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# Livestock Gross Margin–Dairy: An Assessment of Its Effectiveness as a Risk Management Tool and Its Potential to Induce Supply Expansion

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An evaluation of the risk-reducing effectiveness of the Livestock Gross Margin–Dairy (LGM-Dairy) insurance program, using historical futures price data, predicts economically significant reductions in downside margin risk (24–41%) across multiple regions. Supply analysis based on the estimated risk reduction shows a small supply response, assuming minimal subsidization. A decomposition of the simulated indemnities into milk price and feed price components shows comovements in futures prices moderating the frequency and levels of indemnities.

*Key Words:* Dairy Producer Margin Protection Program, Livestock Gross Margin–Dairy, margin insurance, policy analysis, risk management

**JEL Classifications:** Q11, Q18

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Livestock Gross Margin Insurance for Dairy (LGM-Dairy), a public risk management policy program overseen by the Risk Management Agency of the U.S. Department of Agriculture, is designed to reduce producer income risk resulting from volatility in both milk and feed prices (U.S. Department of Agriculture Risk Management Agency [USDA RMA], 2010a). For producers, it has three major advantages over traditional price risk management tools (e.g., forward contracting and the use of futures and options). First, LGM-Dairy effectively insures gross margins—that is, milk output prices less the corresponding feed costs—which are more closely related to profits than milk prices or feed prices alone. Second, it is more "user-friendly" than futures and options because any output level can be insured and its use does not require the maintenance of margin accounts.

Third, producers enjoy flexibility in the feed inputs that they insure. Moreover, LGM-Dairy indemnities are determined by a small set of CME Group futures prices, ostensibly providing more transparency for users.

LGM-Dairy is a pilot product. Since its rollout in 2009, the program has experienced some uptake but has also suffered limited funding, which has shortened the purchasing windows in recent years. This study aims to quantify the effects of LGM-Dairy should it, or something similar, become a more permanent fixture of U.S. dairy policy by estimating the effective risk reduction and its potential to induce longer-term supply expansion. Specifically, we calculate the risk-reducing potential of the LGM-Dairy program by estimating historical gross margins between 2002 and 2011 and comparing these with counterfactual margins that would have resulted had adoption of LGM-Dairy been widespread during this period. We refine this analysis by disaggregating the risk reduction into that from feed prices and that from output prices and by incorporating regional differences in feed costs. We then calculate the longer-term supply increase that can result from the widespread adoption of LGM-Dairy accounting for supply response impacts resulting from both reduced income risk and a potentially higher average margin. Understanding the relative magnitudes of each effect can help in refining the LGM-Dairy program to meet its risk reduction objective while minimizing potential distortionary effects.

## LGM-Dairy Background

In the past, output price risk had been a relatively minor concern for dairy producers as a result of the government's long-standing policy goal of mitigating declines in producer milk prices. The Dairy Product Price Support Program, previously known as the Dairy Price Support Program, was established in the 1940s with the objective of supporting milk prices at specified levels through the government purchase of "surplus" production, which effectively removed it from the domestic market. Although the program did not necessarily prevent milk prices from falling below the support price, it did prevent low prices from persisting over significant periods. Reflecting a general shift in agricultural policies away from direct payments and price supports toward more market-based price risk management tools, the support price was reduced so much during the 1980s that by the 1990s, low prices rarely triggered government milk purchases.

Despite substantial volatility in milk price and, in the most recent decade, feed prices, dairy producers have not widely adopted conventional market-based risk management tools such as forward contracting and the use of futures and options. The LGM-Dairy program and, before it, the Dairy Option Pilot Program (DOPP) were developed to address this apparent market failure. The DOPP, launched in 1999 and concluded in 2002 after four rounds, aimed to increase the use of options among dairy producers by providing education and subsidizing broker fees and put option premiums. Buschena and McNew (2005) find evidence of the DOPP increasing trading volumes of dairy options, but other studies suggest that several obstacles remain to the more widespread use of dairy options markets by producers. For example, hedging effectiveness using options varied by milk class with higher Class III use areas benefiting the most. Hedge ratios and Chicago Merchantile Exchange (CME) contract size make the use of options practical for only very large operations (Maynard, Wolf, and Gearhardt, 2005). Psychological barriers exist in the acceptance and use of options among dairy producers with many considering transactions in futures and options markets as gambles rather than as legitimate tools for risk management (Ibendahl, Maynard, and Branstetter, 2002).

