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ASSESSING THE VALUE OF COOPERATIVE MEMBERSHIP: A Case of Dairy Marketing in the United States

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Abstract

The existence of cooperative organizations in today's business environment, particularly in agriculture, signals their continued ability to provide value to their member owners. However, due largely to data limitations, we know very little about the monetary value of cooperative ownership held by members and how that value may change across members of differing characteristics. Through a discrete choice experiment with more than 200 dairy farmers in the United States we examine this issue explicitly for dairy marketing cooperatives that purchase their members' milk and process it into finished dairy products. Results suggest that dairy farmers, on aggregate, are willing to accept lower per hundredweight compensation, 2.3% of the average milk price, to be cooperative members relative to selling to independent handlers. Estimated partworth utilities also suggest dairy farmers actively consider the industry wide impacts within pricing offers on preferences for other milk pricing attributes. Finally, the inclusion of demographic covariates in our modeling highlights trends important to understanding heterogeneous member interests across U.S. dairy farmers and informing improved cooperative governance strategies and decision making to address them.

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Introduction

Cooperative organizations have maintained relevance and even demonstrated dominance in significant sectors of the modern-day business environment, particularly in agriculture. These organizations are traditionally characterized by the consolidation of member-owners who both patronize the firm and express formal rights to the assets of the firm through control rights and the right to the firm's residual earnings (Chaddad and Iliopoulos 2012). The goal of the cooperative business is designed to further the collective well-being of its member-owners. The choice of an individual to become a member of a cooperative is dependent on the perceived belief that membership will result in utility maximizing outcomes relative to alternative operational strategies.

Representation and democratic governance principles are strongly relevant within the cooperative organization. A cooperative's bylaws will specify the structure of its board of directors, their composition, term dynamics, responsibilities, and power limitations. Members then hold the obligation to exercise continued control over their cooperatives through active participation and voting for directors and other large changes in the cooperative business (e.g., mergers). In this manner, members have direct roles in the management and strategic direction of the firm (GAO 2019).

Transactional relationships are made up of three distinct economic components: the allocation of value, the allocation of uncertainty, and the allocation of property rights (Sykuta and Cook 2001). The theory behind the structure and organization of transactional relationships and minimizing transaction costs within a firm is frequently discussed in terms of transaction cost economics (TCE). TCE address how transactions should be governed and structured to minimize waste (Ketokivi and Mahoney 2017). Organizational structures that are most proficient at reducing transaction cost waste in their given industry and market environment will become dominant in their field (Williamson 1981). Hansmann (1996) explains the existence of different business forms by evaluating ownership costs faced by the patrons. Farmers generally face higher transaction costs because they are likely to encounter information asymmetries with bargaining partners and have limited relative market power. Having market access organized through a farmer cooperative reduces uncertainty as the need for members to negotiate independently with buyers diminishes. Farm-level decisions are still managed by producer-members while other specialized-contractual decisions are collectively decided by the cooperative and decreasing operational costs of decision making (Staatz 1987, Williamson 1981). However, a cooperative structure has the potential for high transaction costs if characteristics of heterogeneous members, diverse strategic goals, and high resource consumption are present (Cook 1996).

In agriculture, cooperatives tend to succeed more commonly through implications of asset fixity. As assets are made more specialized for particular uses, individual-governing market contracting becomes less efficient at distributing them (Williamson 1981). Therefore, a farmer is forced to accept the prices offered by a downstream buyer as they cannot easily shift their asset investments to other forms of production. The ability for opportunistic buyers in downstream markets to "extract price concessions" from suppliers is categorized under Galbraith's definition of countervailing powers (Galbraith 1952). Farmer cooperatives reduce the costs associated with specialized assets by providing and preserving market power and market access. In this manner, negative externalities that threaten independent producers are internalized within the cooperative's structure (Staatz 1987). External agents are forced to treat members of a cooperative equally through existing supply control powers of the association. Opportunistic behaviors of downstream players are more limited due to expanded market control, transactional costs are reduced and more easily monitored and governed, volatile negative externalities are internalized, and information asymmetries are reduced. Ownership of the cooperative firm's assets and governance are shared amongst all members through limited control (property) rights. This usually reduces the individual member's ownership costs in collective decision making due to homogeneity in interests (Hannsman 1996).

Governance responsibilities, such as voting for or serving on the Board of Directors (BoD) may also provide members a level of participatory satisfaction not shared in a more traditional producer-independent buyer relationship. In the U.S. governance model of cooperatives, day-to-day decision management is the responsibility of the management team led by the Chief Executive Officer (CEO). The BoD exercises control through its hiring and monitoring of the CEO. Expressing one's interests through BoD voting powers can limit owner-associated risks through the perceived ability to hold cooperative executives accountable. "Perceived" ability is an important distinction as this benefit is only relevant if cooperative members are able to comprehend the complex issues surrounding firm governance (e.g., assumptions of bounded rationality). The delegation of decision making between the BoD and management team shifts the assumption of risk and formal versus real authority. Additionally, the frequency at which members participate in transactional behavior with their cooperative contributes to the level of interest and stake they have in monitoring its efficiency (Chaddad and Iliopoulos 2012).

Heterogeneity in member interests and transactionary participation increases the cost associated with collective decision making blurring the lines of defined property rights. Heterogeneous interests often become more prevalent and costly the longer a cooperative progresses in its life cycle (Cook 1996). Governance techniques that ensure all member interests are represented are paramount. A reduction in the confidence of an organization to effectively represent an owner's interests limits any property right advantages and delegitimizes the collective value of the governance model (Chaddad and Iliopoulos 2012).

Numerous studies have been conducted to isolate what benefits of the cooperative business model is of the most value to farmers. Alho (2015) uses heterogeneity in Finnish producer organizational structures to pinpoint membership drivers within contemporary cooperative systems. Stated preference methods are utilized to examine producer perceptions of cooperative membership. Both dairy and meat producers valued a stable channel for selling their products as the most important benefit from cooperative membership. Community values, business decision making participation, and governance ranked among the least important to producer members (Alho 2015).

Bravo-Ureta and Lee (1988) survey New England dairy farmers to compare characteristics based on cooperative membership status. Over 80% of respondents were members of a dairy cooperative and approximately 70% of them found membership helpful, primarily because cooperatives offered a stable and guaranteed market for their milk. Demographic characteristics, such as age and education, had little influence on membership status (Bravo-Ureta and Lee 1988). Similarly, Jensen (1990) assessed the important factors related to dairy farmers in Tennessee in joining marketing cooperatives. Their respondent pool included 58% that were existing members of a dairy marketing cooperative to which they were asked to select from a list of choices their primary reason for joining the cooperative. Results indicate that of the cooperative members, 65% joined primarily because of the assured market, followed by 38% stating that services offered were better. Notably, 70% of non-members chose independent handlers because they paid the highest price.

To our knowledge, only Roe, Sporleder, & Belleville (2004) estimate the monetary value of cooperative ownership by estimating producer preferences for contract attributes within the U.S. hog industry. Results suggest that respondents were more likely to choose contracts offered by a cooperative than a feed or packing company, and that hog producers would be willing to accept a \$0.94 and \$0.57 per hundredweight (cwt) reduction in their base rate by cooperatives before switching to a feed company or packing company, respectively. This reduction corresponds to a base price approximately 2.2% below the regional average.

We make important contributions to the literature on measuring the value of cooperative ownership in four distinct yet complementary ways. First, we are the first to estimate the monetary value of membership in dairy marketing cooperatives, a surprising result given that dairy marketing cooperatives handle around 85% of the milk produced in the United States (GAO 2019). We develop and administer a discrete choice experiment (DCE) to U.S. dairy producers regarding their preferences for various milk pricing attributes and milk handler business structure. In doing so, we evaluate the values and strategic tradeoffs between quality premiums, volume premiums, hauling cost structures, and handler business structure (cooperative or independent). By controlling for handler pricing factors specific to milk markets, we more accurately estimate the value of ownership accruing to cooperative members.

Second, we improve on the experimental design of Roe, Sporleder, & Belleville (2004) in which all respondents were asked to state their preference over a single choice set of two hypothetical contracts, and of which one always included a cooperative issuer. In our case, we utilize a Balanced Overlap fractional factorial experimental design where participants are shown six different choice sets to create the optimal variation across attributes needed to elicit a range in choice responses. Firth Bayes adjusted estimates and Hierarchical Bayes methods were employed to reduce bias and incorporate subject level covariates into maximum likelihood functions responsible for generating reliable estimates.

Third, the sets of attributes included assess both preferences and values for individual farm activities and attention to market-based conditions. In particular, volume premium attributes include the consideration of premium payments conditional on overall market conditions to align market value of additional product with payments to producers to appropriately incentivize a production increase. Milk balancing functions provided by dairy marketing cooperatives may also add value to cooperative ownership given their associated market-wide benefits.[2] Finally, using demographic data collected, we explicitly consider implications for cooperative governance under

[2] Dairy marketing cooperatives have assumed expanded operational responsibilities for procurement and distribution of milk in a manner called “balancing,” where supply logistics are optimized in a method that all handlers (co-ops and independents alike) and contractual obligations are more efficiently filled (USDA 2001). Coordinating the manufacture and shipment of milk into more stable products based on current supply minimizes waste and dumping of product. Historically, independent processors sought to avoid the costly and daunting responsibility of obtaining, coordinating, and managing milk supply (USDA 2005). Dairy cooperatives generally agree to market all milk produced by their members. Cooperative handlers came to dominate balancing milk supplies from this commitment and streamlining the coordination of milk supply allocation across markets.

heterogeneous membership conditions. Preference trends between demographically similar farmer groups can be used to inform improved cooperative governance practices to minimize the hindering effects of heterogeneous interests and member factions (Cook 2018).

We continue now with a brief discussion of milk pricing structures and trends in the United States to appropriately set the stage for our empirical approach and experimental design that follows. A summary discussion of the survey data collected follows. We then discuss the DCE results and conclude with a discussion of the implications of the results and directions for future research.

Milk Pricing Structures & Trends

Since the early 1900's, milk pricing in the United States has evolved in response to economic issues involving the production, distribution, and processing of dairy products. In addition to asset fixity issues in production, the perishability of milk as a commodity introduces added considerations (USDA 2001). Government and public policy has played an integral role in the establishment and changes in how milk is priced and organized regionally. Federal- and state-level marketing orders (MOs) play a fundamental role in the orderly sale and movement of milk between producers and consumers. MOs accomplish this by setting minimum raw, fluid-grade milk prices that handlers must pay to dairy farmers. However, since cooperative handlers are owned by their farmer-suppliers, they are permitted to pay their members less than stated minimum order prices. Handlers can, and often do, purchase milk for higher than the minimum set price if economic conditions are conducive (NFBF 2019).

Minimum prices are set for classes of milk, defined by the final product or intended use of the milk sold. The price producers receive for their milk is a blend price or weighted average of class prices based on regional utilization of milk in each market. MOs pool the value of milk in their specified region such that producers within an order receive a uniform price for their milk regardless of the end use. MO prices are calculated and specific to predetermined geographic areas where specific handler competition is isolated (Jesse and Cropp 2008).

Most MOs use multiple component pricing in their pooling calculations. In this pricing mechanism, MOs value contributions to the milk pool based on three or four distinct milk components: butterfat, protein, other solids, and, occasionally, non-fat solids. Producer value is then calculated using the USDA Agricultural Marketing Service announced component prices within the pool plus any Class I and II producer price differentials (PPD). The difference between the component value and handler value divided by the total number of pounds in the pool establishes the level of the PPD. Combined, component values and PPD represent the minimum base price producers can receive from handlers.

Milk checks received by farmers (i.e., the mailbox price) vary from the base value determined by monthly MO calculations based on various pricing premiums and cost deductions depending on competitive offerings from the handler, the location and size of a handler, and other differentiating characteristics. Quality premiums are often offered by handlers to reward or penalize producers for the quantity of somatic cells and/or bacteria present in milk. High somatic cell count (SCC) and bacterial content can be linked to increased white blood cell production in a cow used to fight off potentially harmful pathogens such as mastitis and are undesirable due to their impact on the overall quality and yield of dairy products (Ruegg 2011). Quality premiums provide producers a method to increase marginal profits on their farms and differ from handler to handler over multiple quality compliance brackets, with price advantages to increasingly reward producers who reach the strictest levels.

Volume premiums are another common price incentive offered to milk producers. Though less common today as milk supply continues to grow beyond demand, handlers historically offered volume premiums to incentivize larger milk outputs per farm. Larger per-farm production provides handler cost benefits from economies of scale. Generally, daily or monthly milk shipment brackets are set with associated per cwt payments. Other premiums exist such as protein premiums, marketing or competitive premiums, premiums for organic or kosher production, and rBST free milk. How these premiums are defined, set, and reported varies from handler to handler. In the case of cooperatives, patronage refunds (a member's share of cooperative profits based on use) may also be included in a producer's milk check.

