Aggregate Milk Supply Response to the Milk Income Loss Contract Program

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This research tests for changes in aggregate milk production due to the operation of the Milk Income Loss Contract (MILC) program since 2002. Aggregate production is decomposed into the size of the dairy herd and milk production per cow. We find no statistically significant response in either variable. This finding implies that the simultaneous operation of income and price support programs in the United States has not, thus far, proven self-defeating.

Key Words: dairy, income support, policy, price support

The 2002 Farm Security and Rural Investment Act (2002 Farm Bill) initiated counter-cyclical dairy income support known as the Milk Income Loss Contract (MILC) program. Through this program, producers receive direct payments equal to a portion of any shortfall of fluid milk prices below a specified reference price per unit. As producers' total benefits increase with output, up to a specified limit, this program might be expected to stimulate additional milk production. The MILC program is but a single feature in a complex dairy policy landscape, however. Arguably, the most prominent dairy policy instrument in place today is the Dairy Price Support Program (DPSP), instituted in the early 1930's. Under the provisions of the DPSP, the Commodity Credit Corporation (CCC) stands ready to purchase nonfat dry milk (NFDM), butter, and cheese to support market prices for milk.

Concerns have been raised by dairy industry participants regarding the possible interaction of the DPSP and MILC policy instruments. Specifically, the MILC program could be encouraging increased production, ultimately necessitating additional removals of dairy products to maintain prices at support levels (Stephenson, 2004). Indeed, some lawmakers have asserted that "the MILC program is directly at odds with the Dairy Price Support Program," and the debate in 2005 regarding MILC's renewal was contentious (Dairy Business, 2005, p. 4). Ultimately, the program was extended with slightly different payment features. The new, extended program is referred to as "MILCX."

The expectation that an income support program should result in increased production in periods with low market prices is consistent with a basic theoretical analysis (e.g., Gardner, 1987, pp. 22–24). The original MILC program, however, featured complications that are not considered in textbook examples. First, MILC payments were only paid on the first 2.4 million pounds of each producer's output, implying that industry structure was an important determinant of the extent of the incentive for increased production. Second, the program provided only a partial output price guarantee to producers. Payments were calculated in such a way that as market prices declined, producers' marketing revenue decreased at a faster rate than MILC payments increased, as described in greater detail below. Lastly, the original MILC program featured a "sunset provision," by which payments were meant to cease in September 2005. This provision, combined with a limited ability of producers to increase production in the short-run, might have significantly reduced producers' perceived incentive to increase output, for they might have anticipated that significant increases in their production levels would have arrived only as the program expired. These features of MILC might have been effective in avoiding a significant supply response to the program, and the extent of any such response is an empirical question.

In the present study, we empirically measured the effect of the introduction of the MILC program on aggregate U.S. milk production. More specifically, we tested the hypotheses that the introduction of the MILC program has caused an increase in the equilibrium level of the U.S. dairy herd and that it has caused producers to increase average milk production per cow. Given that changes in herd size occur very slowly, the full effects of the program might not be realized for several years yet, so a further objective of this study was to measure the potential total long-run effect of the continued operation of MILC on U.S. milk supply.[1] Finding a significant positive effect of the operation of the MILC program on milk output would imply that the program has increased potential DPSP expenditure and that the current configuration of U.S. dairy programs is to some extent self-defeating.

The results of this study will be useful to those crafting dairy policy. As stipulated by the 2002 Farm Bill, the original MILC program expired on September 30, 2005, and the program has been renewed for only twenty-three additional months. The possibility of the program's extension beyond the summer of 2007 will undoubtedly be the subject of debate in the near future. Evidence regarding supply response to the program will be useful in this regard.

Background

Dairy policy in the United States is comprised of several interrelated policy instruments, three of which we briefly describe. The oldest component of dairy

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[1] Howard and Shumway (1988) estimated that the dairy herd size adjusts only 9% of the way towards long-run optimum levels in one year. Chavas and Klemme (1986) found that herd size takes more than ten years to adjust to a sustained change in the milk price.

policy, dating to 1933, is the DPSP. Under this program, the CCC purchases any quantities of butter, cheddar cheese, and NFDM that manufacturers wish to sell at specified support prices. Support prices for individual products are set at levels such that processing plants of average efficiency will pay producers the congressionally mandated overall milk support price. The overall milk support price is currently $9.90/cwt., and the support prices of butter, cheese, and NFDM are $1.05, $1.13, and $0.80/lb., respectively. Purchased product may be sold by the CCC into domestic or international markets in times of higher prices or may be distributed gratis through food assistance programs. Net (of CCC sales) expenditure on dairy product price support over the period 2002–2005 totaled approximately $1.4 billion.

