ASSESSING THE VALUE OF AGRICULTURAL 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 signifies their continued ability to provide value within saturated and competitive markets. Increased bargaining power, stable access to markets, and reduced transaction costs are defining features thought to bring the most value to member-owners. Despite the economic importance of agricultural cooperatives, research testing the quantitative worth of cooperative membership is limited. This study takes the abstract market dynamics of the dairy industry to define the current state of member ownership in dairy marketing cooperatives. Discrete choice analysis approaches are deployed to estimate preference through willingness-to-pay and marginal utility values surrounding cooperative membership and associated milk handler pricing structures. The inclusion of demographic filters allows for the analysis of preferences conditional to specific population subsets. A group of 218 farmers were presented with offers for their milk from hypothetical handlers. Within each offer, price level and handler characteristic attributes were randomly assigned to represent dynamics in the dairy industry. These attributes included premium offerings such as quality and volume, the structure of the handler (cooperative or independent), hauling deductions, and the gross handler pay price of milk[1]. Results suggest that dairy farmers, on aggregate, are willing to accept lower per hundredweight compensation to remain cooperative members. Furthermore, handler business type is an important factor in farmer level satisfaction with significant preference for the cooperative business level. Estimated partworth utilities also suggest dairy farmers actively consider the industry wide impacts within milk pricing related decisions. The inclusion of demographic markers highlights trends important to understanding heterogeneous interests across U.S. dairy farmers while informing improved cooperative governance strategies to address these trends.

BIOGRAPHICAL SKETCH

Daniel Matthew Munch was raised in the coastal New England town of East Lyme, Connecticut. In close proximity to mixed-livestock farm, Cranberry Meadow Farm, Daniel became active in local agriculture through the New London County 4-H extension network in association with the local Grassy Hill Bears and Feathers & Hide 4-H Clubs. Daniel received his Bachelor's of Science in Livestock Management & Policy and Resource Economics from the University of Connecticut in 2018. On completion of his undergraduate degree, Daniel, had the opportunity to intern within the U.S. House of Representatives for Congressman Joe Courtney and work on domestic agricultural and dairy policy initiatives and projects. Daniel spent the summer of 2019 as a marketing, credit, and financial services intern within Farm Credit East, ACA, assisting with market research projects and legislative issues. In 2018, Daniel was admitted into the Masters of Science program in Cornell University's Dyson School of Applied Economics & Management with a concentration in Agricultural and Food Economics. He worked alongside Dr. Todd Schmit and Roberta Severson as a graduate research assistant analyzing agricultural cooperative membership dynamics within the U.S. dairy industry.

Dedicated to my parents: Stacy Luccioni-Munch and Matthew Munch, grandparents: Dolores Munch, Josephine Gerbacia, George Gerbacia, and Joseph Luccioni, other family members, and friends for their unconditional support.

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CHAPTER 1
Introduction

Cooperative organizations have maintained relevance and even demonstrated dominance in significant sectors of the modern-day business environment. These organizations traditionally have been 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). Control is generally expressed in the allocation of democratic voting rights, by the one-member one-vote rule (most common) or based on the level a member-owner utilizes the products or services offered by the cooperative firm (Hansmann, 1996). For example, in the case of a dairy marketing cooperative, voting rights may be based on the volume of milk supplied and marketed through the firm. The right to residual earnings resides in the combination of capital equity requirements set forth by a cooperative to its members and the respective level of use each member exercises (Bijman, 2002). Capital equity requirements support business development and infrastructure costs vital to operate the services offered by the cooperative firm. Based on these factors, a cooperative may distribute net earnings in the form of patronage refunds (based on use) or dividends (based on equity) to its member-owners, although the former is more commonly utilized. The goal of the cooperative business is designed to further the collective economic well-being of its member-owners (Bijman, 2002). The choice of an individual to become a member-owner of a cooperative is therefore dependent on the perceived belief that cooperative membership will result in an economically preferable outcome to alternative operational strategies.

Prices offered to dairy farmers for their milk are dependent on numerous production and market conditions. Milk, as an agricultural commodity, possesses unique qualities not frequently found in other commodity goods. It is a “flow-commodity” in that it is produced on a daily basis, is highly perishable, and therefore requires transport at least every other day (USDA, 2001). Dairy cows produce milk regardless of changes in market conditions. During short-run periods of low demand, milk supply cannot be reduced rapidly enough to match that low demand. Milk must be marketed irrespective of supply and demand behavior expressed on a specific day. Seasonality in both the production and demand for milk and milk products also contributes to volatile price and supply rates. Traditionally, milk supply is higher in the spring and early summer when fresh forage is easily accessible and lower in the fall and winter.

Shifts in consumer preferences toward dairy products further complicates demand dynamics. Since 1975, per capita fluid milk consumption in the United States has decreased by over 40%, from 247 to 146 pounds per year, while cheese consumption (not including American and cottage cheese) has risen 368% from 6.1 to 22.5 pounds of cheese per year (USDA, 2019). Concerns revolving around perceived sustainability, worker rights, and animal welfare issues have pushed the development of several non-dairy substitutes.

Through technological advancements and economies of scale, farmers have drastically increased milk production per cow over the last 50 years. Even from 2009 to 2018, production per cow increased 13%, the average number of milk cows increased 2%, and total milk production increased by 15% (USDA, 2018). During the same period, farm-level milk prices fluctuated greatly. In the state of New York, for example, average farm-level prices peaked at $27.3 per hundredweight (cwt) in September 2014 and then dropped to $15.8/cwt in May 2016, over a 40% drop in less than two years (USDA, 2018). As of November 2019, the New York State all-milk price was $20.50/cwt. Given the extreme volatility in price and demand for dairy products, along with a positive trend in overall milk production, oversupply conditions have resulted at different times. The capacity for handlers and processors to market milk is ultimately limited in the short-run. The combination of low prices, reduced demand, and higher competition for marketing contracts creates high financial uncertainty among farmers and, in many cases, unsustainable net margins. USDA reported the loss of 2,731 licensed dairy farms in 2018, a drop of 6.8% nationally (Dickrell, 2019). Tactics to hedge against price volatility and establish market access are highly sought-after for farmers to remain financially afloat. The structure of many dairy marketing cooperatives is designed to provide some form of these protections.

According to the 2017 Census of Agriculture, dairy marketing cooperatives handle around 85% of the milk produced by U.S. producers (GAO, 2019). In 1997, this percentage was over twenty percentage points lower at 61%. Consolidation within the dairy industry has also reduced the total number of existing marketing cooperatives. In 1964, there were 1,244 active dairy marketing cooperatives; by 2017, that number had reduced by 91% to 118 (GAO, 2019). As the name implies, members of a marketing cooperative benefit through the many marketing services the firm provides, most of which can be more efficiently implemented on a level beyond the capabilities of an individual farm (Bijman, 2002). In the case of a dairy marketing cooperative, this includes the collection and processing of raw dairy ingredients and any actions leading up to and beyond the sale of the products. Packaging, advertising, brand development, gathering and processing the information needed to carry out a transaction, negotiating contracts, and policing and enforcing said contracts can all be part of a marketing cooperative's responsibilities (Staatz, 1987).

Contractual responsibilities and costs associated with acquiring sales are commonly referred to broadly as transaction costs. In many cases, dairy marketing cooperatives have also assumed expanded operational responsibilities for procurement and distribution of member milk and dairy products 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 (ERS, 2001). Balancing began as a technique that allowed milk handlers to match organizations who have more product than they need with organizations who don't have enough. Dairy products such as cheese, powder, and butter are more shelf stable and thus have expanded storage opportunities not shared by highly perishable fluid milk. Coordinating the manufacture and shipment of milk into more stable products based on current supply dynamics 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 cooperative handlers, on the other hand, agree to market all milk produced by their members. Cooperative handlers came to dominate the field of balancing milk supply from this commitment to market all milk- streamlining the coordination of milk supply allocation across markets.

The dairy marketing cooperative is, as all other forms of cooperatives, collectively owned and governed by its members. This user-oriented structure relates to the agreement that the dairy marketing cooperative must accept and be responsible for the sale of all milk members produce, regardless of existing market conditions. Access to a secure market provides significant stability for producers of an economically volatile commodity. The ability for farmers to organize under the structure of a cooperative increases market power exertion capabilities. Market power provides various bargaining-type benefits especially those concerning contractual business proceedings and public policy-making. Representation of member interests can take place in the form of participation in federal rule-making efforts that influence dairy pricing support policies and legal protections. Representation can also take the form of receiving more competitive prices from retailers or consumers based on supply control and brand strength.

Representation and democratic governance principles are also 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. Farmer-members then hold the obligation to exercise continued control over their cooperatives through voting for directors and 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). Though not an exhaustive list of properties that define a dairy marketing cooperative, the described features introduce operational factors that provide value to farmer-members. Prior literature and established economic theory suggests these defining features vary in importance when farmers ultimately make the decision to deliver their product through a cooperative or independent handler. The following literature review explores these concepts further.

Literature Review

The dynamics between a buyer of a good or service and a seller or provider of a good or service, such as a dairy farmer and their milk handler, is a form of transactional relationship. As defined by Sykuta and Cook (2001), a transactional relationship is made up of three distinct economic components: the allocation of value, the allocation of uncertainty, and the allocation of property rights. Within this relationship, value is addressed via the delivery of the product and distribution of associated gains, uncertainty is addressed via the assumption of risk such as financial risk, and property rights are allocated via decision making freedoms as defined by the contract (Sykuta and Cook, 2001). Transaction costs consist of any cost associated with maintaining this relationship (Staatz, 1987).

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). According to Ketokivi and Mahoney (2017), TCE intends to address how transactions should be governed and structured to minimize waste. 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). For example, vertical integration within a firm is considered an economically preferable approach to minimizing transaction costs versus complex, recurring contracts between additional external buyers and sellers (Ketokivi and Mahoney, 2017).

Hansmann (1996) explains the existence of different business forms, such as cooperatives and investor owned firms (IOFs), by evaluating ownership costs faced by the patrons (transaction costs). Hansmann describes that farmers generally face higher transaction costs because they are likely to encounter information asymmetries with bargaining partners and have limited market power when compared to these partners. Based on TCE principles, farmers can achieve economic benefits under a cooperative business structure. Under uncertainty, costs of renegotiating contracts increase with the level of uncertainty surrounding an external agreement and reduces effective governance capabilities by a singular individual. Having market access organized through the cooperative reduces uncertainty as the need for farmers 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 - decreasing operational costs of decision making (Staatz, 1987; Williamson, 1981). More specialized, non-member employees are hired in a cooperative to deal with matters outside the scope of a producer-members' expertise and includes managing aspects of transactional processes. A cooperative structure, however, has the potential for high transaction costs if characteristics of heterogeneous members, diverse strategic goals, and high resource consumption are present (Nilsson, 1996).