Milk price deductions and marketing expenses also impact the bottom line paid from handlers to farmers. Like premiums, deductions can be diverse in number and definition depending on the characteristics of the handler. Hauling charges make up the most significant proportion of the deductions reported and account for all associated costs with delivery and movement of milk (e.g., fuel, trucks, maintenance, drivers). The associated structure and payment of hauling charges is linked to the organization of the handler purchasing the milk. Some handlers own their own trucking fleet, while others contract independent trucking businesses. Handlers may choose to charge flat rate hauling charges across their producer base or an altered system based on farm- or region-specific factors such as proximity to processing plants, farm density, or farm size. Other deductions commonly include (where applicable) co-op dues, milk promotion, co-op equity payments, CCC assessments, federal order marketing services, and other charges.

Methods and Experimental Design

DCEs are a widely utilized technique to quantify individuals' preferences when provided a distinct set of options (Louviere, Hensher, and Swait 2000). DCEs force respondents to consider the consequences of the choices they make across choice sets. If an individual chooses one option over another it implies that certain attribute qualities are forgone for the qualities of the chosen option. In this manner, participants are simultaneously considering multiple options and choose the option with most favorable cumulative benefit across attribute levels. Analyzing response data with a utility function provides information on whether provided attribute levels are important, the relative importance of the levels, the rate at which respondents will trade between levels, and partworth utility scores for alternative choice scenarios (Louviere, Hensher, and Swait 2000).

Identification of Attributes & Attribute Levels

Thorough research on milk pricing post MOs and handler organizational structures was conducted to inform attribute selection and attribute levels. New York Department of Agriculture and Markets Payment Reports were utilized to provide a basis for determining which components of milk prices contribute most significantly to the total net value of milk to producers (NYAM 2018). Combined, quality, volume, and marketing (or competitive) premiums made up the bulk of total premiums offered and reported by handlers in New York State (NYS); i.e., approximately 86% of total premiums paid excluding patronage refunds (Munch, Schmit, and Severson 2020). Considering deductions, hauling made up the majority of total marketing costs experienced by handlers; i.e., approximately 74% of total deductions levied (Munch, Schmit, and Severson 2020).

Phone and in-person interviews with several cooperative and independent handlers in NYS were also conducted to get a better sense of what historical, current, and future premium and hauling structures look like across organizations.

DCE are inherently limited by the number of attributes and levels that can be included. Too many attributes places a cognitive burden on respondents while too few can lead to a misrepresentation of the product or contract. Ensuring participants thoroughly consider the economic implications of each attribute is necessary. Ultimately, five attributes were chosen (Table 1).[3]

[Table 1 here]

To represent premium offerings in the marketplace, volume and quality premiums were included, each with three levels. For volume premiums, the first level represents a traditional bracket system as described during handler interviews. This option does not take external market conditions into account and always rewards producers that produce the highest volumes of milk. The second level includes the same bracketed payment incentives of the first, but conditional on a market signal. Specifically, a volume premium is paid only if the current minimum order price is equal to or above the previous three-month average price. The third level represents the volume premium being used by most handlers currently - no volume premiums paid at all, effectively implying no price incentive for farms to increase production. All handlers interviewed reported having volume premiums in the past five years, but only one reported paying a volume premium in the most recent year (2019) - a clear reaction to the current oversupply of milk on the market. Farmers must evaluate their marginal costs of increasing milk production with volume premium levels that reward that increase.

Quality premium levels were constructed as SCC-based brackets that reward farmers for meeting higher thresholds of milk quality via lower SCC (Table 1). All options reward higher quality, but each level compensates farmers differently based on a threshold of strictness. While it is well known that higher quality milk improves processed milk product production efficiencies (i.e., a benefit to the handlers), farmers are limited in their ability to increase milk quality and therefore must consider their perceived ability and cost to meet higher levels of quality in order to maximize on quality premium price benefits.

The third attribute considers the milk handler's business structure: either a farmer-owned cooperative or an independent handler (non-cooperative firm). Each is assumed to act as a proxy for the cumulative perceived advantages and disadvantages a milk producer would experience by contracting with that business structure. The nature of a cooperative handler's business will necessarily affect the value of member ownership; e.g., whether the marketing cooperative simply bargains for improved prices on behalf of its members or whether it conducts processing functions. In our case, both handler types similarly process milk into a set of finished products; e.g., fluid milk, cheese, and yogurt.

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[3] A marketing/competitive premium was initially considered based on the NYAM data (2018) where an annually increasing premium was included based on the number of years a farm supplied milk to the handler. However, comments received during pretesting of the survey with dairy farmers informed us that such a premium was not offered by their handlers or was unnecessary.

Hauling cost levies are, by far, the largest deduction for milk producers. Indeed, many cooperative handlers have completed varied kinds of hauling studies to determine equitable charging mechanisms for their members. While often implemented by handlers, the combination of a "stop charge" and "per cwt charge" was avoided given its wide ranging conditions across handlers interviewed and to reduce DCE fatigue. Instead, hauling cost structures were conceptually presented to respondents by how the costs for transportation and assembly to the handler were allocated across farm suppliers. Each level can be associated with varying levels of interest in how the burden of hauling costs for handlers are shared (or not) across producer suppliers. In so doing, the levels specified encompass the range of actual practices existing in the marketplace.

The final attribute is the Gross Handler Pay Price, with five distinct per cwt monetary levels based on recent market prices (i.e., $19.00, $19.25, $19.50, $19.75, and $20.00). The Gross Handler Pay Price represents the minimum price required by the milk MO and any other handler adjustments (e.g., deducts below the minimum price for cooperative handlers, promotion check-offs, etc.) prior to payment of quality and volume premiums, less hauling charges.

Experimental Design

Choice options utilized in the DCE represent hypothetical contractual offers from milk handlers. Participants were asked to choose between two hypothetical offers based on the attribute levels that define each offer. If a milk producer prefers one offer over another it is assumed that the producer would rather sell their milk to a handler with the chosen attribute levels. The Qualtrics® survey platform and conjoint add-on software were utilized to design the experiment and collect the data. To limit cognitive strain, two packages per choice set question were provided, meaning two hypothetical contractual offers were displayed per question. Qualtrics® software utilizes a randomized factorial design whereby respondents are randomly selected to receive different versions or profiles of choice sets. How the choice sets are created is based on a Balanced Overlap design. Based on this method, the ability to evaluate the wide range of possible choice sets is performed using a much smaller participant pool (Chrzan and Elrod 2000). Using computer optimization functions, Qualtrics® software assess thousands of potential designs and picks the most efficient (Kuhfeld, Tobias, and Garret, 1994). Combined, these methods avoid choice sets in which one or multiple profiles dominate other profiles in attribute frequency and exposure increasing the efficiency of an experimental design.

The data collected in a DCE are limited in quality based on the ability for respondents to place themselves in a setting whereas they are behaving in a manner consistent to what would occur in a true willingness-to-accept scenario. Experimental designs that result in surveys taking over 15 minutes jeopardize the establishment of this setting and lead to increased rates of fatigue (Campbell *et al.* 2015). Based on our chosen number of offers per question (2), Qualtrics® recommended six questions per respondent. In other words, each respondent sees six sets of two offers. Based on these settings, the recommended minimum sample is 208 respondents.[4]

[4] Qualtrics suggests the Sawtooth Software equation to calculate a minimum sample size: $N = (m*c)/(t*a)$, where c is the largest number of levels across attributes, t is the number of tasks or questions, a is the number of alternatives or choice per question, and m is a multiplier value of 300 or 500 depending on whether the experiment is "small" or "large," respectively.

Empirical Model

Choice modeling was pioneered by McFadden (1973) to estimate the probability of individuals making a choice from presented alternatives. In discrete choice analysis, a discrete choice or multiple choice variable takes on multiple unordered qualitative values in the form of attributes and their associated levels. The econometric task within discrete choice is to model the probability of choosing the various options, given the general attribute characteristics of each option and, if desired, possible regressors such as individual subject characteristics.

Sellers are expected to maximize utility by choosing the contractual offer that provides the most marginal utility via the perceived cost or social benefits from the attribute characteristics. Individual choice probabilities can be expressed in logit form using multinomial logit regression models. In McFadden (1973), random utility theory is employed describing the utility that a respondent attaches to profile j ($j = 1,..., J$) in choice set s (s=1,…, S) as the sum of a systematic and a stochastic component:

$$(1) \qquad U_{js} = x'_{js}\beta + \varepsilon_{js}$$

where x_{js} is a $k \times 1$ vector that describes the levels of attributes of profile j in choice set s. The vector β is a $k \times 1$ vector of parameter values representing the effects of the attribute levels on utility. The stochastic component ε_{js} is the error term assumed to be identically and independently standard Gumbel distributed. Under the standard Gumbel assumption, the multinomial logistic probability that a respondent chooses profile j in choice set s is:

$$(2) \qquad p_{js}[\boldsymbol{X}_s, \beta] = \frac{e^{x'_{js}\beta}}{\sum_{t=1}^{J} e^{x'_{js}\beta}}$$

where $\mathbf{X}_S = [x_{1s}, \dots, x_{js}]'$ is the design matrix for choice set s. The stacked $\mathbf{X}_S$ matrices provide the design matrix $\mathbf{X}$ for the choice study. JMP choice modeling statistical software was utilized to analyze collected data in this article (SAS Institute®, Cary, NC, USA). The JMP choice modeling platform employs a conditional logistic regression to estimate the probability that a specific attribute configuration is preferred.

Using maximum likelihood estimation (MLE) techniques for DCE in smaller data sets can cause problems related to separation (in which maximum likelihood estimates do not exist) and bias. Bias-corrected maximum likelihood estimators can be obtained as described by Firth (1993) in a penalized MLE method. This Firth method allows fitting of a multinomial logit model to individual-level data and exploration of heterogeneity in respondent's preferences (Kessels, Jones, and Goos 2019). This is achieved by modifying the score function using a non-informative prior distribution that is proportional to the square root of the determinant of the Fisher information matrix of the model being used (Jeffreys 1946). This method has been shown to produce improved estimates and tests than MLE's without bias correction. JMP software incorporates Firth adjusted estimate calculations.

One drawback to traditional conditional logit models is that they only examine within subject variation but ignores between subject variation. Hierarchical Bayesian (HB) estimates can provide relief from this problem. HB models are referred to as hierarchical because they model participants' preferences as a function of an-upper level model (pooled across responses) and a lower level (within-responses) individual level model (Orne and Howell, 2009). These estimates are based on a HB fit that includes subject level covariates into the underlying likelihood function and estimates their effects on the parameters directly. The Bayesian procedure is combined with the Metropolis-Hastings algorithm to estimate subject-level covariates as described by Train (2001). Bayesian procedures do not require the maximization of any function. Given a distribution of data, they use an iterative process that converges to draws from the distribution to simulate relevant statistics (Train 2001). HB output is in the form of posterior means or the average of subject specific coefficient estimates after each iteration period. In this case, HB estimates are generated utilizing the underlying MLE estimates of the conditional logit model. Both the Firth bias adjusted conditional logit approach and Firth bias adjusted Hierarchical Bayes approach were conducted and compared.

It is important to note that applying traditional tests to partworth utilities from HB is not appropriate (e.g., *t*-tests, *F*-tests, or *p*-values). HB is based on thousands of posterior draws from both an upper and lower level models (hierarchical). Upper level draws are considered *draws of alpha* (*alpha* is the current estimate of a population's mean utility vector) while lower level draws are considered *draws of beta* (*beta* is our current estimate of an individual's utility vector). Statistical testing for HB estimation requires the examination of the distribution of posterior draws of coefficients to see if a strong majority of draws falls on either one side or the other of the null hypothesis (Orne and Howell 2009). This credible interval (CI) is the HB equivalent of a classical confidence interval. The credible interval identifies the range in which there is a 95% probability that the true parameter value falls (for a 95% significance level). Analyzing the credible interval within the HB output is the leading way to confirm statistical significance via the HB approach. Parameter estimates generated through MLE methods of the CL represent numerical scores that measure how much each attribute influences a respondent's choice. Similarly, posterior mean estimates generated through HB can be interpreted simply as average effects of each attribute level on the respondent's choice between offers. Both measurements can be considered partworth utilities.

Across both approaches, effect coding (which constrains partworth utilities to be zero-centered) suggests finding one or more "middle-level" partworth utilities close to zero should not be surprising and such a result would not necessarily mean that the "middle-preference" attribute was being ignored by respondents (Orne and Howell 2009). Observance of a low *t*-value or confidence/credible interval containing zero for a middle attribute level may make an attribute level seem statistically unimportant when the attribute may, in fact, be relevant to individuals' decisions.

