities arise. It is possible that farms above the threshold were waiting until later in the fiscal year to enroll in the program and prices never fell below the target level, thereby leaving them without MILC payments for the year. Alternatively, did large dairy farms never bothered to apply for MILC program in the first place? This study investigates these questions further by (1) evaluating the factors that affect dairy farmers' decision to enroll in MILC program and (2) determining whether participation in MILC has an impact on milk production.

Background

Since its inception in 2002, the MILC program has received relatively less attention in the academic literature. There are several reasons for the paucity of research in this area. First, there is scarce data available to research this issue. The second reason is the regional concentration of the dairy industry to Midwest states like Minnesota and Wisconsin, Northeast States like Vermont, New York, and Pennsylvania, and large dairy farms in California. Finally, the dairy

[4] Dairy farm cost and returns survey, 2005, a special survey of Agricultural Resource Management Survey.

industry is undergoing significant structural changes—under cost cutting endeavors—faced by low milk prices.[5]

In a very early stage of the MILC program, Gould and Hackney (2003) concluded that, given the seasonality in milk prices and production cap, large dairy farms may time annual enrollment in MILC so as to maximize expected level of MILC payments. Jesse (2005) criticizes the configuration of the MILC program and indicated that MILC program is detrimental to the dairy industry in the long run. Herndon and Davis (2005) examined the impact of MILC program on milk production levels in twenty states. Using monthly data from 1995-2004 and Ordinary Least Squares (OLS) the authors analyzed the impact on implementation of MILC—through a dummy variable approach—on aggregate milk production. Herndon and Davis (2005) found a positive and significant relationship between production levels and MILC dummies for only four states (Indiana, Arizona, New Mexico, and Texas).[6]

In 2007 Bryant, Outlaw, and Anderson investigated the impact of MILC on aggregate production. The authors decomposed aggregate production into the dairy size (by number of cows) and milk production per cow. Using bi-annual data from 1996-2006 and a dynamic framework the authors found no significant relationship between MILC and size of dairy or milk production per cow. While few studies have investigated the impact of the MILC program on production, there are several studies that have investigated two major components of federal dairy policy—namely marketing orders and price supports. For example, Helmberger and Chen (1994) found that the federal milk marketing orders (FMMOs) raise fluid prices substantially and lower product prices. The authors also found that the DPSP raises blend prices significantly. On

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[5] It has been argued, among farmers, policymakers and economists that MILC program has slowed current production and supply adjustments and prolonged low milk prices.

[6] The empirical specification of the model estimated by Herndon and Davis (2005) could be characterized as a short-run response to the MILC program.

the other hand, Cox and Chavas (2001) analyzed various alternative dairy policy scenarios. The authors found that eliminating FMMOs would result in lower blend milk prices, sharply lower fluid milk prices and higher product prices.

Chavas and Kim (2004) conclude that market liberalization has been associated with a large increase in price volatility. However, the authors found that DSPS program was effective in reducing short-run price volatility to some extent over January 1980-June 2002 time period. Further, Chavas and Kim (2004) conclude that the effect of DSPS on price volatility disappears in the long-run. Finally, the authors conclude that government policy can have long-term effects on market prices even with limited government involvement—when support prices are nonbinding.

Finally, there are a couple of studies in the dairy sector that have investigated the impact of supply control on supply of milk and other milk products. For example, Kaiser, Streeter, and Liu (1988) investigated the impact of replacing DSPS with mandatory supply controls. They concluded that supply control would result in significant welfare transfers from consumers to producers. Dixon, Susanto, and Berry (1991) examined the effects of the Milk Diversion Program (output reduction) and Dairy Termination Program (herd buyouts) on milk production. The authors concluded that the reduction in output were very small and short-lived. Finally, Bausell, Belsley, and Smith (1992) investigated the impact of the Milk Diversion Program (output reduction) and Dairy Termination Program (herd buyouts) on government dairy product surpluses. The authors concluded that reduced support prices would help lower government dairy product surpluses.