According to Hernández-Espallardo et al. (2012), a farmer's perceived notion of reduced transaction costs and firm efficiency is vital to maintaining cooperative membership. Farmers commonly express the belief that, independently, they have very little control over the price of their products. If farmers trust that cooperative membership provides a level of protection over this price vulnerability they are likely to remain in the organization. Additionally, they found that perceived reduced transaction costs and the associated perception of organizational efficiency were superior factors in determining member satisfaction in a cooperative than the price ultimately received (Hernández-Espallardo et al. 2012).

Farmer's place more satisfaction in their cooperative membership as their confidence in the firm's structural efficiency grows. Preference for reduced transaction costs and operational efficiency may stem from the importance of family farming in western agriculture (Valentinov, 2007). TCE implies that traditional hierarchical organizations are not sustainable in agricultural production due to supervision and monitoring complications. Family farms take advantage of kinship-based loyalty to reduce the need of complex and expensive employment systems. All family members have some stake in the assets of the farm and therefore are incentivized and interested to promote efficiency of production on their own. The use of significant personal relationships as labor and to promote business growth results in reduced transaction costs being incurred (Valentinov, 2007). The combination of unique characteristics that define cooperative businesses complement those of farms in a manner that minimizes incurred transactional costs, establishes market access, and creates satisfaction through perceived or realized efficiency gains.

In agriculture, cooperatives tend to succeed more commonly through implications of asset fixity. Under the asset fixity principle, as assets are made more specialized for particular uses, individual-governing market contracting becomes less efficient at distributing them (Williamson 1981). For instance, milking equipment and milking cows are highly specialized; they cannot produce alternate types of product. Therefore, a dairy farmer is forced to accept the prices offered by a downstream processor in the existing market as they cannot easily shift their investment in dairy production to other forms of production. Based on asset fixity, farmers autonomously selling their milk are more likely to experience reduced revenue based on opportunistic buyers. The ability for these 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) Farmer-members have no incentive to behave opportunistically toward their own cooperative as distributed income is dependent on their personal level of use and the cumulative success of the firm. External IOFs, however, are forced to treat members of a cooperative association equally through existing supply control powers of the association. Pooling of assets within specialized production industries creates barriers against inherent market risk. This is important as price and production volatility in agricultural production is often high and unpredictable.

A cooperative’s ability to utilize pooling provides some level of insured revenue protection and stabilized price offerings to their members (Staatz, 1987). A member who experiences unexpected low milk production one year, perhaps due to bovine disease, can still benefit from the collective resources of the cooperative depending on individual cooperative-level policies concerning retained earnings and patronage payments. Agricultural production’s dependence on nature limits farmers’ ability to forecast, organize, and plan: a complication reduced by the cushion of the cooperative’s structure (Schmitt, 1993). Staatz also argues that farmer-members benefit from increased retainment of farm income in rural areas. IOFs often extract value from areas of high agricultural production and shift it to urban financial centers. Cooperatives counteract this trend by providing net returns to investor-owners- allowing more wealth to remain local and near the source of production supply (Staatz, 1987). Both Hannsman (1996) and Staatz (1987) imply that the organizational benefits of cooperatives are inherently sector specific and most applicable to the various complex attributes that define agriculture.

Considering the factors that prove cooperative business advantageous to the farmer, many stem from the business structure's reliance on vertical integration principles. The cooperative provides member-owners an extension of control power over additional components of the supply chain (Bijman, 2002). Opportunistic behaviors of downstream players is 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 heavily reduced. These forces are likely the reason for increased consolidation in the agricultural and food sectors (Bijmaan, 2002). Integration, however, between members and a cooperative is only partial as farmers still maintain control of their independent farm operations. 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). Heterogeneous interests often become more prevalent and costly the longer a cooperative progresses in its life cycle (Cook, 1996).

Governance responsibilities, such as voting on the Board of Directors (BoD) may also provide member's 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 CEO. The BoD exercises control through its hiring 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 (i.e., 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 a member participates in transactional behavior with their cooperative contributes to the level of interest and stake they have in monitoring its efficiency (Chaddad & Iliopoulos, 2012).

Heterogeneity in member interests and transactionary participation increases the cost associated with collective decision making blurring the lines of defined property rights. Cooperatives experiencing disagreements between member-owners and increased uncertainty often result in implementing corporate managerial models to establish more efficient monitoring mechanisms. 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 & Iliopoulos, 2012).

According to Huffman and Royer (1997), agricultural cooperatives have experienced benefits through their amicable relationships with public policy makers. Cooperatives have been considered "procompetitive forces" that increase general economic welfare through their practices of offering their members' services at cost. In doing so, cooperatives force other, profit-maximizing firms to behave more competitively in a concept coined, "the competitive yardstick effect," (Huffman & Royer, 1997). The effectiveness of a cooperative's presence to promote competitive forces is thought to be associated with its individual policies around membership (i.e., only cooperatives with open membership policies exert competitive yardstick pressures). This favorable public policy status has proven valuable in the existence for legal protections for the cooperative model; e.g., limited antitrust exemptions and single-taxation principles.

Numerous studies have been conducted to isolate which of the discussed benefits of the cooperative business model is of the most value to farmers. Alho (2015) uses heterogeneity in Finnish producer organization structures to pinpoint membership drivers within contemporary cooperative systems. Responses from a survey of Finnish milk and meat producers were analyzed under marketing, supply, and hybrid cooperative types. Meat producers were commonly involved with *hybrid-IOF-like cooperatives* while dairy producers operated in a more traditional manner. In Finland, producer cooperatives represent the traditional cooperative structure (equal treatment of members, equal voting rights, and retained equity). Stated preference methods were utilized for examining 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. Cooperative membership was also found to bring strong business "continuity" to its members through the obligation to collect all agricultural production. Possibilities to expand, regional proximity, and competitive producer price also ranked high among dairy and meat producers. Community values, business decision making participation, and governance ranked among the least important to producer members and that aspects related to bargaining power and control benefits may be losing their relative importance overtime- especially in vertically-integrated/hybrid systems (Alho, 2015).

Bravo-Ureta and Lee (1988) surveyed over 500 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. However, cooperative membership was not found to statistically influence farm-level technical efficiency. Using a logit regression, they found that regional location and the number of extension contacts were positively related to cooperative membership, while output per cow and farm size were negatively related. Demographic characteristics, such as age and education, had little influence on membership status (Bravo-Ureta & Lee, 1988).

Similarly, Jensen (1990) assessed the important factors related to dairy farmers in Tennessee in joining marketing cooperatives. Their respondent pool ($N = 265$) 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 indicated 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, followed by 41% due to more friendly personnel.

Research Objectives

Since the completion of these two studies in the United States, the demographics of dairy cooperatives have changed greatly. Likewise, characteristics positively or negatively related to cooperative membership may have shifted. Overall, these studies stand in alignment with Alho (2015) and confirm that access to a stable and guaranteed market for product has been a leading cause for cooperative membership over the past 40 years. However, none evaluated the value of those characteristics (in dollar terms) in making their marketing decision to join a cooperative. To what extent, for example, does (longer run) market access cover potential (short run) price gains from noncompetitive behavior? In addition, none consider quality-related pricing attributes of the milk they market nor price changes relative to overall market conditions.

To our knowledge, only Roe, Sporleder, & Belleville (2004) estimate the value of cooperative relative to non-cooperative buyers vis-à-vis a stated preference design experiment to calculate producer preferences for contract attributes within the U.S. hog industry. Attributes included organizational structure of the contract issuer (cooperative, feed company, or packing company), base price formula, price floor and ceiling, quality premium schedule, contract length, minimum volume requirements, and ledger provisions. All respondents (N = 371) were asked to state their preference over a single choice set of two hypothetical contracts, of which one contract always included a cooperative issuer. A probit model was employed to measure the probability that a respondent would choose one contract over the other. Results suggested that respondents are more likely to choose contracts offered by a cooperative than a feed or packing company, and that hog growers would be willing to accept a \$0.94/cwt and \$0.57/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. Self-reported levels of trust in contract issuer organizational structures also found that the more important trust was to a producer the stronger the preference for cooperative contracts. This result was more significant among smaller producers than larger producers.

This research contributes to the literature on dairy pricing and cooperative value in three distinct yet complementary ways. First, following the general approach of Roe, Sporleder, & Belleville (2004), we develop and administer a discrete choice experiment (DCE) to U.S. dairy producers regarding their preferences for milk pricing attributes post the establishment of federal and state milk marketing order minimum prices. 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 factors specific to milk markets, we more accurately estimate the value of ownership within dairy marketing cooperatives. In addition, we improve on the experimental design of Roe, Sporleder, & Belleville (2004) by utilizing a Balanced Overlap fractional factorial experimental design. Instead of displaying one choice set (one decision) to each participant, participants are shown six different choice sets to create the optimal variation across attributes needed to elicit a range in choice responses. Each farmer is given the opportunity to express multiple preferences based on alternating attribute levels. As described by Louviere *et. al.* (1994) this approach expands the ability to more efficiently estimate choice model parameters (partworth utilities). Additionally, Firth Bayes adjusted estimates and Hierarchical Bayes methods are employed to reduce bias and incorporate subject level covariates into maximum likelihood functions responsible for generating reliable estimates. Hierarchical Bayes methods require multiple decisions per respondent.

Second, the chosen set of attributes assess both preferences and values for individual farm activities and attention to market-based conditions. For example, quality attribute values reflect not only the value to processing for efficiency gains, but the cost of individual farmers in meeting higher quality levels. Volume attributes include the consideration of premium payments conditional on overall market conditions to align market value of additional product (higher with growing relative demand) with payments to producers to appropriately incentivize a production increase. Finally, using demographic data of dairy farm respondents, explicit consideration is provided regarding cooperative ownership and governance implications under heterogeneous membership conditions. Preference trends between demographically similar farmer groups can be used to inform better cooperative management methodologies and to minimize the hindering effects of heterogeneous interests. Understanding the ultimate values of alternative payment designs provides important information to cooperative boards of directors in assessing milk payment structures that maximize collective benefit.