Survey Administration & Data

The study was limited to active dairy farmers in the United States. On December 11, 2019, the survey went live via an anonymous online link provided by Qualtrics®. Responses were collected until March 31, 2020. University contacts were utilized to help disseminate the survey across a number of handler organizations. State farm bureaus, agricultural associations, College social media platforms, farmer's unions, industry associations, and dairy related media outlets were utilized to advertise the survey. Four reminders were sent during the survey period. In addition to the discrete choice component of the survey, three instructional pages are provided at the start of the survey and demographic questions are included at the end. Instructions provided respondents with information on why the survey was being conducted, what the results would be used for, how the survey is structured, and several baseline assumptions about handler characteristics. A copy of the survey is provided in Appendix A.[5]

Prior to the submission of a response, Qualtrics® monitors for the completion of all presented choice sets, six in our case. If participants failed to complete all six choice set questions, the response was rejected. Therefore, of the 218 collected responses, all choice questions were completed. Demographic questions asked after the choice sets were not required for a response to be collected and response rates varied modestly among them. Demographic questions included farmer age, education level, dairy herd-size, and years of experience dairy farming. These questions allow for subject (interaction) effects to be included in the modeling of utility values across heterogeneous farm characteristics. Understanding preferences toward cooperative membership, for example, toward certain volume premium structures may be influenced by these external defining characteristics.

Information was also collected at the end of survey regarding handler selection. In particular, we asked whether farms have an opportunity to sell to a handler other than their current handler, how many farms their current handler purchases from, and whether they had sold their milk to a different type of handler within the last 10 years. These questions were asked to better understand a farmer's ability to sell to alternative handler organizations.

Table 2 summarizes the farm respondent pool over demographic characteristics collected. Survey distributions are compared with national averages based on the 2017 U.S. Agriculture Census where comparable statistics exist (USDA 2017). In general, farms in the Midwest are undersampled, while farms in the Northeast are oversampled (particularly NYS). That said, the reported handler type is fairly representative of the national average; given our focus on valuing cooperative ownership, this is an appealing result. Nearly one-half of respondents (48.8%) reported not having the opportunity to sell to a handler different than they currently do (regardless of business type). Notably, an additional 13.9% were unsure if they could. Lack of choice or awareness of choice in choosing a milk handler represents a sizable limitation to producers in handler choice and bargaining power.

[Table 2 here]

At the end of the survey we also asked respondents to provide a numerical value to them of their ownership rights or of not having ownership rights, depending on which type of handler they currently sell to. Specifically, we asked those selling to a cooperative handler: "What is the numerical value to you (in $/cwt) of your member ownership rights, responsibilities, and risks by selling to a cooperative?" For those selling to independent handlers we asked: "What is the numerical value to you (in $/cwt) of not having ownership rights, responsibilities, and risks by selling to an independent handler?" While recognizing these are difficult questions to answer,

[5] As the survey was administered to and about farm business decisions it does not meet the definition of "human participant research" as defined by the Department of Health and Human Services Code of Federal Regulations 45CFR 46. Therefore, the research was not subject to review and oversight by Cornell University's Human Research Protection Program, and Institutional Review Board approval was not required.

establishing a baseline self-reported value provides a useful comparison to the conjoint-estimated values. Further, since the range of base milk prices included in the conjoint experiment was $19 to $20/cwt, the estimated value of cooperative ownership from the experiment is bounded at $1 from above, a maximum value we assumed sufficient; i.e., around 5% of milk price. Evaluating the range and mean of self-reported values will help support or refute that assumption.

As seen in Table 3, the number of respondents that answered this question was far fewer than other questions (i.e., only 115 of 166 respondents that sold to cooperative handlers, and only 28 of 44 that sold to independents), adding support to the DCE as a preferred approach in estimating value. On average, answers to both questions were positive; i.e., there is value to some in having ownership ($1.01/cwt) and to others in not having ownership ($0.23/cwt), which one expects given their revealed preference. A crude approximation to a DCE estimated value of cooperative ownership is the difference between them, or $0.78, a level within the $1 maximum DCE constraint. That said, the range of responses were substantial. For those selling to independents, responses ranged from $0 to $2, and for those selling to cooperative handlers, from -$0.25 to $80.00. How producers calculated their responses is unknown, but the ranges suggest the values are somewhat circumspect. Alternatively, the wide range is consistent with the concept of a heterogeneous member base where member needs of a cooperative can be quite different. For cooperatives, the value should not include patronage refunds as respondents were instructed to assume that the expected value of patronage refunds is equal to the annualized value of their capital investment.

Discrete Choice Experiment Results

Given the existing organization of the dairy industry, it was clear that upon deployment of the DCE, a higher proportion of respondents would be members of farmer-owned-cooperative organizations. At first, this appears to suggest that any results to such an experiment will correspondingly favor farmer-owned-cooperatives. The problem with this assumption is that it equates current membership with satisfaction in that membership. Without further knowledge, there is no way to confirm farmers generally prefer cooperative handlers to their independent counterparts, something especially relevant given that 50% of respondents have no opportunity to sell to a different handler than they currently do and an additional 14% are not aware or unsure. Producers with no other current option than to sell to a cooperative handler had the opportunity to select hypothetical offers from independent handlers over those from cooperative handlers. In this manner, participants had the chance to express their individual preferences for milk handler pricing attributes regardless of what their current handler relationship was.

For ease of exposition, summary results of the CL models are presented first to illustrate the importance of the various attributes without (main effects model) and with (interaction effects model) subject-level covariates. As discussed above, summary statistical tests (e.g., p values) are not available in HB models, but do follow the same underlying distribution as the CL. In the context of our research contributions, the main effects model results (CL and HB) serve to inform handler decision making on contractual offers that maximize the collective benefits to their milk suppliers (e.g., the full membership for cooperative handlers). The interaction models then identify where preferences differ over selected farm supplier characteristics. Put differently, the main effects model results identify the overall utility maximizing contract offers and willingness-to-accept levels across attributes, while the interaction effects models evaluate preferences for alternative attribute levels across farm characteristics. For the interested reader, the full estimation results are available in Appendix B displaying parameter estimates for attribute levels individually (Table B1, main effects models) and with subject covariate interactions effects (CL: Table B2, and HB: Table B3).

Main Effects Model Results

In the main effects CL model, all attributes except hauling cost structure (HAUL) are statistically significant at the 95% significance level (Table 4). Based on the logworth estimates and absent gross handler pay price (PRICE), the most important attribute was handler business structure (HANDS), followed more distantly by quality (QUALPREM) and volume (VOLPREM) premiums.

[Table 4 here]

An alternative representation of attribute importance is provided in Table 5, comparing the CL and HB estimates. Given the estimated partworths, an optimal offer based on attribute levels with the highest marginal utilities is constructed. Similar to partworths, the marginal utility represents the gain from "consuming" the attribute level of focus. In this case, the optimal bundle includes the cooperative handler type, the highest and strictest paying quality level, no volume premium, and a region-specific hauling cost structure. The relative importance measures portray how much difference each attribute makes in total producer utility of the selected offer. The similarity across CL and HB models supports the robustness of our results.

[Table 5 here]

Partworths can also be converted to willingness-to-accept (WTA) values relative to a base attribute level. WTA refers to the monetary benefit a person is willing to forgo in exchange for the attribute level under consideration. In our case, the higher the WTA the lower per cwt gross handler pay price a farmer is willing to accept in return for that attribute level. WTA estimates in dollars per cwt are displayed in Table 6, whereby the attribute level with the lowest marginal utility (least preferred level) was used as the base (BASE).[6] The WTA of $0.449 for the cooperative attribute level over an independent handler (HB model), corresponds to a farmer willing to forgo $0.449 per cwt in return for marketing milk through a cooperative relative to an independent handler. Put differently, an independent handler would need to offer a gross pay price of $0.449 higher than a cooperative for a producer to choose the independent offer.

Interaction Effects Model Results

Table 4 summarizes the *p*-values and associated LogWorths for all main and interaction subject effects, arranged in order by statistical significance. While VOLPREM is no longer statistically significant on its own, it becomes more important in the interaction effects model through its interactions with HERDSIZE and EXPERIENCE. Similar to the main effects model, HAUL is not statistically significant on its own; however, preferences for hauling cost structures clearly differ by farms of different sizes given the statistically significant HAUL*HERDSIZE result.

[6] Note that the "upper" and "lower" CI values appear to be switched. Since the WTA is the willingness to forgo a lower price, the lower bounds are equivalent to a higher value (higher reduction) in price while the higher bounds are equivalent to a lower value (lower reduction) in price.

QUALPREM is less important than VOLPREM in the interaction effects model and with preferences varying significantly by the level of farmer experience.

Perhaps most striking in the interaction effects model is that the HANDS attribute remains strongly significant on its own, but also in its relation to preferences by farmer education and years of experience levels. To explore these interaction effects more thoroughly, marginal utilities across attribute levels for VOLPREM*HERDSIZE, HAUL*HERDSIZE. HANDS*EDUCATION, and HANDS*EXPERIENCE are presented in Figures 1 through 4, respectively. Computed marginal utilities include both the direct effect and the indirect effect of the demographic interactions.

Figure 1 illustrates the effect of farm herd size on preference for volume premium levels. Among smaller farms, VOLPREM1, which provides incentives for increased milk production regardless of external market conditions is generally disliked, while VOLPREM3, which provides no volume premium, is preferred. Not surprisingly, the opposite is true of larger farms where VOLPREM3 is heavily disliked relative to VOLPREM1 or VOLPREM2. Notably, larger farms prefer VOLPREM2, which pays on volume conditional on a market signal, to VOLPREM3, while smaller farms have marginal utilities near zero (< 100 cows) or positive (100-499 cows) for the HB model.

[Figure 1 here]

Figure 2 displays the effect of herd size on the choice of hauling cost structure. HAUL1 refers to a cost per cwt rate that is the same across all farm suppliers, HAUL2 is a region-specific rate across all farms supplying milk to a handler within a defined region, and HAUL3 is a farm-specific rate based on milk volume and location to other supplying farms and processing plants. Larger farms demonstrate clear preferences here relative to smaller farms that appear more indifferent. Large farms show a clear preference for the farm-specific rate (HAUL3), which is not surprising given that they likely have in lower unit costs for hauling services to the handler.

[Figure 2 here]

Figure 3 illustrates the effect of years of education on preference toward handler business structure. All groups prefer the cooperative handler business structure, with increasing preference for cooperative handlers by those with higher levels of education.[7] WTA values (HB model) for the farmer-owned cooperative by education level are \$0.28, \$0.47, and \$0.43 per cwt for less than or equal to 12 years, between 13 and 16 years, and more than 16 years, respectively.

[Figure 3 here]

Figure 4 displays the effect of years of dairy farming experience on preference toward handler business structure. Similar to education levels, all experience levels prefer the cooperative handler business structure. WTA values (HB model) for the farmer-owned cooperative attribute level by experience are \$0.18, \$0.44, and \$0.56 per cwt for less than 10 years, between 10 and 30 years, and above 30 years, respectively.

[7] Since there are only two attribute levels for handler business structure, the marginal utilities for independent handlers are of the same magnitude as for cooperative handlers, but opposite in sign.

[Figure 4 here]

Implications and Conclusions

As evidenced by the growing volume of milk handled through cooperatives, the role cooperatives play in the management of milk markets remains prominent. Each year that the number of dairy marketing cooperatives shrinks, the governance responsibilities and jurisdiction over farmer members for the remaining firms grows. Heterogeneous member interests become more prevalent and costly the longer a cooperative exists. Correspondingly, the BoD of these cooperatives is tasked with increased responsibility in managing the representation of these interests. The weaker a BoD at achieving this task, the more blurred the lines become in defining member property rights - a vital factor in ownership.

In estimating underlying preferences towards handler business types we importantly account for external market characteristics as controls to more accurately isolate utility values of ownership. Further, in considering the main effect model results, the non-business-type attribute results (i.e., volume premium, quality premium, hauling cost structure) have their own connections to cooperative ownership dynamics. We find that dairy farmers consider the aggregate success of the dairy industry in their personal preferences. Offering no volume premium as part of the utility maximizing offer bundle can be seen as peverse to farms who have invested to improve production efficiency rates. While the result may be reflective, in part at least, to current oversupply conditions in the industry, the revealed preferences expose a community loyalty, a factor that is central to the identity of many cooperatives. The pooling of equity within a cooperative, for example, provides a level of insured protection to members. Maintaining this cushion, which can be used to support ill-fated members, is limited to the continued agreement among a member base to offer these benefits.

Regarding quality premiums, producers preferred the strictest and highest value of quality payments, suggesting farmers are confident in their ability to reach the highest standards of quality and reap the monetary benefits of the strictest quality level relative to the costs of achieving it. Although not statistically significant in the main effects model, the hauling cost attribute yielded preference for constant rates across producers, but only within defined geographic regions, i.e., regional sharing of differential hauling costs. The preference for this option appears to express an implied compromise between sharing the burden via a same-rate across all farms and the no-sharing option with the farm-specific rate.

