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The Impact on The Milk Supply Response to MPP-Dairy

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This paper presents an analysis of potential milk supply changes by farms due to the newly enacted Margin Protection Plan (MPP) – Dairy. The analysis is done on small, medium, and large farms and compares the MPP-Dairy to the Milk Income Loss Contract and no governmental program. The results show that the medium farms are the most sensitive to margins and governmental policies.

***Key words**:* Dairy, MPP-Dairy, Margin MILC

Dating back to 1949, a variety of government programs have existed to support the dairy industry during times of extreme financial hardship. These safety net programs, which ranged, from government price support purchases in 1949 to the Milk Income Loss Contract (MILC) of 2008 are perceived as either financially infeasible (like the Dairy Price Support Program in the 1980s) or ineffective (like the MILC program) in today's volatile market. As the dynamics of the market changed from a more stationary to a more volatile market in both milk and feed prices, advocates in the dairy industry became more vocal in their demands for a dairy policy that provides better support for the industry during times of extremely low margins (U.S. Congress 2011). The Margin Protection Program for Dairy Producers (MPP-Dairy) passed in the 2014 Farm Bill provides new hope to dairy farmers that they finally have a reliable security net that protects them during catastrophic periods of low margins. The effectiveness of this new MPP-Dairy to fulfill its intentions will be tested by time.

The 2008 Farm Bill (Food, Conservation, and Energy Act of 2008 (Pub.L. 110-234)) included the Milk Income Loss Contract (MILC), Dairy Export Incentive Program (DEIP), and Dairy Product Price Support Program (DPPSP). These programs worked to provide a safety net in the market for periods such as 2009 when low milk prices and high feed costs caused very low margins for dairy farms (Dairy Industry Advisory Committee Report, 2011). Unfortunately, these programs provided too little support for a majority of dairy farms, with some farms losing as much as $200 per head per month in 2009 (Plume, K. 2009).

Starting from a new perspective, the Dairy Security Act (DSA) was adopted from the Foundation for the Future program introduced by National Milk Producers Federation

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(NMPF) (http://futurefordairy.com/program-details). This legislation was initially introduced in 2011 by Rep. Collin C. Peterson, D-Minnesota and Rep. Mike Simpson, R-Idaho. Over the next few years the DSA program was hotly debated and eventually included in February 2014 Farm Bill as MPP-Dairy. The original DSA included both a margin insurance program as well as a market stabilization program. However the bill that passed in 2014 did not include the market stabilization program. Since the first introduction of DSA, researchers have developed extensive literature that explores the impacts of margin insurance on prices, government spending, and general farm welfare in the program. Less research has been conducted on the effects of the proposed programs on the farm level supply of milk.

In this paper, an estimate is conducted on the farm level supply response to MPP-Dairy through dynamic programming. The model compares the simulated profit maximized production scenarios with the actual production in 2009; the different scenarios include: the simulated MILC program, the simulated production without any governmental support, and the simulated MPP-Dairy production levels. We examine these scenarios for different farm size operations.

The results of these simulations show that the simulated MILC program has the most impact on some farms for increasing production. We discuss details of MPP-Dairy followed by a discussion of methodology. We then discuss the date used and the results. Closing remarks and thoughts complete this article.

The 2008 and 2014 Farm Bills

The 2008 Farm Bill extended the Milk Income Loss Contract (MILC) program, which was designed to provide counter-cyclical support for dairy farms. However large farms were at a disadvantage due to the cap placed on benefits. By 2013 this meant that only 40% of the milk production throughout the United States qualified for MILC payments (Newton, J. and T. Kuethe, 2014). This disparity between MILC benefits for small and large farms can also be seen across the different states. Predominantly large farm states, such as California and Texas, had less than a quarter of their production covered under MILC. Whereas states with smaller farms (generally traditional dairy states like Wisconsin and Pennsylvania) had over 50% of their milk production covered (Newton, J. and T. Kuethe, 2014). By 2012, larger farms (500 or more cows) accounted for more than 60% of U.S. milk production thereby making large farm financial resiliency an ever increasing concern.