Another long-standing feature of U.S. dairy policy is the federal milk marketing order (FMMO) system, instituted in 1937. Under this program, USDA establishes minimum prices that producers must be paid by processors and product manufacturers, based on the various uses that they make of raw milk. These uses are divided into four classes; Class I represents the use of milk as a beverage, and the remaining classes cover various non-beverage dairy products. All class prices are calculated using fixed formulas that take wholesale prices for cheese, butter, NFDM, and dry whey as inputs. Accordingly, they serve to guarantee the operating margins of processors, while effectively transmitting product price risk upstream to producers. Individual FMMOs cover most portions of the country, California being a notable exception. Prices for Classes II through IV are consistent across all regions, while Class I prices vary by region according to a schedule of differentials.

Marketing order prices are used as an input in the newest component of U.S. dairy policy, the MILC program, which was first authorized by the 2002 Farm Security and Rural Investment Act. Originally under this program, in months when the Class I milk price under FMMO number 1 (covering the U.S. Northeast) at Boston, Massachusetts was less than $16.94/cwt., producers received 45% of the difference on their milk marketings up to a maximum of 2.4 million lbs./year. This formula applied to producers in all regions of the country, including those not subject to FMMOs. The production limit feature of the program implies that the further a producer's scale was above roughly 128 cows, the smaller benefits were, relative to total production (U.S. Department of Agriculture, 2004). The original MILC program operated through September 30, 2005. The new MILCX extended program covers eligible production from October 1, 2005 through August 31, 2007. MILCX operates in the same manner as the original program, except that producers receive only 34% of the amount by which the Boston Class I price is below $16.94/cwt. Total MILC payments from the program's inception through mid 2006 total slightly over $2.4 billion. MILC expenditures and approximate DPSP expenditures (net of CCC sales) during corresponding time periods are plotted in figure 1. Expenditure on the MILC in the first program year (December 2001 through August 2002) consisted mostly of retroactive benefits. MILC expenditures were fairly high in the first and second program years, but have been substantially lower since.
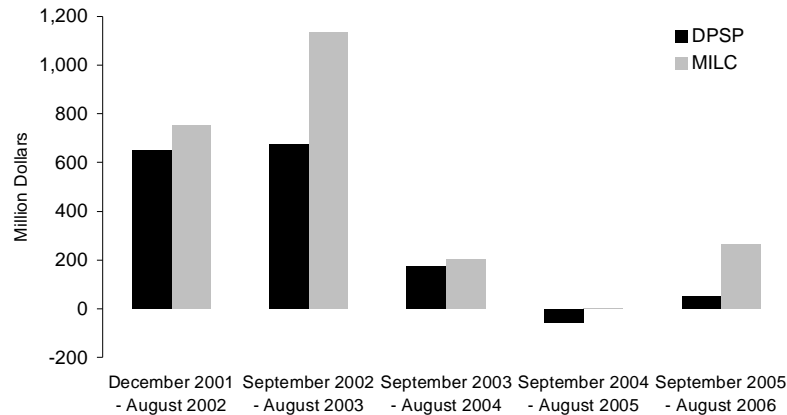
Figure 1. Government expenditure on the Dairy Price Support Program (DPSP) and Mill Income Loss Contracts (MILC)*

* Net expenditure on the DPSP is approximate, and is calculated using published net removals and support price data.

Given the relatively recent introduction of the MILC program, there has been only limited investigation of its implications and effects. Gould and Hackney (2003) described how large producers might time annual enrollment to maximize the expected level of MILC payments given the seasonality in milk prices and production and the 2.4 million pound production cap. Jesse (2005) argued that the original configuration of the MILC program is unsustainable for three reasons. First, the program has been more expensive than anticipated in an environment of growing concerns over the federal budget deficit. Second, the production cap is contentious, with large producers arguing that MILC disproportionately rewards small, inefficient producers. Third, the program would likely be inconsistent with U.S. commitments to liberalize trade, were a new agreement to materialize from World Trade Organization negotiations. Herndon (2005) examined the effects of the MILC program for twenty major milk producing states. The empirical specification he employed does not capture the dynamics of dairy markets, and his tests are therefore for short-run responses to the MILC program. For four of the twenty states (Indiana, Arizona, New Mexico, and Texas), he found a significant and positive relationship between production levels and the MILC dummy.