Unlike previous research, this study investigates the factors that affect farmer’s decision to participate in the MILC program and to assess the impact of participation in MILC on total milk production. Specifically, we model the decision to participate in the program and milk production jointly using two-step probit least squares. Most notable, we find that a higher probability of enrolling in the MILC program is correlated with greater milk production on the farm. Perhaps this indicates a self-perpetuating problem created by the MILC program. The program payments may result in an increased supply of milk, downward pressure on prices, and thereby a greater likelihood of MILC payments.

Data

Data were extracted from the Dairy Production Practices and Costs and Returns Report (Agricultural Resource Management Survey Phase II, commonly referred to as ARMS). Observations were collected using a survey jointly administered by the National Agricultural Statistics Service and the Economic Research Service of the USDA for dairy production during calendar year 2005. The ARMS data includes detailed financial information, such as farm income and expenses, as well as farm and operator characteristics. The specific survey was taken from targeted dairy operations in twenty-four states that account for more than 90% of national milk production and cover all major production areas. It elicited detailed information about the production practices on the farm and costs of milk production.

We first limited our sample to those farms that produce dairy products as the primary farm practice and are excluded farms with zero milk production in 2005. After accounting for non-response and missing data, information on 1,732 farms are used for the analysis. Drawing on previous studies of dairy production (e.g., Abdulai and Tietje, 2007; Balcombe et al., 2006; Bravo-Ureta et al., 2007; Cabrera et al., 2010; Haese et al., 2009; Kompas and Che, 2006; Lawson et al., 2004; Nehring et al., 2009; Tauer and Mishra, 2006), several variables representing the inputs and output of dairy production, socio-demographic characteristics of the farm operator, farm practice, and participation in the MILC program are specified (Table 1). Milk production (Q_{Milk}) in pounds is defined as the production output and four other production inputs are also specified. The variable N_{Cows} is defined as the number of adult cows in the herd. The variable $Cost_{Capital}$ is the capital expense reported by the dairy farm operator, $Cost_{Labor}$ is the cost of hired labor, $Cost_{Tx\&Ins}$ is the cost of taxes and insurance, and $Cost_{Feed}$ is the cost of feed (all in US $). Squared terms for these input costs are also included in the empirical model to test for non-linear relationships between cost and production. Participation in the MILC program is represented by the dummy variable *MILC.* We also include variables for farm size (*Small, Medium, Large*) as defined by herd size. In order to assess the impact of unobserved regional factors affecting participation in MILC and milk production we include regional location dummy variables in the model. We use the five regional classifications defined by NASS (*Atlantic, Western, Midwest, Plains, and South*).

We have included age of the operator (*Op_Age*), operator off-farm wage income (*Off_Income_Op*), spouse off-farm wage income (*Off_ Income_Sp*), and dummy variables for operator education as some of the demographic variables affecting participation in MILC program and quantity of milk produced. *Op_Educ_C* represents farmers with college education and beyond, *Op_Educ_H* represents high school education and some college, and *Op_Educ_B* represents farmers with less than a high school education (used as the base group). Other independent variables reflecting farm management of milk production are also included. A count variable representing milking frequency (*M_Freq*) is defined along with dummies for computerized milking system (*C_Milking*), a dummy variable for farms keeping financial records (*Record*), a dummy variable for farms with milking units that have automatic takeoffs (*M_Auto*), a dummy variable for Internet access (*Internet),* a dummy variable for farms that are organic (*Organic*), and a dummy variable indicating whether the farm is eligible for MILC Payments (*Eligible*). Table 1 provides definition of variables and descriptive statistics for all the variables used in the empirical model.

Empirical Model

As described by Maddala (1983) and Keshk (2003), this research utilizes two-stage probit least squares. This method allows for a continuous and dichotomous variable to be simultaneously determined. In our case, this applies to the production decisions of dairy farmers and their participation decision with regards to the MILC program. For example, farmers enrolling in the MILC program may decrease production to remain under the production threshold. Alternatively, farmers may produce greater amounts of milk after entering the program due to decreased production risks and because the effective milk price is above market levels. Farmers with lower production levels are expected to place a greater value on MILC payments. Simultaneously, farmers that produce greater amounts of milk may be less likely to enter the program. The threshold level of milk production under the program may be a small percentage of their total output; therefore, the revenue generated from the MILC program may not be enough to divert the operator's attention from milk production and sales process. Regardless of the signs of the endogenous variables, it is reasonable that the productive capacity and decision to enroll in the program are determined jointly.