The LGM-Dairy program is a hybrid risk management product; it relies on market-based product prices but also retains the ease of use and familiarity of traditional government-provided insurance products. Despite these features and its risk-reducing potential, it has been underfunded and, as a result, underused. Since 2011, LGM-Dairy has been offered with a 40% premium discount. This subsidy, however, has resulted in shorter enrollment windows (i.e., producers are unable to insure margins

year-round) because the product can no longer be offered once the annually allocated funds are exhausted (USDA RMA, 2011; Wright, 2012).

At purchase, the producer specifies the amount of milk that he or she plans to insure as well as the expected quantities of corn and soybean meal necessary to achieve the specified level of milk production.[1] Indemnities are based on an index constructed using CME futures prices for Class III milk, corn, and soybean meal rather than local prices actually received for milk and paid for feed inputs. It is thus similar to a "bundled option strategy" in that the producer effectively purchases a put option on Class III milk futures as well as call options on corn and soybean meal futures. As such, LGM-Dairy simultaneously protects against decreasing milk prices and increasing feed costs. However, one important difference between LGM-Dairy and a bundled option strategy is that LGM-Dairy indemnities are triggered when margins decrease, whereas a true bundled option strategy provides compensation when either milk prices fall below strike prices or feed prices rise above strike prices.

At the same time, LGM-Dairy retains the user-friendliness of government farm programs. It is available through insurance agents, rather than commodity futures brokers, and producers can choose any level of coverage, allowing even small- and medium-sized dairies the opportunity to hedge their profit margins. Although some cooperatives offer hedging opportunities in smaller contract sizes, this type of service is by no means ubiquitous.

The purchaser's indemnity is the difference between the actual gross margin and the guaranteed gross margin. The actual gross margin for a covered month is a weighted average of futures prices for Class III milk, corn, and soybean meal on the last three trading days of the month before expiration. The guaranteed margin is determined at the time of purchase and is based on nearby futures market closes for milk, corn, and soybean meal over the following ten-month period, as observed at the time of purchase. Whether the purchaser covers one or all ten months over this period, his or her guaranteed margin is determined in the same way.

Purchases take place approximately one month before the start of the ten-month period—specifically, coverage must be purchased during a 16- to 18-hour window on the last business Friday of the month two months before the coverage window. The margin guarantee is based on a three-day average of futures market closes for milk, corn, and soybean meal contracts at the time of purchase. For example, if a producer desires coverage starting in May, he or she will purchase it during the last business Friday of March and will be guaranteed a margin based on the nearby futures closes for milk, corn, and soybean meal for each of the ten contract months beginning in May and ending in February, as observed over the three-day period ending with the purchase day (i.e., the last business Friday of March as well as the preceding Wednesday and Thursday).

It is important to note that the indemnity is paid only once—at the conclusion of the total insured period, whether this is the full ten-month period or a single month. Thus, it is possible that a producer who chooses to insure his or her gross margin for the entire ten months might not be paid any indemnity if, in aggregate, better months offset weaker months (Gould and Cabrera, 2011). For an in-depth description of the product, we direct the reader to Gould and Cabrera (2011).

Because LGM-Dairy is based on these market indices, it poses both the advantages and disadvantages characteristic of index-based insurance products. The use of widely observed and (effectively) exogenous indices minimizes moral hazard and adverse selection on the part of producers, eliminates the need for costly verification on the part of administrators, and increases the transparency of the payout mechanism (Barnett, 2004). At the same time, the use of indices introduces basis risk,[2] which can erode the risk-reducing potential of the LGM-Dairy

[1] There are default values for feed use as well as minimum and maximum values that can be declared.

[2] Unless otherwise stated, by "basis," we refer to the discrepancy between the margins calculated from the index and those that are in fact realized by producers.

program. In the following section we quantify differences in risk-reducing effectiveness of the LGM-Dairy program and take into account a potential source of basis risk: regional differences in milk and feed prices.

## Risk Analysis and Supply Response

In theory, a reduction in risk, or perceived risk, will induce risk-averse agents to increase production, because reducing the riskiness of returns effectively increases the certainty equivalent value. Much of the literature on supply response to risk is based on Chavas and Holt (1990), who model corn and soybean acreage decisions on the part of (potentially) risk-averse producers as a function of variance and covariances of prices. They find evidence of acreage responses to reduced output-price risk through wealth effects and predict nontrivial acreage increases in response to price support programs. Bakhshi and Kerr (2009) modify the Chavas and Holt model to isolate the effect of insurance from those of wealth and market prices in an application to Canadian field crops. They find the insurance effect to be statistically and economically significant and conclude that even decoupled government payments can potentially distort markets by inducing a supply response. Lin and Dismukes (2007) also find revenue risk to be a significant explanatory variable in soybean-planting decisions. Nonetheless, supply responses to risk are specific to crops, regions, and farm programs. Liang et al. (2011), using corn acreage data, find only small supply effects in response to changes in revenue variance. Most relevant to the present study, Luh and Stefanou (1989) find no evidence of a risk response in analyzing Pennsylvania dairy farm data from 1977–1984, a time period when price supports were generally increasing and/or at high levels. More recently, Burdine et al. (forthcoming) find a significant, but small, risk elasticity of supply in their analysis of dairy production data from 2006–2010.

