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Actuarially Fair or Foul? Asymmetric Information Problems in Dairy Margin Insurance

by

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Actuarially Fair or Foul? Asymmetric Information Problems in Dairy Margin Insurance

There is a wide consensus in the academic literature that asymmetric information in the form of adverse selection and moral hazard has resulted in sizable financial outlays for government-sponsored crop insurance programs - ultimately becoming a costly means of transferring risk from farmers to the government. In this analysis we combine simulation and structural modeling techniques to forecast dairy income-over-feed-cost margins and show how asymmetric information problems may drive industry consolidation, production growth, and unforeseen program costs for a recently proposed government-sponsored dairy producer margin insurance program. We conclude by presenting second-best solutions in contract design to the insurance problems of moral hazard and adverse selection.

Keywords: dairy, margin insurance, farm bill, supply-management, dairy security act, dairy freedom act

Introduction¹

Following unprecedented volatility in dairy income-over-feed-cost (IOFC) margins, a consensus has emerged among dairy farmers, processors, and elected representatives that the new Federal dairy safety net should focus on insuring IOFC margins, in contrast to existing policy instruments which place emphasis on milk price support. The policy proposal favored by large dairy cooperatives and promulgated by the National Milk Producers Federation was incorporated in the Dairy Subtitle of the 2013 versions of the House and Senate Farm Bills, which have not yet been passed into law. This reform package, referred to here as the Dairy Security Act (DSA), includes the Dairy Producer Margin Protection Program (DPMPP), and a coupled Dairy Market Stabilization Program (DMSP). The DPMPP is a subsidized IOFC margin insurance program (similar to an option contract) designed to pay an indemnity to a participating farm when the difference between the national average all-milk price and the formula-derived estimate of feed costs falls below a farmer-selected margin trigger. Although participation in the DPMPP is voluntary, those enrolled in the DPMPP are required to participate in the DMSP. The DMSP is a supply management-type program designed to enhance milk prices by occasionally and temporarily reducing the milk supply when IOFC margins fall below a specified threshold. The DMSP aims to enhance milk prices by imposing income penalties on dairy farmers shipping milk over their assigned production level. The DMSP portion of the DSA package has wide-spread support within the dairy farming community and its cooperative leadership, but this support is not nearly unanimous. Significant resistance has been registered by dairy cooperatives, restaurant and food marketers, consumer groups, dairy food manufacturers, and their trade associations. As a result of this lack of unanimity, an alternative dairy policy reform proposal was crafted that would include a standalone margin protection program and exclude the DMSP. This proposal is

¹ The authors would like to acknowledge Drs. Mark Stephenson, Brian Gould, Chris Wolf, and Andy Novakovic for their assistance in data collection and comments during the research process. Funding for this research is provided by the Ohio Agricultural Research and Development Center, The Ohio State University.

the Dairy Freedom Act (DFA) and was introduced, and subsequently defeated, during the House agricultural committee debate (Goodlatte-Scott Amendment to HR 1947).²

Specific language in each of these proposals sets the margin insurance coverage levels to range from \$4.00 to \$8.00 per hundredweight (cwt) in \$0.50 increments. The premiums per cwt range from as little as no cost for the lowest coverage level of \$4.00 to \$1.06 for maximum coverage. Sound insurance practices require setting premiums to take into consideration the likelihood and anticipated level of loss. Getting insurance premiums correct is not a simple matter. Unfortunately, the two proposals up for debate do not follow sound insurance principles when it comes to premiums reflecting the anticipated risk involved. A feature common to both the DSA and DFA is the specification of a fixed premium structure over the life of the farm bill combined with the ability of the dairy farm manager to annually choose the insurance coverage level based on the anticipated risk environment. This fixed premium structure stands in stark contrast to exchange traded risk management instruments, and current government-sponsored livestock insurance programs such as Livestock Gross Margin Insurance for Dairy (LGM-D), whose premiums change to reflect new information on expected prices and volatility.

As currently debated, this preselecting feature allows farms to jump in and out of supplemental coverage and is equivalent to buying fire insurance after you see or smell smoke. Allowing sophisticated dairy operators the opportunity to transfer to the government losses that are imminent will lead to sizable financial outlays during low margin outcomes. Identifying almost certain losses and then buying insurance coverage for these losses is a form of information asymmetry called adverse selection. Adverse selection is not allowed for other insurance products for obvious reasons, and is not at all a necessary attribute for effective catastrophic margin insurance.³

While casual observation indicates these programs are subject to information asymmetry incentives, this is the first attempt, that we are aware of, designed to measure the implications fixed premiums and dynamic insurance decisions on the first-best insurance contract. In this paper a novel method to measure the information asymmetry incentives by estimating the expected benefits of the margin insurance programs is proposed. First, forecasts for dairy income-over-feed-cost margins based on information implied from Chicago Mercantile Exchange (CME) futures and options prices for milk, corn, and soybean meal contracts, as well as historic correlations between these commodities are generated. By facilitating faster margin recovery in the aftermath of low IOFC margins, the DMSP disrupts the historical correlation between prices for consecutive contract months, as well as between contracts for different commodities with the same expiration date. To account for this effect structural parameters on dairy demand and supply are introduced to shock the milk price following a DMSP event. Following these steps a general production framework is considered to determine how these programs may affect farm profitability and insurance decisions under a variety of IOFC margin scenarios.

² For a detailed description of Farm Bill provisions see: Schnepf, R. Dairy Policy Proposals in the 2012 Farm Bill. Congressional Research Service. 2012.

³ This new safety net would not be administered by USDA's Risk Management Agency (RMA); rather USDA's Farm Service Agency (FSA) would oversee the new dairy insurance program. RMA's mission is to promote and regulate sound risk management solutions for the crop and livestock producers (i.e. crop insurance). FSA's mission is to service all farmers and ranchers through the delivery of agricultural programs (i.e. counter-cyclical payments).

The analysis shows that due to the fixed premium structure (and other contract design flaws) the participation decisions and outcomes of each dairy margin insurance program are subject to asymmetric information incentives in the form of adverse selection and moral hazard. Decisions subject to asymmetric information incentives include the insurance coverage decision, selection of the DMSP stabilization base, production behavior with insurance, and non-compliance with DMSP penalties. As a result, depending on the nature of the IOFC margin risk, moral hazard and adverse selection prevent a first-best solution and may lead to unforeseen increases in government outlays and increase the rate of consolidation in the dairy sector. With potentially 80 to 90% of US production eligible for insurance coverage it is easy to anticipate government outlays tallying billions of dollars over the life of the farm bill if these information asymmetry incentives are not addressed.

The research is organized as follows. First, the provisions of the DSA and DFA proposals are outlined. Then, the work of Hart, Babcock, and Hayes (2001) is extended to present a new methodology to forecast commodity prices used to compute the dairy IOFC margins. Next, a theoretical framework for evaluating the production decisions for farmers with and without insurance is developed, where similar to Nelson and Loehman (1987); Just, Calvin, and Quiggin (1999); and Esuola et al. (2007) a comparison of the expected utility framework is the basis for conclusions about insurance problems and the effectiveness of insurance coverage. In an empirical illustration structural parameters on milk demand are combined with Monte-Carlo experiments to derive expectations of program benefits and asymmetric information incentives for a variety of IOFC margin scenarios. Finally, to reduce the need for public subsidy we identify and present second-best solutions in contract design to the insurance problems of moral hazard and adverse selection.

Provisions of proposed dairy margin insurance programs

The DSA and DFA propose a new farm safety net in the DPMPP. The DPMPP program is designed to pay a participating farm when the average difference between the USDA national all-milk price and the national cost of feeding dairy animals during a consecutive 2-month period is below an insured coverage level.⁴ The IOFC margin is given by the following formula:

$$(1) IOFC_t = AMP_t - (1.0728 \times CP_t + 0.00735 \times SBM_t + 0.0137 \times HAY_t),$$

where during month t , IOFC is the income-over-feed-cost, AMP is the USDA National Agricultural Statistics Service (NASS) announced all-milk price per cwt, CP is the USDA NASS announced corn price per bushel, SBM is the USDA Agricultural Marketing Service (AMS) announced central Illinois high protein soybean meal price per ton, and HAY is the USDA NASS announced alfalfa hay price per ton. Figure 1 shows the calculated IOFC margin over the 2000 to 2013 period. The NASS prices are announced on the last business day following the month to which they apply.⁵ Given the timing of the USDA price announcements, IOFC margins

⁴ Consecutive 2-month periods are given by: Jan-Feb, Mar-Apr, ..., Nov-Dec.

⁵ For an overview of NASS agricultural price report methodology visit:

http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Prices/Price_Program_Methodology_v10.pdf

can be announced no earlier than the last business day of the following month (e.g. January margin announced at the end of February).

[INSERT FIGURE 1 ABOUT HERE]

Under DSA participating farms automatically receive coverage on 80% of their base production history (BPH) at the 100% subsidized \$4.00 per cwt margin coverage level. The BPH is defined as the highest annual production over the prior three calendar years prior to the Farm bill start date. When purchasing supplemental coverage a minimum of 25% of the annual production history (APH) must be insured and no more than 90% of the APH may be insured. The APH is defined as the total milk production from the previous calendar year. Under the proposed DFA amendment the insurance coverage maximum would be 80% of the BPH with one important distinction: the BPH is recalculated annually.

The administrative fees and the insurance premiums vary with the level of coverage selected and the amount of milk produced on the farm. In order for a farm to participate in DSA and receive \$4.00 margin protection the farm must pay administrative fees each year (DFA does not require administrative fees). Administrative fees vary depending on farm size but do not exceed \$2,500 annually. The insurance premiums for the supplemental program increase when selecting greater coverage levels. The available insurance coverage levels and associated insurance premiums per cwt are given in Table 1.

[INSERT TABLE 1 ABOUT HERE]

Defining c as the coverage level, y_t as milk marketings, $m_t \geq 0$ as the consecutive two-month margin, α as the supplemental coverage percentage, and γ_t equal to one during months in which a consecutive two-month margin is calculated, the indemnity payment under DSA is given by:

$$(2) I_t(c, Y) = \gamma_t \times \left[\min \left(\sum_{k=1}^2 y_{t-k}, \frac{1}{6} BPH \times 0.80 \right) \times \max(4 - m_t, 0) + \alpha \times \max(c - \max\{m_t, 4\}, 0) \times \min \left(\sum_{k=1}^2 y_{t-k}, \frac{1}{6} APH \right) \right]; \quad \text{for } \alpha \in [0.25, 0.90].$$

Under DFA the indemnity payment is given by:

$$(3) I_t(c, Y) = \gamma_t \times \left[\alpha \times \min \left(\sum_{k=1}^2 y_{t-k}, \frac{1}{6} BPH \right) \times \max(c - m_t, 0) \right] \quad \text{for } \alpha \in [0.25, 0.80].$$

Under the basic program, a farm operator will receive an indemnity payment when the average consecutive 2-month margin is below \$4.00. The indemnity is based on a value equal to the lesser of the two previous months of milk marketings and one sixth of the BPH multiplied by 80%, multiplied by the per cwt indemnity payment. Supplemental payments will be made to a farm when the average consecutive 2-month margin is below the elected coverage level. The indemnity paid is based on a value equal to the coverage percentage, multiplied by lesser of the two previous months of marketings and one sixth of the APH, then multiplied by the per cwt

indemnity payment, less payments due under the basic coverage level (equation 2). Under DFA the indemnity is based on a value equal to the coverage percentage, multiplied by lesser of the two previous months of production and one sixth of the BPH, then multiplied by the per cwt indemnity payment (equation 3).