Following Keshk (2003), we can describe the production and participation equations with the following:

$$y_1 = \delta_1 y_2^* + \beta_1' X_1 + \varepsilon_1 \quad (1)$$

$$y_2^* = \delta_2 y_1 + \beta_2' X_2 + \varepsilon_2 \quad (2)$$

In equations (1) and (2), $y_1$is a continuous, endogenous variable that represents the total production of milk from a dairy farm, and y_2^* is a dichotomous, endogenous variable that takes a value of 1 when dairy farmers participate in the MILC program and 0 otherwise. δ_1 and δ_2 are parameters for the endogenous regressors. X_1 and X_2 are vectors of exogenous, explanatory variables, and β_1' and β_2' are the respective vectors of parameters.

In our model, $X_1 = f(Cost_i, Cost_i^2, N_{Cows}, N_{Cows}^2, \text{Op\_Age}, \text{Op\_Educ\_C}, \text{Op\_Educ\_H}, \text{M\_Freq}, \text{M\_Auto}, \text{C\_Milking}, \text{Internet}, \text{Organic}, \text{Region}_k)$ and $X_2 = f(\text{Op\_Age}, \text{Op\_Educ\_C}, \text{Op\_Educ\_H}, \text{Org\_Cert}, \text{Small}, \text{Medium}, \text{M\_Price}, \text{Record}, \text{Off\_Income\_Op}, \text{Off\_Income\_Sp}, \text{Eligible}, \text{Region}_k)$ where *i=Labor*, *Tax & Insurance*, *Feed*, *and Capital* and *k= Atlantic*, *Western*, *Midwest*, *and Plains.* The stochastic error term for each equation is represented by ε_1 and ε_2.

The structural equations (3 & 4) can be re-written to account for y_2^* being unobserved. First, divide both sides of equation (2) by the variance (σ_2) of y_2^*, yielding:

$$\frac{y_2^*}{\sigma_2} = \frac{\delta_2}{\sigma_2} y_1 + \frac{\beta_2'}{\sigma_2} X_2 + \frac{\varepsilon_2}{\sigma_2} \quad (3)$$

Now let $\frac{y_2^*}{\sigma_2} = y_2^{**}$ and the structural equations can be written as follows:

$$y_1 = \delta_1 \sigma_2 y_2^{**} + \beta_1' X_1 + \varepsilon_1 \quad (4)$$

$$y_2^{**} = \frac{\delta_2}{\sigma_2} y_1 + \frac{\beta_2'}{\sigma_2} X_2 + \frac{\varepsilon_2}{\sigma_2} \quad (5)$$

A two-step estimation process is then used to estimate these equations. Broadly, predicted values for each of the endogenous variable will be estimated from each model, these values will then be used as a proxy for the endogenous variables in the structural equations, and finally corrected standard errors are calculated for hypothesis testing.

Specifically, in the first stage all of the exogenous variables (X) in the model will be used to estimate predicted values for the endogenous variables (denoted by $\hat{y}_1$ and $\hat{y}_2^{**}$). The vector of parameters in the following equations is denoted by π_1 and π_2.

$$y_1 = \pi_1'\mathrm{X} + v_1 \quad \rightarrow \hat{y}_1 = \hat{\pi}_1\mathrm{X} \tag{6}$$

$$y_2^{**} = \pi_2'\mathrm{X} + v_2 \quad \rightarrow \hat{y}_2^{**} = \hat{\pi}_2\mathrm{X} \tag{7}$$

The parameters values for equation (6) are estimated via OLS regression while equation (7) is estimated using a probit model. The structural equations can then be re-written incorporating these predicted values.