We continue now with some background discussion of U.S. milk pricing structures and recent trends in milk premium structures in NYS, differentiated by type of handler (Chapter 2). The conceptual background and empirical methodology follows (Chapter 3), along with a description of the data collected from the conjoint experiment (Chapter 4). Empirical results are discussed in Chapter 5 and we conclude with a discussion of the implications of the results and directions for future research.

CHAPTER 2
Milk Pricing Structures & Trends

Understanding the fundamentals of U.S. milk pricing behavior, structures, and contracts was necessary in informing the selection of attributes and structural design of the survey. The discussion below does so generally for the United States, and more specifically to New York State where historical data were available in assessing the composition of milk premiums and hauling costs differentiated by type of handler (cooperative or independent).

U.S. Milk Pricing Structures

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 its production, unique features of milk as a commodity, such as its perishability, introduces added considerations to market dynamics and equilibria to its production. Government and public policy has also played an integral role in the establishment and continued changes to how milk is priced and how distribution is organized regionally. The existence of government systems and supports, along with the cooperation of nongovernment organizations, allows consumers to get the milk they desire while providing economic returns to support dairy producers.

When considering milk prices, one must become accustomed to the multitude of prices defined by government institutions. These include, but are not limited to: milk support price, all milk-price, minimum Class prices defined under federal or state marketing orders (MOs), wholesale prices, and retail prices. Public programs that contribute to the calculation and monitoring of these prices include federal and state milk marketing programs, federal price supports, import restrictions, and export subsidies. Of these programs, federal and state MOs play a fundamental role in the orderly sale and movement of milk between producers and consumers. Orders accomplish this goal by setting minimum raw, fluid-grade milk prices that handlers must pay to dairy farmers. However, since cooperative handlers are owned by their farmer-supplier-members, cooperative handlers are allowed to pay their members less than stated order minimum 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 numerous classes of milk, defined by the final product or intent of use of the milk sold (i.e., Class 1= fluid milk beverages; Class 2= soft products such as ice cream and yogurt, Class 3= hard cheese products, and Class 4= butter and dry powdered milk products). The price producers receive for their milk is not a combination of the independent class prices of their milk but a "blend" price or weighted average of class prices based on the regional utilization of milk in each market. MO's pool the value of milk in their specified region to allow producers to 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 & Crop, 2008).

Currently there are 11 federal MOs and an array of state MOs with jurisdiction where federal marketing orders do not exist. Within the pooling phase of MO pricing, two schemes: multiple component pricing and skim-fat pricing, exist. Skim-fat pricing is limited to the Appalachian, Arizona, Florida, and Southeast federal MO's, and relies on higher valuation of Class 1 and II skim and fat due to regional utilization differentials. Orders that use component pricing value handlers based on their utilization on three or four distinct milk components: butterfat, protein, other solids, and, occasionally, non-fat solids. The producer value is then calculated using the USDA-AMS announced prices of the components within the pool plus any Class I and II producer price differentials. The difference between the component value and handler value divided by the total number of pounds in the pool establishes the basis of the equity (shared) payment from the pool known as Producer Price Differential (PPD). Combined, the component values and PPD represent the minimum base price producers can receive from handlers. MOs govern the fact that handlers and processors each pay a different price for their milk, depending on the end-product they are producing, while producers receive an average-blended price based on the use of milk within an order. Existing pricing legislation provides cooperative organizations with the ability to be more flexible in retuning the announced blend price to their members. By taking advantage of voting rights through an order referenda, cooperatives may re-blend milk receipts across markets they operate in (Jesse & Johnson, 1985).

Milk checks received by farmers vary from the base value determined by monthly MO calculations. Various pricing premiums and cost deductions exist depending on competitive offerings from a 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 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). Handlers offer price advantages to farmers who work to reduce somatic cell and bacteria counts, incentivizing high quality milk production. Quality premiums provide producers a method to increase marginal profits on their farms and often significantly impact the price of milk they receive. Defined calculations of quality premiums differ from handler to handler but generally rely on raw milk quality test brackets (i.e. SCC < 200,000/ml). Handlers may set multiple quality compliance brackets with corresponding per cwt price advantages to increasingly reward producers who reach the strictest levels. Farmers may choose to invest in equipment or livestock management improvements that reduce the presence of unwanted microbes if they believe the investment will provide net positive returns through received quality premium gains (Ruegg, 2011).

Volume premiums are another common form of price incentive offered to milk producers. Though less common 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 an associated per cwt payment. Some handlers use hauling subsidies or fixed hauling charges in lieu of volume premium payments. Numerous other premiums exist such as protein premiums, marketing or competitive premiums, premiums for organic or kosher production, and rBST free premiums. How these premiums are defined, set, and reported varies greatly from handler to handler. In the case of cooperatives, patronage refunds may be included in a producer's milk check.

Milk price deductions and marketing expenses impact the bottom line paid from handlers to farmers. Like premiums, deductions can be diverse in number and definition depending on the characteristics of each individual handler. Hauling charges (including stop charges) makeup the most significant proportion of the total deductions reported and account for all associated costs with delivery and movement of milk (fuel, trucks, maintenance, drivers, etc.). 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. Additionally, 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.

Premium Structures and Trends in New York State

The New York State Department of Agriculture and Markets (NYAM) Division of Milk Control and Dairy Services collects handler-level pricing data from both cooperative and independent handlers. To provide context to the concepts presented above, a descriptive analysis of this data was conducted, while also serving as a base to the experimental design that follows later.

Payment Report

Handler-level data were collected from NYAM on the pricing of farm milk for calendar years 2000 through 2017. NYAM regularly uses such data to publish dairy statistics and an overview of the dairy industry within the state (NYAM, 2018). Beyond general statistics, such reporting provides valuable information on more detail-specific areas including receipts of milk and dairy products and payments to dairy farmers. For the purposes of this study, the data are used to present trends in premium structures, patronage payments, and dairy farmer cooperative memberships.

Data are collected via monthly Payment Reports (Schedule G) to track payments made directly to dairy farmers from all milk handlers operating in the state. Additionally, the report is used by dairy cooperative associations to report payments made to member farmers when milk may be received by another dealer. These requirements are described in the guidelines listed in part 1 (General) of the Payment Report:

a. A Payment Report must be completed and filed for each plant and bulk tank unit where milk is received from dairy farmers and the reporting dealer pays the farmer directly.

b. Cooperatives must file a Payment Report covering their member's milk that is delivered to a plant or bulk tank unit operated by the cooperative.

c. Cooperatives must also file a Payment Report covering their member's milk that is delivered to a plant or bulk tank which is operated by another dealer.

Figure 1 illustrates the Payment Report. Line items are filled out at the discretion of handlers with little formal definition provided by NYAM. Without formal definitions of line item categories, it is likely that procedural methods in how handlers report values vary. Such inconsistencies limit the ability to verify the origin of specific milk price values and may impact cumulative trends. Fortunately, it is expected that individual handlers will report information in a consistent manner over time, which provides some stability to collected information. It is NYAM's policy to take handlers at their word as long as they report all payments and deductions made to farmers.

According to NYAM, line item G0006 (total PPD) is reported by handlers in a method different from what is defined by MOs. Handlers are aware of the component pricing values for butterfat, protein, and other solids (G0041, G0045, and G0005) based on federal MOs. They are also aware of how much they paid producers in gross value excluding premiums (G0007). Therefore, for convenience, most handlers subtract component values from G0007 to get their cumulative PPD value paid to all farmers.

One section of the payment report that deserves further clarification are line items G0925 (RBST FREE), G0930 (Other), and G0920 (Competitive) within G0009 (special premiums paid this month). NYAM has clarified that former two sections are "catch-all" categories for any premium that does not fall under the four categories of G0095 (volume), G0010 (protein), G0015 (quality), and G0020 (competitive).

DIS 423 PR (1/07)

STATE OF NEW YORK
DEPARTMENT OF AGRICULTURE & MARKETS
DIVISION OF DAIRY INDUSTRY SERVICES
I0B AIRLINE DRIVE, ALBANY, NY 12235

P A Y M E N T   R E P O R T

For Month of:

This report properly prepared and signed must be submitted to the above address not later than the 28th day following the month to which the report applies.
If you have any questions, please call (518) 457-3169.

SCHEDULE G - ALL PAYMENTS MADE DIRECTLY TO NEW YORK DAIRY FARMERS THIS MONTH

Line	For Milk Receipts Reported in Line 9998, Schedule A of Your Plant Report Form DIS 423 or Schedule R of Your BTU Report		
G0002	Number of New York Dairy Farmers -		
G0003	Pounds of Milk -		
G0004	Butterfat Test ___.___ ___ ___	Protein Test ___.___ ___ ___	Other Solids Test ___.___ ___ ___
G0041	Pounds of Butterfat	Butterfat Price $	Butterfat Value $
G0045	Pounds of Protein	Protein Price $	Protein Value $
G0005	Pounds of Other Solids	Other Solids Price $	Other Solids Value $
G0006	Total Producer Price Differential Value -		$
G0007	Total Gross Value of Milk (Exclusive of Special Premiums) - - - - - - - - - - - - - - - - - -		$
G0008	Average price (Exclusive of Special Premiums) (Line 0007 divided by Line 0003 then multiplied by 100)		$ ___ ___.___ ___ ___
G0009	Special Premiums Paid This Month:	(Total G0905 through G0930) - - -	$.
	G0905 Volume $ ______________	G0920 Competitive $ ________________	
	G0910 Protein $ ______________	G0925 **RBST FREE** $ ________________	
	G0915 Quality $ ______________	G0930 Other $ ________________	Identify: ____________
G0010	Cooperative Associations Report Cash Dividends Paid This Month. - - - - -		$.
G1010	Adjustment for Cooperative Forward Contract Agreement		$
G0011	Gross Value of Milk(INCLUDING SPECIAL PREMIUMS & COOP. DIVIDENDS)		$.
	Deductions from Gross Value: POUNDS	(If different from line 3)	AMOUNT
G0012	Hauling (Include stop charges)		$ ___________._____
G0013	Coop. dues		$ ___________._____
G0014	Milk Promotion (Both N.D.B. & Local)		$ ___________._____
G0015	Coop. Equity Payments		$ ___________._____
G1505	C.C.C. Assessment		$ ___________._____
G1510	Federal Order Marketing Services		$ ___________._____
G0016	Other (Identify)		$ ___________._____
	NOTE: Do not include advance payments, 3rd party assignments, insurance, supplies, loans & similar items.		
G0017	Total Deductions -		$.
G0018	Net Value of Dairy Farmers Milk (Line G0011 minus Line G0017) - - - -		$.