During times of low margins, it is in collective interest of dairy producers to reduce production to boost margins quickly to sustainable levels. However, even in absence of coordinated collective action, periods of low margins are generally a temporary phenomenon. Through herd liquidations, milk supply naturally adjusts to return margins to average levels, as evidenced by historic IOFC margin patterns and the term structure of forward IOFC margins (Bozic et al. 2012). The downside of relying exclusively on markets to govern supply correction is that the recovery may be delayed for as long as revenue from milk production covers at least variable costs. Thus, to expedite recovery DSA couples DPMPP with a supply management-type program.

Under DSA enrollment in the DPMPP will automatically subject participating dairy farms to income payment limitations when the DMSP is triggered. The DMSP is triggered when announced IOFC margins are below \$6.00 per cwt for two consecutive months, or below \$4.00 per cwt for a single month. When low-margin thresholds are satisfied the stabilization program is effective beginning the first of the month following a margin calculation. The principle method of fostering quicker margin recovery is to incentivize producers to cut back their production. Enrolled producers may select a stabilization program base annually from one of two options: the 3-month rolling average production immediately preceding the announcement of the stabilization program, or the milk production from the same month in the preceding year. Production disincentives increase as announced IOFC margins drop lower. For example, if margins for the preceding two months were lower than \$6.00 but higher than \$5.00 per cwt, payments to producers would be based on the maximum of 98% percent of the stabilization program base and 94% of actual milk marketings. However, if observed margins were lower than \$4.00 for the preceding month, payments to producers would be based on the maximum of 96% of the stabilization base and 92% of actual milk marketings. The percentage penalties differ based on IOFC triggers, but do not exceed 8% of actual farm marketings. The stabilization pounds are given by: $s_t = \max(B_t R_t, y_t A_t)$, for $t = 1, \dots, 12$ and where R is the payment percentage of the stabilization base B , and A is the payment percentage of actual milk marketings. From this expression the pounds subject to DMSP penalty are given by: $y_t^* = \max[y_t - s_t, 0]$. Farms are not subject to payment reductions if the actual milk marketings are less than the applicable percentage of stabilization program base.

The largest level of payment reductions required are continued monthly until DMSP is suspended by the Secretary of USDA. For DMSP to be suspended, either IOFC margins must recover to over \$6.00 for two consecutive months, or domestic prices of leading dairy commodities - cheddar cheese and nonfat dry milk - must be found to be sufficiently higher than world (Oceania) prices.⁶ The implication of the two previous provisions is that absent international price disparity the DMSP penalties are in place for a minimum of two months and the penalty percentage may only get worse. For example, if the January margin (calculated in

⁶ The US cheddar prices was found to be higher than the Oceania cheddar price 34% of the time during 2007-2012.

February) is below the \$4 threshold, payment reductions from the stabilization program would be in effect for March and April milk, and the milk checks affected would be April and May.⁷

Once a farm operator has elected to participate in the program the farm will remain enrolled for the remaining length of the farm bill. Additionally, once enrolled in the program, the selected coverage level percentage remains fixed for the entire calendar year. These binding decisions prevent farms from opting out of the insurance program. The stabilization base decision (for DSA only), insurance coverage level, and percent of coverage are the only decisions a farm operator can make each year.

Production under dairy margin insurance programs

Prices are partially exogenous and uncertainty enters the model through the commodity prices used to determine the IOFC margin, z . Let $z^n \in Z$, for $n = 1, \dots, 5000$ be a random draw of IOFC margin trajectories from the set Z which is a subset of \mathbb{R} . Thus $z^n = \{z_1^n, \dots, z_{12}^n\}$ is a series of IOFC margins with $\Pr(z^n) \equiv \pi(z^n)$. The function $\pi(\cdot)$ when used with z^n denotes the probability of observing an IOFC margin trajectory of $z^n = \{z_1^n, \dots, z_{12}^n\}$ for the 12-months of the model.

Having described the vector of IOFC margin trajectories, the focus now shifts to the effects of the alternative dairy policy proposals in the framework of a stochastic production model. Assume there is one output denoted by Y and n inputs denoted by x_i , $i = 1, \dots, n$. The production function is denoted by: $Y = F(X, \theta)$ where $X = (x_1, \dots, x_n)$ is the vector of inputs allocated to producing Y and θ represents the policy regime.

A representative farmer will choose inputs to maximize the expect utility of profit. In a policy regime without insurance θ the expected utility of profit is defined as:

$$(4) \underset{x}{Max} EU(\Pi(X, \theta, p, w)) = \sum_{z^n \in Z} \pi(z^n) U(p(z^n)F(X, \theta) - C(w, X)) \text{ subject to } x_i \geq 0 \forall i,$$

where z^n has strictly positive probability over the set Z , $C(\cdot)$ is the cost function, and $\Pi(\cdot)$ denotes profit.

In the presence of insurance, $\tilde{\theta}$, a farmer will purchase an insurance contract with an indemnity schedule $I(\cdot)$ and premium $q(\cdot)$. The arguments of $I(\cdot)$ include expected prices under the state of nature, z^n , insurance coverage level c , realized milk production Y , and milk pounds subject to DMS y^* . The arguments of $q(\cdot)$ include historical milk production $Y(L)$, and the insurance coverage level. Farmers enrolled in the DSA margin insurance program are subject to income penalties on milk delivered to the market over their assigned production level when

⁷ Federal Milk Marketing Orders enforce minimum payments to producers and cooperatives no later than the 17th day after the end of the month (Code of Federal Regulations 2012).

DMSP is effective. Defining p^* as the DMSP enhanced all-milk price and y^* as the milk marketings subject to DMSP income penalties, the expected utility of profit for a participating farm is defined as:

$$\begin{aligned} & \underset{X}{Max} EU(X|\tilde{\theta}, I, q) = \\ (5) & \sum_{z^n \in Z} \pi(z^n) U \left[\begin{aligned} & ((1 - \phi(z^n))p(z^n) + \phi(z^n)p^*(z^n))F(X, \tilde{\theta}) - C(w, X) \\ & + I(z^n, \tilde{\theta}, c, Y, y^*) - q(Y(L), c) - \phi(z^n)(p^*(z^n)y^* - \psi C(w, X^*)) \end{aligned} \right] \end{aligned}$$

where $\phi(z^n) = 1$ if the stabilization program is effective, and $\psi = 1$ if a farm elects to not produce beyond the DMSP stabilization base ($\phi, \psi = 0$ otherwise, and are bound at zero under the proposed DFA insurance program). The DMSP penalty is calculated as the forgone milk revenue, assuming no changes to feed rations or other farm management decisions such as culling lower producing cows, etc. For this analysis we assume that the representative farm follows a production pattern as if there was no DMSP, finding an on farm use or disposal for milk production in excess of the stabilization base ($\psi = 0$). Thus, by not sending milk to market during DMSP, the pounds eligible for DPMPP indemnity payments are potentially reduced in subsequent months. An important distinction in this model is the actions of the representative farm do not have a market impact on the macro-level price shock (the farm is assumed to be a price taker).

Assuming risk neutrality and no production changes in the presence of insurance the utility of net expected benefits (denoted Δ) determined by subtracting equation (4) from (5) is given by:

$$(6) \Delta = \sum_{z^n \in Z} \pi(z^n) U \left[\phi(\cdot)F(X, \tilde{\theta})(p^*(z^n) - p(z^n)) + I(\cdot) - q(\cdot) - \phi(\cdot)(p^*(z^n)y^*) \right].$$

Here the net expected benefits are equal to the benefit of DMSP enhanced prices, plus the indemnity payment, less insurance premiums and DMSP financial penalties.

In a policy regime with DFA, in which $\phi = 0$, and assuming no production changes in the presence of insurance the utility of net expected benefits are given by:

$$(7) \Delta_{DFA} = \sum_{z^n \in Z} \pi(z^n) U [I(\cdot) - q(\cdot)].$$

where the net expected benefits for a stand-alone margin insurance program are equal to the indemnity payment less insurance premiums.⁸

As demonstrated with either insurance program the incentive to participate and demand for supplemental insurance is positively correlated with the risk of loss. Since the government is unable to factor this correlation into the insurance premium both programs suffer information asymmetry incentives.

Information asymmetry in dairy margin insurance

⁸ The arguments of $I(\cdot)$ do not include pounds subject to DMSP for the DFA representation.

To demonstrate the information asymmetry incentives we construct the counterfactual outcome for non-participating farms. This counterfactual is needed in order to determine the net benefits of the margin insurance programs on the participants. Once an expression for net benefits is derived it is then possible to see how adverse selection and moral hazard may affect farm decisions. The counterfactual is the expected utility of profit for a farm not participating in the margin insurance program:

$$(8) \text{Max}_X EU(X|\theta) = \sum_{z^n \in Z} \pi(z^n) U \left[((1 - \phi(\cdot))p(z^n) + \phi(\cdot)p^*(z^n))F(X, \theta) - C(w, X) \right],$$

Where, under DSA, the price enhancing benefits of DMSP are realized without the need to participate in the insurance program (free-rider benefits). Thus, the net benefit for a farmer participating in DSA is determined by subtracting (8) from (5):

$$(9) \Delta_{\text{DSA}} = \sum_{z^n \in Z} \pi(z^n) U \left[I(\cdot) - q(\cdot) - \phi(\cdot)(p^*(z^n)y^*) \right],$$

From equation (9) the net benefits no longer include DMSP enhanced prices. For an individual farmer then, the first-best insurance contract should be designed such that the non-subsidized premium is equal to expected benefits from insurance:

$$(10) q(\cdot) = \sum_{z^n \in Z} \pi(z^n) U \left[I(\cdot) - \phi(\cdot)(p^*(z^n)y^*) \right],$$

where the farmer selects an insurance coverage level that maximizes expected utility subject to a break-even constraint. With $\phi=0$ binding for DFA the break-even constraint becomes $q(\cdot) = \sum_{z^n \in Z} \pi(z^n) U [I(\cdot)]$ for a standalone margin insurance program.