$$y_1 = \delta_1\hat{y}_2^{**} + \beta_1'X_1 + \varepsilon_1 \tag{8}$$

$$y_2^{**} = \delta_2\hat{y}_1 + \beta_2'X_2 + \varepsilon_2 \tag{9}$$

The second stage of the procedure then occurs when equation (8) is estimated via OLS and equation (9) is estimated using probit. Notice the absence of the variance term in these structural equations relative to the equations (4) and (5). We must now correct the standard errors to account for our using predicted values rather than actual values of y_1 and y_2^{**} in the second stage regression. From Maddala (1983) and Keshk (2003) the following terms are defined:

$$\alpha_1' = (\delta_1\sigma_2, \beta_1') \tag{10}$$

$$\alpha_2' = (\frac{\delta_2}{\sigma_2}, \frac{\beta_2'}{\sigma_2}) \tag{11}$$

$$c = \sigma_1^2 - 2\delta_1\sigma_{12} \tag{12}$$

$$d = \left(\frac{\delta_2}{\sigma_2}\right)\sigma_1^2 - 2\left(\frac{\delta_2}{\sigma_2}\right)\left(\frac{\sigma_{12}}{\sigma_2}\right) \tag{13}$$

$$H = (\pi_2, J_1) \tag{14}$$

$$G = (\pi_1, J_2) \tag{15}$$

$$V_o = Var(\hat{\pi}_2) \tag{16}$$

Using the probit model results in normalization of σ_2 to one. The corrected variance-covariance matrix of α_1 and $\alpha_2$are then calculated:

$$V(\hat{\alpha}_1) = c(H'X'XH)^{-1} + (\delta_1\sigma_2)^2(H'X'XH)^{-1}H'XV_oX'XH(H'X'XH)^{-1} \quad (17)$$

$$G(\hat{\alpha}_2) = (G'V_o^{-1}G)^{-1} + d(G'V_o^{-1}G)^{-1}G'V_o^{-1}(X'X)^{-1}V_o^{-1}G(G'V_o^{-1}G)^{-1} \quad (18)$$

This entire two-step procedure was easily implemented using the CDSIMEQ command created by Keshk (2003) in Stata 11. Corrected standard errors were also provided by this command.

Results

Table 2 provides the marginal effects estimated for the production and participation equations. First, the results of interest are the endogenous variables $\hat{Q}_{Milk}$ and $\widehat{Pr}_{MILC}$. Only the predicted probability of enrolling in the MILC program was found significant. In fact, we find that a marginal increase in the probability of enrolling in the MILC program results in increased levels of milk production. While this variable was significant at the 10% level, nonetheless it does not diminish the fact that participation in MILC program increases milk production. This result lends support to the criticism that the MILC program extends the periods of low prices. Indeed if farmers who are more likely to enroll in the MILC program produce more milk, then there may be an excess supply of fluid milk being produced. This would result in a downward pressure on prices and increase the probability of future MILC payments occurring. An alternative explanation may also be provided by the risk mitigation benefits of the MILC program. Perhaps the MILC program provides farmers the necessary income stability required to move to the higher levels of production needed to satisfy consumer demanded for dairy products. In which case there would be less downward pressure on prices and the self-perpetuating cycle described previously would not occur.

We included variables in the MILC participation equation for operator and spouse off-farm labor income, the price of milk, and an interaction variable indicating whether the farmer was below both thresholds. The marginal effects for spouse off-farm income (4.33E-06) and the price of milk (-0.034) were found significant. We found that farms with spouses earning greater levels of off-farm income were more likely to participate in the MILC program. One explanation for this may be farmer's preference for income stability. Those farm households working greater hours off-farm have been shown to have lower income volatility (Mishra and Goodwin 1997). Dairy farmers may be utilizing the MILC program, other government programs, and off-farm employment to stabilize their annual earnings.

Significant evidence of this effect may also be seen with regards to the impact of the organic certification cost share subsidy on MILC participation. We find significant evidence that those participating in the organic program are more likely to participate in the MILC program. This program reimburses the dairy farm for up to 75% of the organic certification cost, thereby smoothing the cash flows of the farm business. Again, the income stabilization benefits of the program are increasing the likelihood of participation. It may also be the case that a dairy farmer who is already familiar and participating in one government program may be more willing to participate in another out of proximity. Similarly, farmers that are more aware of their financial situation are also more likely to participate in the MILC program. The marginal effect for the *Record* variable (0.615) is highly significant and shows the positive relationship between financial awareness and MILC participation.