Several studies have looked at the effects of the two major components of federal dairy policy—marketing orders and price supports. LaFrance and de Gorter (1985) estimated the total costs (government expenditure plus changes in total surplus) of government dairy programs from 1965 through 1980 to be approximately one-half billion 1980 dollars per year. Helmberger and Chen (1994) found that FMMOs raise blend milk prices somewhat, raise fluid prices substantially, and lower product prices. They also found that the DPSP program raises blend prices substantially. Cox

and Chavas (2001) investigated the likely effects of various alternative dairy policy scenarios. Their results are consistent with Helmberger and Chen (1994), showing that eliminating the DPSP would somewhat lower blend milk prices, lowering producer surplus and increasing consumer surplus. Simultaneously eliminating FMMOs would result in even lower blend milk prices, sharply lower fluid milk prices, and higher product prices overall, although these effects varied across regions. Chavas and Kim (2004) found one redeeming quality in the DPSP: the program was effective in reducing price volatility to some extent over their sample period, although the reductions in support levels in the 1990's caused increases in volatility. They also found that the program affects price levels even over periods when the support prices are nonbinding.

Other studies have been concerned with supply controls and government surpluses of products accumulated through the DPSP in the 1980's. Kaiser, Streeter, and Liu (1988) examined the implications of replacing the DPSP with mandatory supply controls. They concluded that supply controls would result in significant welfare transfers from consumers to producers and that government surpluses of removed products were likely to subside anyway following DPSP reforms instituted in the Food Security Act of 1985. Dixon, Susanto, and Berry (1991) measured the effects of two voluntary supply control programs implemented in the mid 1980's on milk production: the Milk Diversion Program (output reductions) and the Dairy Termination Program (herd buyouts). They found that reductions in output were minimal and fleeting. Bausell, Belsley, and Smith (1992) found that those same programs were minimally effective in reducing government dairy product surpluses. They concluded that reduced support prices under the DPSP would be considerably more effective.

Modeling Strategy, Data, and Estimation

Changes in aggregate milk production are commonly explained by changes in the size of the dairy herd and changes in the average yield of milk per cow. Previous research has shown that a small portion of overall milk supply response to some stimulus is due to changes in yield and that a larger portion is due to slowly realized changes in herd size (Levins, 1982; Chavas and Klemme, 1986; Howard and Schumway, 1988; Adelaja, 1991). It is therefore critically important that long-run herd dynamics be adequately represented in our model of supply. Two broad strategies have been employed in previous work. Some authors consider a dynamic optimization problem faced by a representative producer, while others model aggregate industry behavior using more empirical dynamic models. The former approach was employed by Howard and Schumway (1988) and Weersink and Howard (1990). In their models, a representative producer optimally controls herd size to maximize the discounted stream of current and future profit based on (unanticipated) changes in throughput prices and expectations regarding technical change. Chavas and Klemme (1986) also followed the dynamic programming

approach and incorporated extensive biological information regarding cow reproduction, growth, and productivity over their life cycles.

A greater number of studies, however, have employed empirical dynamic models rather than explicit dynamic optimization. These models can be further classified into two varieties: (a) those that model herd size (or overall milk production in papers that do not model herd size and yield separately) as some form of distributed lag in milk prices (Chen, Courtney, and Schmitz, 1972; Levins, 1982; Kaiser, Streeter, and Liu, 1988; Adelaja, 1991) and (b) those that model herd size as a partial adjustment process (LaFrance and de Gorter, 1985; Dixon, Susanto, and Berry, 1991; Bausell, Belsley, and Smith, 1992; Helmberger and Chen, 1994).