The break-even constraint indicates that the non-subsidized insurance premiums must reflect indemnity expectations. The price expectation argument of $I(\cdot)$ are observable to the government and farmers using CME futures and options prices yet they are not factored into the cost of insurance.⁹ The arguments of $q(\cdot)$ do not reflect anticipated risk; rather the premiums are fixed and vary only based on insured pounds and historical milk production. To preserve actuarial fairness the insurance premiums should reflect the risk of loss and the expected benefits of participation. When the risk environment indicates a high probability for indemnity payments the insurance premiums should be more expensive. Alternatively, when the risk environment indicates a low probability of indemnity payments the insurance premiums should be less expensive.

Adverse selection

The failure of the subsidized premiums to reflect the risk environment at the time an insurance decision is made presents adverse selection incentives in the margin insurance program. Adverse

⁹ In addition to CME futures and options prices a number of USDA reports provide commodity price and production estimates for U.S. and global agriculture. One such example is the World Agricultural Supply and Demand Estimates Report.

selection arises when farmers are better informed about the distribution of expected benefits and thus are better able to assess the actuarial fairness of their premiums than the government - who by having fixed premiums does not consider the anticipated risk environment. When the probability of indemnity payments is high, producers who recognize that their expected benefits exceed their premiums are more likely to purchase supplemental insurance coverage. Alternatively, when the risk environment is low producers who recognize that their expected benefits are less than their expected premiums are less likely to purchase supplemental insurance coverage (e.g. Miranda 1991; Glauber 2004). This contract design flaw creates the potential for windfall indemnity payments during poor IOFC margin years.

In addition to the insurance coverage decision (with respect to DSA only) adverse selection incentives are also present in the selection of DMSP stabilization base. Due to monthly changes in milk production the financial impact on an individual farm from the DMSP penalty depends critically on a farm's election of stabilization base. It is possible for monthly changes in an individual farm's milk production such as the spring flush period to result in an elected stabilization base that exceeds or differs only slightly from actual production - thereby preventing or minimizing DMSP incentives to reduce production. For example, using price expectations a farm operator may consider a stabilization base that minimizes the value of expected milk supply reductions such that:

$$(11) B_t = \begin{cases} y_{t-12} & \text{if } \mathbf{E} \left[\sum_{t=1}^{12} \varphi_t p_t^* y_{t-12} \geq \frac{1}{3} \sum_{t=1}^{12} \sum_{k=1}^3 \varphi_t p_t^* y_{t-k} \right] \\ \frac{1}{3} \sum_{k=1}^3 y_{t-k} & \text{if } \mathbf{E} \left[\sum_{t=1}^{12} \varphi_t p_t^* y_{t-12} < \frac{1}{3} \sum_{t=1}^{12} \sum_{k=1}^3 \varphi_t p_t^* y_{t-k} \right] \end{cases}$$

This decision represents a form of adverse selection because farm operators have a better understanding of which DMSP base will provide the lowest financial penalty. With proper foresight this decision has the potential to mute the desired price-enhancing effect of the DMSP on U.S. all-milk prices by keeping a portion of the milk on the market.

Moral hazard

While adverse selection is the most severe problem facing the dairy margin insurance programs, in that it has the potential to facilitate large government outlays, another problem associated with the margin insurance programs is moral hazard. Moral hazard occurs when producers alter their behavior after purchasing insurance in an effort to increase their expected benefits. Under DSA and DFA the primary source of moral hazard would arise if producers increased their production after purchasing insurance. For example, if risk in the dairy sector is effectively curbed through receipts of indemnity payments, the price and marginal cost relationship will be distorted and may provide motivation for an increase in the milk supply. Additionally, the security provided via margin insurance may improve loan collateral and provide better access to credit from lenders. Improved access to credit may allow a reduction in the fixed cost of production through debt and equity restructuring and could accelerate farm expansion. The resulting production expansion would increase net expected benefits in the short-run. These examples of a supply response to risk reductions are consistent with Chavas and Holt (1990); and Lin and Dismukes (2007) who found that a reduction in perceived risk lead to increased production. However, as a consequence of aggressive farm expansion, long-run average margins could be depressed;

thereby increasing the frequency and severity of indemnity payments. This effect would lead to even greater wealth transfers from the taxpayer to the farmer (e.g. Stephenson and Nicholson 2011).

Under DSA the incentive to increase production is muted to a certain degree as there are financial incentives to reduce production when IOFC margins are below threshold levels. However, this DMSP penalty presents yet another moral hazard opportunity in the form of leakage. Leakage is a process whereby farms develop methods to circumvent DMSP financial penalties. Such methods may include cattle buyback options, moving cows to a non-participating farm and sharing in the revenue from milk sales, or establishing an additional farm operation under the same management for the sole purpose of shifting production in the event of DMSP penalties. From equation (10) the leakage incentives are given by:

$$(12) EU = \sum_{z^n \in Z} \pi(z^n) U \left[I(\cdot) - q(\cdot) + \phi(\cdot) (p^*(z^n) y^* (\ell - 1)) \right],$$

where $\ell \in [0,1]$ represents the percent of DMSP financial penalties avoided through forms of leakage. For a farm not participating in the margin insurance program the incentive to facilitate leakage is given by:

$$(13) EU = \sum_{z^n \in Z} \pi(z^n) U \left[((1 - \phi(\cdot)) p(z^n) + \phi(\cdot) p^*(z^n)) F(\cdot) - w \cdot X + \phi(\cdot) \sum_j (1 - \ell_j) (p^*(z^n) y_j^* - C(w_j, X_j^*)) \right],$$

where $\ell_j \in [0,1]$ represent the percent of DMSP financial penalties avoided through forms of leakage for farm j . A non-participating farm may provide leakage opportunities for $j \geq 0$ farms. As a result, leakage poses a threat to the ability for the DMSP to stabilize prices in the event of low IOFC margins. The incentive to shirk the DMSP penalty is undesired, but given dairy farmer ingenuity is not unforeseen.

The theoretical framework presented in this section indicates that the outcomes of a margin insurance program depend on a myriad of factors including but not limited to: price expectations, insurance coverage strategy, and national participation percentages. Appropriate foresight into these uncertain parameters allows a farm to exploit information asymmetry problems in the contract design to maximize the benefits of participation. If not adequately addressed these contract design flaws could become a costly method for transferring risk from farmers to the government. The following section will use an empirical illustration to estimate the magnitude of asymmetric information incentives under a variety of IOFC margin outcomes.

In order to empirically illustrate insurance benefits and incentives to participate an accurate forecast of IOFC margins including DMSP induced price shocks is required. The following section details the methods whereby CME futures and options implied moments are used to construct 12-month forward IOFC margins conditional on DMSP triggered supply shocks. Once price are simulated, the information may be used in Monte Carlo experiments to estimate information asymmetry incentives.

Model framework

Rather than analyzing historical margins, the focus in this analysis is on *expected* margins. The forecast performance of agricultural futures markets has been extensively studied and reported on in the published literature. Tomek provides an extensive review of the literature and empirical evidence on futures markets as commodity price forecasts (Tomek, 1996). A general conclusion which can be drawn from this literature is that detailed structural models do not succeed in outperforming futures prices as a short-term forecasting tool. Therefore, a logical conclusion is that a model that seeks to be based on expected margins should start with futures prices. A challenge with such an approach is that none of the four government reported prices that enter the farm bill IOFC margin formula correspond directly to any commodity that trades at a commodity exchange. As a consequence, futures price for NASS All-milk price, corn, and alfalfa hay, or AMS soybean meal cannot be directly observed. As such, we need to investigate their relationship with commodities for which futures prices do exist.

The CME lists futures contracts for class III and class IV milk, corn and soybean meal; however, there are often considerable price spreads between USDA announced prices and CME futures contract final settlement prices. To account for the price spreads, adjustments to CME futures prices were obtained using OLS models of the USDA announced prices with the CME closing prices and lagged USDA announced prices as the relevant conditioning information.¹⁰ OLS regressions were also employed to estimate the announced alfalfa hay price since alfalfa futures do not exist.

Among the complications in estimating the all-milk price spread include price dynamics inherent in classified milk pricing and low liquidity in class IV futures markets. To deal with these issues separate estimators for the all-milk price conditional on the time period being forecast are proposed. For the first six months of the 12-month forecast we modeled the announced all-milk price as a function of the current month's Announced class III and class IV prices and a lagged variable as a proxy for the class I price. Forecasted CME class III and IV prices were used to generate the lagged variable as we iterated our forecast forward. This method reflects the fact that the all-milk price reflects announced prices for class I, class II, class III and class IV milk, producer premiums, and class I differentials. Due to the low liquidity in class IV futures beyond six months we did not use the CME class IV price in the model for months seven through 12. As a result, the AMP forecast for months seven through 12 was a function of only the class III price.¹¹ Table 2 includes OLS parameter estimates used to convert CME commodity prices to USDA announced prices.¹²

[INSERT TABLE 2 ABOUT HERE]

In order to model the joint probability density functions of class III milk, class IV milk, corn, and soybean meal for 12 calendar months several steps were employed: First, log-normal distributions of terminal class III, class IV, corn, and soybean meal futures prices were estimated for each commodity. Then, historical data on futures price deviates were used to estimate

¹⁰ We investigated whether lagged futures prices and seasonal dummy variables should be included as conditioning information in the OLS estimators and found the parameter estimates were not statistically significant.

¹¹ The open interest remains in the 200-800 range for the first six nearby contracts during the time period analyzed.

¹² Autocorrelation was found in the OLS models for milk, hay, and soybean meal but correlated error terms do not bias the coefficient estimates.

conditional rank correlations between the milk and feed variables. The marginal distributions of milk and feed prices were then joined together through the Iman-Conover (1982) procedure in order to preserve milk and feed price co-movement.

For estimates of the log-normal distribution we require estimates of the mean and the standard deviation. Using numerical techniques, the combination of futures prices and at-the-money option premiums can be employed to recover the price distribution for the underlying asset. The implied volatilities were solved using the inverse function of the binomial option pricing model (Cox, Ross, and Rubinstein 1979; Hart, Babcock, and Hayes 2001; Miranda and Fackler 2010), and were de-annualized by multiplying by the square root of the time to maturity. The implied volatility, $\hat{\sigma}$, and the annualized time to maturity, $\tau = (T - t) / 252$, determine the variance of the log-normal distribution. This information, together with the current futures price, determines the mean of log-normal distribution such that: $\ln f_T \sim N(\mu, \sigma^2)$ with $\sigma^2 = \hat{\sigma}^2 \tau$ and $\mu = \ln f_t - \sigma^2 / 2$. We then proceed to constructing the density function by calculating the price p such that for a given probability π , $\Pr(f_T \leq p) = \pi$ where $\pi_i = i / 5001$ for $i = 1, \dots, 5000$. The prices for commodity j are given by: $p_{ij} = \exp[\Phi^{-1}(\pi_i) \hat{\sigma}_j + \mu_j]$ where Φ is the standard normal cumulative distribution function.