We also find significant evidence that medium sized farms are more likely to participate in the MILC program. Medium sized farms in our sample are those with a cowherd of 100 to 299 cows. From Brown et al. (2010), the U.S. average cowherd equating to 2.985 million pounds of milk is 148. This average “critical herd size” falls squarely in the middle of the interval defined as medium farms. Our results indicate that farms operating within the neighborhood of the production limit for MILC participation are more likely to enter the MILC program. Linear and squared terms for the number of cows were included in the farm production equation as well. The results show that production is increasing with the number of cows but at a decreasing rate. We also found significant evidence that organic farms produced fewer pounds of milk. Considering 84% of the organic farms in our sample were also classified as small farms (fewer than 100 cows) lower levels of milk production are expected.

In addition to herd size, M_Freq was found positively correlated with milk production. The marginal effect (10,042.07) was highly significant and indicates that more frequent daily milking results in greater production levels. Technologies like computerized data collection and internet access were, surprisingly, found negatively correlated with milk production. Perhaps the time and resources diverted to these technologies come at the expense of time dedicated to milk production. There may also be some interaction effect between adopters of these technologies and organic farming thereby leading to use by smaller farmers. The linear and squared cost measures for both labor and feed were both found positive and significantly correlated with milk production. This indicates that costs are increasing at an increasing rate with higher levels of milk production.

Operator characteristics, like age and education, were found to be important determinants of MILC participation and farm production. Specifically, the marginal effects of Op_Educ_C and Op_Educ_H on MILC participation are 0.444 and 0.532 (both significant at 1%). More educated farmers were found more likely to participate in the MILC program than those without a high school education. The education obtained through additional years of school may help them understand the full benefit of the program and how to maximize the benefits to the farm. There also may be a connection between risk aversion and level of schooling leading to greater participation in the MILC program.

Operator education had no effect on the quantity of milk produced, but age did have a negative and significant impact. An additional year in age resulted in 125.873 fewer pounds of milk produced. This effect can be explained in large part by differences in milking frequency across age groups. In our sample, the average age of farmers milking four times per day is 41.4 years, three times per day is 51.2 years, two times per day is 51.5 years, and one time per day is 56.7 years. There is a 15.3 year gap between the average ages of the dairy farmers milking four times and once per day; therefore, production will be expected to decline as the farmer ages and thereby milks fewer times per day. Finally, we account for the region of the U.S. in which the farm is located. The Atlantic, Western, Mid-Western, and Plains regions were all found to produce greater amounts of milk than the Southern region. With regards to the MILC participation, there was no effect of region on the probability of farms participating. The constant in both equations were found negative and significant as well.

Conclusion

This research finds provides valuable information on the causes of farmers entering the MILC program and the impacts on production of this decision. We find that more educated, organized, and financially concerned farmers who are currently participating in other government programs are more likely to enter the MILC program. Farm families desiring more stable income would track the financial performance of the farm, have the spouse engage in off-farm work to earn more stable wages, and also participate in various government programs to stabilize farm income. These considerations were found to converge into a higher likelihood of entering the MILC program.

We found that as the predicted probability of MILC participation increases so does the amount of milk produced on the farm. This result is troubling if indeed MILC payments are sustaining inefficient smaller farms, leading to excess supply, downward pressure on milk prices, and thereby a higher likelihood of future MILC payments. In the coming Farm Bill debates, the outcries by larger dairy farmers and other opponents of the MILC program will become even louder if this is indeed the case.

Alternatively, this effect may also be due to the timing of enrollment by farmers. Perhaps farmers that plan to enroll in the program do so early in the fiscal year and simply produce their desired quantity of milk regardless of the production limit. In this case, they are assured of receiving a stable payment on their first 2.985 million pounds of milk if prices fall below target. Farmers can the assume market risk or use other tools to hedge risk on the remaining output. More research needs to be done to discern which explanation is most plausible and look further at the timing of the enrollment decision. In any case, it appears the MILC program is effective at stabilizing the incomes of farm families and encouraging producers to continue operations.