For our application, we selected the partial adjustment specification, to avoid the complexities associated with the dynamic programming approach and the uncertain economic interpretation associated with distributed lag models. We posited a long-run equilibrium level of the U.S. dairy herd that is desired at time t:

$$(1) \qquad CN_t^* = X_t \beta + u_t,$$

where X_t is a vector of supply determinants, β is a fixed parameter vector, and u_t is a random disturbance. We assumed that actual cow numbers, CN_t, evolve according to a partial adjustment process:

$$(2) \qquad CN_t - CN_{t-1} = (1-\lambda)(CN_t^* - CN_{t-1}),$$

where λ is a scalar speed of adjustment parameter, with $0 \geq \lambda > 1$. The model is estimated after substituting (1) into (2) and solving for CN_t:

$$(3) \qquad CN_t = X_t \tilde{\beta} + \lambda CN_{t-1} + \tilde{u}_t,$$

where $\tilde{\beta} = (1-\lambda)\beta$ and $\tilde{u}_t = (1-\lambda)u_t$. Short run effects of the supply determinants on cow numbers are given by $\tilde{\beta}$, while long run effects are given by β.

We expect $\lambda > 0$ (i.e., cow numbers do not instantly adjust to the desired level) for at least three reasons. First, there are limits on the rate at which the dairy herd can expand due to biological considerations and constraints on the number of replacement heifers available for import. Second, dairy producers are likely to be reluctant to adjust their capital stock if they believe current market conditions might not endure. Third, dairy producers' information regarding current market conditions might be poor due to delays (associated with the operation of co-ops and the FMMO system) in receiving the proceeds of sales.

We used expected levels of throughput prices as supply determinants, per economic theory. We assumed these expectations are naïve.[2] The specific-price series employed are the real U.S. All Milk Price (*AMP*), the real value in Decatur,

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[2] Chavas (2000) found that naïve expectations are the most common variety in U.S. beef production, a closely related industry.

Illinois of farm corn and 48% soybean meal needed to produce a 16% protein concentrate feed (*FEEDP*), and the real price of boning utility cows in Sioux Falls, South Dakota (*UTILP*). Dairy cows and feed are clearly complimentary inputs in the production of milk; therefore, we anticipated that the feed price would have a negative effect on cow numbers. A larger herd can produce more milk; therefore, we anticipated a positive relationship between milk prices and equilibrium cow numbers. A large quantity of the joint product, utility beef, is produced by reducing cow numbers; therefore, we expected a negative relationship between those two variables. Our estimation equation is:

$$(4) \qquad CN_t = \tilde{\beta}_0 + \tilde{\beta}_1 MILC_t + \tilde{\beta}_2 AMP_{t-1} + \tilde{\beta}_3 MILC_t \times AMP_{t-1}$$
$$+ \tilde{\beta}_4 FEEDP_{t-1} + \tilde{\beta}_5 UTILP_{t-1} + \tilde{u}_t,$$

where *MILC* is a dummy variable that indicates the operation of the MILC program. We included the interaction term $MILC_t \times AMP_{t-1}$ to allow for the possibility that the long run equilibrium dairy herd size might have become more sensitive to the milk price since the introduction of MILC. We expect $\tilde{\beta}_1 \geq 0$ (i.e., the equilibrium herd size is not lower due to the introduction of MILC).

We employed a yield model very similar to the one used in Chavas and Klemme (1986) and Kaiser, Streeter, and Liu (1988), wherein yield is a function of output price (*AMP*), the non-fixed input price (*FEEP*), and a trend variable *TREND* that serves as a proxy for improvements in production technology and herd genetics. The equation we estimated is:

$$(5) \qquad YIELD_t = \gamma_0 + \gamma_1 MILC_t + \gamma_2 TREND + \gamma_3 D_t^{Season} + \gamma_4 AMP_{t-1}$$
$$+ \gamma_5 MILC_t \times AMP_{t-1} + \gamma_6 FEEDP_{t-1} + v_t,$$

where $YIELD_t$ is average milk production per cow, D_t^{Season} is a dummy variable that is zero for the first half of the year and one for the second half (corresponding to our bi-annual data frequency), v_t is a random disturbance, and the γ_i are fixed parameters. We again included the interaction term to allow for the possibility that yield might have become more sensitive to milk prices since the introduction of MILC. We expect, $\gamma_1 \geq 0$, for producers might have changed feeding practices to increase milk production in response to the income support provided by MILC. We expect, $\gamma_3 < 0$, for milk production naturally tends to be highest in the spring.