When MILC was first introduced in 2002, just over 40% of the milk production was from operations with over 500 cows (NASS Quickstats). By 2012, 63% of the milk production in the United States. was produced by operations with over 500 cows. As the landscape of the dairy industry changed, the MILC program failed to protect the U.S.

dairy farms from catastrophic market conditions. This was particularly true in 2009 and 2012 when the low margins significantly impacted United States dairy farms. The difficulty faced by large farms can be seen by the numbers. From 2000-2012 the number of large farms increased except for the years 2009, 2010, and 2012. For 2009 and 2010 there were 0 net farms added and in 2012 there were 100 fewer farms reported by NASS.

Programs from the 2008 Farm Bill (MILC, DEIP, and DPPSP) were replaced by MPP-Dairy and the Dairy Product Donation Program. MPP-Dairy is now the main governmental safety net available for dairy farms.[1] MPP-Dairy acts as a counter-cyclical payment for dairy farms when their margins decline to a specified level, with the intention of the program to protect producers' margins. MPP-Dairy is a voluntary program whose basic coverage level is free to all farms (except for a yearly $100 administrative fee). The other new program is the Dairy Product Donation Program, which is triggered when dairy farms face low margins. The program requires USDA to purchase dairy products for food banks and other feeding programs.

MPP-Dairy

MPP-Dairy provides farms a cash payment if the national margin (milk price less feed costs using national prices published by USDA) dips below a selected level for a two month period. The margin per hundredweight (cwt) is calculated as: All milk price - 1.0728*price of corn per bushel - 0.00735* price of soybean meal per ton - 0.0137*price of alfalfa hay per ton. The two month periods are defined as: (1) January and February, (2) March and April, (3) May and June, (4) July and August, (5) September and October, and (6) November and December.

A farm can decide to join MPP-Dairy at any year, but once they sign up they are committed until the end of the 2014 Farm Bill. To join, a farm must establish a production history and pay a yearly $100 administrative fee. By joining, they are enrolled in a $4/cwt margin protection for up to 90% of their production history. If a farm wants a higher margin coverage, they can obtain coverage ranging from $4.50/cwt to $8/cwt in $0.50 increments. At the $4/cwt level there is no premium payment; above $4/cwt the premiums range from $0.010 to $0.475 for the first four million pounds and $0.020 to $1.360 for anything above four millions pounds. The farm can also choose what percentage of their production history is covered from 25% to 90%. The coverage level and percentage is adjustable by the producer once a year.

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[1] The other safety net available for dairy farms is Livestock Gross Margin for Dairy Cattle (LGM-Dairy) which is handled by the Risk Management Agency. Part of the new policy states that a farm can only sign up for either LGM-Dairy or MPP-Dairy. Not both.

Previous Research on DSA

The Dairy Security Act (DSA) was the conceptual basis for the MPP-Dairy program. There has been substantial research done on the implications of DSA. Due to their similarities, we will look at the previous research done on DSA. There are two parts to the DSA Dairy Producer Margin Protection Program (DPMPP): base and supplemental margin insurance. The base margin is coverage at the $4/cwt level while the supplemental coverage is any coverage above $4/cwt. Research by Novakovic and Stephenson (2012), Nicholson and Stephenson (2011), and Brown (2012) indicates that to benefit more from DSA, the producers would most likely sign up for supplemental insurance. If a farm decides to maintain the same level of supplemental insurance over the life of the farm bill, then Novakovic and Stephenson (2012) and Brown (2012) suggest that $6.50/cwt is in the range of an advisable coverage level. Of course producers can also choose to purchase supplemental insurance for years when they think there will be a larger indemnity payment based on their expectations on the milk and feed prices.

Methodology

In this section, we develop a framework to evaluate the impacts of MPP-Dairy on the supply response. The methodology used for this analysis is a stochastic dynamic optimization, which breaks the optimization problem into smaller sub problems, and allows for shocks to be incorporated without reestimating the entire objective function. The following are assumptions for this analysis to maintain a framework which is applicable to real world scenarios.