The results of our DCE found that handler business structure is a considerably important characteristic when farmers consider marketing channels for their milk. When competing with the other attributes, handler business structure had the largest influence in determining the chosen offer by dairy farmer respondents and, whereby, the cumulative perceived benefits of the farmer-owned cooperative handler attribute was favored to the cumulative perceived benefits of the independent seller attribute. As defined in the survey instructional pages, assumptions were outlined to shift the participant views of handler business structures away from possible monetary benefits and to factors specifically related to member participation in governance and ownership control rights. The significance of the farmer-owned handler attribute to farmers' decisions implies cooperative governance structures and ownership are advantageous. It is likely that known advantages of cooperatives including bargaining power, access to a secured market, and reduced transaction costs also play a role in this outcome.

Considering the HB WTA results, on aggregate, farmers were willing to forgo approximately \$0.45/cwt on their milk check to remain a cooperative handler over the independent handler option; i.e., the value of cooperative ownership is \$0.449/cwt. This is a significant result that exposes a level of rigidity in farmers' commitment towards cooperative business structures. In other words, members need to be comfortably compensated to give up their member-ownership rights. The \$0.45/cwt value corresponds to a 2.3% of the average gross handler pay price, a level nearly identical to the 2.2% decrease in regional price observed by Roe, Sporleder, & Belleville (2004) in the hog industry. Though the difference in experimental design limits complete comparison, perhaps the value of cooperative membership is relatively constant across agricultural industries.

The \$0.45/cwt WTA value is also higher than the WTA values accruing to the other attributes, suggesting cooperative membership rivals the importance of any individual pricing component post marketing order. Even if respondents considered expected patronage refunds when selecting preferred handler offers, \$0.45/cwt is more than three times the average annual level of \$0.12/cwt paid by cooperative handlers through patronage refunds in NYS in recent years (Munch, Schmit, and Severson 2020). The difference of \$0.33 still implies a variety of non-monetary benefits experienced through cooperative ownership.

The interactions effect model results have important implications for informing improved governance techniques in agricultural cooperatives. Our results imply a disagreement between small and large farms when it comes to paying on volume and, by proxy, managing the market supply of milk. Reasonably, large farms are generally opposed to eliminating volume premiums while small farms are generally opposed to handlers paying them. That said, paying volume premiums conditional on the strength of existing milk markets (VOLPREM2) had positive or near zero marginal utility appeal across all farm sizes. In fact, among larger farmers, this was the most preferred option. From a cooperative governance perspective, this suggests that a BoD can limit conflict between small and large farms by going with the more compromise based option. This outcome is also consistent with base-excess programs many cooperatives are currently implementing to limit milk supply that only pay full price on a base level milk production based on some historical average. Based on our results, conditional volume premium payments may be another option for consideration.

In the case of hauling cost structure preferences differentiated by herd size, we observe that large farms express clear preference for charging farm-specific rates. This is also reasonable given that they are the ones with presumably lowest unit costs of hauling and to whom would take on the bulk of monetary impact of more equity based (subsidized) hauling options. However, given the collective nature of a cooperative organization, the representation of all members is important. Given that small farms (less than 100 cows) made up the largest segment of dairy farms in the respondent pool, region-specific hauling costs provide the most equitable solution given these options, as confirmed by the optimal offer bundle in the main effects model (Table 5). However, individual cooperatives with different distributions of members by farm size, relative to our respondent pool, may come to a different optimal result (Figure 2).

The statistically significant interactions business structure attribute with education and dairy farming experience imply important functions for cooperatives in communicating value to their members. Considering years of education, those with 12 years or less expressed lower marginal utilities compared to those with more education. This difference may relate to the ability of cooperative members to comprehend the complex issues surrounding firm governance. Finding that farmers with higher levels of education express more satisfaction towards cooperatives may also relate to better comprehension of other benefits cooperatives provide to the milk market (e.g., in balancing). Finally, more education may be associated with more participation by members within cooperative governance. Members who more actively express their ownership rights provides validation of the democratic components of cooperative businesses.

Finally, we show stronger preferences toward cooperative handlers as years of dairy farming experience increase. This result bodes well for the variety of benefits cooperative ownership is thought to imply. If farmers did not believe cooperative handlers provided these benefits it would be odd to observe farmers with the most years of dairy farming experience expressing the highest levels of satisfaction with that handler type. Years of experience could also reflect the ability of members to obtain management roles (e.g., committees, BoD) in cooperative organizations. Dairy farming experience is likely positively associated with more connections in the industry and a higher reputation in understanding the inter-workings of dairy markets. Accordingly, farmers with the most experience may have more influential roles within the cooperative and, thus, increase their preference for cooperative handlers. At the same time, the result suggests importance in member education efforts by cooperatives to communicate the value they bring to existing younger members for member retention and in recruiting new members to the cooperative.

The handler business structure attribute included in this choice experiment consisted of two levels and where handlers provided marketing functions including purchasing, processing, and sales activities. Hybrid types of cooperatives exist across global agricultural markets, with varying market and governance functions. Employing similar research methodologies across alternative cooperative structures and industries would better identify differences in ownership value across cooperative functions (e.g., bargaining, marketing, supply, service). Furthermore, additional research is necessary in understanding the complexities surrounding the worth of specific cooperative benefits; e.g., voting rights and board/committee participation.

Dissemination and advertisement of the survey and the associated ability to obtain a demographically representative sample size of U.S. was limited. Some producer states and farmers over 65 years of age were less represented, which may impact the robustness and scope of our implications. While utilization of an online software program simplified the collection of surveys and allowed for the employment of more advanced analytical techniques, it also contributed towards sample diversity issues. It would be useful to expand the respondent pool in order to test for regional differences in cooperative value, if they exist.

Table 1. Experiment Attributes & Attribute Levels

ATTRIBUTES (Abbreviation)	LEVELS (1 through 5 = Level codes)
Volume Premium ¢/CWT based on 1,000 pounds of milk sold each month **(VOLPREM)**	**1.** 200-400 = 10¢, 400-600 = 15¢, each additional 200 = 2¢, Max 30¢ **2.** IF minimum order price ≥ average 3-month prior minimum order price then: 200-400 = 10¢, 400-600 = 15¢, each additional 200 = 2¢, Max 30¢; ELSE No volume premium **3.** No volume premium
Quality Premium ¢/CWT based on 1,000 Somatic Cell Count **(QUALPREM)**	**1.** ≤ 200 = 30¢, ≤ 150 = 40¢, ≤ 100 = 50¢ **2.** ≤ 250 = 20¢, ≤ 200 = 30¢, ≤ 150 = 40¢ **3.** ≤ 300 = 10¢, ≤ 250 = 20¢, ≤ 200 = 30¢
Handler Business Structure (HANDS)	**1.** Farmer-owned cooperative handler **2.** Independent (non-cooperative) handler
Hauling Cost Structure ¢/CWT **(HAUL)**	**1.** Same rate across all farms supplying milk to handler **2.** Region-specific rates across all farms supplying milk to handler **3.** Farm-specific rates based on milk volume & location to other supplying farms & processing plants
Gross Handler Pay Price $/CWT **(PRICE)**	**1.** $19.00 **2.** $19.25 **3.** $19.50 **4.** $19.75 **5.** $20.00

Table 2. Demographic Statistics of Farm Respondents

Variable	Count	% Sample	% U.S.
Farm Location (Division, Region):	201		
New England, Northeast	9	4.8	3.6
MidAtlantic, Northeast	97	48.3	25.2
East North Central, Midwest	62	30.8	36.8
West North Central, Midwest	12	6.0	16.6
South Atlantic, South	6	3.0	4.6
East South Central, South	3	1.5	3.1
West South Central, South	4	2.0	2.2
Mountain, West	3	1.5	3.2
Pacific, West	5	2.5	4.9
Current Handler Type:	209		
Cooperative	165	78.9	85.0
Independent	44	21.1	15.0
Dairy Herd Size:	203		
1-99 cows	81	39.9	74.3
100-499 cows	66	32.5	19.4
500-999 cows	24	11.8	2.8
1000+ cows	32	15.8	3.6
Education:	200		
High School graduate or less	38	19.0	NA
Some college, Associate’s degree	66	33.0	NA
Bachelors degree	81	40.5	NA
Masters or Doctoral degree	15	7.5	NA
Years Dairy Farming:	203		
< 10 years	29	14.3	27.0
10-30 years (> 10 years Census)	75	36.9	73.0
31+ years	99	48.8	
Number of farms supplying to your handler	209		
Under 250	66	31.6	NA
250-750	30	14.4	NA
Over 750	69	33.0	NA
Not sure	44	21.1	NA
Opportunity to sell to other handler(s)?	209		
Yes	78	37.3	NA
No	102	48.8	NA
Not Sure	29	13.9	NA
If sell co-op, sold independent in last 10 yrs?	160		
Yes	29	18.1	NA
No	131	81.9	NA
If sell independent, sold co-op in last 10 yrs?	43		
Yes	10	23.3	NA
No	33	76.7	NA

NA = Comparable figure not available.

Table 3. Self-Reported Value, $/cwt, of Chosen Handler Business Structure ($/hundredweight)

Statistic	Cooperative *N* = 115	Independent *N* = 28
Average	1.01	0.23
Standard Deviation	7.57	0.43
Minimum	-1.50	0.00
Maximum	80.00	2.00

For farms currently selling to cooperatives, value represents the value to them of having ownership in their handler. For farms selling to independents, value represents the value to them of not having ownership in their handler.

Table 4. Conditional Logit Results Summary, Main Effects and Interaction Effects Models

	Main Effects Model		Interaction Effects Model	
Model Effects	**LogWorth**	**p value**	**LogWorth**	**p value**
PRICE	24.209	0.000	23.688	0.000
VOLPREM*HERDSIZE			11.047	0.000
HANDS	8.200	0.000	3.676	0.000
HAUL*HERDSIZE			3.290	0.001
QUALPREM*EDUCATION			2.398	0.004
VOLPREM*EXPERIENCE			1.995	0.010
HANDS*EDUCATION			1.684	0.021
HANDS*EXPERIENCE			1.288	0.051
QUALPREM	2.792	0.002	0.869	0.135
VOLPREM*EDUCATION			0.416	0.384
VOLPREM	1.659	0.022	0.413	0.387
HANDS*HERDSIZE			0.366	0.431
QUALPREM*EXPERIENCE			0.338	0.460
HAUL*EXPERIENCE			0.270	0.537
HAUL	0.639	0.230	0.250	0.562
HAUL*EDUCATION			0.244	0.570
QUALPREM*HERDSIZE			0.199	0.633
N	2,616		2,400	
-2LogLikelihood	-820.050		-755.722	
AIC	1,662.303		1,637.315	

Order of model effects are based on relative importance and statistical significance from the interaction effects model. LogWorth = (-log10(p-value)). Full model results, including Hierarchical Bayes Adjusted estimates are shown in Appendix B.

Table 5. Optimal Offer (Utility Maximizing Bundle), Main Effects Models (*N*=2,616)

		Conditional Logit		Hierarchical Bayes Adjusted	
Attribute	**Attribute Level**	**Marginal Utility**	**Relative Importance**	**Marginal Utility**	**Relative Importance**
Gross handler pay price	PRICE5: $20.00	0.594	0.510	0.538	0.480
Handler business structure	HANDS1: Farmer-owned cooperative	0.234	0.184	0.236	0.216
Quality premium	QUALPREM1: ≤200 = 30¢, ≤150 = 40¢, ≤100 = 50¢	0.138	0.132	0.139	0.139
Volume premium	VOLPREM3: No volume premium	0.153	0.105	0.134	0.107
Hauling cost structure	HAUL2: Region-specific rate	0.099	0.069	0.058	0.058
	Total	1.218	1.000	1.106	1.000

Table 6. Willingness to Accept (WTA), Main Effect Models (N = 2,616)

	Conditional Logit			Hierarchical Bayes Adjusted		
Attribute Level	**WTA**	**CI Lower**	**CI Upper**	**WTA**	**CI Lower**	**CI Upper**
Volume Premiums:						
VOLPREM1	BASE	BASE	BASE	BASE	BASE	BASE
VOLPREM2	$0.056	$0.059	$0.052	$0.077	$0.079	$0.064
VOLPREM3	$0.205	$0.212	$0.198	$0.223	$0.291	$0.185
Quality Premiums:						
QUALPREM1	$0.259	$0.269	$0.249	$0.291	$0.391	$0.218
QUALPREM2	$0.200	$0.206	$0.194	$0.183	$0.241	$0.154
QUALPREM3	BASE	BASE	BASE	BASE	BASE	BASE
Handler Business Structure:						
HANDS1	$0.360	$0.368	$0.352	$0.449	$0.611	$0.316
HANDS2	BASE	BASE	BASE	BASE	BASE	BASE
Hauling Cost Structure:						
HAUL1	$0.040	$0.043	$0.037	$0.083	$0.097	$0.076
HAUL2	$0.135	$0.143	$0.126	$0.120	$0.168	$0.100
HAUL3	BASE	BASE	BASE	BASE	BASE	BASE

Base attribute levels assigned as least preferred (lowest marginal utility). CI = Confidence Interval for Conditional Logit model and Credible Interval for Hierarchical Bayes model (20,000 iterations), each based on a 95% significance level.