We used bi-annual data covering the sample period 1993 through the first half of 2006. The MILC program was in operation for the last four years in this sample (second half of 2002 onward). Natural logarithms of series other than *MILC*, *TREND*, and D^{Season} were used for estimation in both equations. The data series used and their sources are summarized in table 1.

Table 1. Data Series

Series	Description	Source
CN	Cow numbers, United States	*Livestock, Dairy, and Poultry Outlook*
AMP	Real all milk price	*Livestock, Dairy, and Poultry Outlook*
FEEDP	Real value of corn and soybean meal used needed for 16% protein feed	*Livestock, Dairy, and Poultry Outlook*
UTILP	Real utility cow price	*Livestock, Dairy, and Poultry Outlook*
YIELD	Average milk per cow	*Livestock, Dairy, and Poultry Outlook*
MILC	Dummy indicating the operation of the MILC program	--
D^{Season}	Dummy indicating the second half of year	--
TREND	Linear trend variable	--

Equation (4) was estimated using ordinary least squares (OLS). Given that this equation includes a lagged dependent variable, the presence of serial correlation would render the OLS estimator inconsistent. We therefore carried out Durbin's (1970) Lagrangian multiplier test for serial correlation in the presence of a lagged dependent variable. The *h*-test statistic was 0.058, which is distributed standard normal, implying a p-value of 0.52. We therefore did not reject the null hypothesis of no positive first-order serial correlation in u_t.

Equation (5) was initially estimated using OLS. The resulting Durbin-Watson test statistic was 1.35, which implies an inconclusive result for the 5% significance level (Savin and White, 1977) and the possible presence of serial correlation and inefficient estimates. We therefore based inference on a maximum likelihood estimate of (5) with an autoregressive error structure: $v_t = \rho v_{t-1} + e_t$, where we assumed that e_t is normally, identically, independently distributed for all *t*.

Results and Discussion

Parameter estimates and their associated p-values are presented in table 2. Ignoring the *MILC* coefficients momentarily, in the herd-size equation, all parameter estimates were of the expected signs with the exception of the *UTILP* coefficient, a finding that is not statistically significant. We found that the all-milk price had a positive effect on herd size and was significant at the 20% level. The feed price had a significant negative effect on cow numbers. The estimate of the speed of adjustment

parameter, $\hat{\lambda}$, 0.967, implies that cow numbers should take approximately 21 periods, or 10.5 years, to move halfway towards their long-run equilibrium level in response to a sustained change in a supply determinant. Previous researchers have found similarly slow responses in cow numbers, as noted above.

Table 2. Estimated Models of Herd Size and Yield

Variables	Coefficient Estimate	P-value
Herd Size Equation		
Constant	0.177	0.820
$MILC_t$	−0.025	0.536
AMP_{t-1}	0.016	0.182
$MILC_t \times AMP_{t-1}$	0.014	0.499
$FEEDP_{t-1}$	−0.011	0.056
$UTILP_{t-1}$	0.000	0.988
CN_{t-1}	0.967	0.000
R^2	0.966	
Yield Equation		
Constant	8.236	0.000
$MILC_t$	0.076	0.327
$TREND_t$	0.001	0.000
D_t^{Season}	−0.039	0.000
AMP_{t-1}	0.044	0.089
$MILC_t \times AMP_{t-1}$	−0.040	0.302
$FEEDP_{t-1}$	−0.033	0.010
v_{t-1}	0.366	0.281
R^2	0.993	

In the yield equation, we found that non-MILC related conditional mean coefficients were significant and of the expected signs. The trend coefficient indicated significant increases in yield over time, and the dummy variable coefficient indicated lower yields during the second half of the year, as expected. Also as expected, yields responded negatively to increases in feed prices. The p-value of 0.281 associated with the autoregressive coefficient for disturbances indicated no significant serial correlation at the 20% level. The elasticities of herd size, average yield, and aggregate milk production with respect to feed prices and the milk price are presented in table 3. Like previous studies, we found that long-run milk supply responses are substantially larger than short-run responses.