Given the long history of dairy policy and mixed success of past price risk management tools, it is important to understand the effectiveness of LGM-Dairy and estimate the potential supply response that it may cause. In this study, we use data from the 10-year period from 2002–2011 and pose the question, "Had LGM-Dairy been available over this entire period, to what extent would it have reduced the gross margin risk of participating producers?" This reduction in margin risk is then decomposed into that arising from milk price indemnities, corn price indemnities, and soybean meal price indemnities. Finally, we estimate the supply response resulting from the resultant change in the distribution of gross margins using published estimates of risk and output price elasticities. To gauge the sensitivity of the main results to regional differences in prices, the risk reduction and supply response are estimated for 13 major milk-producing regions.

The LGM-Dairy program has been previously analyzed from several perspectives. In particular, the optimal coverage strategy has received considerable attention given that producers are free to choose production coverage levels for up to ten contiguous months in a single contract. Valvekar, Cabrera, and Gould (2010) determine the optimal monthly coverage levels for a target gross income level. Bozic et al. (2012) compare the risk-reducing performance of multiple rule-of-thumb coverage strategies, one of which is the coverage strategy used in this analysis. Valvekar et al. (2011) gauge the sensitivity of the optimal coverage strategy to program subsidy levels over a range of risk preferences; they reach the general conclusion that LGM-Dairy is beneficial to risk-averse producers but that participation is highly sensitive to premium subsidies. In contrast, this study assumes a single coverage strategy and calculates the associated risk reduction had it been implemented (and had LGM-Dairy been available) over the period 2002–2011. By using region-specific prices, we are able to partially address the question of regional differences in the program's risk-reducing efficacy. The estimated risk reduction is then used to calculate an upper-bound supply response should participation in LGM-Dairy become widespread.

We construct the historical distributions of gross margins without LGM-Dairy and compare these with those that would have resulted had it been available throughout the entire study period. In both of these distributions,

each observation corresponds to a purchasing month and its value is the per-hundred-weight-of-milk gross margin summed over a ten-month LGM-Dairy contract period. It is assumed that the producer purchases pooled insurance every month with each contract representing ten percent of production during the ten-month contract period. In this way, 100% of each month's production is insured over ten successive, overlapping LGM-Dairy contract periods. This contract design corresponds to the "Flat 10" strategy analyzed in Bozic et al. (2012); we use it here because it is a relatively simple strategy that covers all of the production. Margins are calculated for each purchasing month in the period beginning January 2002 and ending December 2011.

Regional gross margins in the absence of LGM-Dairy are calculated using historical monthly mailbox milk prices and state-level corn prices, where available. Historical mailbox milk price data are available online from Gould (2013) for the following regions: Northwest, California, New Mexico, western Texas, Minnesota, Wisconsin, Illinois, southern Missouri, Michigan, Ohio, Appalachia, Florida, and New England. State-level monthly average corn price data (USDA National Agricultural Statistics Service, 2013) are used for the following subset of regions: western Texas, Minnesota, Wisconsin, Illinois, Missouri, Michigan, Ohio, and Appalachia (Kentucky data used). For the remaining regions, national average prices are used. National averages are used exclusively for soybean meal prices, because the ten cash markets for which the USDA Agricultural Marketing Service collects price data align poorly with the regions defined in the present analysis.

Under LGM-Dairy, the producer receives the gross margin described previously less a premium plus indemnities in months when the actual gross margin is less than the guaranteed gross margin. The indemnity (I) on a ten-month contract purchased in month $i$ is

$$I_i = max\left\{\sum_{j=i+2}^{i+12} GMG_{ij} - AGM_j, 0\right\}. \quad (1)$$

where the Gross Margin Guarantee (GMG) at purchase month $i$ for coverage month $j$ is calculated as follows:

$$GMG_{ij} = \propto(\hat{P}_{ij}^{milk} - \beta\hat{P}_{ij}^{corn} - \gamma\hat{P}_{ij}^{SBM} - deductible) \quad (2)$$