1. While farm sizes range from a few cows to many thousand, we separate the farms into three sizes: (1) small-under 9.13 million pounds of milk a year, (2) medium-9.13 to 18.25 million pounds of milk a year, and (3) large-18.25 and more million pounds of milk a year.

2. The control variable is the percentage change of milk production, which is used to ensure a continuous and concave function. This percent change is limited by a maximum decrease of 23%, 19%, and 14% for the small, medium, and large farms, respectively of daily production levels. The maximum increase is constrained at 40% for the small, 31% for the medium and 15% for the large sized dairies. This is based on historical month over month changes in the daily averages for the years 2000-2009. The constraints are an average on the maximum decrease and increase for every producer in the three size groups.[2] This constraint is included since financial constraints via debt and

[2] These percentages are after controlling for extreme outliers.

equity are not modeled.

3. Since we use the percent change as the control variable, costs for increasing herd size versus increasing output per cow cannot be disaggregated. Therefore, we combine the costs into a value for how much it costs for one more unit of milk production.

4. Since we are particularly interested in the effect of MPP-Dairy on production, to simplify the modeling the margin and"other variable costs"[3] are used as opposed to price and costs.

5. This model does not include any feedback from changes in production to the milk price received.

Given the assumptions above, we can now write our Bellman equation for each farm size as:

$$V(q_{ti}) = \max\left[f(q_{ti}, u_{ti}, m_{t-1}, c_{i,t}, \delta) + \beta V(q_{t+1,i}) | q_{t+1,i} = g(q_{ti}, u_{ti})\right] \quad (1)$$

where q_{ti} is the production level at time t for farm size i, u_{ti} is the control variable defined as the percent change desired for next month's production for farm size i, $c_{i,t}$ is the non-feed costs for each different farm size[4], δ is the probability of receiving a specific margin payment level, β is the discount factor (set at 0.943), and $m_{t-1,i}$ is the margin payment at time $t-1$ and varies based on the farm size[5]. The time period used for the analysis is monthly. The margin payment is lagged one month behind due to the nature of dairy purchases and payments. The milk check[6] is paid in two instances: (1) around the 15th of the current month and (2) at the beginning of the following month.

Equation (1) takes on the functional form

$$V(q_{ti}) = \max_{u}\left[q_{ti}(1 + u_{ti})(m_{t-1} - c_{i,t})\delta + \beta\delta V(q_{t+1,i}) | q_{t+1,i} = q_{ti}(1 + u_{ti})\right] \quad (2)$$

[3] Other costs are variable costs that are estimated monthly and are allowed to vary per farm size; it is supported by ERS data on dairy farm costs.
[4] This cost number is taken from ERS's dairy farm cost of production numbers and is allowed to vary monthly.
[5] This price number is taken from ERS's annual dairy farm cost of production numbers.
[6] This is the conventional term used to describe the bimonthly payments farms receive from milk processors.

By using $q_{ti}(1+u_{ti})(m_{t-1}-c_{i,t})$ we can capture the choices a farm operation makes. The operation will look at the monthly margin (which includes the price and feed costs), m_{t-1} and take out any additional variable costs ($c_{i,t}$) and make decisions about improving the output per cow and herd size. Equation 2 can be simplified into

$$V(q_{ti}) = \max_{q_{t+1}} \left[q_{ti} \left(\frac{q_{t+1,i}}{q_{ti}} \right) (m_{t-1} - c_{i,t})\delta + \beta\delta V(q_{t+1,i}) \right] \quad (3)$$

With this specification, we will run a theoretical model and then extend the analysis to an empirical application for 2009. The main hypothesis is that simulations will show the reduction in production by large and small farms will be gradual, while medium-sized farms will be more likely to reduce production at a quicker pace.

Data

The sources of data used were: (1) Federal milk marketing order farm data and (2) USDA's Economic Research Service (ERS), Agricultural Marketing Service (AMS) and National Agricultural Statistical Service (NASS). The data sources are detailed below with the USDA data used for general numbers such as cost of production and the farm data used for the simulations through setting the initial milk production variable levels for December 2008.