Table 3. Milk Supply Elasticities

Variables	Yield	Herd Size		Milk Production	
		Short Run	Long Run	Short Run	Long Run
Elasticities with respect to:					
Milk Price	0.044	0.016	0.718	0.060	0.762
Feed Price	−0.033	−0.011	−0.512	−0.044	−0.545

The primary quantities of interest are, of course, the coefficient estimates associated with the MILC dummy variable. The estimated MILC dummy coefficients were not significantly different from zero in either equation. We were thus unable to discern a statistically significant effect of operation of the MILC program on either the size of the U.S. dairy herd or average milk production per cow. Even if we made a type II error in failing to reject the null hypothesis that $\tilde{\beta}_1$ is zero, the overall effect of the MILC program would still likely be fairly small. The coefficients associated with the milk price interaction terms in each equation were also not statistically significant; therefore, we concluded that neither equilibrium herd size nor average yield had become more sensitive to changes in the milk price due to the introduction of MILC.

We considered several possible causes for this result. First, the recent appearance of Bovine Spongiform Encephalopathy (BSE) in Canada has affected the U.S. industry. The U.S. has banned the import of dairy replacement heifers from Canada since mid May 2003. This ban might have constrained the ability of U.S. producers to increase the herd size, for all growth has necessarily been internal. Dairy cattle imports from Canada totaled 67,203 head in 2002, the last full year of imports. The U.S. dairy herd expanded by 121,000 in the last year (July 2005 – June 2006) in an environment of high prices (see figure 2). The availability of Canadian replacement heifers could have resulted in lower prices and facilitated a more rapid expansion. However, this availability would affect the speed of adjustment towards equilibrium rather than the equilibrium level of the herd size (in terms of our empirical model, λ rather than β). Therefore, our inference with respect to supply response to MILC should not be affected.

A second possible explanation for our result is the sunset provision of the MILC program. The legislation authorizing the original MILC program stipulated that the program would end on September 30, 2005, roughly three years after its initiation. This provision, combined with the fact that the herd size can only increase fairly slowly, might have led producers to refrain from adjusting their operating policies. Not only would a policy of increasing herd size only begin to bear fruit in the late stages of the original MILC program's tenure, but producers might also have perceived a risk that they would be situated with a larger than optimal herd for some period of time after the program concluded. The sunset provision of the original MILC program, combined with production delays, might therefore have resulted in
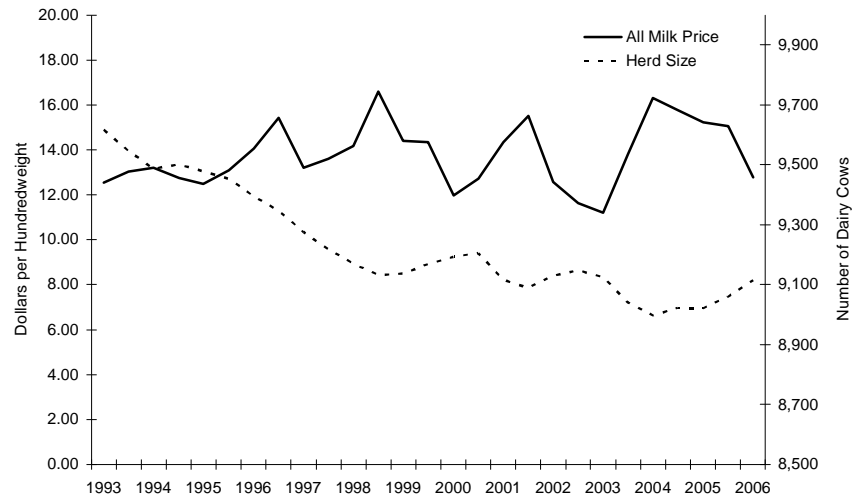
Figure 2. Evolution of all milk price and U.S. dairy cow herd size

a production analog to Friedman's (1957) permanent income hypothesis: producers did not alter their behavior in response to supposedly temporary, one-time benefits. Given that the program has been renewed, however, producers might not regard future expiration provisions as credible and not view program benefits as temporary. We must therefore caution that our primary result might not hold in the future.