Once we have obtained distributions for class III milk, class IV milk, corn, and soybean meal prices, we transform the prices to USDA prices using the OLS estimators. Next an IOFC margin is constructed by making correlated draws from each commodity price distributions. Therefore, it was first necessary to model the correlation structure capturing tendencies of these commodities to exhibit co-movement. We proceed in several steps. First, on the 15th of each calendar month, we identify which is the first, second, etc. nearby milk, corn, and soybean meal contract. The first nearby contract is defined as the contract first in line to expiry still actively trading on the exchange. For example, if $t = \text{Oct 15, 2010}$, the first nearby milk contract at that time t was the October 2010 contract, and the first nearby corn and soybean meal contracts are the respective December 2010 contracts. We do this for every month and contract from January 2000 through September 2012.¹³ Then for each contract we identify the futures price as it was traded on that particular day, and the terminal price for that contract at expiry for up to 12 months into the future. The difference between the futures price and the contract closing price is denoted as the unexpected price deviate. Under the assumption of futures price unbiasedness and no arbitrage conditions the entire difference was unexpected at time t . This procedure gives us an initial 142 by 33 matrix of price deviates: 12 class III nearby contracts, 6 class IV nearby contracts, 6 corn, and 9 soybean meal nearby contracts.^{14 15} The matrix of price deviates was used to estimate a matrix of Spearman's rank correlation coefficients (Table 3).

[INSERT TABLE 3 ABOUT HERE]

¹³ At the time of this analysis the September 2012 was the last contract to close on the CME.

¹⁴ Due to the thinness of the class IV market rows of the matrix of price deviates were removed where at least one of the nearby class IV contracts had zero open interest. After trimming the matrix the final matrix of price deviates was 74 by 33.

¹⁵ An alternative method for evaluating nearby contract correlation involved populating a correlation matrix using column by column comparisons; however, this method resulted in a correlation matrix that was not positive semi-definite.

For the Monte-Carlo experiment we have $n = 5000$ draws from $k = 33$ random variables, and for months in which CME contracts do not trade a weighted average of nearby months is used to extrapolate the prices. To ensure the desired correlation in the draws we follow the Iman and Conover procedure. Mechanics of the Iman Conover procedure involve generating a $n \times k$ matrix of sorted integers from 1 to 5000, defining this matrix as Λ . Next, we create $n \times k$ matrix of Van der Waerden (1952; 1953) normal scores. The Van der Waerden scores are probit transformations, $\Phi^{-1}(i/(5000+1))$ for $i=1, \dots, n$, where Φ is the standard normal cumulative distribution function. This transformation ensures that each column vector has a mean of zero and a standard deviation of one. The Van der Waerden samples are then re-sorted to induce the same rank correlation as the matrix of Spearman's rank correlation coefficients. Then we rearrange the Λ matrix of sorted integers such that elements of the matrix correspond to percentiles of the milk and feed cumulative density functions while preserving the historical correlation achieved by re-sorting the Van der Waerden sample. This is similar to the procedure that is used in the rating method for livestock revenue insurance (e.g. Hart, Babcock, and Hayes 2001; Gould and Cabrera 2011) and utilized LGM-D. However, unlike LGM-D this method allows for non-zero correlation between milk and feed markets.

Combined these methods provide $n = 5,000$ correlated draws of prices p_{mj} for simulation n , commodity j , and time t . The prices are then used to estimate 5000 IOFC margins, z , up to 12 months in the future. These first-stage forecasted IOFC margins are used to estimate outcomes from participation in the stand-alone margin insurance program.¹⁶ Under DSA the matrix of first-stage prices can be used to identify Monte-Carlo experiments in which IOFC margin trajectories trigger a DMSP price shock. During this first-stage we use structural parameters on dairy demand to modify simulated IOFC margin paths. We alter the milk prices (and thereby the IOFC margin) following a DMSP triggering event by a shock variable η that captures the price-elasticities of demand observed in empirical data (e.g. Thraen and Hammond 1986; Schmit et al. 2002). Since milk demand is highly inelastic in the short-run moderate changes in the milk supply may induce severe price corrections. The magnitude of the supply shift depends on the severity of the stabilization penalty R_1 , the percent of milk that remains on the market despite DMSP penalties (defined as leakage) ℓ , and the program participation rate as a portion of the total milk supply $\lambda \in [0, 1]$. Combining all the parameters, the DMSP effect in the event of a price shock is given by $\varepsilon = [-(1 - R_1)\lambda\eta^{-1}(1 - \ell)] > 0$. The DMSP enhanced price is given by: $p^* = (1 + \varepsilon)p$.¹⁷ As demonstrated, the net effect of the shock depends on the severity of the DMSP penalty, the national participation rate parameter, program leakage, and the price-elasticity of demand. As the product of the participation rate and leakage approaches one the full effect of the elasticity parameter is realized in the DMSP shock triggering an increase in prices. In contrast lower participation rates, and/or high leakage, minimize the DMSP shock and ensuing price response.

¹⁶ Since DFA does not include DMSP provisions the first-stage simulated IOFC margins are used to estimate program benefits and insurance problems.

¹⁷ The shift in the milk supply as a result of the DMSP may have implications on the demand for feed grains. The reduced demand for feed grains would have implications on feed prices but was not incorporated into this analysis.

Following the first-stage IOFC margin adjustments the prices are used to model the second-stage of DSA. In the second-stage we consider the expected benefits and asymmetric information incentives from participation in the DSA margin insurance program under the expected utility framework.

Empirical illustration¹⁸

In order to analyze the benefits of both margin insurance programs we focus on a representative 360-cow dairy farm. The production pattern for this farm is modeled over a 4 year period and is structured to capture herd growth rates and seasonal changes in milk production (Figure 2). In all of the analyses we use the milk marketings in months 1-36 to construct the production histories (BPH, APH) and months 37-48 are used to analyze the performance of the margin insurance programs.

[INSERT FIGURE 2 ABOUT HERE]

Margin scenarios at annual enrollment

Under provisions of both programs, participating farmers can select once each year how much of their production to insure under supplemental margin protection program and at what margin level. Section 1415(a) of H.R. 1947 states that “a participating dairy producer may annually purchase supplemental margin protection to protect, during the calendar year for which purchased, a higher level of income of a participating dairy producer than the income level guaranteed by basic margin protection under section 1414.” Additionally, DFA section 1511(f)(4)(D)(ii)(II) adds that the annual premium must be paid by no later than January 15 of the calendar year. In all of our analyses, we assume that producers must decide on coverage level and coverage percentage for the calendar year by the 15th of January of the year.

From Bozic et al. (2012) we know that expected margins are likely to be mean-reverting. As such we identify six beginning-of-the-year expected margin scenarios that should well cover the space of likely expected margin environments at annual sign-up:

- (i) Catastrophic Margins. Expected margins are well below long-run average, but revert to mean by the end of the year.
- (ii) Below Average Margins. Expected margins are rather flat, but below long-run average.
- (iii) Mean-Reverting Margins. Expected margins for the first quarter of the year are well above historical average, but revert to long-run average.
- (iv) Long-Run Average Margins. Expected margins are very close to the historical average.
- (v) Moderately Above-Average Margins. Expected annual average margin is almost \$1 per cwt above average.
- (vi) January 15, 2013. Expected margins derived using January 15, 2013 futures and options prices.

These scenarios, depicted in Figure 3, are based on actual expected margins, as observed on January 15 in one of the previous seven years.¹⁹ However, they are never treated as sequential

¹⁸ Empirical results presented for DSA use the Farm Bill language from H.R. 1947.

events as this analysis is not an imposition of the provisions of DSA or DFA using historical price patterns.

[INSERT FIGURE 3 ABOUT HERE]

The coverage percentage for DSA and DFA are set at their maximum levels of 90% and 80% respectively. The only two structural parameters in our model are participation rate, and a measure of the own-price elasticity of demand for milk in all uses (leakage was bound at zero). As with any structural modeling, the choice of a particular parameter value may end up driving the results. To account for uncertainty regarding participation rate and the magnitude of elasticity of demand, we categorize the DSA results under two extreme sets of parameter choices that would render policy either very effective, which we label *high-boost*, or ineffective, which we label *low-boost*. For a *high-boost* scenario we choose very favorable parameter values, setting elasticity of demand to be -0.2 and participation rate at 75% of milk volume. For a low-boost scenario, unfavorable parameter values are chosen such that elasticity of demand is -0.4 and participation rate is only 25% of milk volume.^{20 21} The *high-boost* simulation results in a price response to DMSP that is six times as strong as that in a *low-boost* environment.²² Given the volatility observed in milk prices, if DMSP does become part of the law, the actual impact is likely to lie between these two multiplier values, and vary from year to year.

Tables 4 to 6 examines the expected benefits of DFA and DSA under both price shock regimes. Results of the simulations indicate that the expected benefits from program participation are strongly influenced by the anticipated risk environment in the forthcoming 12 months and depend significantly on the farms coverage decision. Additionally, we find the both DSA and DFA programs offer effective income support when IOFC margins are low. For example, during catastrophic IOFC margin outcomes expected benefits for the representative farm are identified between \$87,000-128,000 for \$8 supplemental coverage.

Comparing table 4 and 5 the decline in net benefits from the low- to high-boost DMSP regime reflects the ability for the DMSP program to quickly stabilize milk prices. Higher milk prices improve IOFC margins which lower the indemnity payments and reduce the duration of the DMSP program. If DMSP is effective in enhancing price, the frequency and severity of margin payments will be reduced and a portion of the benefit will come from DMSP induced higher all-milk prices; thereby reducing the taxpayer burden. Alternatively, as the participation levels approach zero the DMSP shock is minimized.²³ If the DMSP is not effective in enhancing milk prices farmers will receive benefits from the insurance program over a wide array of coverage options, similar to DFA, but will remain subject to DMSP financial penalties. If the DMSP is effective in enhancing the all-milk price then all farmers, whether participating or not,

¹⁹ Catastrophic scenario corresponds to 01/15/2009, Below Average to 01/15/2012, Mean Reverting to 01/15/2008, Long-Run Average to 01/15/2007 and Moderately Above Average to 01/15/2010.

²⁰ Since DFA does not include DMSP provisions the first-stage simulated IOFC margins are used to estimate program benefits and insurance problems.

²¹ For this study Thraen and Hammond's elasticity of -0.17 and Schmidt et al. elasticity of -0.24 are considered as the basis for analysis.

²² The percentage price change is estimated by inverting the own-price elasticity of demand formula and using the percentage of milk participating in the program to estimate the change in milk supply.

²³ Participation rates near zero would also considerably reduce expected government expenditures as a smaller portion of the U.S. milk supply is enrolled in the program.

will receive a higher milk price in a low-margin scenario. Table 7 demonstrates these free-rider incentives for the representative dairy.