I hereby certify that the information in this report is correct to the best of my knowledge.

Signature of Person Preparing Report: | Title: | Date:

PLEASE PRINT NAME OF PERSON TO CONTACT ABOUT THIS REPORT | Phone No:

Figure 1. Schedule G Payment Report (NYAM, 2018).

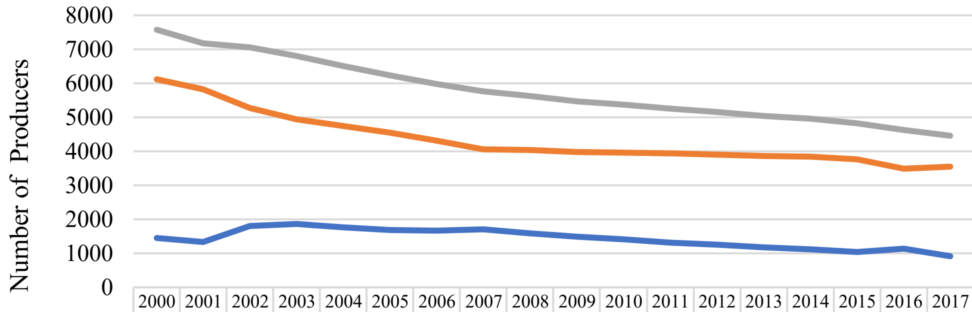
Over the last 5-10 years, NYAM has attempted to focus G0930 (Other) on premiums paid for organic/kosher attributes and shifted G0925 to rBST free premiums. However, handlers still place other types of premiums in these categories. Many of these “other” premiums reported in G0930 and G0925 are handler specific such as signup/contract premiums, other somatic cell premiums, seasonal premiums, technical assistance premiums, cost plus adjustments, and transportation credits. Handlers are asked to identify these “other” premiums but often default to writing “other” to encompass the wide range of premiums paid.

G0920 (Competitive) premiums also has a loose definition from the perspective of NYAM, but generally refers to any premium provided to producers as an incentive to continue to sell to a specific handler (i.e., to make a handler’s pricing more “competitive”). These premiums are often referred to under the alternate title of “marketing” premiums and depend on the flexibility of a handler’s operating expenses. Competitive premiums can be considered benefits to suppliers for their continued loyalty. Often unreported on their own, competitive premiums are thought to be included in certain base price figures, possibly contributing to unexplained variations within a MO region. Patronage refunds are not considered a form of competitive premium. The complexity and sheer number of premium types across handlers and cooperatives provides a unique challenge to understanding their structure and implication to producer interests.

Line item G0010 (cooperative associations report cash dividends paid this month) is expected to represent patronage or payments made to cooperative members given an association decides to distribute a proportion of their annual profits. Historically, NYAM had handlers report monthly equivalents of this value. In the last five years NYAM has ceased collection of monthly cash dividend statistics and instead collects data on the annual check (known as the 13th check) paid to farmers. A cooperative's decision to pay members an annual patronage dividend payment based on profitability is a distinguishing factor from independent handlers.

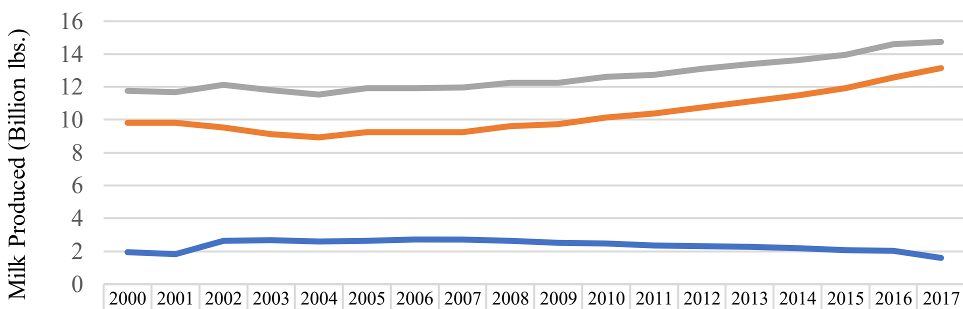
Regardless of likely inconsistencies in handler reporting, data collected through required monthly Payment Reports provide a rare and reputable source to analyze baseline compensation variations between dairy farmers that are members of cooperatives and those who are not. Between 2000 and 2017, an average of 75.8% of NYS producers were identified as a member of a dairy cooperative association (hereafter referred to as cooperative producers), the balance sell to independent handlers (hereafter referred to as non-cooperative or independent producers). Over the course of the 18-year period, the proportion of cooperative to non-cooperative producers has remained relatively stable with the cooperative proportion increasing by an average of 0.3% annually (Figure 2). Likewise, an average of 81.8% of milk in NYS was produced by cooperative members, implying, at least on average, that the size of farms which sell to cooperatives are only slightly larger than those selling to independent handlers. That said, the proportion of milk produced by cooperative members has increased by an average of 0.4% annually over the 18-year period (Figure 3). Indeed, in 2017 (the last year for which data were currently available), cooperative member-produced milk made up the highest proportion (90.8%) of NYS milk produced within the 2000-2017 timeframe. Figures 2 and 3 match industry norms where the number of producers and total production of milk are inversely related. For the time period evaluated, an average of 186 dairy producers each year left the industry or exited the state.

Figure 4 shows the annual difference in the number of cooperative and non-cooperative producers. Though total number of dairy producers has decreased (Figure 2), Figure 4 suggests that some of change in producer membership is a result of joining or leaving the opposite group.



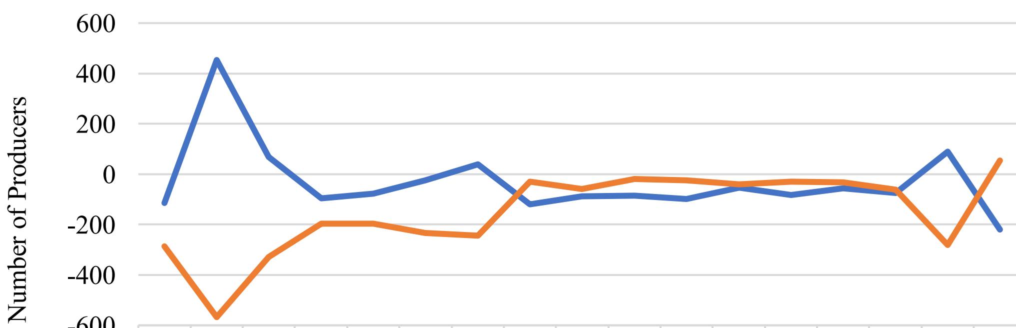
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-Coop Members	1457	1342	1796	1863	1767	1689	1666	1704	1584	1497	1411	1313	1260	1179	1122	1046	1135	915
Coop Members	6119	5833	5265	4937	4741	4545	4311	4068	4038	3979	3959	3933	3894	3865	3834	3771	3490	3544
Total Producers	7576	7175	7061	6800	6508	6234	5977	5771	5622	5475	5370	5246	5154	5044	4955	4817	4624	4459

Figure 2. Number of New York Dairy Producers by Handler Type (NYAM, 2018)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NON-COOP MILK	1.9	1.8	2.6	2.7	2.6	2.7	2.7	2.7	2.6	2.5	2.5	2.3	2.3	2.3	2.2	2.1	2.0	1.6
COOP MILK	9.8	9.8	9.5	9.1	8.9	9.3	9.2	9.2	9.6	9.8	10.1	10.4	10.8	11.1	11.5	11.9	12.6	13.1
TOTAL MILK	11.8	11.7	12.1	11.8	11.5	11.9	11.9	11.9	12.3	12.3	12.6	12.7	13.1	13.4	13.6	14.0	14.6	14.7

Figure 3. New York State Milk Production by Handler Type (NYAM, 2018)



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-Coop Members	-115	454	67	-97	-78	-24	38	-120	-87	-86	-98	-52	-82	-57	-76	89	-220
Coop Members	-287	-568	-329	-196	-196	-234	-243	-29	-59	-20	-26	-39	-29	-31	-62	-282	54

Figure 4. Annual Difference in Number of Producers by Handler Type (NYAM, 2018)

Each increase or decrease in non-cooperative producers is matched with a relatively equal but opposite trend in cooperative producer rates. It is likely that from years 2001-2007 and in 2016 more cooperative members left their organization and became independent producers while in years 2008-2015 and in 2017 more independent producers joined cooperative associations. The overall net change, however, is still negative.

Milk Premium Pricing Analysis

Understanding the conditions that lead to producers' decisions to leave or join a cooperative can be informed by a closer examination of the similarities and differences in their milk pricing structures. Premiums are reported monthly on Payment Report in line section G0009. The available categories include G0095 (volume), G0010 (protein), G0015 (quality), G0020 (competitive), G0925 (rBST free), and G0930 (other). As discussed above, G0025 (rBST free) and G0930 (other) were, until recently, included as "catch-all" categories for all premiums not included in the other four categories.

Figure 5 illustrates the total premiums paid to producers by cooperative and non-cooperative handlers annually from 2000 through 2017, excluding patronage refund payments by cooperative handlers. On average, non-cooperative handlers paid $0.57/cwt while cooperatives paid $0.76/cwt in total premiums. In fact, 2017 is the only year where cooperatives paid less premiums per cwt than non-cooperatives. In performing a difference of means t-test on average annual premiums paid, the p-value is < 0.05, rejecting the null hypothesis and supporting the fact the differences between these two means are, in fact, statistically significant.

Table 1 summarizes the individual and aggregate premiums paid by type of handler. Non-cooperative handlers had lower coefficient of variation (CV) values for five of the six premium categories (all but protein). Additionally, non-cooperative handlers had a lower total premium CV (i.e., 25% versus 38%), implying that farmers selling to independent handlers experienced lower variability in premium payments from year-to-year when compared to cooperatives.