A third possible explanation is that the built-in limits on the quantities of milk produced that are used for calculating MILC payments might result in a negligible effect (i.e., the payment limit has been effective in limiting the supply response to the MILC program's operation). Based on marketing order prices and actual total MILC payments closer to the program's inception, it appears that roughly one-fifth of current production is used to calculate benefits. However, it is the extent of potential new eligible production that is relevant to assessing the incentive for increased output. Assuming no new entry into milk production, and assuming that economies of scale will discourage existing large operations from dividing to increase overall eligible production (which, at any rate, is not allowed under MILC program rules), this potential will be determined by the number of existing operations producing less than 2.4 million lbs./year and the extent to which their production levels are below that limit. As of 2002, approximately 80% of dairy operations had herds of under 100 head (U.S. Department of Agriculture, National Agricultural Statistical Service, 2004), which would produce under 2.4 million pounds per year, even at above average yields per cow. Approximately 45% of dairy operations had herds of under 50 head. If only these latter operations' herd sizes increased by 50 head each, then at average yields per cow, total milk production in the United States would increase by approximately 30%. Thus, existing small producers could generate substantial additional quantities of qualifying production.

A related consideration, however, is the evolution of industry structure and the relative competitiveness of small producers. Jesse (2005) noted that since the inception of the MILC program, the proportion of the dairy herd held by small producers has declined, and the proportion held by larger producers has increased. This shift suggests that increasing quantities of eligible milk production are being held by producers for whom potential MILC payments are small relative to overall revenue and whose decisions are less likely to be substantially influenced by the program. Larger economic forces such as economies of scale and regional comparative advantage are likely driving industry structure to evolve away from a condition in which it would be responsive to MILC, even though the production limit is not technically binding for many existing small producers.

Conclusions

This study tested for significant positive effects of the recently-instituted MILC program on the size of the U.S. dairy herd and average milk production per cow. A positive supply response to MILC would cause lower market prices for dairy products than would otherwise have prevailed. These decreases, in turn, would result in additional removals of products under the price support program in periods of low prices. Therefore, it seems that simultaneous use of these two policy instruments is, to some extent, self-defeating. We were ultimately unable to discern any statistically significant supply response to the MILC program.

One explanation for our primary result is that the eligible production limit has been effective in suppressing a supply response. Industry structure is such that existing small producers could bring significant quantities of new qualifying milk production to market. Industry structure has, however, been evolving towards larger producers for whom the program is less beneficial relative to the scale of operations. As a practical matter, the small producers are likely to be less competitive than the large operations and less able to expand, even though they do not face a binding MILC production limit. It might then be the case that the production limit is working as intended, despite the possibility of new qualifying production from existing producers. It is almost certain that a permanent income support program with no such limit would result in a significant supply response.

Another explanation is that the producers might have been wary of increasing herd size, anticipating that significant production increases and MILC program benefits would arrive only as the original program expired. This latter explanation implies that policy makers cannot safely assume that the continued use of simultaneous dairy income and price support policies will not ultimately prove self-defeating, despite the lack of evidence of such effects to date.

Concerns are often expressed regarding market distortions associated with programs that feature benefits tied to current production. Our results suggest that at the aggregate level, MILC is the cause of little if any market distortion. There is therefore little motivation for decoupling payments from current production, unless

the U.S. is compelled to do so because of multilateral trade considerations. Our aggregate analysis may mask important regional effects, however.

To the extent that small producers are more heavily concentrated in the Northeast and Upper Midwest, the regional effects of the MILC program should not be overlooked. The program has benefited these producers during a period of low milk prices and might have retarded the rate at which small producers are exiting the industry. Dairy policy has been heavily influenced by regional considerations in the past, and the MILC program is no exception. It might be that MILC is a regionally and structurally targeted program that has been effective in providing aid to a particular subset of producers.

Additional research might be helpful in understanding the possible effects that the MILC program is having in dairy markets. State-level analysis similar to the analysis performed in the present study might reveal differences among regions with varying proportions of smaller producers. Also, repetition of the aggregate analysis performed here after additional post-MILC renewal observations are available could prove useful in determining whether the minimal or non-existent response that we found is due to trepidation associated with the original expiration threat or due instead to the evolution of industry structure away from producers who most appreciate the program's benefits.

References

Adelaja, A. O (1991, February). "Price changes, supply elasticities, industrial organization, and dairy output distribution." *American Journal of Agricultural Economics* 73(1), 89–102.