USDA Data

ERS data provides the estimated costs for different sized farms annually. They also supply a monthly cost of production for dairy farms, but it does not break the data into different farm sizes. The annual data (with the different size operators' costs of production) were used to estimate the costs and margins for the different farm sizes ($c_{i,t}$ and $m_{i,t}$), and the monthly costs of production were used to estimate the non-feed variable costs for dairy farms. The other variable costs varied monthly and for each farm size over the course of the analysis. To calculate the monthly margin and other variable cost estimates, a ratio of the farm size over the weighted average from the annual breakdown provided by ERS was used.

The other USDA data sources used were the NASS and AMS data. We used the NASS and AMS data to calculate the margins for the MPP-Dairy program. In the ERS data there is a breakdown for both payments and feed costs. As with the other variable costs, the payments and feed costs were adjusted to account for farm size. This helps to limit the bias of profitability for the larger farms.

Producer Data

The data were collected from the records of three Federal Milk Marketing Orders (FMMO or FO): the Upper Midwest (FO 30), the Northeast (FO 1), and the Southwest (FO 126). The Upper Midwest Order includes most of the milk produced in Wisconsin and Minnesota and portions of the milk produced in Iowa and North and South Dakota. The Northeast Order includes most of the milk produced in the Northeastern states ranging from Maryland to Maine. Considerable shares of milk from the Middle Atlantic states are also included, primarily from Virginia. The Southwest Order encompasses most of the milk produced in Texas and New Mexico.

Thus, this data set represents 1) a large number of farms, 2) a high percentage of farms from the respective regions, and 3) farms from a fairly diverse area in the United States by virtue of farm sizes in these three regions, the vast majority of farms are in the traditional milk-producing areas of the Upper Midwest and Northeast. In 2010, each Market Administrator (MA) was asked to provide data for farms that were continuously pooled from January 2000 through 2009. Although this analysis uses the data for 2009, it does not include any farms who entered the market after 2000. Hence, new entrants and exiting farms are ignored.

One reason for the continuous pooling requirement was to control for farms whose pool status switches temporarily since farm milk is priced based on the location of the plant to which it is shipped. If a plant changes customers or if a marketing cooperative changes its distribution patterns, a farm may find that their milk is priced under a different order. This can be a permanent or temporary shift. Pool qualification criteria have become stricter, especially in northern orders, but historically there would likely be a considerable number of farms that were de-pooled for periods of time. The criteria for selecting farm records was intended to reduce the chance of mistaking a change in milk marketing that were the result of a change in pool status, as opposed to farm production.

In providing the data, each MA office employed a slightly different selection rule. This impacts how the data is interpreted and consequent results. FOs 126 and 30 included farms whose monthly total payroll pounds per farm were continuously marketed milk between 2000 and 2009. FO 1 supplied monthly data for farms that were continuously pooled from 2000 to 2009, but FO 1 also excluded any farm associated with a year-over-year production increase of more than 500%. It may have excluded farms that made very large expansions, but this would be a small number of farms. The 2009 calendar year was chosen for the following analysis since it was the most recent year in which MPP-Dairy programs would have been triggered at all coverage levels, and for which we have data. These programs would also have been triggered in 2012; however, we do not have farm records for 2012.

Analysis

In this section, we maximize the Bellman equation (eq. 3). First descriptive statistics for the data we used are presented. Following the discussion of the polynomial approximation we discuss the results from the optimization and the simulations. To compute the stochastic dynamic programming, we used a polynomial approximation (as introduced by Howitt, et al., 2002) that is further described below.

Descriptive Statistics

For this analysis we used daily production levels to mitigate calendar composition issues[7]. Since only had monthly production data was available, we calculated the daily production numbers as the monthly production divided by the number of days. With only production data was available, the farms were divided into classification that corresponded with the ERS data. Smaller farms are categorized as 500 cows and under, medium sized farms are categorized as between 500 cows to 1000 cows, and large farms are categorized as anything above 1000 cows. A cluster analysis was also conducted which generally corresponded with the ERS numbers. Table 1 shows that these three farm sizes (small, medium, and large) are distinct groups.