Here $\hat{P}_{ij}^{milk}$ ($\hat{P}_{ij}^{corn}$,$\hat{P}_{ij}^{SBM}$) is the futures price for Class III milk (corn, soybean meal) in coverage month $j$ as observed in purchase month $i$, $\alpha$ is the coverage level, $\beta$ is the corn coefficient, and $\gamma$ is the soybean meal coefficient. The Actual Gross Margin (AGM) for coverage month $j$ is as follows:

$$AGM_j = \propto(P_j^{milk} - \beta P_j^{corn} - \gamma P_j^{SBM} - deductible) \quad (3)$$

Actual gross margins are also calculated using futures price data; "actual" milk, corn, and soybean prices are, in fact, averages of futures settlement prices over the final three days before expiration. A historical record of these futures prices is made available online in the "Underlying Data" section of Gould's (2013) web site, "Understanding Dairy Markets." For months with no futures contracts, a weighted average of surrounding months is used (Gould, 2013). All gross margin calculations assume coverage of 1 cwt of milk, default feed coefficients of 0.5 bu/cwt of corn ($\beta = 0.5$) and 0.002 ton/cwt of soybean meal ($\gamma = 0.002$), and a zero deductible.[3] These coverage levels correspond to a producer who relies on a combination of purchased and home-produced feed.

Premiums for each ten-month contract period are calculated using the same simulation data used to construct the actual LGM-Dairy premiums, also available on Gould's web site. For each month in each contract period, 5000 simulated prices of milk, corn, and soybean meal are provided, allowing the calculation of 5000 "actual" gross margin values.[4] By comparing these with the gross margin guarantee

[3] These assumptions are consistent with 2011 contract specifications. We do not use prior calculation methods such as the basis adjustments for milk and corn that were used before July 2009.

[4] Each combination of milk, corn, and soybean meal price is, effectively, a draw from a joint distribution based on historical monthly prices. The simulation method is described starting on page 5 of the following document: http://future.aae.wisc.edu/lgm-dairy/rma_material/rating_methods.pdf.

values for the corresponding contract period, 5000 indemnities are calculated. The unsubsidized premium used in this analysis is the average of these simulated indemnities plus a three percent load. This same method is used to calculate a premium with an 18% subsidy, which, as of this writing, applies to pooled coverage with a zero deductible (USDA RMA, 2010b. The calculation method follows the guidelines in place since December 17, 2010 (USDA RMA, 2010b) and assumes the default feed ration values, pooled coverage for ten-month contract periods, and a zero deductible. Figure 1 shows the evolution of this subsidized premium and the simulated indemnity over the study period.

Indemnities (and premiums) are thus determined at a national level, although gross margin fluctuations are obviously region- and even producer-specific. The effectiveness of LGM-Dairy in reducing gross margin risk may vary across space, especially in locations with low Class III use or during periods when farm-level milk prices do not closely track Class III prices. Just as producers who hedge in futures and options markets face basis risk, participants in LGM-Dairy face an analogous risk of indemnity payments not necessarily occurring when realized gross margins are low. This basis risk can arise from weak correlations between national-level prices and local prices, but also from the very design of the LGM-Dairy insurance product. Indemnities do not necessarily occur when absolute gross margin levels fall; they occur when gross margins fall from higher expected levels during the life of a contract. That is, participants can fail to receive indemnities even when gross margins are very low, if they are not as low as expected. LGM-Dairy simply allows producers to protect margins offered by the current market, which may not always translate into profit. This is the nature of futures as a price risk management tool—it does not provide countercyclical risk protection, but rather allows producers the opportunity to capitalize on the expectations of prices in the future manifested within futures contracts.

In the comparisons of regional gross margin distributions with and without LGM-Dairy, we use root mean squared downside deviations from the median as the measure of risk. That is, $risk = \left( \frac{1}{2I} \sum_{1 \le i \le I} [M_i < \mu](\mu - M_i)^2 \right)^{1/2}$, where $M_i$ is the mailbox margin (in \$/cwt) corresponding to purchase month $i$ and $\mu$ is the median value of monthly mailbox margins from January 2002 to December 2011. We use deviations from the median, rather than the mean, because the mean may not represent a "typical" outcome if the distribution is skewed. Squaring the downside deviations places greater weight on larger deviations. Although variance is a convenient and commonly used measure of risk (e.g., Chavas and Holt, 1990), there is no inherent reason to expect gross margin distributions to be symmetric. Moreover, producers are