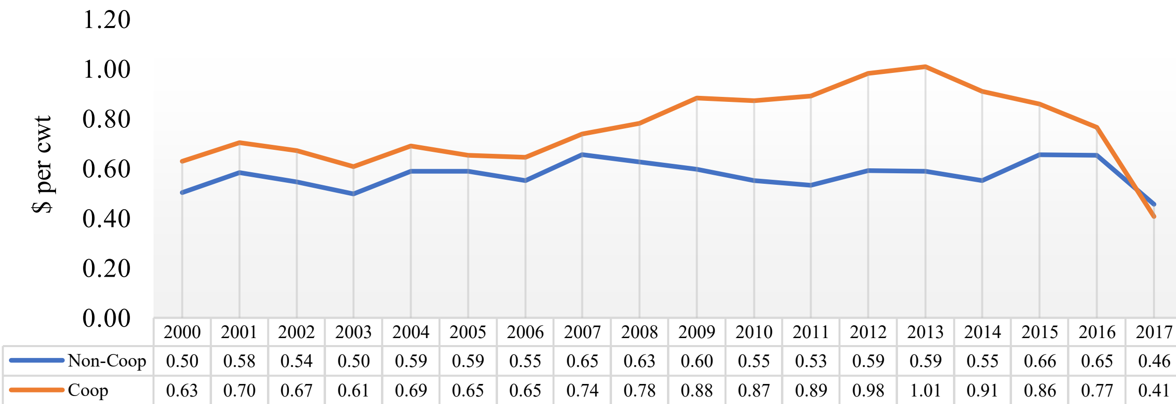


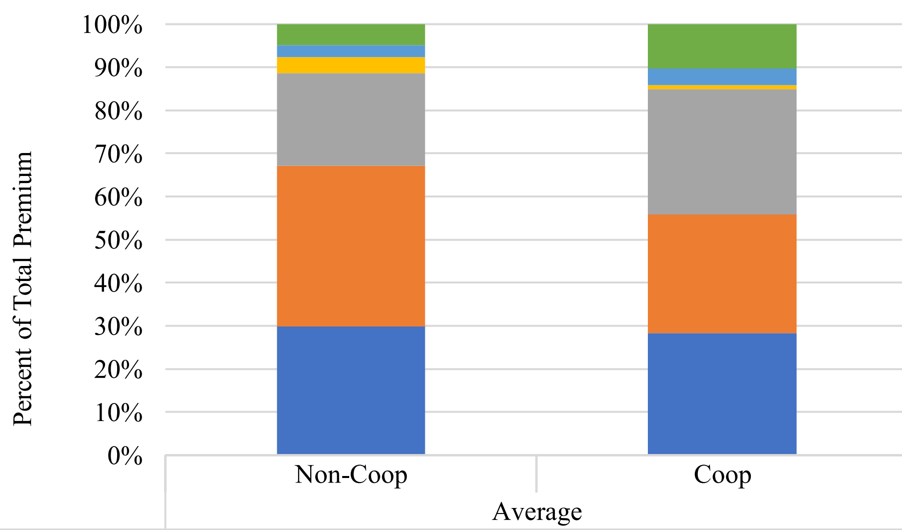
Figure 5. Total Premiums Paid by Handler Type (NYAM, 2018)

Table 1. Average Premium Components by Handler Type (2002-2017)

Premium Component	Mean ($ per cwt)	Standard Deviation	Coefficient of Variation
Cooperative Handler			
Volume	0.22	0.073	34%
Quality	0.21	0.057	27%
Competitive	0.22	0.077	35%
Protein	0.01	0.002	28%
Other incl. rBST Free	0.03	0.032	107%
Other incl. Organic/Kosher	0.08	0.046	60%
Total Premiums	0.76	0.068	38%
Non-Cooperative Handler			
Volume	0.17	0.037	22%
Quality	0.21	0.018	8%
Competitive	0.12	0.036	29%
Protein	0.02	0.024	110%
Other incl. rBST Free	0.02	0.013	79%
Other incl. Organic/Kosher	0.03	0.015	55%
Total Premiums	0.57	0.027	25%

Source: NYAM (2018)

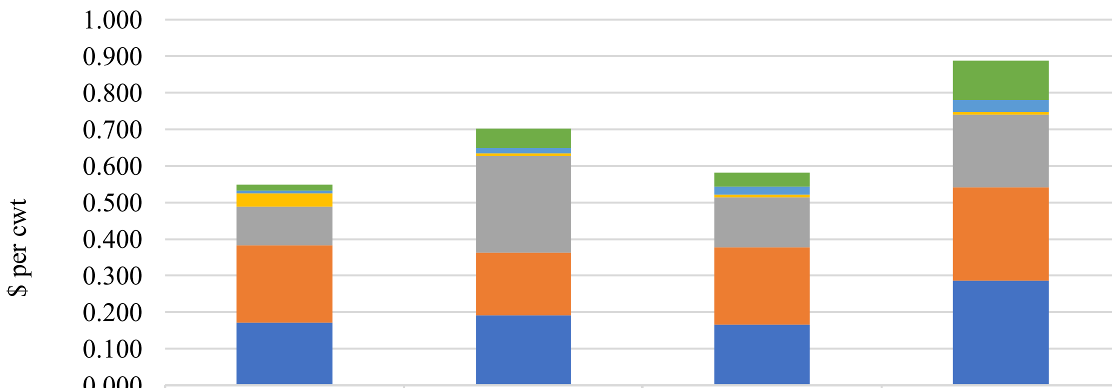
Figure 6 provides premiums paid by handler types based on their relative contributions to the total. Cooperative handers gave higher premiums, on average, for organic/kosher and competitive, while non-cooperative handlers gave higher quality and protein premiums. Notably, quality premiums made up the largest percentage for non-cooperative handlers (37%) while competitive premiums made up the largest percentage for cooperatives (29%). Higher quality premiums need not necessarily imply higher quality milk, but also larger premium rates for similar levels of quality. The higher proportion of competitive premiums offered by cooperative handlers may relate to offering enhanced benefits to member-owners. The user-oriented governance structure may lend itself to increasing payments to producer members who remain loyal to the cooperative.



	Non-Coop	Coop
Other incl. Organic/Kosher	5%	10%
Other incl. rBST	3%	4%
Protein	4%	1%
Competitive	21%	29%
Quality	37%	27%
Volume	30%	28%

Figure 6. Average Premium Composition, Percent of Total, by Handler Type (NYAM, 2018)

It is also useful to consider whether handlers alter their premium structures to changes in market conditions. A crude, but effective, way to consider this is in the comparison of premium structures during high price (i.e., relatively high demand to supply) and low price (i.e., relatively low demand to supply) years (Figure 7).[1] Overall, both cooperative and non-cooperative handlers gave higher total premiums during high milk price years, but the differential varied considerably. Specifically, non-cooperative handlers increased average total premiums in high price years by only $0.03/cwt while cooperative handlers paid an additional $0.18/cwt relative to low price years. This suggests cooperatives may be quicker to respond to higher (lower) demand years through raising (reducing) premiums beyond what is indicated by MO minimum price changes, and perhaps influenced by differences in governance policies between the two groups.



	AVG LOW Non-Coop	AVG LOW Coop	AVG HIGH Non-Coop	AVG HIGH Coop
Organic/Kosher	0.016	0.053	0.039	0.106
rBST	0.008	0.015	0.021	0.034
Protein	0.037	0.007	0.007	0.007
Competitive	0.106	0.265	0.138	0.199
Quality	0.211	0.171	0.211	0.256
Volume	0.171	0.191	0.166	0.285

Figure 7. Average Premium Composition, High versus Low Price Years, by Handler Type (NYAM, 2018)

[1] The highest (lowest) years for the total milk price were defined by being at least one standard deviation above (below) the mean federal MO statistical price between 2000 and 2017. Years 2002, 2003, 2006, and 2009 were allocated as low-price-years, while 2007, 2011, 2013, and 2014 were allocated as high-price-years.

Considering these recent trends, and assuming that demographic characteristics of the farm suppliers are similar, cooperative handlers in NYS tend to provide more monetary value to producers through premiums than non-cooperatives. Paying higher premiums may be a relevant incentive for producers to join cooperative associations. Pricing behavior within specific premium categories could appeal differently to farmers with varying production characteristics. Additional Payment Report data provide information on other aspects of milk pricing to help determine the impact premium structures have on the final net value of milk to farmers.

Patronage Dividends

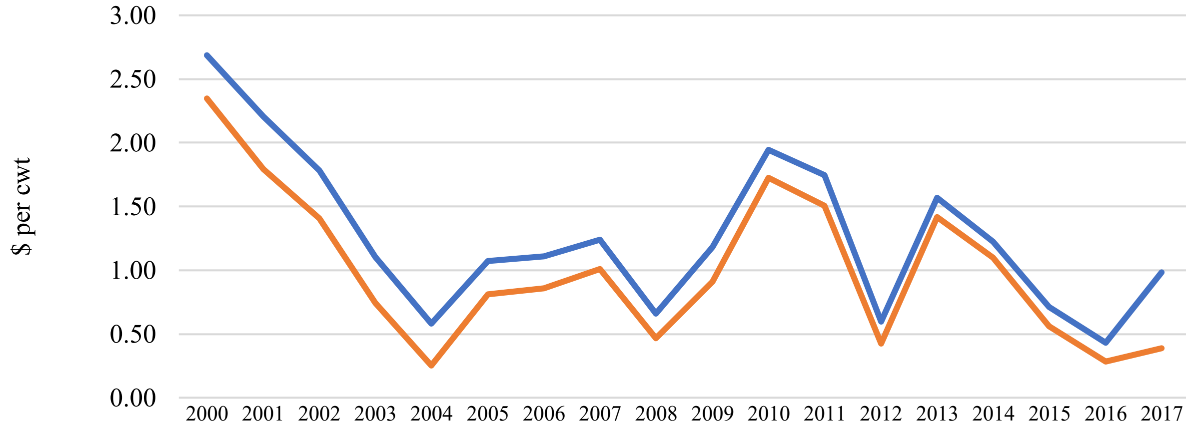
Since the collection of monthly cash dividend data by NYAM ended, patronage refunds have been recorded annually through the reporting of the "13th check." Over the 18-year period, over $223 million have been paid to NYS dairy producers through patronage payments with an average of $0.12/cwt paid annually. Adding the $0.12/cwt to the composite total of premiums paid by cooperative handlers increases the difference between average annual total premium payments, to $0.31/cwt more for cooperative handlers; i.e., $0.57 for non-cooperative handlers versus $0.88 for cooperative handlers, including patronage refunds. This extra income source for producers would appear to make the decision between cooperative and non-cooperative membership obvious. Any strategy that would provide a milk producer an average of $0.31/cwt more than independent handlers is a clear economic advantage. That said, premiums and patronage are not the only components that make up the net value of milk. Base component pricing (butterfat, protein, and other solids), producer price differentials (PPD), and deductions must also be considered.