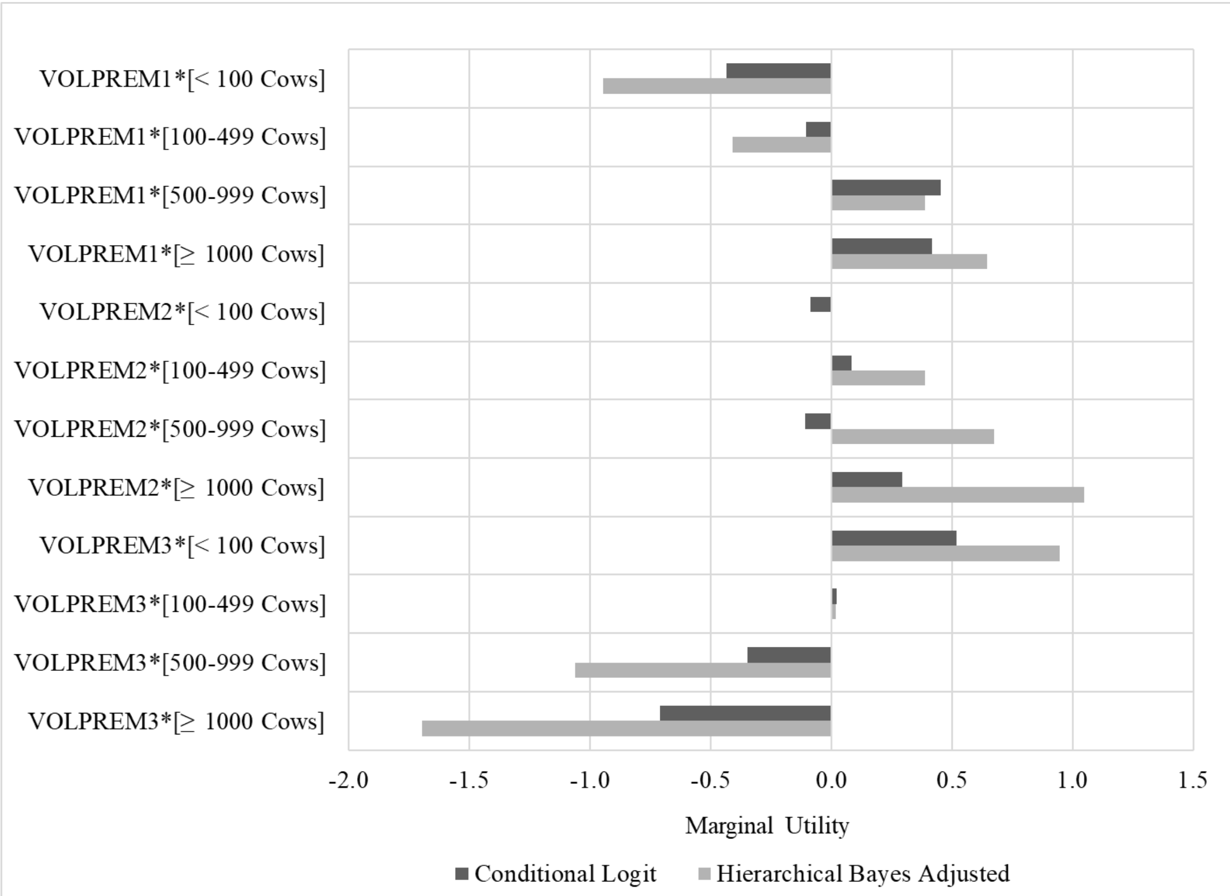

Figure 1. Marginal utilities on volume premium levels by herd size, Conditional Logit and Hierarchical Bayes Adjusted models. VOLPREM1 = always pay, VOLPREM2 = conditional pay, VOLPREM3 = never pay.

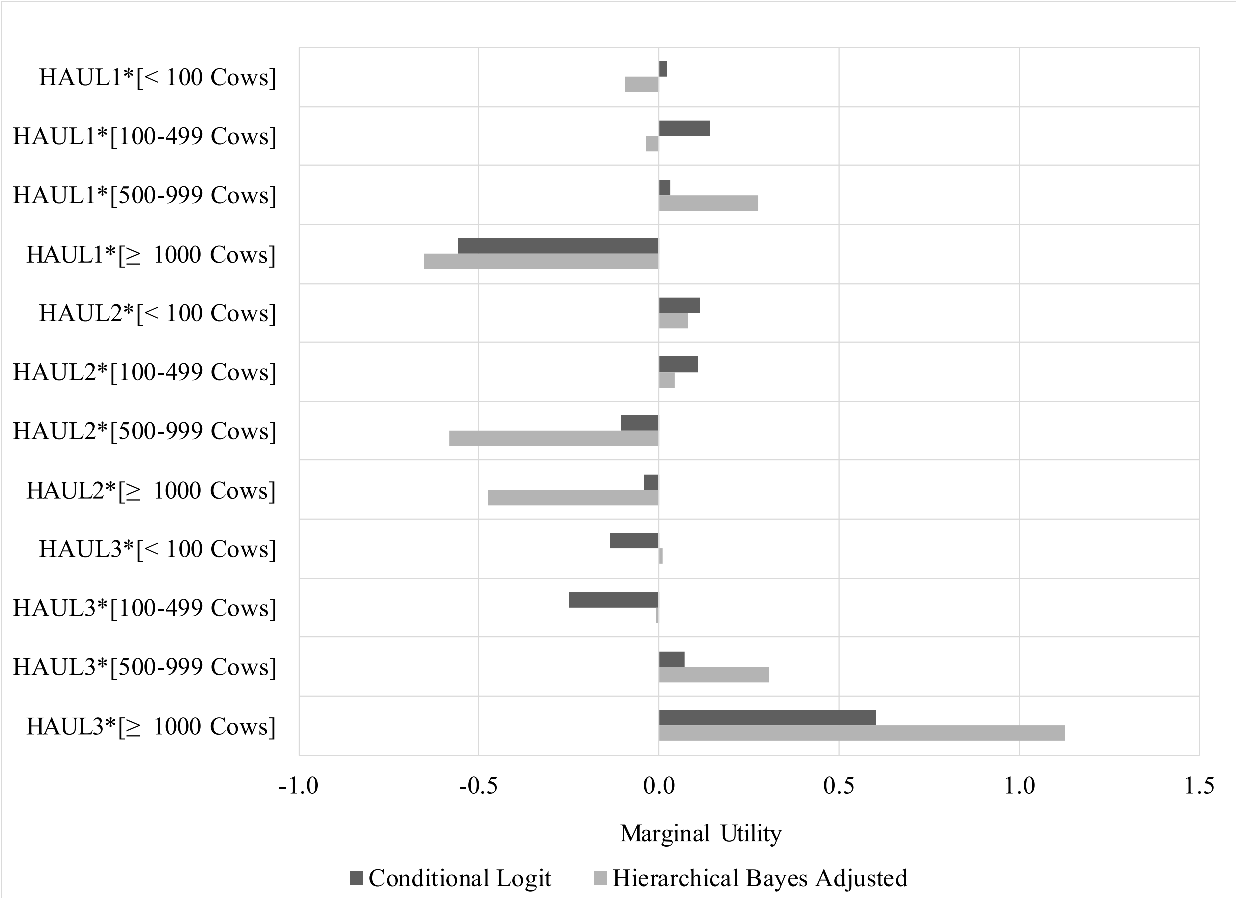

Figure 2. Marginal utilities on hauling cost structure levels by herd size, Conditional Logit and Hierarchical Bayes Adjusted models. HAUL1 = same rate for all farms, HAUL2 = same rate by farm regions, HAUL3 = farm-specific rate.

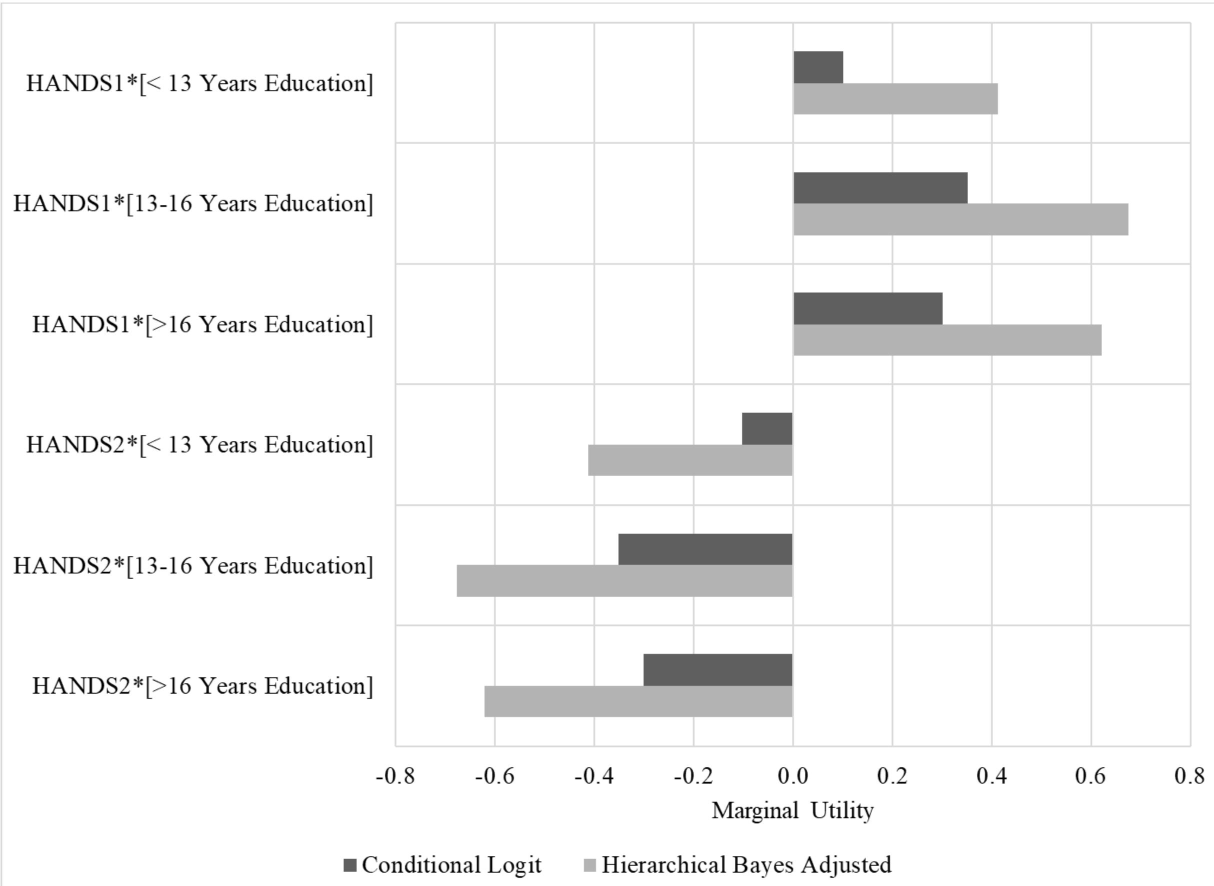

Figure 3. Marginal utilities on handler business structure levels by years of education, Conditional Logit and Hierarchical Bayes Adjusted models. HANDS1 = cooperative, HANDS2 = independent.