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Figure 1: Total MILC Payments by Fiscal Year

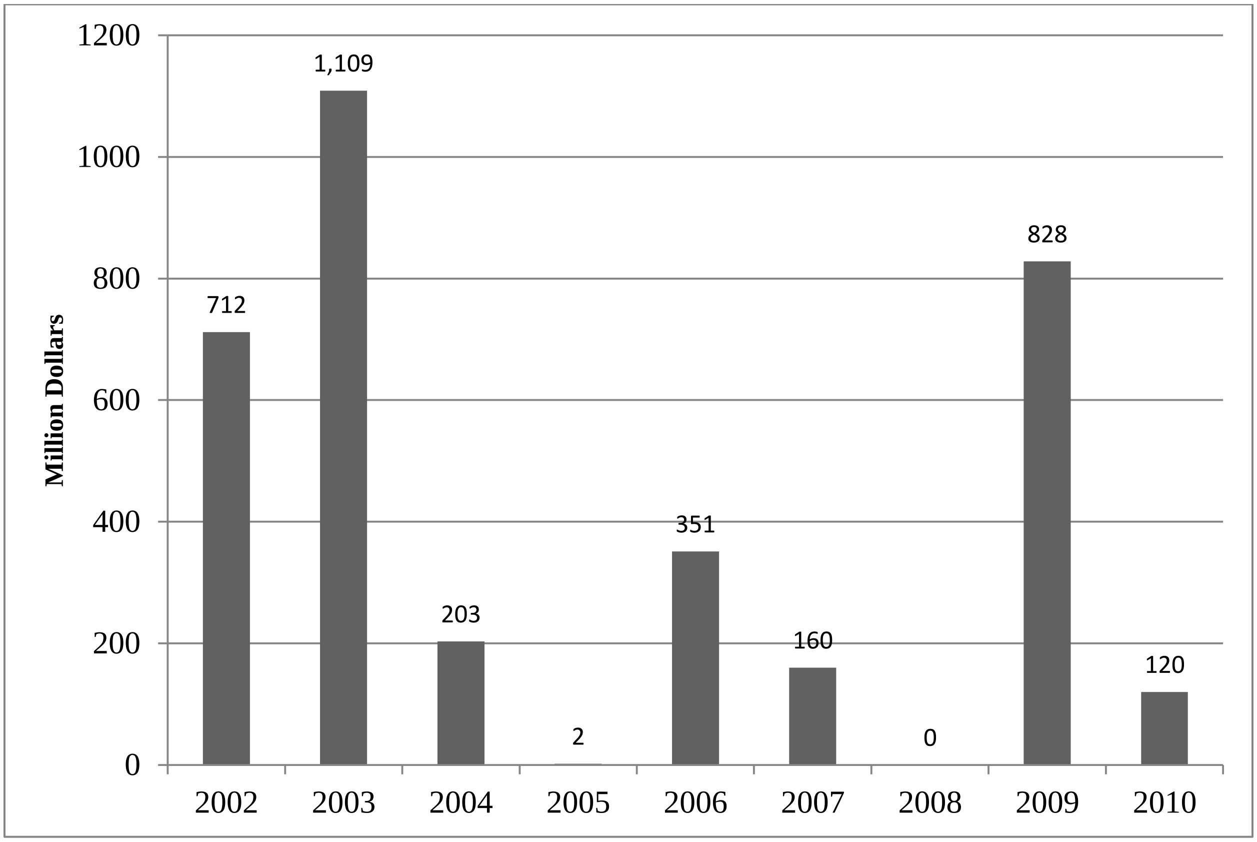

Table 1: Variables and Summary Statistics

Variable	Description	Mean	Std Dev
Q_{Milk}	Quantity of milk produced	70,373.4	144,347.4
MILC	1 if enrolled in MILC program; 0 otherwise	0.418	0.493
M_Price	Price of milk received by farmer ($ per cwt)	16.632	3.446
M_Freq	Number of times milked per day	2.156	0.375
$Cost_{Labor}$	Cost of hired labor ($)	129,989	311,577
$Cost_{Tx\&Ins}$	Cost of taxes and insurance ($)	12,206	26,650
$Cost_{Feed}$	Cost of feed ($)	552,443	1,067,48
$Cost_{Capital}$	Cost of capital ($)	163,436	331,898
Op_Age	Age of farm operator	51.476	11.200
Off_Income_Op	Income earned from off-farm labor of operator ($)	2,473	20,287
Off_Income_Sp	Income earned from off-farm labor of spouse ($)	8,666	17,178
Op_Educ_C	College education and beyond	0.212	0.409
Op_Educ_H	High school education and some college	0.609	0.488
Op_Educ_B	Less than high school education	0.179	0.384
N_{Cows}	Number of Cows	329	622
Small	1 if less than 100 cows; 0 otherwise	0.438	0.496
Medium	1 if there are 100 or more cows but less than 300; 0 otherwise	0.289	0.453
Large	1 if 300 or more cows; 0 otherwise	0.273	0.446
Record	1 if survey information derived from farm financial records; 0 otherwise	0.909	0.288
Org_Cert	1 if received organic certification cost share subsidy; 0 otherwise	0.044	0.206
Organic	1 if farm produced certified organic milk in 2005; 0 otherwise	0.194	0.396
C_Milking	1 if using computerized data gathering during milking; 0 otherwise	0.113	0.317
M_Auto	1 if using milking units with automatic takeoffs; 0 otherwise	0.544	0.498
Internet	1 if access to internet; 0 otherwise	0.526	0.499
Eligible	1 if below production and off-farm income requirements; 0 otherwise	0.583	0.493
Atlantic	1 if farm in NASS Atlantic Region; 0 otherwise	0.355	0.479