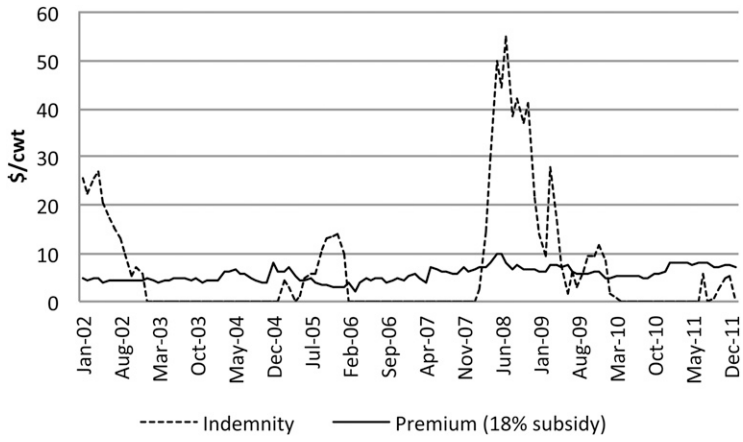


**Figure 1.** Indemnities and Premiums

sensitive primarily to downside risk, because it can pose a real threat to their operations.

The risk reduction is then decomposed into that from the milk price component, that from the corn price component, and that from the soybean meal price component. Because the LGM-Dairy product is, in many ways, a bundled option, we essentially "unbundle" the three components and measure the extents to which risk would be reduced under three hypothetical products: Class III milk price insurance, corn price insurance, and soybean meal price insurance. The former is essentially a put option on milk futures and the latter two are call options on corn and soybean meal futures, respectively. To provide a true comparison with the LGM-Dairy product, however, we model the three products as paying out only during the months in which the LGM-Dairy product itself pays out. The indemnity paid by the milk price insurance product is simply the expected futures price minus the futures price realized just before expiry, whenever this value is positive; and the indemnity of the corn (and soybean meal) insurance product is the realized futures price minus the expected futures price whenever this value is positive. Risk reduction under each of the three products is calculated using the same futures price data and feed ration assumptions as described previously. Again, the effectiveness of each of these counterfactual products is a function of the correlation between the CME prices and local prices. Like in the previous main analysis, we use mailbox milk prices and state-level corn prices (for regions where these are available) to address basis risk.

Finally, we predict the marginal supply response resulting from the presence of LGM-Dairy using a first-order approximation of the supply function and published estimates of supply elasticities. Note that LGM-Dairy can potentially shift the average gross margin in addition to downside risk, either because of loaded or subsidized premiums or premiums that are not actuarially fair. LGM-Dairy premiums contain a three percent reserve load, which we expect to lower the average margin for LGM-Dairy users. Premium subsidies, however, are expected to more than offset the impact of the reserve load, possibly resulting in a net increase in the average margin.

We therefore approximate the producer's response to a shifted gross margin distribution as the sum of two effects: the risk effect and the price (average gross margin) effect. The risk component is calculated as the percentage risk reduction multiplied by the risk elasticity of supply. The price component is calculated by multiplying the percent change in expected gross margin by the price elasticity of supply.

$$\%\Delta\text{supply} \approx \%\Delta\text{risk} \times \varepsilon_{risk}^{supply} + \%\Delta\text{averagemargin} \times \varepsilon_{price}^{supply} \tag{4}$$

Estimates of risk elasticity are rare, and those specific to milk production even more so. Two exceptions are Luh and Stefanou (1989) who are unable to reject risk neutrality and, more recently, Burdine et al. (forthcoming), who find a significant but small risk response. In this analysis, we consider the range –0.025 to –0.10, where a value of –0.10 indicates that a one-percent decrease in risk (measured here as root mean squared downside deviations from the median of regional gross margins) would increase milk production by one-tenth of one percent. Published estimates of dairy price elasticity of supply range from 0.08 (Bozic and Gould, 2009) to 0.36 (Adelaja, 1991) for the short run and 0.51 (Bozic and Gould, 2009, six-year elasticity) and 0.52 for the long run (Adelaja, 1991). In the present analysis we assume a supply elasticity of 0.5. To provide an upper-bound estimate of the supply response, we use a value of supply elasticity that is from the high end of the plausible range.