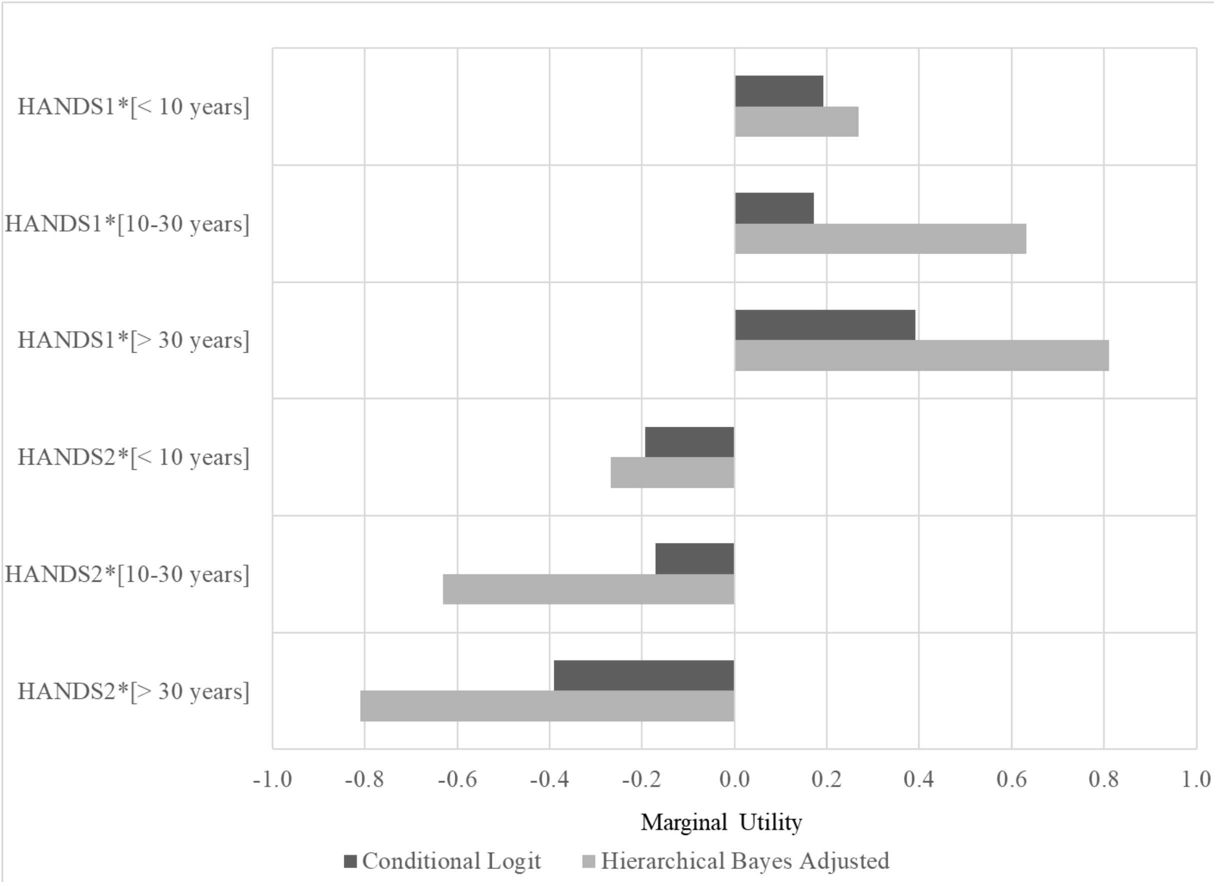

Figure 4. Marginal utilities on handler business structure levels by years of dairy farming experience, Conditional Logit and Hierarchical Bayes Adjusted models. HANDS1 = cooperative, HANDS2 = independent.

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Appendix A

DAIRY PRODUCER SURVEY

Introduction and Instructions, Page 1

Hello and welcome to the Dairy Farmer Pricing Survey!

This survey has been developed to better understand farmers' willingness to accept alternative premium programs, related milk premium adjustments, and milk handler business structures. The survey is <u>not</u> specific to any particular federal or state milk marketing order as our focus is on price adjustments made by the handler after the required minimum price is determined by the relevant milk marketing order. Your answers will be used to determine preferred premium structures under a range of market conditions. The results will serve as valuable guidance to dairy farmers and milk handlers when considering alternative pricing structures beyond the milk marketing order and the expected results therefrom.

The survey is limited to current dairy farmers and should be completed by the primary owner/operator in charge of the milk production portion of the farm business. Only one survey should be completed per farm. The survey should take approximately 15-20 minutes to complete.

Your participation in this study is completely voluntary. There are no foreseeable risks to you or your business associated with this project. However, if you feel uncomfortable answering any question, you can withdraw from the survey at any time. The responses collected will be kept strictly confidential and maintained in a secure location. Any sort of report made public will not include any information that will make it possible to identify you.

Participants who complete this survey have the opportunity to enter into a raffle for one of **five $100 Visa gift cards**. Simply enter an email address at the end of the survey where directed to be included in the drawing.

The survey is being offered through the Charles H. Dyson School of Applied Economics & Management at Cornell University. Please contact Dr. Todd M. Schmit (tms1@cornell.edu, 607.255.3015) or Roberta M. Severson (rmh27@cornell.edu, 607.255.1987) with any questions or concerns.

Click the red arrow button on the right to continue!

DAIRY PRODUCER SURVEY

Introduction and Instructions, Page 2

You will be provided offers from two hypothetical milk handlers. Carefully analyze both offers and select the one you would prefer to sell to. Offers are not necessarily representative of current market conditions or offerings.

Elements not specified are assumed the same across offers. All handlers are assumed to contract for milk hauling services. Hauling costs charged to each farm cover the total costs to the handler charged by the transport firm.

Offers are displayed in a table format containing 5 attribute/level combinations. For each attribute only one level is included in any specific offer. Numerical attributes are based on hundredweights (CWT) of milk. The possible levels for each attribute are presented here for your information. Please familiarize yourself with this information before proceeding.

ATTRIBUTES	LEVELS
Volume Premium ¢/CWT based on 1,000 pounds of milk sold each month	• 200-400 = 10¢, 400-600 = 15¢, each additional 200 = 2¢, Max 30¢ • IF minimum order price ≥ average 3-month prior minimum order price then: 200-400 = 10¢, 400-600 = 15¢, each additional 200 = 2¢, Max 30¢; ELSE No volume premium • No volume premium
Quality Premium ¢/CWT based on 1,000 Somatic Cell Count	• ≤ 200 = 30¢, ≤ 150 = 40¢, ≤ 100 = 50¢ • ≤ 250 = 20¢, ≤ 200 = 30¢, ≤ 150 = 40¢ • ≤ 300 = 10¢, ≤ 250 = 20¢, ≤ 200 = 30¢
Handler Business Structure	• Farmer-owned cooperative handler • Independent (non-cooperative) handler
Hauling Cost Structure ¢/CWT **(HAUL)**	• Same rate across all farms supplying milk to handler • Region-specific rate across all farms supplying milk to handler within a region (as defined by handler) • Farm-specific rate based on milk volume & location to other supplying farms & processing plants
Gross Handler Pay Price $/CWT **(PRICE)**	• $19.00 • $19.25 • $19.50 • $19.75 • $20.00

The Gross Handler Pay Price represents the minimum price required by the milk marketing order with any handler adjustments prior to payment of quality and volume premiums, less hauling charges. The Net Handler Pay Price equals the Gross Handler Pay Price plus any volume and or quality premiums, less hauling charges. The Net Handler Pay Price is comparable to the mailbox price to farmers.

Click the red arrow button on the right to continue!

DAIRY PRODUCER SURVEY

Introduction and Instructions, Page 3

Choosing to sell to a cooperative handler implies a joint decision to sell your milk and join the co-op as a member-owner. As a member, an at-risk capital investment is required (determined by the co-op's board of directors (BOD)), you are eligible for patronage refunds (in cash and/or equity) from the profits of the co-op each year based on your level of milk sales and approval by the BOD, you are expected to actively participate in the co-op through member input and meeting attendance, you have voting rights (one member, one vote) on decisions that come to the full membership (including large financial decisions and election of the BOD), and you have the opportunity to serve in various leadership positions in the cooperative. For the purposes of this survey, you should expect that the annualized value of your capital investment is equal to the expected annual patronage refunds received.

Contracting with an independent handler implies a single decision on the milk sales transaction. You do not make an at-risk capital investment in the handler's business, you do not have any governance responsibilities or voting rights, and you do not receive a share of the profits earned by the handler.

For either type of handler, there are recognized volume efficiency gains in terms of reduced transaction costs in hauling and in reductions in the average cost of producing finished milk products. All handlers produce the same set of finished products; i.e., a selection of fluid milk, yogurt, and cheese products, branded under the handler's business name.

Please keep these conditions in mind when making decisions on the offers presented.

Click the red arrow button on the right to begin!

[6 Generated Choice Sets Follow]

[Example Choice Set is Shown Below]

(1/6) Please select your preferred milk payment offer below.

	Payment Offer 1	Payment Offer 2
Volume premium: ¢/CWT based on 1,000 pounds of milk sold each month	No volume premium	200-400= 10¢, 400-600= 15¢, each additional 200 = 2¢, Max 30¢
Quality premium: ¢/CWT based on Somatic Cell Count (000)	≤ 200 = 30¢, ≤ 150 = 40¢, ≤ 100 = 50¢	≤ 200 = 30¢, ≤ 150 = 40¢, ≤ 100 = 50¢
Handler Business Structure	Farmer-owned cooperative	Independent (non-cooperative)
Hauling costs: ¢/CWT of milk	Farm-specific rate based on milk volume & location to other supplying farms & processing plants	Region-specific rate across all farms supplying milk to handler within a region (as defined by handler)
Gross Handler Pay Price: $/CWT	$20.00	$19.75
	○	○

DAIRY PRODUCER SURVEY

Demographic & General Questions after Choice Set Handler Offers Completed

Q1: How many farms does your current handler purchase from?

1. Under 250
2. Between 250 & 750
3. Over 750
4. I am not sure

Q2: Do you have the opportunity to sell your milk to a different handler than you currently do?

1. Yes
2. No
3. I am not sure

Q3: Do you currently sell your milk to a cooperative milk handler?

1. Yes
2. No

Q3a: (if Yes is selected in Q3) What is the numerical value to you (in cents per CWT) of your member **ownership** rights, responsibilities, and risks by selling to a cooperative?

Q3b: (if Yes is selected in Q3) Did you previously sell to an independent handler in the last 10 years?

1. Yes
2. No

Q3c: (if No is selected in Q3) What is the numerical value to you (in cents per CWT) of not having **ownership** rights, responsibilities, and risks by selling to a cooperative?

Q3b: (if No is selected in Q3) Did you previously sell to a cooperative milk handler in the last 10 years?

1. Yes
2. No

Q4: What age category do you fall under?

1. Under 35
2. 35-44
3. 45-54
4. 55-64
5. 65+

Q5: How many consecutive generations has your dairy farm been in operation?

1. 1st
2. 2nd
3. 3rd
4. 4th
5. 5+

Q6: How long has the dairy farm been in operation (across generations, if applicable)?
1. Under 10 years
2. 11-30 years
3. 31-50 years
4. More than 50 years

Q7: How long have you been dairy farming?
1. Under 5 years
2. 5-10 years
3. 11-20 years
4. 21-30 years
5. 31+ years

Q8: What is the highest level of school you have completed?
1. Less than high school degree
2. High school graduate (high school diploma or equivalent including GED)
3. Some college no degree
4. Associate degree in college (2-year)
5. Bachelors degree in college (4-year)
6. Master's degree
7. Doctoral degree
8. Professional degree (JD, MD)

Q9: In which state do you currently farm? (drop down of all states, D.C. & Puerto Rico)

Q10: How large is your milking herd? (Number of cows)
1. 1-29
2. 30-49
3. 50-99
4. 100-199
5. 200-499
6. 500-999
7. 1000-1999
8. 2000+

Q11: How many owner operators of your farm have primary management responsibilities?
1. 1
2. 2
3. 3
4. 4
5. 5+

DAIRY PRODUCER SURVEY

Final Raffle Page

You're almost done! If you would like to be entered into a raffle for one of five $100 Visa gift cards please enter your preferred email address below. Emails will be used solely for conducting the raffle and will be discarded after completion of the survey and remuneration of gift cards.

APPENDIX B

Table B1. Main Effects Model Results: Conditional Logit and Hierarchical Bayes Adjusted, in Order of Importance and Statistical Significance (*N*=2,616)

	Conditional Logit (CL)					Hierarchical Bayes (HB)		
Attribute Level	**Parameter Estimate**	**Standard Error**	**CI Lower 95%**	**CI Upper 95%**	**t-Value**	**Parameter Estimates**	**CI Lower 95%**	**CI Upper 95%**
Gross Handler Pay Price (CL p value = 0.000)								
PRICE1	-0.700	0.085	-0.867	-0.534	-8.251	-0.513	-0.800	-0.347
PRICE2	-0.194	0.079	-0.349	-0.038	-2.445	-0.161	-0.280	-0.063
PRICE3	-0.004	0.079	-0.158	0.150	-0.049	-0.027	-0.128	0.069
PRICE4	0.309	0.080	0.153	0.466	3.877	0.164	0.084	0.257
PRICE5	0.589	0.083	0.425	0.752	7.057	0.538	0.462	0.889
Handler Business Structure (CL p value = 0.000)								
HANDS1	0.237	0.042	0.155	0.318	5.682	0.236	0.154	0.405
HANDS2	-0.237	0.042	-0.318	-0.155	-5.682	-0.236	-0.430	-0.201
Quality Premiums (CL p value = 0.002)								
QUALPREM1	0.135	0.056	0.026	0.244	2.420	0.139	0.061	0.244
QUALPREM2	0.062	0.057	-0.050	0.174	1.078	0.027	-0.039	0.103
QUALPREM3	-0.196	0.057	-0.308	-0.084	-3.433	-0.166	-0.316	-0.106
Volume Premiums (CL p value = 0.022)								
VOLPREM1	-0.110	0.055	-0.218	-0.002	-2.002	-0.101	-0.186	-0.028
VOLPREM2	-0.037	0.057	-0.150	0.075	-0.652	-0.034	-0.112	0.035
VOLPREM3	0.148	0.057	0.036	0.259	2.590	0.134	0.063	0.271
Hauling Cost Structure (CL p value = 0.230)								
HAUL1	-0.023	0.057	-0.134	0.088	-0.410	0.011	-0.072	0.009
HAUL2	0.093	0.057	-0.018	0.205	1.638	0.058	-0.008	0.143
HAUL3	-0.070	0.057	-0.183	0.042	-1.224	-0.069	-0.217	-0.001

Note, CI = Confidence Interval for the Conditional Logit model and Credible Interval for the Hierarchical Bayes model.