In either scenario, under both insurance options it is possible to identify coverage strategies such that returns on the premium are non-zero during low IOFC outcomes or losses are minimized when IOFC margins are above indemnity thresholds. Comparing scenarios most favorable to the representative farm the information asymmetry incentives become clear as decisions such as supplemental coverage percentage and DMSP stabilization base may have adverse financial consequences.

Implications of adverse selection on coverage decisions

Adverse selection incentives are easier to identify and explain. The incentive to alter the supplemental coverage level every year in order to increase net returns to participation is demonstrated in tables 4-6. Consider first the net expected benefits presenting in table 4 (DSA low-boost parameterization). During a catastrophic margin scenario the net expected benefits for the representative farm are the highest under \$8 supplemental coverage at \$123,511. Insurance coverage below the \$8 threshold would only lower net expected benefits.

When forward margins are below average or mean-reverting the net expected benefits are the highest under \$6.50 supplemental coverage at \$12,100 and \$3,389 respectively. Insurance coverage levels above or below these thresholds would only lower net expected benefits. As the forward margins improve to at or above the long-run average the net expected benefits are the highest under the basic \$4.00 protection at -\$873 and -\$474. Finally, using forward margins as they were observed on January 15, 2013 net expected benefits are the highest under \$8 supplemental coverage at \$39,614.

Applying this logic to the data in tables 5 and 6 we see that the ability to change the supplemental coverage level to exploit current information to one's advantage constitutes a major part of expected revenue enhancements under current proposals. In a high-boost DSA parameterization (Table 6) the coverage levels with the highest net expected benefits are (in descending order): \$8.00, \$6.50, \$6.50, \$4.00, \$4.00, and \$8.00 for each of the margin scenarios in table 5. Accordingly, under DFA the coverage levels with the highest net expected benefits are (in descending order): \$8.00, \$7.00, \$7.00, \$4.00, \$4.00, and \$7.00 for each of the margin scenarios in table 6. The difference in coverage selection is attributable to differences in premium subsidy among the \$6.50 and \$7.00 supplemental coverage levels for DFA and DSA.

[INSERT TABLES 4 TO 7 ABOUT HERE]

The financial implications of adverse selection during low-margin outcomes are emphasized when examining expected loss ratios. The loss ratio is defined as the ratio of expected indemnities divided by the premiums collected. Loss ratios greater than one hundred percent indicate that the government is not collecting enough in premiums to cover expected indemnities. Looking at the catastrophic margin scenario the net expected benefit (for DSA low-boost) includes a \$214,592 indemnity payment which is equivalent to a 287% loss ratio. When surveying the expected indemnities under this catastrophic margin scenario the 287% loss ratio was in fact the lowest. Loss ratios across the coverage options were as high as 6,119%. As a barometer of the severity of these loss ratios consider that from 1981-93 the aggregate loss ratio

for crop insurance was slightly higher than 150% (Glauber 2004). It is possible to observe loss ratios that more closely align with those of crop insurance, but the ability for farms to opt-out of supplemental insurance when risks seem remote make these loss ratios immaterial as the amount of funds collected may not meet needed premium reserves during favorable margin years.

As demonstrated, careful consideration of the coverage decision can not only identify which coverage levels are most likely to provide positive net expected benefits, but in some cases can isolate strategies that provide returns on the premium of well over 100%. Such an ability on the part of participants in either of these programs should be a concern as to program design. The implications are clear. Given an accurate forecast of IOFC margins the incentive to purchase supplemental insurance only when losses are forthcoming will lead to a smaller pool of insurance participants during more favorable margin periods. With fewer participants at higher coverage levels the costs to the government increase dramatically, and with no way to adjust premiums annually the fragile design of the taxpayer-funded safety net is compromised.

The ability for farmers to exploit flaws in the contract design to develop expectations on the probability and value of program participation such that expected benefits are non-zero, or losses are minimized, confirm the presence of insurance problems related to adverse selection. Under DSA, this adverse selection problem is somewhat reduced as participating producers remain subject to DMSP when margins for two consecutive months fall below \$6.00. For example, under the moderately above-average scenario (low-boost) there is less than 1% probability that the annual average margin will be below \$6.00 per cwt. As such, should producers choose to underinsure by choosing a coverage level below \$6.00 when forward margins look close to the historical average, they expose themselves to the possibility of DMSP penalties in terms of forgone milk revenue without receiving any indemnities from the margin insurance component of the program. These long-odds may be enough of a deterrent to prevent farms from adversely selecting lower coverage options leading to annually chosen supplemental coverage levels which deviate less from the \$6.00 or \$6.50 level than under DFA specifications which contains no disincentives to exploit this contract design flaw.

Adverse selection of DMSP stabilization base

The DMSP program carries financial penalties which limit program benefits; however, even this feature is subject to adverse selection incentives. As demonstrated in tables 4 and 5, each DMSP stabilization base carries a different financial penalty.²⁴ For example, the DMSP penalty under a low-boost catastrophic margin scenario was \$32,799 with a prior year base calculation and \$16,297 with a 3-month base calculation, a difference of \$16,502 in foregone revenue. The difference in penalty under each base is a function of the farm's production patterns and DMSP severity so this relationship between a prior year and 3-month base is not constant across farm profiles. However, using this representative dairy farm as a guide we see that the penalty associated with the 3-month average DMSP base is approximately 50% less than the penalty associated with the prior year base in all of the scenarios analyzed. Based on these anticipated penalties, the selection of a 3-month DMSP base may reduce the realized penalty; thereby, keeping those pounds in the marketplace and the revenue from milk sales on the farm.

²⁴ The U.S. all-milk price was used to estimate the DMSP penalty. In practice the DMSP penalty will reflect the price of milk received by the farm and may include premiums, marketing assessments, and other authorized deductions.

This example illustrates that with proper foresight it's possible for the DMSP stabilization base to differ only slightly from actual production. This is a deliberate feature in the contract design that provides farmers the opportunity to prevent or minimize DMSP incentives to reduce production and limit the effectiveness of the DMSP program.

Implications of moral hazard

In addition to adverse selection bias, moral hazard incentives also exist in the form of increased production and leakage. In the short-run the incentive to increase production is best viewed by considering expansion opportunities for both participating and non-participating farms. Let's first consider the expansion incentives for a participating farm. Taking the partial derivative of (5) with respect to production we see that the price and marginal cost relationship is no longer binding. Instead marginal benefits now include not only the anticipated price but also expected returns from the insurance program:

$$(14) \quad \frac{\partial U(\cdot)}{\partial y} = I'(\cdot) + (1 - \phi(\cdot))p(\cdot) + \phi(\cdot)p^*(\cdot) \left(1 - \frac{\partial y^*}{\partial y} \right) - C'(w, X).$$

Thus we see that when:

$$(15) \quad I'(\cdot) + (1 - \phi(\cdot))p(\cdot) + \phi(\cdot)p^*(\cdot) \left(1 - \frac{\partial y^*}{\partial y} \right) > C'(w, X)$$

a farm has an incentive to increase production in the short run. Under DSA when $\phi = 1$ equation (15) simplifies to:

$$(16) \quad I'(\cdot) + \phi(\cdot)p^*(\cdot) \left(1 - \frac{\partial y^*}{\partial y} \right) > C'(w, X),$$

and we see that if DMSP is effective it may mute the production response in the short-run as the benefits may not exceed marginal costs. Under DFA, and when $\phi = 0$, equation (15) simplifies to:

$$(17) \quad I'(\cdot) + p(\cdot) > C'(w, X)$$

such that marginal benefits include both the price of milk and the per cwt indemnity payment. When the expected indemnity returns are positive the farm has an incentive to increase production in the short-run. Given the net expected benefits identified in tables 4-6 and a farmer's ability to adversely select coverage positive benefits may spur considerable expansion despite anticipated adverse market conditions.

Next consider a non-participating farm. Taking the partial derivative of (8) with respect to production:

$$(18) \quad \frac{\partial U(\cdot)}{\partial y} = (1 - \phi(\cdot))p(\cdot) + \phi(\cdot)p^*(\cdot) - C'(\cdot)$$

we see that the price and marginal cost relationship is dependent on the frequency and severity of DMSP price enhancement. Under DSA when $\phi=1$, and given that $p^* > p$, equation (18) simplifies to:

$$(19) \quad \phi(\cdot)p^*(\cdot) > C'(\cdot).$$

Here we see that the more effective DMSP the more severe the incentive is for non-participating farms to increase production and exploit the DMSP price enhancement features. For example, the high-boost parameterization has the potential to increase prices by as much as 15% in a given month. An anticipated price increase of 15% would provide strong incentives for non-participating farms to capitalize on higher valued farm milk production. Under DFA, the incentive for non-participating farms to increase production is not as clear since the non-participating farms may suffer lower prices received in the short-run as a result of participating farm expansion.

Thus we see that one complication of moral hazard is the potential for both participating and non-participating farms to expand under DSA, and under DFA participating farms have incentives to increase production without consequence. Furthermore, given economies of scale the incentives to expand production may be greater for larger dairy operations that have lower marginal cost of production than their smaller counterparts. This structural element may lead to accelerated consolidation as larger operations are more able to exploit production incentives as they arise. Additionally, if we assume that this program improves loan collateral and facilitates better access to credit then the production expansion and industry consolidation could occur rapidly. The implications of such expansion may result in chronic milk oversupply and prolonged periods of low IOFC margins with farm revenue bolstered by highly subsidized taxpayer insurance. Such a scenario may be undesired, but would not be unforeseen.

Finally, it's important to acknowledge that moral hazard incentives also arise in the form of leakage. By engaging in leakage a farm is attempting to retain DMSP foregone revenue. With expected penalties proportional to the size of the farm operation the leakage incentives are not insignificant. For the representative farm the leakage incentives were in the tens of thousands of dollars and would become stronger as IOFC margins deteriorate. Widespread leakage could render the DMSP program ineffective. An ineffective DMSP program shifts the burden of providing risk protection from the marketplace, in the form of higher milk prices, to the taxpayer, in the form of indemnity payments. Under widespread leakage, DSA and DFA become nearly identical in their inability to stabilize IOFC margins. With highly subsidized insurance, and in the absence of a coordinated collective action, such as a reduction in milk supply or milk cows, the periods of low margins would no longer be a temporary phenomenon. Instead each program would endure prolonged payments so long as the market prices remained at indemnity qualifying levels. If DMSP is effective it may mute the production response in the short-run, but given less than stringent audit requirements and farmer sophistication, neither program would do much to slow expansion.