Western	1 if farm in NASS Western Region; 0 otherwise	0.183	0.386
Midwest	1 if farm in NASS Midwest Region; 0 otherwise	0.357	0.479
Plains	1 if farm in NASS Plains Region; 0 otherwise	0.047	0.211
South	1 if farm in NASS South Region; 0 otherwise	0.058	0.234

Table 2: Marginal Effects from Two-Step Probit Least Squares Estimation of Q_{Milk} and MILC

Farm Performance Equation (Q_{Milk})			**MILC Participation Equation (MILC)**		
Variable	**Marginal Effect**	**Std Error**	**Variable**	**Marginal Effect**	**Std Error**
$\widehat{Pr}_{MILC}$	4,852.623*	2,651.124	$\hat{Q}_{Milk}$	-4.17E-07	6.97E-07
$Cost_{Labor}$	0.078***	0.010	Op_Age	0.002	0.003
$Cost_{Tx\&Ins}$	0.036	0.076	Op_Educ_C	0.444***	0.108
$Cost_{Feed}$	0.026***	0.005	Op_Educ_H	0.532***	0.090
$Cost_{Capital}$	-0.008	0.007	Org_Cert	0.858***	0.165
$Cost_{Labor}^2$	0.000***	0.000	Small	0.183	0.158
$Cost_{Tx\&Ins}^2$	0.000	0.000	Medium	0.217*	0.121
$Cost_{Feed}^2$	0.000***	0.000	M_Price	-0.034***	0.011
$Cost_{Capital}^2$	0.000	0.000	Record	0.615***	0.120
N_{Cows}	157.673***	7.871	Off_Income_Op	-3.21E-06	3.36E-06
N_{Cows}^2	-0.007***	0.001	Off_Income_Sp	4.33E-06**	1.82E-06
Op_Age	-125.321*	65.311	Eligible	-0.083	0.114
Op_Educ_C	296.269	2,688.759	Atlantic	0.137	0.148
Op_Educ_H	-3,182.851	2,438.830	Western	0.178	0.157
M_Freq	10,042.070***	2,384.258	Midwest	0.190	0.148
M_Auto	-1,150.982	1,665.804	Plains	0.158	0.196
C_Milking	-4,643.685*	2,576.884	Constant	-1.042***	0.324
Internet	-4,073.111**	1,672.100			
Organic	-3,920.531**	1,944.096	N = 1732		
Atlantic	15,671.880***	3,344.464	* p < 0.10, ** p < 0.05, *** p < 0.01		
Western	14,440.630***	3,611.528	Marginal Effects Evaluated at Means		
Midwest	18,496.060***	3,392.613	Dependent Variable in Parentheses		
Plains	10,837.060**	4,531.293	$\hat{y}$ denotes predicted values of dependent variables		
Constant	-28,181.470***	7,161.866			