Table B2. Interaction Effects Model Results, Conditional Logit, in Order of Importance and Statistical Significance (N=2,400)

Attribute Level	Marginal Utility	Parameter Estimate	Standard Error	CI Lower 95%	CI Upper 95%	t-Value
Gross Handler Pay Price (p value = 0.000)						
PRICE1	-0.714	-0.714	0.090	-0.891	-0.538	-7.938
PRICE2	-0.189	-0.189	0.084	-0.354	-0.024	-2.243
PRICE3	0.010	0.010	0.084	-0.156	0.175	0.114
PRICE4	0.272	0.271	0.085	0.105	0.438	3.188
PRICE5	0.622	0.622	0.089	0.447	0.797	6.976
Volume Premium*Herd Size (p value = 0.000)						
VOLPREM1*[< 100 Cows]	-0.435	-0.519	0.101	-0.716	-0.321	-5.146
VOLPREM1*[100-499 Cows]	-0.104	-0.187	0.104	-0.391	0.016	-1.808
VOLPREM1*[500-999 Cows]	0.455	0.371	0.146	0.085	0.658	2.539
VOLPREM1*[≥ 1000 Cows]	0.418	0.335	0.156	0.028	0.641	2.141
VOLPREM2*[< 100 Cows]	-0.086	-0.131	0.103	-0.332	0.070	-1.277
VOLPREM2*[100-499 Cows]	0.082	0.037	0.106	-0.170	0.245	0.352
VOLPREM2*[500-999 Cows]	-0.109	-0.154	0.158	-0.463	0.155	-0.977
VOLPREM2*[≥ 1000 Cows]	0.293	0.248	0.125	0.004	0.492	1.990
VOLPREM3*[< 100 Cows]	0.521	0.650	0.105	0.444	0.855	6.201
VOLPREM3*[100-499 Cows]	0.021	0.150	0.105	-0.056	0.356	1.428
VOLPREM3*[500-999 Cows]	-0.346	-0.217	0.155	-0.521	0.087	-1.397
VOLPREM3*[≥ 1000 Cows]	-0.711	-0.583	0.127	-0.831	-0.334	-4.594
Handler Business Structure (p value = 0.000)						
HANDS1	0.252	0.252	0.075	0.105	0.398	3.372
HANDS2	-0.252	-0.252	0.075	-0.398	-0.105	-3.372
Hauling Cost Structure*Herd Size (p value = 0.001)						
HAUL1*[< 100 Cows]	0.021	0.112	0.101	-0.087	0.310	1.103
HAUL1*[100-499 Cows]	0.142	0.233	0.106	0.026	0.441	2.203
HAUL1*[500-999 Cows]	0.032	0.123	0.140	-0.152	0.398	0.876
HAUL1*[≥ 1000 Cows]	-0.559	-0.475	0.138	-0.746	-0.204	-3.438
HAUL2*[< 100 Cows]	0.114	0.095	0.102	-0.106	0.296	0.929
HAUL2*[100-499 Cows]	0.108	0.090	0.105	-0.117	0.296	0.849
HAUL2*[500-999 Cows]	-0.105	-0.123	0.141	-0.399	0.152	-0.878

Attribute Level	Marginal Utility	Parameter Estimate	Standard Error	CI Lower 95%	CI Upper 95%	t-Value
HAUL2*[≥ 1000 Cows]	-0.042	-0.061	0.124	-0.304	0.182	-0.493
HAUL3*[< 100 Cows]	-0.135	-0.207	0.105	-0.412	-0.002	-1.978
HAUL3*[100-499 Cows]	-0.251	-0.323	0.106	-0.531	-0.114	-3.037
HAUL3*[500-999 Cows]	0.072	0.000	0.147	-0.288	0.289	0.003
HAUL3*[≥ 1000 Cows]	0.601	0.529	0.129	0.276	0.782	4.093
Quality Premium*Education (p value = 0.004)						
QUALPREM1*[< 13 Years Education]	0.017	-0.160	0.103	-0.362	0.041	-1.559
QUALPREM1*[13-16 Years Education]	0.365	0.187	0.100	-0.008	0.382	1.882
QUALPREM1*[>16 Years Education]	0.150	-0.027	0.099	-0.221	0.166	-0.274
QUALPREM2*[< 13 Years Education]	0.012	0.062	0.109	-0.151	0.275	0.568
QUALPREM2*[13-16 Years Education]	0.081	0.131	0.105	-0.076	0.337	1.243
QUALPREM2*[>16 Years Education]	-0.243	-0.193	0.088	-0.365	-0.020	-2.187
QUALPREM3*[< 13 Years Education]	-0.029	0.099	0.126	-0.149	0.346	0.781
QUALPREM3*[13-16 Years Education]	-0.446	-0.318	0.088	-0.491	-0.146	-3.617
QUALPREM3*[>16 Years Education]	0.092	0.220	0.125	-0.025	0.465	1.758
Volume Premium*Experience (p value = 0.010)						
VOLPREM1*[< 10 years]	0.282	0.198	0.105	-0.009	0.405	1.879
VOLPREM1*[10-30 years]	-0.079	-0.162	0.089	-0.337	0.012	-1.823
VOLPREM1*[> 30 years]	0.048	-0.036	0.095	-0.221	0.150	-0.376
VOLPREM2*[< 10 years]	0.213	0.168	0.106	-0.040	0.376	1.585
VOLPREM2*[10-30 years]	-0.068	-0.113	0.088	-0.286	0.060	-1.280
VOLPREM2*[> 30 years]	-0.010	-0.055	0.092	-0.234	0.125	-0.600
VOLPREM3*[< 10 years]	-0.495	-0.366	0.098	-0.558	-0.175	-3.749
VOLPREM3*[10-30 years]	0.147	0.276	0.099	0.082	0.470	2.784
VOLPREM3*[> 30 years]	-0.038	0.091	0.093	-0.092	0.273	0.974
Handler Business Structure*Education (p value = 0.021)						
HANDS1*[< 13 Years Education]	0.102	-0.150	0.078	-0.304	0.004	-1.909
HANDS1*[13-16 Years Education]	0.352	0.100	0.077	-0.051	0.251	1.303
HANDS1*[> 16 Years Education]	0.301	0.050	0.086	-0.118	0.217	0.579
HANDS2*[< 13 Years Education]	-0.102	0.150	0.070	0.013	0.287	2.140
HANDS2*[13-16 Years Education]	-0.352	-0.100	0.063	-0.225	0.024	-1.581

Attribute Level	Marginal Utility	Parameter Estimate	Standard Error	CI Lower 95%	CI Upper 95%	t-Value
HANDS2*[> 16 Years Education]	-0.301	-0.050	0.088	-0.222	0.123	-0.561
Handler Business Structure*Experience (p value = 0.051)						
HANDS1*[< 10 years]	0.193	-0.059	0.080	-0.216	0.098	-0.736
HANDS1*[10-30 years]	0.171	-0.080	0.068	-0.214	0.053	-1.185
HANDS1*[> 30 years]	0.391	0.140	0.071	0.000	0.279	1.964
HANDS2*[< 10 years]	-0.193	0.059	0.059	-0.056	0.174	1.002
HANDS2*[10-30 years]	-0.171	0.080	0.072	-0.060	0.221	1.120
HANDS2*[> 30 years]	-0.391	-0.140	0.067	-0.271	-0.008	-2.072
Quality Premiums (p value = 0.135)						
QUALPREM1	0.178	0.178	0.095	-0.009	0.364	1.863
QUALPREM2	-0.050	-0.050	0.103	-0.253	0.152	-0.485
QUALPREM3	-0.127	-0.127	0.088	-0.300	0.045	-1.447
Volume Premium* Education (p value = 0.384)						
VOLPREM1*[< 13 Years Education]	0.221	0.138	0.106	-0.071	0.346	1.293
VOLPREM1*[13-16 Years Education]	0.037	-0.047	0.106	-0.254	0.160	-0.443
VOLPREM1*[>16 Years Education]	-0.007	-0.091	0.099	-0.284	0.103	-0.918
VOLPREM2*[< 13 Years Education]	0.036	-0.009	0.103	-0.212	0.193	-0.091
VOLPREM2*[13-16 Years Education]	-0.008	-0.053	0.103	-0.256	0.149	-0.517
VOLPREM2*[> 16 Years Education]	0.108	0.063	0.121	-0.174	0.300	0.519
VOLPREM3*[< 13 Years Education]	-0.257	-0.128	0.087	-0.298	0.042	-1.478
VOLPREM3*[13-16 Years Education]	-0.029	0.100	0.088	-0.071	0.272	1.144
VOLPREM3*[> 16 Years Education]	-0.101	0.028	0.123	-0.214	0.270	0.226
Volume Premiums (p value = 0.387)						
VOLPREM1	0.084	0.084	0.103	-0.118	0.285	0.813
VOLPREM2	0.045	0.045	0.103	-0.156	0.246	0.441
VOLPREM3	-0.129	-0.129	0.090	-0.305	0.048	-1.428
Handler Business Structure*Herd Size (p value = 0.431)						
HANDS1*[< 100 Cows]	0.255	0.003	0.074	-0.143	0.148	0.039
HANDS1*[100-499 Cows]	0.309	0.057	0.080	-0.100	0.213	0.712
HANDS1*[500-999 Cows]	0.342	0.090	0.110	-0.125	0.305	0.823
HANDS1*[≥ 1000 Cows]	0.102	-0.150	0.100	-0.347	0.047	-1.496

Attribute Level	Marginal Utility	Parameter Estimate	Standard Error	CI Lower 95%	CI Upper 95%	t-Value
HANDS2*[< 100 Cows]	-0.255	-0.003	0.081	-0.162	0.156	-0.036
HANDS2*[100-499 Cows]	-0.309	-0.057	0.080	-0.213	0.099	-0.714
HANDS2*[500-999 Cows]	-0.342	-0.090	0.109	-0.303	0.123	-0.830
HANDS2*[≥ 1000 Cows]	-0.102	0.150	0.088	-0.023	0.323	1.702
Quality Premium*Experience (p value = 0.460)						
QUALPREM1*[< 10 years]	0.231	0.053	0.105	-0.151	0.258	0.512
QUALPREM1*[10-30 years]	0.202	0.024	0.089	-0.150	0.198	0.272
QUALPREM1*[> 30 years]	0.100	-0.078	0.097	-0.267	0.112	-0.803
QUALPREM2*[< 10 years]	0.072	0.123	0.109	-0.091	0.337	1.123
QUALPREM2*[10-30 years]	-0.145	-0.095	0.092	-0.276	0.086	-1.031
QUALPREM2*[> 30 years]	-0.078	-0.028	0.090	-0.204	0.149	-0.306
QUALPREM3*[< 10 years]	-0.303	-0.176	0.097	-0.366	0.014	-1.812
QUALPREM3*[10-30 years]	-0.056	0.071	0.097	-0.118	0.260	0.735
QUALPREM3*[> 30 years]	-0.022	0.105	0.091	-0.074	0.284	1.152
Hauling Cost Structure*Experience (p value = 0.537)						
HAUL1*[< 10 years]	0.047	0.138	0.107	-0.071	0.347	1.293
HAUL1*[10-30 Years]	-0.209	-0.118	0.092	-0.300	0.063	-1.282
HAUL1*[> 30 years]	-0.110	-0.019	0.089	-0.194	0.156	-0.216
HAUL2*[< 10 years]	-0.113	-0.132	0.094	-0.317	0.053	-1.398
HAUL2*[10-30 Years]	0.148	0.129	0.089	-0.045	0.303	1.452
HAUL2*[> 30 years]	0.022	0.003	0.104	-0.202	0.208	0.028
HAUL3*[< 10 years]	0.066	-0.006	0.090	-0.182	0.171	-0.064
HAUL3*[10-30 Years]	0.061	-0.011	0.096	-0.198	0.177	-0.111
HAUL3*[> 30 years]	0.088	0.016	0.090	-0.159	0.192	0.183
Hauling Cost Structure (p value = 0.562)						
HAUL1	-0.091	-0.091	0.097	-0.281	0.099	-0.937
HAUL2	0.019	0.019	0.101	-0.180	0.218	0.186
HAUL3	0.072	0.072	0.085	-0.095	0.239	0.845
Hauling Cost Structure*Education (p value = 0.570)						
HAUL1*[< 13 Years Education]	-0.134	-0.044	0.103	-0.245	0.158	-0.424
HAUL1*[13-16 Years Education]	-0.029	0.062	0.101	-0.136	0.261	0.613