Solutions in contract design

In order to limit the government's risk exposure in the event of low IOFC margins and other structural problems several solutions in contract design are offered:

1. Since the optimality condition in equation (10) cannot be satisfied the second-best solution involves changing the premiums based on anticipated IOFC margin risk. Changing the premiums based on the risk environment is common in other agricultural insurance products such as LGM-D. By changing the premium to reflect the risk environment long-run aggregate loss ratios will be reduced and the government can build sufficient cash reserves from premiums to facilitate payment during indemnity qualifying events.
2. Policy makers may consider implementing a minimum gap of six months between the annual enrollment date and insurance coverage with an emphasis on fiscal year versus calendar year protection. This modification would more closely align dairy with existing crop insurance programs. A six-month gap spanning the crop growing season would significantly reduce the incentives to adversely select coverage as information on crop yields, inventories, milk supply, and demand conditions are less certain.
3. Instead of offering annual coverage decisions each program could require multi-year coverage level commitments.²⁵ Continuous insurance coverage would smooth the benefits identified in nearby CME futures and options prices over a multi-year horizon reducing the adverse selection incentives.
4. To address adverse selection in DMSP stabilization base policy makers could consider removing one of the options. By fixing the DMSP stabilization base calculation adverse selection incentives relative to DMSP are eliminated
5. To address leakage DSA may include more stringent audit provisions to monitor participating farm and ensure DMSP circumventing methods are not employed. Current provisions of the dairy title include periodic and random audits but only focus on compliance with the timeliness and accuracy of information and remitted monies. Improving this audit procedure and imposing pecuniary penalties on farms circumventing DMSP would address leakage. For example, farms found eluding DMSP penalties could be ruled ineligible to receive basic and supplemental margin insurance payments. Potential loss of indemnity benefits would reduce the moral hazard incentives gained through leakage.

The potential for many of the information asymmetry incentives to go unnoticed in the absence of this research is concerning. We hope that policy makers exercise restraint, and heed to the old adage “*less is more.*” Offering heavily subsidized margin insurance that is rife with information asymmetry incentives may lead to sizeable government outlays and other structural problems. These contract design flaws are not necessary to prevent ad hoc disaster payments or to foster a high level of participation. With these suggested modifications the coverage decisions are more likely to be made based on an individual farm’s risk tolerance and average margin insurance subsidy, not on anticipated year-specific financial gains from the program.

Conclusion

From 1949 to 1990, federal dairy safety net was in the form of a milk price floor. The price floor stayed in place through the 2008 farm bill. The counter-cyclical MILC program started with the 2002 farm bill as a supplement to the rather ineffective fixed price floor. Designed for an economic environment with stable feed costs MILC is now viewed to be vastly

²⁵ In the 2010 National Milk Producers Federation “Foundation for the Future” proposal the purchase of supplemental coverage and coverage level was binding for the life of the Farm Bill (Brown 2010).

inadequate for the current commodity price regime characterized by rising and volatile grain prices. As an alternative to revenue and price support programs several new safety net programs with an emphasis on government funded IOFC margin insurance are proposed.

Results of this analysis indicate that both DSA and DFA programs are successful in their ability to manage IOFC margin risk but suffer from adverse selection and moral hazard problems. If it was the intention of policy makers to design an effective and actuarially fair catastrophic risk management program then this analysis reveals shortcomings in contract design that should be corrected. As a result of the contract design flaws, loss ratios and returns on the premiums point toward the potential for sizeable indemnity payments during times of low IOFC margins. Trading dollars and allowing farms to keep the subsidy amounts to a retooled counter-cyclical payment program, and absent means testing, may lead to a rapid expansion of the farm milk supply and increase the rate of consolidation in the dairy industry. To ensure that the proposed programs are actuarially fair we have presented several solutions in contract design aimed at aligning premiums with expected program benefits similar to other livestock insurance programs; thereby preserving the integrity of the taxpayer-funded safety net and market-based long-run equilibrium dairy prices.

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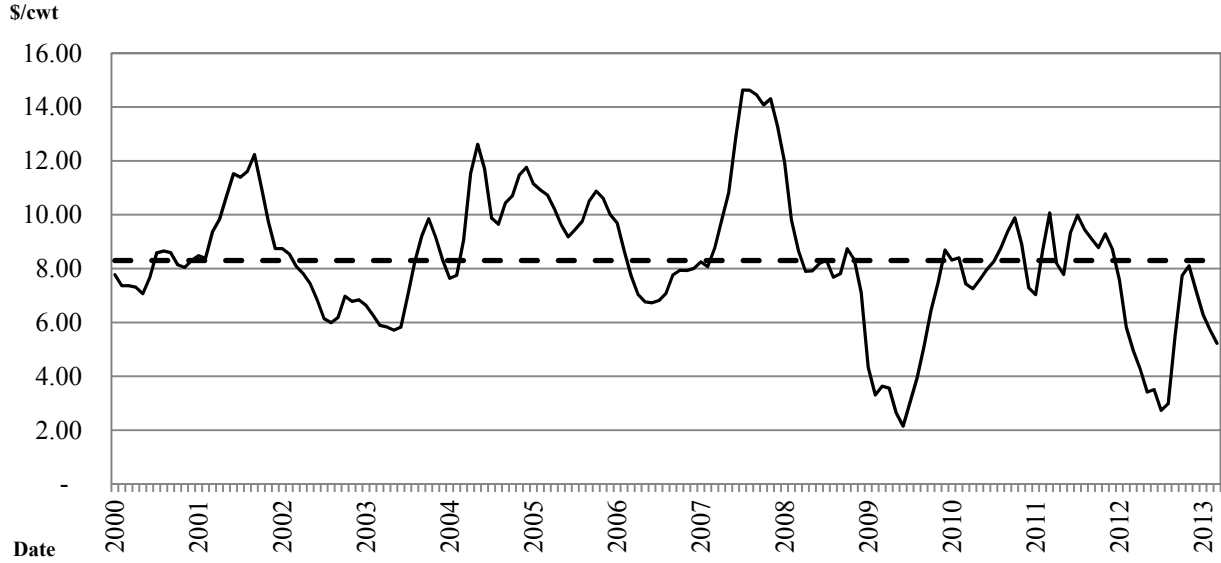
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Figure 1. Income-over-feed-cost margin, 2000-2013, \$/cwt



The solid black line represents monthly IOFC margin and the dotted line represents the average over the sample period.

Figure 2. Milk production for representative 360-cow dairy (in cwt produced)

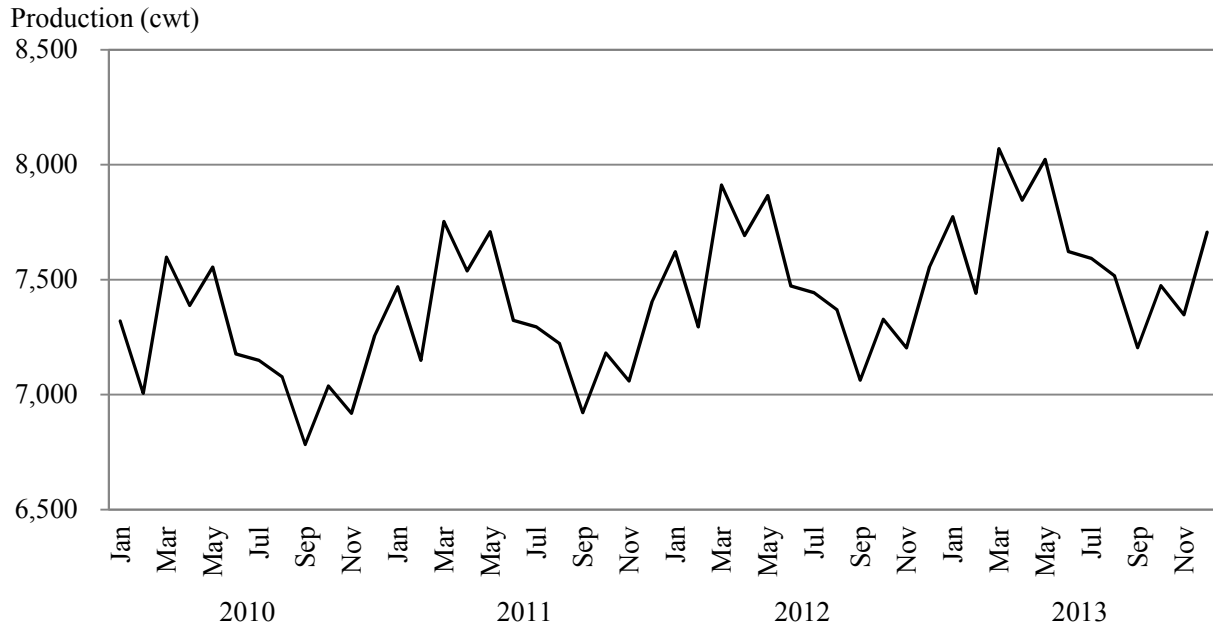
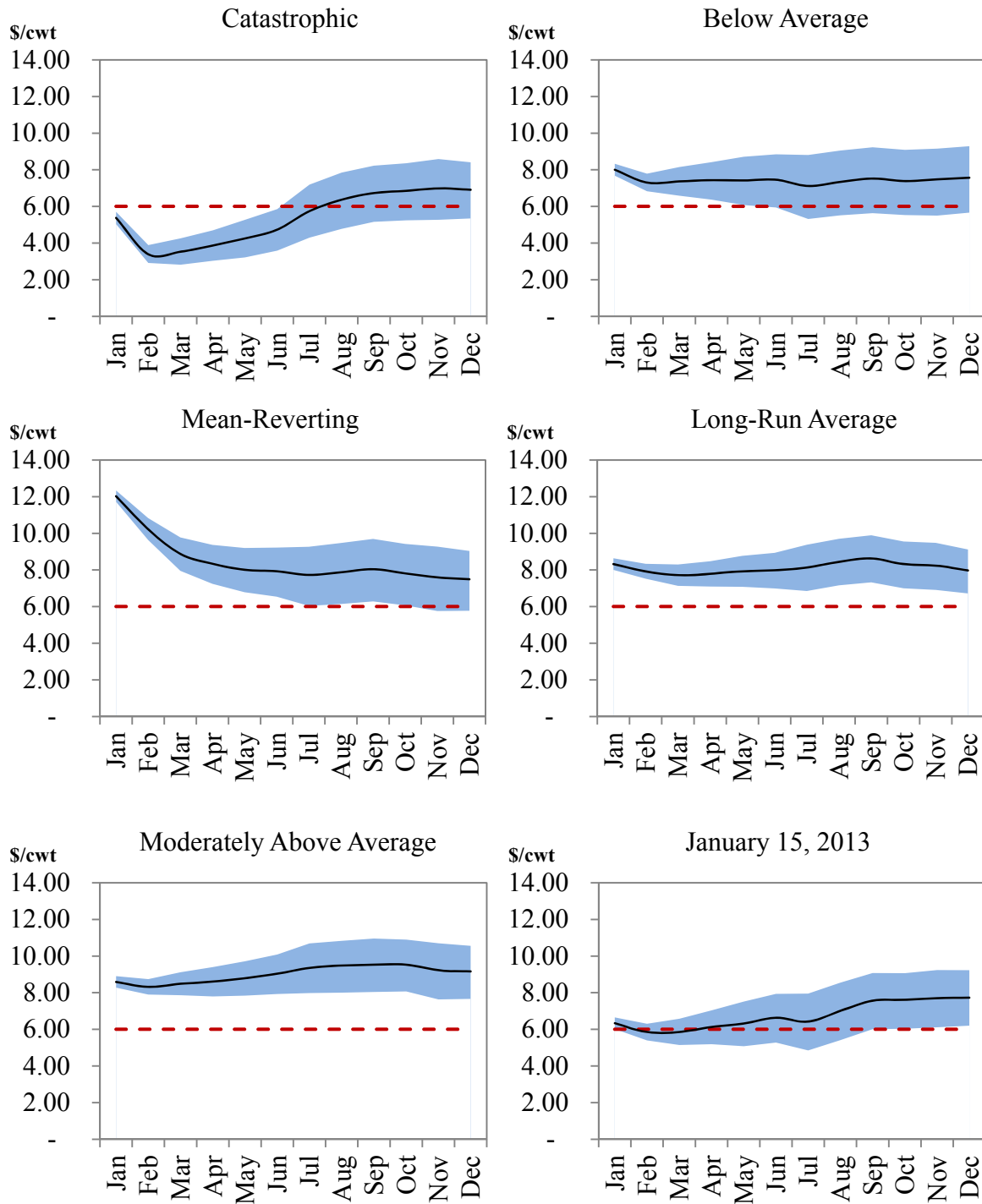