Next we will go over the polynomial approximation, then present the optimization, after which we simulate the model using the actual margins in 2009 and the Federal Order data to set the initial values.

Table 1: Producer Data Daily Production, lbs. per day

Farm Size	N	Mean	Std. Dev	Min	Max
Small	11,663	3,835	3,421	500	34,962
Medium	220	25,128	9,367	15,007	64,522
Large	57	129,815	15,007	55,244	380,222

[7] Calendar composition issues arise since milk is produced every day and changes in production can be obscured by the number of days in a month.

Polynomial Approximation

Polynomial approximation is a method developed by Howitt et. al (2002) that provides a numerical approximation for the infinite horizon value function approach. The orthogonal polynomial approximation maps the relationship given by $V^{s+1} = TV^{s}$ where T maps such that a stable value holds between the next approximation and the current approximation such that $V = TV$. The Chebychev polynomial is chosen to map the approximations and takes the form $V(x) = \sum_{p} a_p \phi_p(M(x))$ where a_p is the coefficient of the p^{th} polynomial term $\phi_p(M(x))$. The Chebychev polynomial, which is defined on [-1,1] interval can be expanded by the numerical recursion relationship:

$$\phi_1(\hat{x}) = 1 \tag{4}$$

$$\phi_2(\hat{x}) = \hat{x} \tag{5}$$

$$\phi_3(\hat{x}) = 2 \cdot \hat{x}\phi_2(\hat{x}) - \phi_1(\hat{x}) \tag{6}$$

$$\phi_n(\hat{x}) = 2 \cdot \hat{x}\phi_{n-1}(\hat{x}) - \phi_{n-2}(\hat{x}) \tag{7}$$

As seen above, the polynomial is sinusodial in nature and has a relationship as $\phi_n(\hat{x}) = \cos(n \cdot \cos_{-1}(\hat{x}))$. The steps involved in using this polynomial approximation are:

1. Estimate the nodes at which the value function approximation is evaluated.

2. Solve the Bellman equation at each of the nodes identified above and save the maximized values to be used as the initial values for the next iteration.

3. Use the polynomial coefficient values to obtain the updated value function for use in the next iteration.

4. Iterate the procedure until the polynomial coefficients numerically converge.

For more details on this methodology see Howitt et al. (2002). Using this method, we first optimize the model which incorporates a probability distribution for the margins as calculated using the 2013 Farm Bill specifications.

Optimization Results

For the stochastic aspect, we calculated probabilities of expected margins using data from

2000 to 2013. Table 3 shows the probabilities where, as expected, the probabilities are highest in the middle ranges. It is interesting that the left tail does seem a little fatter than the right tail which implies that lower margins are slightly more probable than higher margins.

Table 2: Margin Probabilities

Margin Band	Probability
1.55 - 3.80	0.062
3.81-5.35	0.037
5.36-6.90	0.142
6.91-8.45	0.321
8.46-10.00	0.259
10.01-11.55	0.086
11.56-13.10	0.056
13.11-14.65	0.037

Using these probabilities as the stochastic element we maximize Bellman equation (eq. 3) so that the future present values are optimized along with the current period. Since we are using a polynomial approximation for an infinite horizon we optimize the current time period with the approximation optimizing the future time periods.

One of the more interesting results from the optimization is that the small farms seem to have a higher marginal effect in the transition equation than the medium and large farms (Table 3). When the model is maximized for the expected net present value, the optimal level of increasing production are the upper bounds of the constraints, 41%, 31%, and 15% for small, medium, and large farms, respectively. The maximized expected present value of net benefit shows all the sized farms relatively similar with the large farms receiving $31,816 with the small farms having $34,145. A unconstrained optimization shows that the largest farms would see a larger present value of net benefit than the small and medium sized farms.