Attribute Level	Marginal Utility	Parameter Estimate	Standard Error	CI Lower 95%	CI Upper 95%	t-Value
HAUL1*[> 16 Years Education]	-0.109	-0.019	0.118	-0.249	0.212	-0.157
HAUL2*[< 13 Years Education]	-0.027	-0.046	0.109	-0.260	0.168	-0.419
HAUL2*[13-16 Years Education]	0.081	0.062	0.107	-0.147	0.272	0.583
HAUL2*[> 16 Years Education]	0.002	-0.017	0.123	-0.258	0.224	-0.135
HAUL3*[< 13 Years Education]	0.161	0.089	0.087	-0.081	0.260	1.028
HAUL3*[13-16 Years Education]	-0.052	-0.124	0.088	-0.297	0.048	-1.416
HAUL3*[> 16 Years Education]	0.107	0.035	0.123	-0.207	0.277	0.285
Quality Premium*Herd Size (p value = 0.633)						
QUALPREM1*[< 100 Cows]	0.065	-0.113	0.101	-0.310	0.085	-1.119
QUALPREM1*[100-499 Cows]	0.143	-0.035	0.102	-0.235	0.165	-0.339
QUALPREM1*[500-999 Cows]	0.386	0.208	0.142	-0.071	0.487	1.463
QUALPREM1*[≥ 1000 Cows]	0.117	-0.061	0.104	-0.265	0.144	-0.583
QUALPREM2*[< 100 Cows]	0.075	0.125	0.102	-0.076	0.325	1.219
QUALPREM2*[100-499 Cows]	0.039	0.089	0.105	-0.117	0.294	0.847
QUALPREM2*[500-999 Cows]	-0.185	-0.135	0.146	-0.421	0.152	-0.921
QUALPREM2*[≥ 1000 Cows]	-0.129	-0.079	0.127	-0.327	0.169	-0.623
QUALPREM3*[< 100 Cows]	-0.140	-0.012	0.144	-0.295	0.271	-0.084
QUALPREM3*[100-499 Cows]	-0.182	-0.054	0.105	-0.259	0.151	-0.519
QUALPREM3*[500-999 Cows]	-0.201	-0.073	0.143	-0.353	0.206	-0.515
QUALPREM3*[≥ 1000 Cows]	0.012	0.140	0.126	-0.107	0.387	1.109

Note: CI = Confidence Interval for Conditional Logit Model.

Table B3. Interaction Effects Model Results, Hierarchical Bayes Adjusted, in Order of Importance and Statistical Significance (*N*=2,400)

Attribute Level	Marginal Utility	Posterior Mean	CI Lower 95%	CI Upper 95%
Gross Handler Pay Price				
PRICE1	-1.151	-1.151	-1.501	-0.835
PRICE2	-0.482	-0.482	-0.882	-0.114
PRICE3	-0.052	-0.052	-0.417	0.340
PRICE4	0.458	0.458	0.147	0.847
PRICE5	1.227	1.227		
Volume Premium*Herd Size				
VOLPREM1*[< 100 Cows]	-0.944	-0.865	-1.424	-0.368
VOLPREM1*[100-499 Cows]	-0.408	-0.329	-0.860	0.274
VOLPREM1*[500-999 Cows]	0.387	0.467	-0.479	1.245
VOLPREM1*[≥ 1000 Cows]	0.647	0.726		
VOLPREM2*[< 100 Cows]	-0.001	-0.529	-1.010	0.016
VOLPREM2*[100-499 Cows]	0.389	-0.139	-0.915	0.621
VOLPREM2*[500-999 Cows]	0.675	0.147	-0.960	1.146
VOLPREM2*[≥ 1000 Cows]	1.050	0.522		
VOLPREM3*[< 100 Cows]	0.945	1.393		
VOLPREM3*[100-499 Cows]	0.020	0.468		
VOLPREM3*[500-999 Cows]	-1.062	-0.614		
VOLPREM3*[≥ 1000 Cows]	-1.696	-1.248		
Handler Business Structure				
HANDS1	0.570	0.570	0.207	1.020
HANDS2	-0.570	-0.570		
Hauling Cost Structure*Herd Size				
HAUL1*[< 100 Cows]	-0.092	0.034	-0.499	0.517
HAUL1*[100-499 Cows]	-0.035	0.091	-0.501	0.912
HAUL1*[500-999 Cows]	0.276	0.402	-0.360	1.137
HAUL1*[≥ 1000 Cows]	-0.652	-0.526	-0.175	0.845
HAUL2*[< 100 Cows]	0.081	0.314	-0.232	0.851
HAUL2*[100-499 Cows]	0.045	0.277	-1.076	0.270
HAUL2*[500-999 Cows]	-0.582	-0.349		
HAUL2*[≥ 1000 Cows]	-0.476	-0.243		
HAUL3*[< 100 Cows]	0.011	-0.348		
HAUL3*[100-499 Cows]	-0.010	-0.368		
HAUL3*[500-999 Cows]	0.306	-0.053		
HAUL3*[≥ 1000 Cows]	1.128	0.769		
Quality Premium*Education				
QUALPREM1*[< 13 Years Education]	-0.173	-0.462	-0.998	0.298
QUALPREM1*[13-16 Years Education]	0.821	0.532	-0.173	1.065
QUALPREM1*[> 16 Years Education]	0.218	-0.070		
QUALPREM2*[< 13 Years Education]	0.055	0.293	-0.309	0.999
QUALPREM2*[13-16 Years Education]	0.108	0.346	-0.363	0.944
QUALPREM2*[> 16 Years Education]	-0.877	-0.639		

Attribute Level	Marginal Utility	Posterior Mean	CI Lower 95%	CI Upper 95%
QUALPREM3*[< 13 Years Education]	0.118	0.169		
QUALPREM3*[13-16 Years Education]	-0.929	-0.878		
QUALPREM3*[> 16 Years Education]	0.659	0.709		
Volume Premium*Experience				
VOLPREM1*[< 10 years]	0.132	0.211	-0.306	0.833
VOLPREM1*[10-30 years]	-0.249	-0.169	-0.670	0.344
VOLPREM1*[> 30 years]	-0.122	-0.042		
VOLPREM2*[< 10 years]	1.046	0.518	-0.233	1.171
VOLPREM2*[10-30 years]	0.255	-0.274	-0.710	0.213
VOLPREM2*[> 30 years]	0.283	-0.245		
VOLPREM3*[< 10 years]	-1.178	-0.730		
VOLPREM3*[10-30 years]	-0.006	0.443		
VOLPREM3*[> 30 years]	-0.161	0.287		
Handler Business Structure*Education				
HANDS1*[< 13 Years Education]	0.413	-0.157	-0.665	0.407
HANDS1*[13-16 Years Education]	0.676	0.106	-0.439	0.576
HANDS1*[> 16 Years Education]	0.621	0.051		
HANDS2*[< 13 Years Education]	-0.413	0.157		
HANDS2*[13-16 Years Education]	-0.676	-0.106		
HANDS2*[> 16 Years Education]	-0.621	-0.051		
Handler Business Structure*Experience				
HANDS1*[< 10 years]	0.268	-0.302	-0.838	0.207
HANDS1*[10-30 years]	0.632	0.062	-0.374	0.571
HANDS1*[> 30 years]	0.810	0.240		
HANDS2*[< 10 years]	-0.268	0.302		
HANDS2*[10-30 years]	-0.632	-0.062		
HANDS2*[> 30 years]	-0.810	-0.240		
Quality Premiums				
QUALPREM1	0.289	0.289	-0.168	0.814
QUALPREM2	-0.238	-0.238	-0.700	0.308
QUALPREM3	-0.051	-0.051		
Volume Premium*Education				
VOLPREM1*[< 13 Years Education]	0.192	0.271	-0.218	0.835
VOLPREM1*[13-16 Years Education]	0.101	0.181	-0.461	0.751
VOLPREM1*[> 16 Years Education]	-0.532	-0.452		
VOLPREM2*[< 13 Years Education]	0.274	-0.255	-0.821	0.224
VOLPREM2*[13-16 Years Education]	0.245	-0.283	-0.889	0.328
VOLPREM2*[> 16 Years Education]	1.066	1.514		
VOLPREM3*[< 13 Years Education]	-0.465	-0.017		
VOLPREM3*[13-16 Years Education]	-0.346	0.102		
VOLPREM3*[> 16 Years Education]	-0.534	-0.086		
Volume Premiums				
VOLPREM1	-0.080	-0.080	-0.637	0.392
VOLPREM2	0.528	0.528	0.150	0.882

Attribute Level	Marginal Utility	Posterior Mean	CI Lower 95%	CI Upper 95%
VOLPREM3	-0.448	-0.448		
Handler Business Structure*Herd Size				
HANDS1*[< 100 Cows]	0.616	0.046	-0.503	0.524
HANDS1*[100-499 Cows]	0.341	-0.229	-0.811	0.500
HANDS1*[500-999 Cows]	1.053	0.483	-0.281	1.114
HANDS1*[≥ 1000 Cows]	0.271	-0.300		
HANDS2*[< 100 Cows]	-0.616	-0.046		
HANDS2*[100-499 Cows]	-0.341	0.229		
HANDS2*[500-999 Cows]	-1.053	-0.483		
HANDS2*[≥ 1000 Cows]	-0.271	0.300		
Quality Premium*Experience				
QUALPREM1*[< 10 years]	0.526	0.237	-0.255	0.816
QUALPREM1*[10-30 years]	0.244	-0.044	-0.431	0.293
QUALPREM1*[> 30 years]	0.096	-0.193		
QUALPREM2*[< 10 years]	-0.215	0.023	-0.453	0.496
QUALPREM2*[10-30 years]	-0.405	-0.167	-0.548	0.228
QUALPREM2*[> 30 years]	-0.094	0.144		
QUALPREM3*[< 10 years]	-0.312	-0.261		
QUALPREM3*[10-30 years]	0.160	0.211		
QUALPREM3*[> 30 years]	-0.001	0.050		
Hauling Cost Structure*Experience				
HAUL1*[< 10 years]	-0.033	0.093	-0.430	0.546
HAUL1*[10-30 Years]	-0.244	-0.118	-0.680	0.459
HAUL1*[> 30 years]	-0.101	0.025		
HAUL2*[< 10 years]	-0.381	-0.148	-0.771	0.543
HAUL2*[10-30 Years]	-0.038	0.194	-0.334	0.676
HAUL2*[> 30 years]	-0.279	-0.046		
HAUL3*[< 10 years]	0.414	0.055		
HAUL3*[10-30 Years]	0.282	-0.077		
HAUL3*[> 30 years]	0.380	0.021		
Hauling Cost Structure				
HAUL1	-0.126	-0.126	-0.677	0.464
HAUL2	-0.233	-0.233	-0.689	0.215
HAUL3	0.359	0.359		
Hauling Cost Structure*Education				
HAUL1*[< 13 Years Education]	-0.118	0.008	-0.642	0.544
HAUL1*[13-16 Years Education]	0.265	0.391	-0.239	0.977
HAUL1*[> 16 Years Education]	-0.525	-0.399		
HAUL2*[< 13 Years Education]	-0.130	0.103	-0.551	0.790
HAUL2*[13-16 Years Education]	0.091	0.323	-0.253	0.843
HAUL2*[> 16 Years Education]	-0.659	-0.426		
HAUL3*[< 13 Years Education]	0.248	-0.111		
HAUL3*[13-16 Years Education]	-0.356	-0.714		
HAUL3*[> 16 Years Education]	1.184	0.825		

Attribute Level	Marginal Utility	Posterior Mean	CI Lower 95%	CI Upper 95%
Quality Premium*Herd Size				
QUALPREM1*[< 100 Cows]	0.331	0.042	-0.543	0.594
QUALPREM1*[100-499 Cows]	0.245	-0.044	-0.646	0.715
QUALPREM1*[500-999 Cows]	0.435	0.146	-0.731	0.916
QUALPREM1*[≥ 1000 Cows]	0.145	-0.144		
QUALPREM2*[< 100 Cows]	-0.172	0.066	-0.476	0.589
QUALPREM2*[100-499 Cows]	0.151	0.389	-0.292	1.107
QUALPREM2*[500-999 Cows]	-0.903	-0.666	-1.355	0.072
QUALPREM2*[≥ 1000 Cows]	-0.027	0.211		
QUALPREM3*[< 100 Cows]	-0.159	-0.108		
QUALPREM3*[100-499 Cows]	-0.396	-0.345		
QUALPREM3*[500-999 Cows]	0.469	0.520		
QUALPREM3*[≥ 1000 Cows]	-0.118	-0.067		

Note, CI = Credible Interval for Hierarchical Bayes (HB) models. Posterior means estimated using 10,000 iterations. HB models including multiple interaction terms are much more sensitive across the iterative process thereby limiting the ability to obtain CI ranges for all variables. It does not impact the impact the estimation of marginal utility values or posterior means. Statistical significance can be approximated by evaluating the confidence intervals within the conditional logit results (Table B2), while recalling the interpretation of significance for "middle category" attributes as discussed in the text.

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