## Results

Results from the risk analysis suggest that LGM-Dairy was effective in reducing the risk faced by dairy producers. Risk—as measured by the downside semivariance of gross margin—is considerably smaller under LGM-Dairy participation than in its absence. Table 1 shows regional risk reduction levels assuming a zero deductible. Although the extent of risk reduction varies somewhat between regions—estimates of risk reduction range from 24% in

**Table 1.** Risk Reduction Associated with LGM-Dairy (January 2002 to January 2012)

| Region | Risk without LGM-Dairy | Risk with LGM-Dairy | Risk Reduction |
|---|---|---|---|
| Northwest[a] | 21.46 | 14.91 | 30% |
| California[a] | 20.67 | 14.10 | 32% |
| New Mexico[a] | 21.03 | 12.38 | 41% |
| Western Texas | 21.03 | 13.56 | 36% |
| Minnesota | 23.79 | 15.82 | 34% |
| Wisconsin | 24.75 | 17.29 | 30% |
| Illinois | 24.87 | 17.01 | 32% |
| Southern Missouri | 22.42 | 14.35 | 36% |
| Michigan | 23.09 | 15.09 | 35% |
| Ohio | 22.65 | 15.57 | 31% |
| Appalachia | 22.36 | 16.91 | 24% |
| Florida* | 20.49 | 13.79 | 33% |
| New England* | 25.60 | 18.23 | 29% |

[a] National average used for corn price.
Note: Risk is measured as the downside semivariance of gross margins.

Appalachia to 41% in New Mexico—we consistently find a moderate risk reduction in each of the regions included in this analysis. This is a notable finding in light of an analysis of the Dairy Options Pilot Program (Maynard, Wolf, and Gearhardt, 2005), which found that the risk-reducing effectiveness varied considerably across regions as a result of differences in Class III use rates.

The respective effects of the milk price, corn price, and soybean meal price components of LGM-Dairy are gauged by estimating risk reduction under each of the three hypothetical products described in the previous section. Figure 2 shows their respective indemnities over the study period. When an indemnity payment is triggered under LGM-Dairy, the primary component of the payout is the result of the difference between the expected and "actual" milk price. The next largest component (in terms of magnitude) of the total indemnity is that from corn. In general, the corn component is of the opposite sign as the milk component, indicating that when the actual price of milk is lower than the expected price, the actual price of corn, too, is lower than its expected price. This positive correlation between milk and corn prices is, of course, precisely what LGM-Dairy is designed to take advantage of. Lastly, the effect of the soybean meal component is very small and shows less of a pattern.

Using the same downside semivariance measure as in the main analysis, we estimate gross margin risk under each of the three hypothetical products by themselves and compare these with the gross margin risk in the absence of any products. The results are presented in Table 2 and are consistent with the mentioned findings. The indemnities and therefore risk-reducing effectiveness of the LGM-Dairy product are driven primarily by the milk basis.[5] Furthermore, because the corn basis is positively correlated with the milk basis in the months when LGM-Dairy pays indemnities, the corn component generally increases the variance of the gross margin. Finally, the soybean meal price plays a very small role in the risk-reducing potential of LGM-Dairy. Again, this positive correlation between the milk and feed basis is what underpins LGM-Dairy; the program was designed such that producers would receive payments only when lower-than-expected milk prices are not accompanied by commensurately lower-than-expected feed prices or when higher-than-expected feed prices are not accompanied by higher-than-expected milk prices.

We now turn to the expected gross margin results in Table 3 assuming a zero deductible, which is associated with an 18% premium subsidy. Under these assumptions, LGM-Dairy increases the expected gross margin only modestly; the gain is roughly one percent, or approximately 13 cents per hundredweight of milk. Like in the risk analysis results, this finding is consistent across regions.

The results in Table 4 indicate that the short-term milk supply impacts from LGM-Dairy are likely to be small. The supply response is less than five percent across all regions, even at the highest assumed risk elasticity level of –0.10, which is expected to be in the upper tail of the

[5] Here we use the term basis to refer to the difference between the expected futures price (at purchase) and the realized futures price (just before contract expiry).

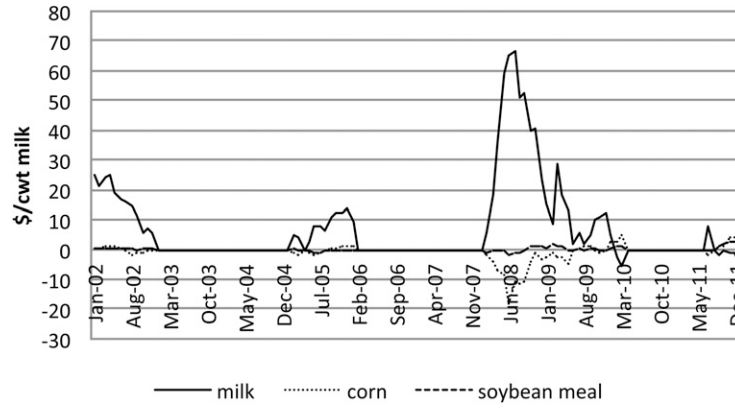


**Figure 2.** Decomposition of LGM-Dairy Indemnity

risk-elasticity distribution and an assumed price (average margin) elasticity of 0.5, which is itself a long-run elasticity estimate. Given that this value is an upper-bound estimate of the supply response and that LGM-Dairy participation is far from universal, the actual industry-level supply response resulting from LGM-Dairy will likely be lower, amounting to a modest supply response.