Table 3: Marginal values for the transition equation for the 8 margin scenarios

Margin Band	Small	Medium	Large	Probability
1.55-3.80	0.6911	0.072	0.0205	0.062
3.81-5.35	0.4147	0.0432	0.0123	0.037
5.36-6.90	1.5895	0.1657	0.0472	0.142
6.91-8.45	3.5937	0.3746	0.1066	0.321
8.46-10.00	2.9026	0.3026	0.0861	0.259
10.01-11.55	0.9675	0.1009	0.0287	0.086
11.56-13.10	0.622	0.0648	0.0185	0.056
13.11-14.65	0.4147	0.0432	0.0123	0.037
Weighted Average	0.2903	0.0303	0.0086	

Simulation Results

For the simulation, we used the observed margin levels as defined by the 2014 Farm Bill specifications for data year 2009. Those margin levels ranged from $2.25 to $8.69 with the months May through July being the months with the lowest margins. We choose 2009 as the sample year because of its uniqueness to the dairy industry as one of the worst years in recent history for dairy farms. In 2009, many dairy farms either went out of business or acquired additional debt. The current program aims to provide impactful revenue stream protection mitigation for the dairy farm sector.

To model the MILC and MPP-Dairy programs, the payments are included into the margin payment as well as any premium payment, and the production response in the simulation is then measured. The payment time frame is modeled as directed with the legislation. The MILC payments are made on a monthly basis (if there is a payment) and capped for the larger farms. The MPP-Dairy payments are made on a bimonthly basis as is laid out in the legislation. The $m_{t-1,i}$ includes the actual margin (as is calculated in the MPP-Dairy), premiums paid for MPP-Dairy, and any payment to the producer that would have occurred. Since we are interested in the effect of MPP-Dairy on farm-level production, the suggested margin for DSA is $6.50/cwt at maximum (90%) coverage level is used for the simulation. (Stephenson and Novakovic (2012) and Brown (2012)) The simulation results compares the actual average production for each farm size against different simulation scenarios: (1) simulated with no government program, (2) simulated with MILC payments, (3) simulated with MPP-Dairy alone. The lower bounds on the daily milk production for all three sizes is 1,000 pounds per day. The upper bounds for the daily milk production is 30,000, 65,000, and 380,000 for the small, medium, and large farm sizes, respectively. We also limit the increase and decrease of u_{ti} to the average increase and decrease for the 2009 period for each farm size instead of across 2000 to 2009 as is done in the optimization. This keeps the farms from increasing or decreasing their production at an improbable rate since financial constraints are not modeled.

It is assumed that the small farms get the MILC payments for every month that payments are announced; but due to the larger production level limits, medium farms only get MILC payments for March, April, May and part of June, while large farms only elect the MILC payments for June (and only for half of one month's production). This is due to the MILC payment caps on production. For the medium and large sized farms it is assumed that the farms will average their MILC payments to ensure they meet their costs over the length of the low margin months in 2009. For the MPP-Dairy simulation, the farms average their payments over the immediate two months after receipt of payment during 2009.[8] Different assumptions for this averaging will lead to different results.

Figures 1, 2, and 3 show the different simulation scenarios for small, medium and large farms. The simulation results show drastic reductions between the amount of production with MILC and without any government support program. These results are different from what we would expect to see in reality in a couple of ways: (1) There would be an offsetting price impact and (2) farms would not necessarily extend marginal output reductions deep into their core production.[9] This analysis should be used as a way to qualitatively compare different policies. All of the three figures tell a similar story that the MILC program has production at the highest level while having no government program drops the production levels. Changing two of the assumptions would change the results of simulation. First, changing the growth variable from a constrained to unconstrained would significantly change the results since in an unconstrained simulation the high payments from MPP-Dairy earlier in the year would likely show that large dairy farms would increase their production to levels above those shown with MILC. Large farms would likely end their production above the MILC production line at the end of the year. Second, changing the assumption on how the large farms average their margin payments versus their MILC payments would change the pattern of the production curve.

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[8] We use a two month period since MPP-Dairy is paid in two month increments when it is in effect.

[9] However, it's also true that there is no recent historical basis for knowing how farms would respond to effective margins that were even lower than the supported margins of 2009, so knowing what response at the farm-level would have been is difficult.