Base Component Pricing & Producer Price Differential

The pricing of base components in milk (butterfat, protein, and other solids) is set based on minimum prices regulated by the relevant MOs (in the case of NYS, both federal and state MOs are contained within its boundaries). This means, regardless of being a member of a cooperative or not, the price received for these components is equal. Because western NY is regulated by a state MO, there may be some variation in prices when compared to federally determined rates. Further, differences in the location of farm suppliers between handler types offers an additional source of variation. That said, the average total component price for both cooperative and non-cooperative handlers was $15.65/cwt between 2000 and 2017, and reached a maximum at $23.51/cwt in 2014. The role federal and state policy play in the pricing of milk components creates a baseline price that handlers must enhance through premiums to best appeal to producers.

Like base component pricing, producer price differentials (PPD) are meant to be set by federal or state orders. MOs calculates the PPD each month after all the details of milk receipts and utilization have been reported. However, on NYAM Payment Reports, handlers tend compute their PPD as a residual term. As described above, handlers are aware of component pricing values for butterfat, protein, and other solids and are also aware of how much they paid producers in gross value excluding premiums. Therefore, for convenience, most handlers subtract component values from the gross price to calculate their cumulative PPD value paid to farmer suppliers. Since payment reports are cumulative summaries of all milk paid to a handler’s producer base, this simplified approach is acceptable to NYAM.

Figure 8 shows the average PPD/cwt paid by cooperative and non-cooperative handlers annually between 2000 and 2017. Non-cooperative handlers reported an average annual PPD $0.30/cwt higher than that for cooperative handlers (i.e., $1.30 versus $1.00). It is unclear why non-cooperative handlers would be reporting higher PPD’s when per producer payments are based on federally determined values, but differences in the number and location of farmers between the two groups likely has some impact (e.g., pooled under the federal or state MO).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-Coop	2.69	2.20	1.78	1.11	0.58	1.07	1.11	1.24	0.66	1.18	1.95	1.74	0.60	1.57	1.23	0.71	0.43	0.98
Coop	2.35	1.79	1.41	0.74	0.25	0.81	0.86	1.01	0.47	0.91	1.73	1.51	0.43	1.42	1.10	0.56	0.29	0.39

Figure 8. Average Producer Price Differential by Handler Type (NYAM, 2018)

When component prices (butterfat, protein, and other solids) are combined with PPD, premiums, and patronage refunds, the value is defined as the gross value of milk (line item G011 on the Payment Report). Per Payment Report data, component prices are equal between cooperatives and non-cooperatives, PPD payments are $0.30 higher for non-cooperatives, and premium payments (including patronage) are $0.31 higher for cooperatives. This results in a gross value of milk that is nearly identical equal between cooperative and non-cooperative handlers (i.e., $17.50 and $17.49, respectively), providing some evidence to relatively competitive markets between handlers, and similar gross price offers to farm suppliers.

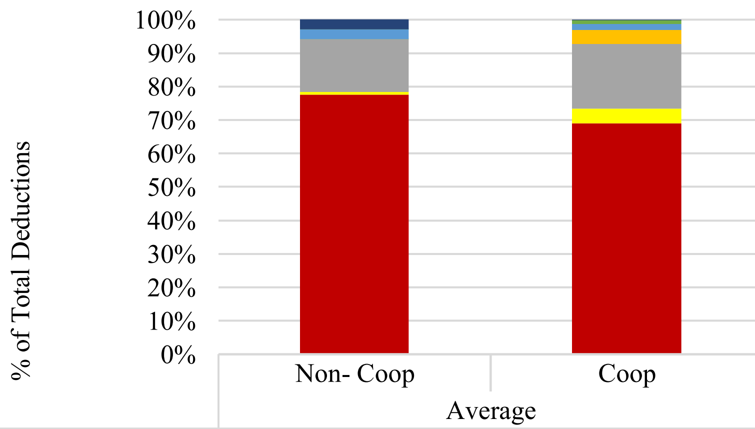
Deductions

To calculate the net value of dairy farmer's milk, handlers must also include marketing cost deductions on their Payment Reports. Seven different marketing expense categories are included: hauling, cooperative dues, milk promotion, cooperative equity payments, Commodity Credit Corporation (CCC) assessments, federal order marketing services, and a category for other. Table 2 summarizes the individual and aggregate deduction values by type of handler, while the relative composition of total deductions is illustrated in Figure 9.

Table 2. Average Deduction Components by Handler Type (2002-2017)

Deduction Component	Mean ($ per cwt)	Standard Deviation	Coefficient of Variation
Cooperative Handler			
Hauling	0.53	0.062	12%
Dues	0.03	0.014	41%
Milk Promotion	0.15	0.002	1%
Cooperative Equity Payments	0.03	0.009	28%
Other Deductions	0.01	0.021	132%
CCC Assessment	0.01	0.008	69%
Federal Order Marketing Services	0.00	0.001	49%
Total Deductions	0.76	0.088	11%
Non-Cooperative Handler			
Hauling	0.74	0.043	6%
Dues	0.01	0.004	56%
Milk Promotion	0.15	0.008	5%
Cooperative Equity Payments	0.00	0.001	232%
Other Deductions	0.03	0.054	198%
CCC Assessment	0.00	0.000	201%
Federal Order Marketing Services	0.03	0.004	15%
Total Deductions	0.96	0.064	7%

Source: NYAM (2018)



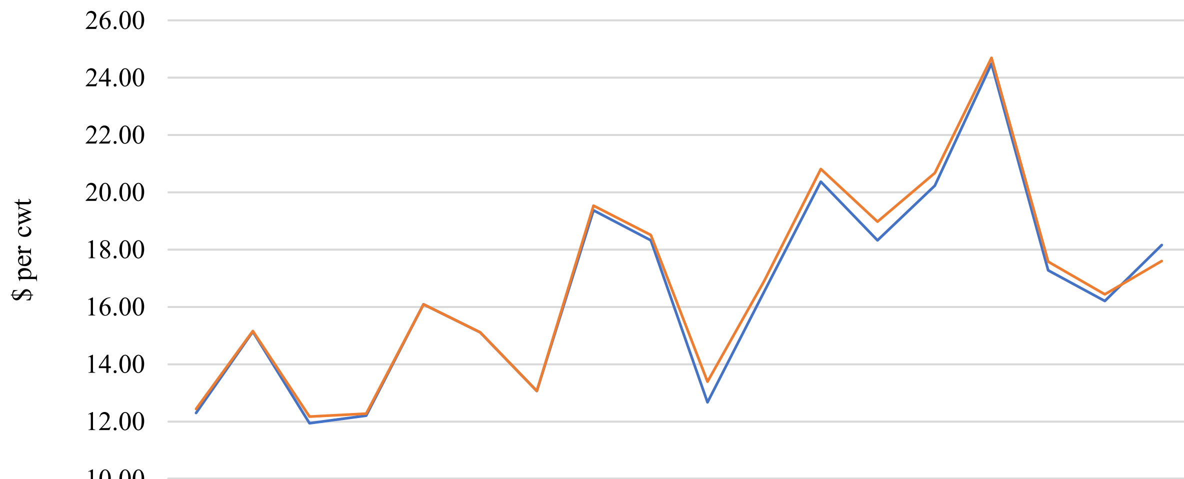
	Non- Coop	Coop
Federal Order Marketing Services	3%	0%
CCC Assesment	0%	1%
Other Deductions	3%	2%
Coop Equity Payments	0%	4%
Milk Promotion	16%	19%
Coop Dues	1%	4%
Hauling	78%	69%

Figure 9. Average Deduction Composition, Percent of Total, by Handler (NYAM, 2018)

Cooperative handlers averaged $0.76/cwt in deductions while non-cooperative handlers averaged $0.95/cwt. This $0.19 difference is largely explained by higher hauling costs (the largest category by far for either handler group) paid by non-cooperative handlers ($0.74 versus $0.53 per cwt). While some anecdotal evidence suggests that cooperative handlers "subsidize" the cost of hauling for their members, if true, this would simply result in a reduction in patronage refunds received, such that the full cost of hauling is still reflected in the net value of milk to members after patronage refunds are accounted for, albeit with some distributional implications.[2]

A lower level of deductions (on average) for cooperative handlers suggests that cooperatives may hold an advantage in minimizing marketing expenses for their members over independent handlers. However, to the degree that cooperative members are more geographically proximate to each other and to processing facilities (relative to those for independent handlers), lower hauling costs per cwt would result. Line item G0018 of the Payment Report subtracts total deductions from the gross value of milk to calculate the net value of dairy farmer's milk (inclusive of patronage refunds). In total, cooperatives had an average net value of $16.74/cwt compared to $16.54/cwt for non-cooperative handlers. Average net values by year are illustrated in Figure 10, whereby years for which cooperative values are higher correspond to relatively stronger market years and likely reflect higher than average patronage refund payments.

[2] Note, milk promotion costs are identical regardless of handler and are based on federal ($0.05) and state ($0.10) check off assessments.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-Coop	12.29	15.12	11.94	12.21	16.09	15.11	13.05	19.37	18.32	12.67	16.52	20.36	18.31	20.23	24.49	17.26	16.21	18.16
Coop	12.42	15.15	12.17	12.28	16.10	15.11	13.06	19.53	18.51	13.39	16.90	20.81	18.98	20.67	24.69	17.58	16.43	17.60

Figure 10. Net Value of Dairy Farmers' Milk by Handler Type (NYAM, 2018)

Implications

Dairy producers are making conscious decisions on their cooperative association membership status each year. The innate need for these decisions suggests that advantages offered by cooperative business organizations and independent handlers have varied over time. Handler payment reports over the last 18 years suggest that cooperatives, on average, provide a larger price advantage to producers when solely considering premium structures. In years where cooperatives paid substantially higher total premiums, the rate of loss of cooperative producers shrunk while the rate of loss in non-cooperative members increased. It is conceivable that during these years, producers shifted to cooperative handlers to take advantage of higher premiums.