## Conclusions and Policy Implications

From this study, we conclude the following. First, LGM-Dairy is an effective tool for risk reduction and that its risk-reducing efficacy is robust to regional differences in milk and feed prices. Second, LGM-Dairy—because it insures the margin itself—achieves this result without the "excessive" insurance coverage (and higher cost) associated with a milk-feed options bundle (as noted by Bozic et al., 2012). Our decomposition of risk and indemnities shows that the corn basis is positively correlated with the Class III milk basis, indicating that indemnities are most likely paid when milk prices are lower than expected and feed prices are not commensurately lower. Moreover, when payouts are triggered, this positive correlation reins in

**Table 2.** Decomposition of Risk Reduction (January 2002 to January 2012)

| Region | Risk without LGM-Dairy | Risk with Milk Product | Risk Reduction | Risk with Corn Product | Risk Reduction | Risk with Soybean Meal Product | Risk Reduction |
|---|---|---|---|---|---|---|---|
| Northwest[a] | 21.46 | 13.76 | 36% | 23.71 | –11% | 21.43 | 0% |
| California[a] | 20.67 | 14.54 | 30% | 21.82 | –6% | 19.57 | 5% |
| New Mexico[a] | 21.03 | 12.07 | 43% | 22.74 | –8% | 20.25 | 4% |
| Western Texas | 21.03 | 12.77 | 39% | 23.22 | –10% | 20.95 | 0% |
| Minnesota | 23.79 | 15.74 | 34% | 25.73 | –8% | 24.73 | –4% |
| Wisconsin | 24.75 | 16.74 | 32% | 26.26 | –6% | 24.71 | 0% |
| Illinois | 24.87 | 15.42 | 38% | 26.45 | –6% | 24.73 | 1% |
| Southern Missouri | 22.42 | 14.22 | 37% | 23.74 | –6% | 22.18 | 1% |
| Michigan | 23.09 | 14.90 | 35% | 24.25 | –5% | 22.59 | 2% |
| Ohio | 22.65 | 15.47 | 32% | 24.52 | –8% | 22.59 | 0% |
| Appalachia | 22.36 | 15.02 | 33% | 23.34 | –4% | 21.91 | 2% |
| Florida[a] | 20.49 | 13.34 | 35% | 21.36 | –4% | 20.49 | 0% |
| New England[a] | 25.60 | 17.46 | 32% | 27.41 | –7% | 25.83 | –1% |

[a] National average used for corn price.

Note: Risk is measured as the downside semivariance of gross margins.

**Table 3.** Average Realized Margins (January 2002 to January 2012)

| Region | Average Margin without LGM-Dairy (per cwt milk) | Average Margin with LGM-Dairy (per cwt milk) | Change in Margin |
|---|---|---|---|
| Northwest[a] | $12.60 | $12.72 | 0.9% |
| California[a] | $11.81 | $11.93 | 1.0% |
| New Mexico[a] | $11.76 | $11.88 | 1.0% |
| Western Texas | $12.58 | $12.70 | 0.9% |
| Minnesota | $13.67 | $13.79 | 0.8% |
| Wisconsin | $13.68 | $13.79 | 0.8% |
| Illinois | $13.64 | $13.76 | 0.8% |
| Southern Missouri | $13.32 | $13.43 | 0.9% |
| Michigan | $13.25 | $13.37 | 0.9% |
| Ohio | $13.79 | $13.91 | 0.8% |
| Appalachia | $14.32 | $14.44 | 0.8% |
| Florida[a] | $16.34 | $16.45 | 0.7% |
| New England[a] | $14.09 | $14.20 | 0.8% |

[a] National average used for corn price.

the indemnities paid. As long as premiums are actuarially fair, the positive correlation supports a lower-cost product for insuring margins.

Third, any supply response resulting from the LGM-Dairy product will be modest. Although the supply response estimates depend on our choices of risk elasticity and price elasticity of supply, our overall conclusion of an insignificant supply response will hold as long as the LGM-Dairy premiums are not heavily subsidized, because the supply response is mainly driven by the price (expected margin) effect. Combined with the finding that program participation is highly sensitive to subsidization levels (Valvekar et al., 2011), this result suggests that the level of subsidization will be the biggest factor in LGM-Dairy's potential to distort the dairy market.