Bausell, C. W., D. A. Belsley, and S. L. Smith. (1992, August). "An analysis of 1980's dairy programs and some policy implications." *American Journal of Agricultural Economics* 74(3), 605–616.

Chavas, J. (2000, June). "On information and market dynamics: The case of the U.S. beef market." *Journal of Economic Dynamics and Control* 24(5-7), 833–853.

Chavas, J., and K. Kim. (2004, August). "A heteroskedastic multivariate Tobit analysis of price dynamics in the presence of price floors." *American Journal of Agricultural Economics* 86(3), 576–593.

Chavas, J., and R. Klemme. (1986, February). "Aggregate milk supply response and investment behavior on U.S. dairy farms." *American Journal of Agricultural Economics* 68(1), 55–66.

Chen, D., R. Courtney, and A. Schmitz. (1972, February). "A polynomial lag formulation of milk production response." *American Journal of Agricultural Economics* 54(1), 77–83.

Cox, T., and J. Chavas. (2001, February). "An interregional analysis of price discrimination and domestic policy in the U.S. dairy sector." *American Journal of Agricultural Economics* 83(1), 89–106.

"DPW Washington." (2005, March 28). *Dairy Profit Weekly* 16(12), 4.

Dixon, B. L., D. Susanto, and C. R. Berry. (1991, August). "Supply impact of the milk diversion and dairy termination programs." *American Journal of Agricultural Economics* 73(3), 633–640.

Durbin, J. (1970, May). "Testing for serial correlation in least square regression when some of the regressors are lagged dependent variables." *Econometrica* 38(3), 410–421.

Friedman, M. (1957). *A Theory of the Consumption Function*. Princeton: Princeton University Press.

Gardner, B. (1987). *The Economics of Agricultural Policies*. New York: Collier Macmillan.

Gould, B. W., and J. H. Hackney. (2003, September). "Enrollment in the 2003/2004 MILC program: Does timing matter?" Marketing and Policy Briefing Paper no. 82, University of Wisconsin-Madison Cooperative Extension.

Howard, W. H., and C. R. Schumway. (1988, November). "Dynamic adjustment in the U.S. dairy industry." *American Journal of Agricultural Economics* 70(4), 837–847.

Helmberger, P., and Y. Chen. (1994, December). "Economic effects of U.S. dairy programs." *Journal of Agricultural and Resource Economics* 19(2), 225–238.

Herndon, C. W. (2005, July 27). "Does the MILC program affect milk supply response across regions of the U.S.?" Paper presented at the annual meetings of the American Agricultural Economics Association, Providence, Rhode Island.

Jesse, E. (2005, March). "Dairy policy in the next farm bill: An early assessment." Marketing and Policy Briefing Paper no. 89, University of Wisconsin-Madison Cooperative Extension.

Kaiser, H. M., D. H. Streeter, and D. J. Liu. (1988, November). "Welfare comparisons of dairy policies with and without mandatory supply control." *American Journal of Agricultural Economics* 70(4), 848–858.

LaFrance, J. T., and H. de Gorter. (1985, November). "Regulation in a dynamic market: The U.S. dairy industry." *American Journal of Agricultural Economics* 67(4), 821–832.

Levins, R. A. (1982, May). "Price specification in milk supply response analysis." *American Journal of Agricultural Economics* 64(2), 286–288.

Savin, E., and K. White. (1977, November). "The Durbin-Watson test for serial correlation with extreme sample sizes or many regressors." *Econometrica* 45(8), 1989–1996.

Stephenson, M. (2004). "Dairy price support program and the milk income loss contracts." In Dairy Policy and Product Innovation (pp. 17–20), Proceedings of the 11th Annual Workshop for Dairy Economists and Policy Analysts held in Washington D.C., April 15–16, 2004. Cornell: The Cornell Program on Dairy Markets and Policy.

U.S. Department of Agriculture, National Agricultural Statistical Service (2004). 2002 Census of Agriculture. Washington, D.C.

U.S. Department of Agriculture (2004). "Economic effects of U.S. dairy policy and alternative approaches to pricing." Report to Congress. Washington, D.C.

Weersink, A., and W. Howard. (1990, July). "Regional adjustment response in the U.S. dairy sector to changes in milk support price." *Western Journal of Agricultural Economics* 15(1), 13–21.