Handler pricing data also revealed that non-cooperative handlers had a lower premium level variation over time. Cooperative organizations, by nature, must balance the financial needs of their members with the financials needs of the organization itself. Therefore, a cooperative association may be more reactive to market changes by more quickly passing on advantageous pricing changes to their member-owners. Cooperatives generally agree to accept and market all milk produced by members without limitation. However, this also then implies that premiums, like volume premiums, could change drastically from year to year depending on production rates, demand, and the fiscal strength of the organization. Such evidence currently exists with respect to a growing implementation of base-excess programs by cooperative handlers. Independent handlers, on the other hand, can be more restrictive on their operational strategy resulting in less variable premium payments over time.

Patronage refunds provides additional price advantages for cooperative members based on the downstream success of cooperative activity post the farm gate, albeit they are not guaranteed and, in some years, could be negative. That said, an added monetary benefit of $0.12/cwt, on average, was found during the time-period evaluated. Deductions were also lower, on average, for cooperative handlers. Since cooperatives are often formed explicitly to provide marketing efficiencies for a group of dairy farmers through pooled resources, lower marketing costs may be a natural result of the organizational model. That said, deduction rates remained relatively stable from 2000 through 2017 for both cooperative and non-cooperatives implying producers are likely not basing member status decisions on these costs.

The cumulative net value of dairy farmer's milk including all base price components, PPD, premiums, patronage, and deductions was, on average, $0.20/cwt higher for cooperative members. This pricing advantage may contribute to an already proportionally high number and growing percentage of NYS dairy farmers that are members of cooperatives. The extent that farmers individually forecast deduction and premium rates, however, is unknown. Whether a producer has the resources to accurately predict future trends in these pricing components would impact the rate at which this information would be used in determining member status. Additionally, considering the entire average net value of milk, $0.20/cwt is a relatively small percentage of around 1% of average farm mailbox prices. Year-to-year base price fluctuations are far more drastic than the average annual monetary benefits experienced by cooperative members. To that end, it is likely that producers may evaluate other structural qualities offered by handlers beyond pricing features when deciding on cooperative membership status. It is known that farmers are likely to prefer cooperative business structures for perceived market access and efficiency gains and the obligation to purchase all milk produced. Other factors like democratic governance, voting for the board of directors, and voice to the direction of an association should also be considered. Nonetheless, the data presented here provide an objective perspective on pricing factors that influence the bottom line of a producer's milk check.

CHAPTER 3
Methods & Experimental Design

Discrete choice experiments (DCEs) are a widely utilized technique to quantify individuals' preferences when provided a distinct set of options (Louviere, Hensher, & Swait, 2000). Commonly referred to as choice sets, participants choose between two or more competing options and indicate the option they prefer. Choice sets are defined using a set of fixed attributes that vary in their levels. Attributes can be of qualitative or quantitative value. Results from DCEs allow the relative importance of each attribute to be assessed. Including a price attribute in a DCEs allows for the valuation of willingness-to-pay or willingness-to-accept attribute levels comparatively in a dollar equivalency.

DCEs have been predominantly used to elicit personal preferences from consumers evaluating products and services, but have also been used to explore producers' preferences when choosing between sellers (Roe, Sporleder, & Belleville, 2004). 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. In economics, this level of perceived benefit or satisfaction is more commonly referred to as utility. 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, & Swait, 2000).

Performing DCEs involves the following steps: (1) identification of attributes and attribute levels, (2) experimental design of the choice sets and survey, (3) sample selection and survey administration, and (4) model and statistical data analysis. Each are described below in the context of the research objectives.

Identification of Attributes & Attribute Levels

To meet our research objectives, thorough research on milk pricing and handler organizational structures was necessary to inform attribute selection and attribute levels. NYAM Payment Report analysis provided a basis for determining which components of milk prices contribute most significantly to the total net value of milk to producers. Combined, quality, volume, and marketing/competitive premiums made up the bulk of total premiums offered by handlers in NYS (i.e., approximately 86% of total premiums paid). Considering deductions, hauling made up the majority of total marketing costs experienced by handlers (i.e., approximately 74% of total deductions levied). Other types of premiums and deductions held much less stake on the overall net value of milk.

Phone and in-person interviews with several cooperative and independent handlers in NYS were also conducted by the research team. Interviews were used to get a better sense of what historical, current, and future premium and hauling structures looked like across organizations. Handler-specific data collected in these interviews is confidential; however, the data was used to establish ranges for attribute levels consistent with industry practices. Handlers were asked a variety of demographic questions including how many dairy farm suppliers were in their pipeline and the average amount of milk produced by the farms in the most recent year. Remaining questions related to specific premium offerings and assembly and transport deductions.

The first major determination from these interviews was that handlers reported paying minimal or no marketing/competitive premiums to their producers- a stark contrast to NYAM Payment Report data where competitive premiums made up of 25% of total premiums paid, on average. Marketing premiums, where they existed, included offering a baseline value for being a member and/or a seasonal premium to incentivize production in the fall.

Quality and volume premiums were much more common and varied across handlers interviewed. Handlers reported offering quality premiums based on SCC (Somatic Cell Count), PLC (Plate Loop Count), LCP (Laboratory Pasteurization Count), and/or other tests examining somatic cell and bacterial contents. Quality premium structures ranged from three to four separate brackets, with each bracket providing an incremental per cwt monetary value based on acceptable thresholds of a bacterial or somatic cell test. Table 3 illustrates two example quality premium structures within the range of collected samples. The higher the threshold of quality reached, as defined by milk test standards, the higher the monetary incentive.

Table 3. Premium Structure Examples

Quality Premium Example 1		**Quality Premium Example 2**	
Description	Value ($/cwt)	Description	Value ($/cwt)
< 200,000 SCC, < 10,000 PLC, < 5 LCP	$0.30	< 300,000 SCC, < 20,000 Raw plate, < 250 LCP	$0.15
< 250,000 SCC, < 10,000 PLC, < 5 LCP	$0.25	< 250,000 SCC, < 15,000 Raw plate, < 200 LCP	$0.30
< 350,000 SCC, < 20,000 PLC, < 5 LCP	$0.15	< 150,000 SCC, < 5,000 Raw plate, < 150 LCP	$0.45
		< 100,000 SCC, < 5,000 Raw plate, < 100 LCP	$0.65
Volume Premium Example 1		**Volume Premium Example 2**	
Description	Value ($/cwt)	Description	Value ($/cwt)
250,000 to 450,000 lbs.	$0.15	Up to 200,000 lbs.	$0.10
450,000 to 650,000 lbs.	$0.25	200,000 to 700,000 lbs.	$0.15
Over 850,000 lbs.	$0.30	Each additional 200,000 lbs.	$0.01
		2,000,000 lb. cap, maximum premium	$0.20

All interviewed handlers reported 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. Most historical volume premium structures resemble that of quality premiums with three to four separate brackets, in this case defined by monthly quantities of milk produced and a corresponding $/cwt value. Some organizations specified a cap at which the volume premium is no longer added. Other handlers utilized a sliding scale volume premium structure that incrementally increases with level of production. In most cases, handlers offered a baseline volume premium to producers regardless of size. Two examples are illustrated in Table 3 As most handlers are currently not offering volume incentives in NYS, there is a clear motivation in our experimental design to connect overall market characteristics with payments of volume premiums. For cooperative handlers, many are considering (or have already implemented) base-excess programs, where a base level of milk is established based on a historical production period that will be priced fully and where milk deliveries in excess of that base receive a discounted price.

Assembly and transportation deduction structures varied across handlers. Some handlers owned their own trucking fleet while others contracted to one or multiple trucking companies. Nearly all trucking companies charge a fee for driving to each farm (i.e., a stop charge) ranging from $8 to $60. In addition, farms were charged a specified per cwt amount ranging from $0.30 to $1.30/cwt. Some handlers reported volume incentives or disincentives through subsidized/reduced or increased trucking costs. Incentives were normally meant to increase production during the fall. Excess volume charges were based on per farm previous year delivery volumes. Other handlers incorporated regional pricing mechanisms based on a farm's or group of farms' distance to the nearest plant. The closer a farm is to a plant, the lower the cost of hauling (reduced deductions). Deductions were reported by all handlers as having a significant impact on farm suppliers.

In designing the choice model, results from handler interviews and Payment Report data were considered. 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. Five attributes were chosen to represent milk pricing structures and form of handler business structure (Table 4).[3]

To represent premium offerings in the marketplace, volume and quality premiums were included, each with three levels. Both premiums significantly contribute to the total percentage of premiums paid to farmers and have important production and economic implications. 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 given market signal to be true. Specifically, if the current minimum order price is equal to or above the previous three-month average price, else no volume premium is paid. This option considers external market conditions such as oversupply driving milk prices down. 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.

Quality premium levels are generic SCC-based brackets that reward farmers for meeting higher thresholds of milk quality via lower SCC (Table 4). All options reward higher quality, but each level compensates farmers differently based on a threshold of strictness. For example, the first level rewards farmers who can achieve <100,000 SCC/ml with $0.50/cwt, <150,000 SCC/ml with $0.40/cwt, and <200,000 SCC/ml with $0.30/cwt. The second level does not offer the strictest level of <100,000 SCC/ml bracket but does offer a higher SCC threshold level for a monetary

[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.

payment. Quality premiums for like brackets across levels pay the same premium but the strictness of the quality eligible for payment varies. 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.

Table 4. 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 rate across all farms supplying milk to handler within a region (as defined by handler) **3.** Farm-specific rate 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

To estimate the value of ownership in dairy marketing cooperatives, the third attribute considers the handler 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 the handler's business will necessarily affect the value of cooperative 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, we assume the marketing cooperative processes member milk into a variety of processed products; e.g., fluid milk, cheese, and yogurt.

Hauling deductions are, by far, the largest deduction for milk producers and where we focus our attention, particularly as numerous cooperative handlers have done varied kinds of hauling studies to determine the most equitable charging mechanisms for their member-owner suppliers. The use of a more complex stop charge and per cwt charge combination was avoided given its wide ranging conditions across handlers interviewed and to reduce DCE fatigue. Instead, hauling structures were more conceptually presented by how costs for transportation and assembly to the handler were allocated across farm suppliers. The first level represents a model where all farm suppliers pay the same per cwt charge, regardless of size or proximity to processing plants; a form common historically with cooperatives where members are relatively homogenous in size and location. The second level is similar to the first however specified to regional delineations where all farms within a given region pay the same per cwt rate, which implies consideration of distance and farm density concentrations in a region. The third level represents a model where farms pay a farm-specific rate that accounts for individual farm location (including proximity to other farms and processing plants) and volume of milk supplied. Each level can be associated with varying levels of interest in how the burden of hauling costs for handlers are shared (or not) across producers. In so doing, the levels so 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 (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. The $19.00-$20.00/cwt range is slightly above the current U.S. all milk price, but is within projected all milk price forecasts for 2020 (USDA, 2019). A Net Handler Pay Price; i.e., Gross Handler Pay Price plus premiums less hauling, is comparable to the mailbox price to farmers.