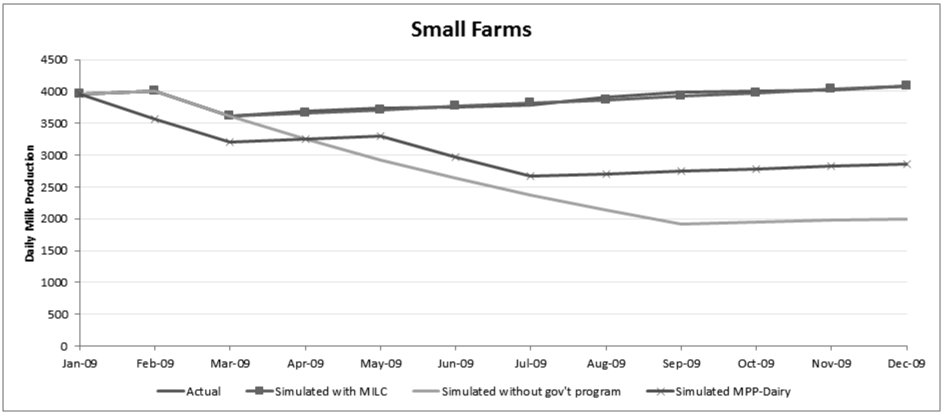

Figure 1: Comparing Actual Production Against Simulated Governmental Policies for Small Farms

The simulated results show that the medium-sized farms reduce production greatly when the market is bad. This agrees with the hypothesis that small and large farms make production changes slower than the medium sized farms, especially without any governmental program. This fundamentally occurs since the medium-sized farms have the lowest margins due to their cost structure. Since they are still expanding, they cannot take advantage of the same economies of scale like the large farms. However, since they are expanding, they face higher costs per cwt than the small farms. It is also interesting to note that the actual data and the simulated MILC payments track each other closely. In fact the difference is so small that on Figure 2 they lay directly on top of each other. Figure 3 shows that in this simulation all farms would have produced less under MPP-Dairy than MILC. Of course this simulation uses the margin as given. The effect of the reduced production is not taken into account here.

Another analysis that was done, but not shown in the figures below, looked at how the MPP-Dairy payment schedule could affect the production of milk. If the farms expect to receive their payments in one lump sum and immediately reinvest the payments into their farm to produce more milk, the end result would be higher volatility in the "realized margin"[10] and overall lower production levels at the end of the year. However, if the farms get their indemnity payments over a period of two months and decide to average their reinvestment into the farm over the low margin months, then the production curve is what is shown in the figures 1, 2, and 3 for the MPP-Dairy line. This curve contains

[10] Realized margin = observed margin + average MPP-Dairy payment.

fewer production swings which, one could reason, lead to less price volatility. This would imply that the impact of this program on volatility will depend on how farms view the indemnity, and what short term spending habits they decide to follow.

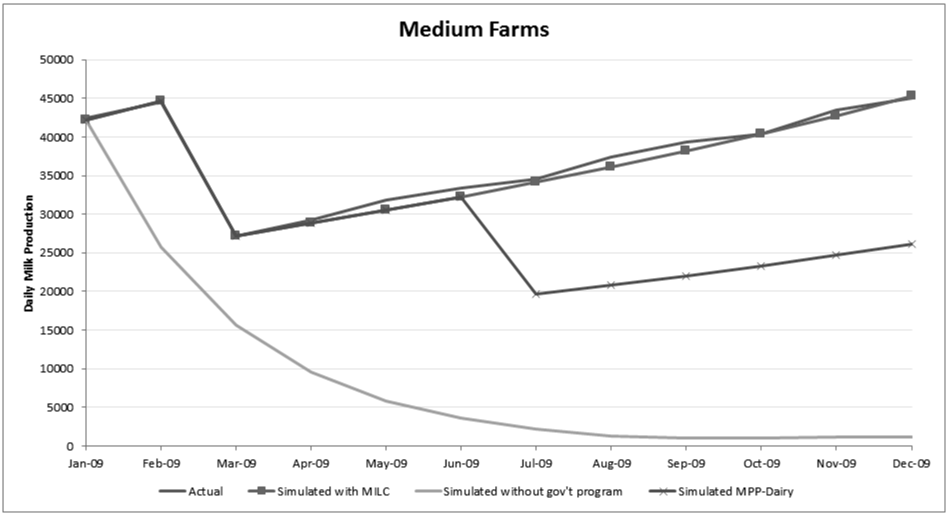

Figure 2: Comparing Actual Production Against Simulated Governmental Policies for Medium Farms