Figure 3. Simulated dairy IOFC margin scenarios



The solid black line represents the expected IOFC margin based on futures prices, the shaded region represents middle 50% of simulated IOFC margin trajectories, and the dotted red line represents the DMS threshold of \$6.00/cwt.

Table 1. Insurance premiums under S. 954, H.R. 1947, and DFA Amendment to H.R. 1947, \$/cwt.

Insurance Coverage Level	H.R. 1947 Insurance Premium (First 4M lbs. Annual Production History)	H.R. 1947 Insurance Premium (Over 4M lbs. Annual Production History)	S. 954 Insurance Premium (First 4M lbs. Annual Production History)	S. 954 Insurance Premium (Over 4M lbs. Annual Production History)	DFA Insurance Premium (First 4M lbs. Annual Production History)	DFA Insurance Premium (Over 4M lbs. Annual Production History)
				\$/cwt.		
\$4.00	0.000	0.000	0.000	0.000	0.000	0.030
\$4.50	0.010	0.015	0.010	0.020	0.010	0.045
\$5.00	0.025	0.036	0.020	0.040	0.020	0.066
\$5.50	0.040	0.081	0.035	0.100	0.035	0.110
\$6.00	0.065	0.155	0.045	0.150	0.045	0.185
\$6.50	0.090	0.230	0.090	0.290	0.090	0.290
\$7.00	0.434	0.434	0.400	0.620	0.180	0.380
\$7.50	0.590	0.590	0.600	0.830	0.600	0.830
\$8.00	0.922	0.922	0.950	1.060	0.950	1.060

Table 2. OLS models of USDA announced prices

	AMP_{t≤6}	AMP_{t>6}	CP_t	SBM_t	HAY_t
Intercept	1.84**	3.03**	0.19**	-1.29	9.28**
f_t^{III}	0.40**	0.88**			
f_t^{IV}	0.24**				
$\max(f_{t-1}^{III}, f_{t-1}^{IV})$	0.33**				
f_t^{Corn}			0.88**		5.06**
f_t^{SBM}				1.01**	-0.04*
Hay Price_{t-1}					0.87**
R²	0.99	0.93	0.97	0.98	0.97

Note: *p-value < 0.10, **p-value < 0.05

Table 3. Milk-Feed nearby contract conditional rank correlations based on 2000-2012 data

	<i>CI III 1</i>	<i>CI III 2</i>	<i>CI III 3</i>	<i>CI III 4</i>	<i>CI III 5</i>	<i>CI III 6</i>	<i>CI III 7</i>	<i>CI III 8</i>	<i>CI III 9</i>	<i>CI III 10</i>	<i>CI III 11</i>	<i>CI III 12</i>
<i>CI III 1</i>	1.00											
<i>CI III 2</i>	0.13	1.00										
<i>CI III 3</i>	0.06	0.67	1.00									
<i>CI III 4</i>	0.07	0.47	0.77	1.00								
<i>CI III 5</i>	0.04	0.42	0.62	0.88	1.00							
<i>CI III 6</i>	0.04	0.47	0.48	0.70	0.87	1.00						
<i>CI III 7</i>	0.03	0.39	0.44	0.63	0.74	0.91	1.00					
<i>CI III 8</i>	-0.03	0.33	0.44	0.65	0.71	0.80	0.90	1.00				
<i>CI III 9</i>	-0.01	0.26	0.43	0.60	0.66	0.72	0.80	0.91	1.00			
<i>CI III 10</i>	-0.05	0.27	0.39	0.52	0.59	0.67	0.73	0.82	0.92	1.00		
<i>CI III 11</i>	0.01	0.33	0.40	0.48	0.54	0.64	0.69	0.77	0.84	0.93	1.00	
<i>CI III 12</i>	0.01	0.30	0.38	0.46	0.51	0.59	0.64	0.73	0.78	0.84	0.92	1.00
<i>Corn 1</i>	-0.15	0.21	0.25	0.29	0.24	0.10	0.16	0.23	0.25	0.25	0.26	0.25
<i>Corn 2</i>	-0.14	0.25	0.36	0.33	0.28	0.21	0.25	0.27	0.32	0.32	0.33	0.30
<i>Corn 3</i>	-0.15	0.22	0.23	0.34	0.38	0.30	0.34	0.34	0.36	0.36	0.36	0.38
<i>Corn 4</i>	-0.17	0.19	0.25	0.35	0.35	0.37	0.43	0.43	0.45	0.46	0.44	0.46
<i>Corn 5</i>	-0.05	0.10	0.24	0.31	0.32	0.29	0.32	0.39	0.41	0.49	0.46	0.59
<i>Corn 6</i>	-0.05	0.18	0.22	0.26	0.25	0.30	0.32	0.33	0.34	0.43	0.45	0.53
<i>SBM 1</i>	-0.00	0.13	0.20	0.17	0.11	0.04	0.06	0.08	0.04	0.09	0.09	0.09
<i>SBM 2</i>	-0.08	0.29	0.39	0.27	0.20	0.10	0.11	0.14	0.16	0.19	0.14	0.16
<i>SBM 3</i>	-0.13	0.21	0.30	0.26	0.23	0.14	0.14	0.18	0.20	0.20	0.20	0.16
<i>SBM 4</i>	-0.01	0.26	0.29	0.23	0.17	0.15	0.19	0.23	0.25	0.25	0.25	0.27
<i>SBM 5</i>	0.04	0.22	0.17	0.21	0.15	0.16	0.21	0.26	0.28	0.29	0.30	0.39
<i>SBM 6</i>	0.03	0.15	0.18	0.20	0.14	0.16	0.21	0.26	0.29	0.33	0.31	0.41
<i>SBM 7</i>	0.09	0.08	0.16	0.18	0.17	0.17	0.17	0.21	0.26	0.32	0.29	0.41
<i>SBM 8</i>	0.00	0.07	0.16	0.15	0.16	0.20	0.16	0.18	0.21	0.29	0.30	0.41
<i>SBM 9</i>	0.18	0.14	0.14	0.12	0.09	0.16	0.15	0.15	0.17	0.22	0.25	0.36

(Table 3. Continued)

	<i>Corn 1</i>	<i>Corn 2</i>	<i>Corn 3</i>	<i>Corn 4</i>	<i>Corn 5</i>	<i>Corn 6</i>	<i>SBM 1</i>	<i>SBM 2</i>	<i>SBM 3</i>	<i>SBM 4</i>	<i>SBM 5</i>	<i>SBM 6</i>	<i>SBM 7</i>	<i>SBM 8</i>
<i>Corn 1</i>	1.00													
<i>Corn 2</i>	0.58	1.00												
<i>Corn 3</i>	0.52	0.75	1.00											
<i>Corn 4</i>	0.44	0.64	0.77	1.00										
<i>Corn 5</i>	0.39	0.43	0.57	0.71	1.00									
<i>Corn 6</i>	0.22	0.27	0.41	0.56	0.83	1.00								
<i>SBM 1</i>	0.49	0.29	0.17	0.20	0.14	0.06	1.00							
<i>SBM 2</i>	0.50	0.62	0.42	0.33	0.31	0.15	0.49	1.00						
<i>SBM 3</i>	0.41	0.64	0.53	0.46	0.30	0.19	0.40	0.73	1.00					
<i>SBM 4</i>	0.32	0.57	0.57	0.52	0.39	0.25	0.30	0.65	0.74	1.00				
<i>SBM 5</i>	0.27	0.41	0.46	0.52	0.46	0.31	0.29	0.47	0.63	0.81	1.00			
<i>SBM 6</i>	0.37	0.35	0.39	0.50	0.55	0.41	0.31	0.49	0.51	0.71	0.83	1.00		
<i>SBM 7</i>	0.28	0.27	0.29	0.40	0.64	0.55	0.19	0.41	0.47	0.55	0.70	0.81	1.00	
<i>SBM 8</i>	0.10	0.17	0.24	0.28	0.61	0.65	0.09	0.23	0.31	0.45	0.51	0.63	0.79	1.00
<i>SBM 9</i>	0.03	0.06	0.14	0.21	0.48	0.65	0.08	0.17	0.21	0.33	0.39	0.45	0.63	0.78
<i>CI IV 1</i>	0.16	0.17	0.24	0.38	0.29	0.34	0.21	0.31	0.30	0.29	0.28	0.27	0.32	0.25
<i>CI IV 2</i>	0.13	0.13	0.15	0.23	0.26	0.35	0.28	0.30	0.22	0.16	0.19	0.19	0.22	0.23
<i>CI IV 3</i>	0.18	0.21	0.28	0.35	0.37	0.39	0.17	0.29	0.30	0.17	0.15	0.17	0.20	0.22
<i>CI IV 4</i>	0.19	0.29	0.31	0.39	0.36	0.38	0.07	0.29	0.31	0.21	0.15	0.19	0.21	0.20
<i>CI IV 5</i>	0.18	0.26	0.30	0.38	0.37	0.43	0.08	0.25	0.29	0.22	0.18	0.18	0.21	0.20
<i>CI IV 6</i>	0.12	0.20	0.24	0.34	0.32	0.43	0.03	0.18	0.23	0.18	0.16	0.13	0.17	0.17