From the standpoint of aiding milk producers, which is the lesser of two evils—inducing price declines through subsidized premiums or discouraging participation through unsubsidized

**Table 4.** Estimated Supply Response (January 2002 to January 2012)

| Region | Risk Reduction | Supply Response[a] $E_{risk} = -0.10$ | Supply Response[a] $E_{risk} = -0.05$ | Supply Response[a] $E_{risk} = -0.025$ |
|---|---|---|---|---|
| Northwest[b] | 30% | 3.51% | 1.98% | 1.22% |
| California[b] | 32% | 3.67% | 2.08% | 1.29% |
| New Mexico[b] | 41% | 4.61% | 2.55% | 1.52% |
| Western Texas | 36% | 4.01% | 2.24% | 1.35% |
| Minnesota | 34% | 3.77% | 2.10% | 1.26% |
| Wisconsin | 30% | 3.44% | 1.93% | 1.18% |
| Illinois | 32% | 3.59% | 2.01% | 1.22% |
| Southern Missouri | 36% | 4.03% | 2.24% | 1.34% |
| Michigan | 35% | 3.90% | 2.17% | 1.30% |
| Ohio | 31% | 3.55% | 1.98% | 1.20% |
| Appalachia | 24% | 2.84% | 1.62% | 1.01% |
| Florida[b] | 33% | 3.63% | 1.99% | 1.17% |
| New England[b] | 29% | 3.29% | 1.85% | 1.13% |

[a] Assumes a price elasticity of supply of 0.5.

[b] National average used for corn price.

premiums? Program funding constraints made the question academic so far. Our research suggests that offering subsidies that are invariant to quantity insured or that are variable only at a sufficiently extensive margin could be one policy option.

It is likely that much of the current dairy policy was patterned after LGM-Dairy. Current dairy policy (as stated in the House and Senate versions of the 2013 Farm Bill) reflects a continued shift away from payments based on the milk price alone and a growing focus on the producer margin. Both versions of the current Farm Bill phase out the Milk Income Loss Contract (MILC) payments program and the Dairy Product Price Support Program (DPPSP), keep the LGM-Dairy program, and introduce the Dairy Producer Margin Protection Program (DPMPP). Much like LGM-Dairy, the DPMPP focuses on margins (milk price over feed costs) rather than the milk price alone; it replaces the DPPSP and is offered to producers effectively in exchange for elimination of the MILC payment, which is triggered solely by changes in the fluid milk price.

Although similar in concept to LGM-Dairy, the DPMPP uses the difference between the U.S. all-milk price and "average feed cost" as its relevant margin. The average feed cost includes the price of alfalfa hay in addition to those of corn and soybean meal, and the feed ratios are fixed, providing no opportunity for producers to adjust the feed price. Furthermore, although LGM-Dairy offers producers the opportunity to capitalize on margins that exist in the futures market, DPMPP guarantees a specific margin and pays when it is not attained over a two-month period; this latter difference is the most interesting from a policy perspective. Futures markets, and therefore LGM-Dairy, do not offer countercyclical protection. If market conditions are such that dairy margins are expected to be low, LGM-Dairy can only offer the opportunity to guarantee those low margin levels. In contrast, DPMPP guarantees a $4.00/cwt production margin and offers producers the opportunity to insure a greater margin through the Supplemental Production Margin Protection. Although evolving futures prices would likely prevent LGM-Dairy indemnities from occurring over a long period of time, no such market mechanism exists within the DPMPP itself, potentially incentivizing producers to seek rents by increasing both insured margins and production levels. Tellingly, in the current Senate version of the Farm Bill, enrollment in the DPMPP requires simultaneous enrollment in the Dairy Market Stabilization Program, which encourages, through reduced milk checks, the scaling back of dairy production whenever operating margins are low.

Although the specific details of the Farm Bill with respect to dairy policy are still unclear, it is possible that producers may have to choose between the LGM-Dairy program and the DPMPP. If so, producers are effectively offered a choice between a more market-based program (LGM-Dairy) and a more traditional program (DPMPP, in combination with the Dairy Market Stabilization Program). At the time of this writing, it is unclear whether enrollment in DPMPP would be for a single year or multiple years. If producers are permitted to enroll in DPMPP on an annual basis, or if they have some flexibility to move between the two programs, it is reasonable to expect that they will choose between LGM-Dairy and the DPMPP based on market conditions each year. In years when expected margins are high, LGM-Dairy will likely offer more attractive margin guarantees. However, in years when expected margins are low, the guaranteed margin under LGM-Dairy will also be low, making the fixed margin guaranteed under DPMPP comparatively more attractive. The possibility of switching between the two programs could provide another opportunity for "rent seeking" and saddle the DPMPP with an adverse-selection problem.

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