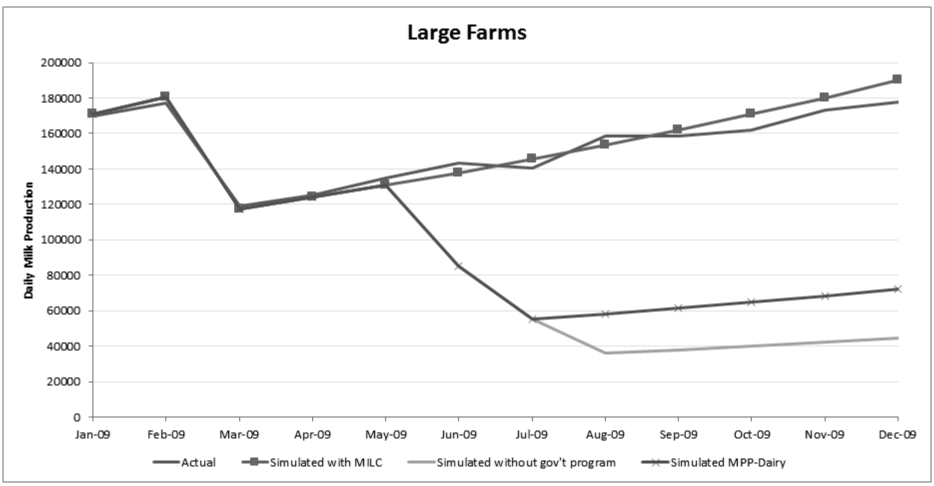

Figure 3: Comparing Actual Production Against Simulated Governmental Policies for Large Farms

Conclusion

In this paper we studied the supply response of past and current programs through stochastic dynamic programming. Both MILC and MPP-Dairy are found to reduce milk supply responsiveness to margin declines, but MPP-Dairy was found to have less distortionary effect on the aggregate milk supply. Consequently, the simulation model suggests milk supply in 2009 would have shrank faster and stronger had MPP-Dairy been in effect instead of MILC. However, since more milk on large farms is eligible for MPP-Dairy payments than for MILC, changing the model assumptions to allow more aggresive growth may change our results and result in MPP-Dairy having a bigger impact on aggregate milk supply. Due to the constraints of the model, expected behavior of the farms may be significantly different if the program goes into effect due to unseen effects of human behavior. Payment timing of MPP-Dairy is critical when the model is optimized. If the farms reinvest all of their indemnity payments, then supplies could increase, potentially impacting prices with increased volatility.

By focusing on farm performance based on farm size, it was determined that medium sized farms were the quickest to respond to both low and higher margins when there was no governmental program, whereas small and large farms responded slower and with less intensity. The simulation of milk production without governmental support programs, predicted that the medium sized farms decreased production the most which suggests that medium farms would be the most at-risk group of shutting down without any governmental support. As a tool to examine policy, this analysis contributes to the current discussion on MPP-Dairy by presenting a perspective on the potential impacts that various policy changes can have on farms. This research, in addition to the current knowledge base examining government spending and general farm welfare in the program, provides an important dialog on how to best proceed when it comes to dairy policy in the present and for years to come. There are more avenues to research in dairy policy, such as the addition of parameters like seasonality, utilizing ARMS data[11], and relaxing the u_{it} assumptions to contribute new dimensions to the discussion.

[11] Agricultural Resource Management Survey is a product provided by ERS and NASS. See http://www.ers.usda.gov/data-products/ for more information., accessed: 7-10-2013

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