(Table 3. Continued)

	<i>CI III 1</i>	<i>CI III 2</i>	<i>CI III 3</i>	<i>CI III 4</i>	<i>CI III 5</i>	<i>CI III 6</i>	<i>CI III 7</i>	<i>CI III 8</i>	<i>CI III 9</i>	<i>CI III 10</i>	<i>CI III 11</i>	<i>CI III 12</i>
<i>CI IV 1</i>	0.05	0.32	0.43	0.44	0.38	0.35	0.35	0.39	0.40	0.40	0.41	0.42
<i>CI IV 2</i>	0.13	0.41	0.55	0.51	0.41	0.35	0.33	0.33	0.29	0.30	0.35	0.37
<i>CI IV 3</i>	-0.02	0.44	0.62	0.71	0.64	0.53	0.45	0.48	0.41	0.39	0.39	0.42
<i>CI IV 4</i>	0.03	0.29	0.54	0.73	0.73	0.60	0.52	0.55	0.52	0.44	0.42	0.45
<i>CI IV 5</i>	-0.07	0.27	0.44	0.64	0.70	0.69	0.60	0.61	0.57	0.53	0.48	0.50
<i>CI IV 6</i>	-0.02	0.19	0.38	0.55	0.61	0.68	0.66	0.65	0.63	0.58	0.57	0.54

(Table 3. Continued)

	<i>SBM 9</i>	<i>CI IV 1</i>	<i>CI IV 2</i>	<i>CI IV 3</i>	<i>CI IV 4</i>	<i>CI IV 5</i>	<i>CI IV 6</i>
<i>SBM 9</i>	1.00						
<i>CI IV 1</i>	0.23	1.00					
<i>CI IV 2</i>	0.24	0.66	1.00				
<i>CI IV 3</i>	0.20	0.53	0.78	1.00			
<i>CI IV 4</i>	0.16	0.47	0.60	0.88	1.00		
<i>CI IV 5</i>	0.16	0.38	0.49	0.75	0.89	1.00	
<i>CI IV 6</i>	0.15	0.32	0.42	0.60	0.74	0.91	1.00

Table 4. Dairy Security Act Insurance Costs and Benefits with a low-boost DMSP parameterization (\$), does not include DMSP price enhancement value

IOFC Margin Scenario as Anticipated at Annual Sign-up Deadline	Insurance Coverage Level								
	\$4.00	\$4.50	\$5.00	\$5.50	\$6.00	\$6.50	\$7.00	\$7.50	\$8.00
Catastrophic Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	15,299	27,538	45,139	64,056	91,914	119,307	149,011	180,843	214,592
<i>DMSP Penalty</i>			3-Month	16,297				Prior Year	32,799
<i>Expected Net Benefit</i>	(1,249)	9,959	26,078	45,437	66,076	89,207	97,380	116,601	123,511
Below Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	2,843	5,021	8,329	13,238	20,312	30,114	43,182	60,674	83,927
<i>DMSP Penalty</i>			3-Month	4,211				Prior Year	8,157
<i>Expected Net Benefit</i>	(1,618)	(473)	1,354	3,705	6,561	12,100	3,637	8,518	4,932
Strongly Mean-Reverting Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	1,435	2,784	4,956	8,208	12,974	19,704	28,907	41,018	56,282
<i>DMSP Penalty</i>			3-Month	2,513				Prior Year	4,343
<i>Expected Net Benefit</i>	(1,328)	(1,011)	(321)	374	922	3,389	(8,940)	(9,440)	(21,015)
Long-Run Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	107	295	722	1,599	3,355	6,668	12,513	22,211	37,658
<i>DMSP Penalty</i>			3-Month	730				Prior Year	1,403
<i>Expected Net Benefit</i>	(873)	(1,717)	(2,773)	(4,453)	(6,916)	(7,865)	(23,551)	(26,464)	(37,856)
Moderately Above-Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	37	120	291	633	1,359	2,728	5,254	9,632	17,205
<i>DMSP Penalty</i>			3-Month	262				Prior Year	447
<i>Expected Net Benefit</i>	(474)	(1,425)	(2,735)	(4,951)	(8,443)	(11,336)	(30,342)	(38,575)	(57,841)
January 15, 2013									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	2,534	4,913	8,978	15,753	26,831	43,899	66,475	92,971	122,478
<i>DMSP Penalty</i>			3-Month	8,079				Prior Year	17,540
<i>Expected Net Benefit</i>	(5,796)	(4,449)	(1,866)	2,351	9,212	22,016	23,061	36,946	39,614

Notes: Basic Production History: 89,821 cwt, Annual Production History: 89,821 cwt, Anticipated Milk Marketings in Year 1: 91,618 cwt, Supplemental Coverage Percentage: 90%, Elasticity of demand: -0.40, Participation rate: 0.25, All-Milk price basis: \$0.00.

Table 5. Dairy Security Act Insurance Costs and Benefits with a high-boost DMSP parameterization (\$), does not include DMSP price enhancement value

IOFC Margin Scenario as Anticipated at Annual Sign-up Deadline	Insurance Coverage Level								
	\$4.00	\$4.50	\$5.00	\$5.50	\$6.00	\$6.50	\$7.00	\$7.50	\$8.00
Catastrophic Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	8,320	17,065	30,669	48,172	68,601	91,659	117,305	145,542	176,294
<i>DMSP Penalty</i>			<i>3-Month</i>	14,767				<i>Prior Year</i>	28,548
<i>Expected Net Benefit</i>	(6,697)	1,016	13,138	28,083	44,294	63,089	67,204	82,830	86,743
Below Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	1,423	2,862	5,264	9,116	15,046	23,671	35,616	52,128	74,592
<i>DMSP Penalty</i>			<i>3-Month</i>	3572				<i>Prior Year</i>	7,571
<i>Expected Net Benefit</i>	(2,399)	(1,992)	(1,073)	222	1,934	6,296	(32,990)	610	(3,764)
Strongly Mean-Reverting Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	765	1,696	3,351	6,016	10,162	16,243	24,838	36,436	51,287
<i>DMSP Penalty</i>			<i>3-Month</i>	2218				<i>Prior Year</i>	4,138
<i>Expected Net Benefit</i>	(1,703)	(1,804)	(1,631)	(1,524)	(1,596)	222	(12,714)	(13,727)	(25,715)
Long-Run Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	65	195	507	1,217	2,764	5,846	11,438	20,899	36,166
<i>DMSP Penalty</i>			<i>3-Month</i>	639				<i>Prior Year</i>	1,313
<i>Expected Net Benefit</i>	(825)	(1,727)	(2,897)	(4,744)	(7,416)	(8,597)	(24,536)	(27,685)	(39,257)
Moderately Above-Average Margins									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	34	91	230	532	1,185	2,475	4,922	9,215	16,738
<i>DMSP Penalty</i>			<i>3-Month</i>	246				<i>Prior Year</i>	438
<i>Expected Net Benefit</i>	(463)	(1,438)	(2,781)	(5,037)	(8,601)	(11,574)	(30,659)	(38,977)	(58,292)
January 15, 2013									
<i>Prem. & Admin. Fees</i>	250	1,283	2,764	5,322	9,540	13,803	35,334	47,945	74,784
<i>Expected Indemnity</i>	927	2,186	4,646	9,319	17,890	32,265	52,139	76,086	103,402
<i>DMSP Penalty</i>			<i>3-Month</i>	6,580				<i>Prior Year</i>	14,303
<i>Expected Net Benefit</i>	(5,903)	(5,678)	(4,698)	(2,583)	1,770	11,881	10,224	21,561	22,037

Notes: Basic Production History: 89,821 cwt, Annual Production History: 89,821 cwt, Anticipated Milk Marketings in Year 1: 91,618 cwt, Supplemental Coverage Percentage: 90%, Elasticity of demand: -0.20, Participation rate: 0.75, All-Milk price basis: \$0.00.

Table 6. Dairy Freedom Act (Standalone Margin Insurance) Costs and Benefits (\$)

IOFC Margin Scenario as Anticipated at Annual Sign-up Deadline	Insurance Coverage Level								
	\$4.00	\$4.50	\$5.00	\$5.50	\$6.00	\$6.50	\$7.00	\$7.50	\$8.00
Catastrophic Margins									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	17,424	29,137	45,676	66,046	88,984	114,104	141,178	170,035	200,493
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	16,228	27,023	42,405	60,542	80,170	99,665	120,273	117,753	127,845
Below Average Margins									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	3,297	5,418	8,599	13,212	19,768	28,719	40,535	56,261	77,077
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	2,102	3,305	5,329	7,708	10,954	14,281	19,629	3,980	4,429
Strongly Mean-Reverting Margins									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	1,662	2,977	5,026	8,048	12,432	18,553	26,849	37,715	51,368
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	467	864	1,755	2,544	3,618	4,114	5,944	(14,567)	(21,280)
Long-Run Average Margins									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	126	318	727	1,547	3,156	6,157	11,404	20,066	33,831
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	(1,070)	(1,796)	(2,543)	(3,958)	(5,657)	(8,281)	(9,502)	(32,216)	(38,817)
Moderately Above-Average Margins									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	43	122	281	600	1,263	2,495	4,760	8,663	15,406
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	(1,153)	(1,991)	(2,989)	(4,904)	(7,551)	(11,944)	(16,146)	(43,618)	(57,242)
January 15, 2013									
<i>Prem. & Admin. Fees</i>	1,196	2,114	3,271	5,504	8,814	14,439	20,906	52,281	72,649
<i>Expected Indemnity</i>	3,181	5,641	9,708	16,224	26,604	42,317	62,853	86,805	113,359
<i>DMSP Penalty</i>	-	-	-	-	-	-	-	-	-
<i>Expected Net Benefit</i>	1,985	3,527	6,438	10,720	17,790	27,878	41,947	34,524	40,710

Notes: Annual Production History: 89,821 cwt, Anticipated Milk Marketings in Year 1: 91,618 cwt, Supplemental Coverage Percentage: 80%.

Table 7. DMSP revenue enhancement under low- and high-boost parameterization (\$)

	DMSP High-Boost	DMSP Low-Boost
Catastrophic Margins	64,405	10,734
Below Average Margins	15,638	2,606
Strongly Mean-Reverting Margins	8,241	1,374
Long-Run Average Margins	2,443	407
Moderately Above-Average Margins	790	132
January 15, 2013	33,458	5,576

Notes: For DMSP high-boost Elasticity of demand: -0.20, participation rate: 0.75. For DMSP low-boost Elasticity of demand: -0.40, participation rate: 0.25. Value estimated by multiplying change in all-milk price by the milk marketings. DMSP price boost is a free-rider benefit and is not included in net benefits of DSA participation. From a policy perspective, when comparing DSA and DFA the DMSP revenue boost should be considered as a DSA program benefit.