Experimental Design

Choice options utilized in this DCE represent hypothetical contractual offers from milk handlers. Participants, in this case active dairy farmers from the United States, are asked to choose between two hypothetical offers based on their attitude and preferences related to 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 was utilized to design the experiment and collect the data. Once attributes and levels were chosen, they were coded into the Qualtrics® software to generate the optimal experimental design. Traditional DCE's present between two and four offers to survey respondents per question. To limit cognitive strain, the default settings of two packages per choice set question was used, meaning two hypothetical contractual offers were displayed per question.

DCE can be defined by full profile (FP) or partial profile (PP) designs. Full profile experiments display a level from all attributes included in the study across offers. Partial profile experiments specify attribute levels based on a subset of attributes (Chrzan, 2000). A full profile design was utilized in this experiment, presenting the need for a fractional factorial design plan in the generation of discrete choice questions. In a full factorial design, all main effects and two-way interactions are estimable and uncorrelated. However, full factorial designs are cost-prohibitive and tedious since all subjects would need to provide preferences across all possible offer combinations (i.e., 270 unique offers in our case) so fractional factorial designs are used (Kuhfeld *et al.*, 1994). 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 four separate methods of computer design generation:

1. **Complete Enumeration**. Profiles are made as orthogonal as possible (i.e., each pair of levels appears equally across all pairs of attributes within the design) and all two-way frequencies of level pairings between attributes are equally balanced. This method forces attribute levels to be duplicated as little as possible. This method may require that a very large number of concepts be evaluated to construct each task posing a hefty processing job for computer systems.

2. **Shortcut**. This occurs when profiles are constructed using the least often previously used attribute level for each respondent (considers attributes one-at-a-time). If attribute levels are tied for the smallest number of previous frequencies a selection is made at random. Overlap is limited and each one-way frequency within attributes is balanced.

3. **Random**. This occurs when profiles are constructed randomly and with replacement from the "universe" of all possible profiles and placed into choice sets. Overlap occurs but not between choice sets that are identical across all attributes.

4. **Balanced Overlap**. This method combines aspects from Complete Enumeration and Random, allowing more overlap than complete enumeration but less (approximately one-half as much) than random. Balanced Overlap tracks co-occurrences of all pairs and attribute levels (Chrzan, 2000).

Qualtrics® utilizes the Balanced Overlap method in the formation of its discrete choice experimental designs. Based on this method, the ability to evaluate the wide range of possible choice sets is performed using a much smaller participant pool. Using computer optimization functions present in computer search algorithm's allows Qualtrics® software to assess thousands of potential designs and pick the most efficient (Kuhfeld *et al.*, 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 goodness of an experimental design in DCE (efficiency) can be quantified as a function of the variances and covariance's of the attribute parameter estimates (β). Two common efficiency measures, *A-efficiency* and *D-efficiency* are based on the idea of "average variance." *A-efficiency* is a function of the arithmetic mean of eigenvalues (nonzero vectors that change at most by a scalar factor when that linear transformation is applied to it) which is given by trace$[X'X]_{-1/p}$. *D-efficiency* is a function of the geometric mean of the eigenvalues which is given by $|[X'X]_{-1}|_{1/p}$. In *A-efficiency*, an experimental design is A-optimal if it minimizes the sum of the variances of the regression coefficients. In *D-efficiency*, an experimental design is D-optimal if it minimizes the volume of the joint confidence region for the vector of regression coefficients (Kuhfeld, 2002). Measures of efficiency are scaled on [0, 100]. Efficiencies closer to 100 tend to provide results preferred to that of lower efficiency alternative designs. Efficiency diagnostics were calculated using JMP® by SAS® software based on the experimental design generated by Qualtrics® for our chosen number of attributes, attribute levels, and choice set characteristics. Both efficiencies are above 99% (*A-efficiency* = 99.79% and *D-efficiency* = 99.89%) providing a strong basis of confidence in our empirical results.

The data collected in a DCE is 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-pay or 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® suggested six questions to be evaluated per respondent. In other words, each respondent who submitted a finished survey saw 6 sets of 2 offers within the survey design. Figure 11 provides an example of one choice set question generated through Qualtric's Balanced Overlap fractional factorial randomization technique.

(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

Figure 11. Example Choice Set

Empirical Model

Choice modeling was pioneered by McFadden (1973) and is used to estimate the probability of individuals making a choice from presented alternatives. Choice modeling is also referred to as conjoint choice modeling, discrete choice analysis, and conditional logistic regression. 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. For example, in our case, attribute 1, volume premium, takes on three separate categorical levels that vary between offers (Table 4). These levels and the outcomes that result during respondent selection are not ordered in any natural way. Instead, the outcomes are a choice among distinct qualitative alternatives. 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 (e.g., how large a farmer's milking heard is).

Utility maximization principles are most often utilized to design models to analyze discrete choice data. These principles imply that consumers should spend their limited money income on the goods and services that provide the most marginal utility (satisfaction) per dollar. This is demonstrated in the following utility maximization rule: $MU_x/P_x = MU_y/P_y$, where MU_x is the marginal utility derived from good x, P_x is the price of good x, MU_y is the marginal utility of good y and P_y is the price of good y. The model is generalizable to the condition of consumer purchasers or producer sellers. In the case of this study, farmers (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. Logit regressions are nonlinear regression models specifically designed for binary dependent variables.

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

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

where $X_s = [x_{1s}, \ldots, x_{js}]'$ is the design matrix for choice set s. The stacked Xs matrices provide the design matrix X for the choice study.

JMP choice modeling statistical software was utilized to analyze collected data in this study (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. Conditional logistic models allow for the use of stratification or matching as a means to control cofounding. Unlike simple logistic regressions, choice modeling uses a linear model to model choices based on response attributes and not solely upon subject characteristics.

The analysis that takes place in logistic analysis is a multiple iterative procedure to find the maximum likelihood estimation (MLE) solution for fitting the conditional logistic model to the data. When only the main-effects are estimated, partworths are produced for each attribute level. These partworths can be interpreted as an average utility value for the respondents analyzed. Once the logit analysis converges on a solution, the output is of these generated partworths.

Using MLE techniques for DCE in smaller data sets can cause problems related to separation (in which MLE 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 *et al*., 2019). This is achieved by modifying the score function using a non-informative prior distribution which 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 in default choice modeling.

Like least squares, logistic analysis is reliant on dependencies among attribute levels when all levels are coded into the computational software. One level from each attribute, therefore, is dropped although the results of that attribute level can be obtained by inference from the alternative levels. In JMP choice analysis, the last attribute level is dropped and remaining levels are represented using effect coding. Unlike dummy coding, effect coding, uses more values than just 0 or 1 and allows analysis across other forms of comparisons. The rule in effect coding is that all values within any new attribute must sum to zero (i.e., 0, 1, -1).

Logit analyses are frequently evaluated using Chi Square statistics, a procedure that uses the log likelihood that would be obtained if the estimated effects were all zero given the sample size and characteristics of the data. This log likelihood is then compared to the log likelihood of for the estimates generated. Two times the difference between these two log likelihood quantities are distributed Chi-Square, with degrees of freedom equal to the number of parameters estimated. *p*-values, or the measure of strength and evidence against null hypotheses are generated within the model. An effect summary output utilizes the generated *p*-values plus a transformation adjustment defined as $-\log_{10}(p\text{-value})$ to provide the LogWorth, or relative importance of each attribute in the model.

Researchers conducting consumer choice studies often experience that the conditions necessary to provide accurate estimations are flawed. Respondents may bunch or weigh first choice sets higher and pay less attention as the survey progresses, they may get bored strongly considering each attribute within all choice sets, and overall generally fail to distinguish between preferred attributes as precisely as researchers would prefer. These problems can lead to data discrepancies such as collinearity which results when one predictor variable in a multiple regression model can be predicted from other variables with a high degree of accuracy. Hierarchical Bayesian (HB) estimates can provide relief from many of these problems. HB analysis has provided a way to estimate stable individual choice models (Albert and Chib, 1993). HB models are referred to as *hierarchical* because it models participants' preferences as a function of an-upper level (pooled across responses) model 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 burn-in iteration period. In this case, HB estimates are generated utilizing the underlying MLE estimates of the conditional logit model.

The HB computational process used by JMP software is defined in the 2018 JMP Choice Models Report:

"Within the HB estimation process, participants are assigned a unique vector of parameter estimates, treating estimates as random effects and covariates. This vector is assumed to originate from a multivariate normal distribution with arbitrary mean and covariance matrix. The likelihood function for the utility parameters for a given subject is based on a conditional logit model for each subject's preference within a choice set, given the attributes in the choice set. The prior distribution for a given subject's vector of coefficients is normal with mean equal to zero and a diagonal covariance matrix with the same variance for each subject. The covariance matrix is assumed to come from an inverse Wishart distribution with a scale matrix that is diagonal with equal diagonal entries. For each subject, a number of burn-in iterations at the beginning of the chain is discarded. In JMP, this number is equal to half of the Number of Bayesian Iterations specified on the launch window"

Both the Firth bias adjusted conditional logit approach and Firth bias adjusted Hierarchical Bayes approach were conducted and compared. The former, mirroring the more classical statistical method that involves combining MLEs of the population distribution with the choices made by a single individual. The latter, linking the information about the distribution of coefficients across responses with information about choices made across individuals to obtain individual values (Train, 2009).

CHAPTER 4
Survey Administration & Data

Survey Administration

In addition to the discrete choice component of the survey, three instructional pages were provided at the start of the survey and demographic questions were 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 (See APPENDIX, page 94).[4] For example, the following text was included:

> *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), 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.*

For the purpose of this research, isolating the value of cooperative ownership is of upmost interest. The clarifications above were necessary to better define the rights and responsibilities associated with handler business structure. Recognizing that both types of handlers offer volume efficiency gains and benefits associated with product development and brand association, incentivizes participants to focus on qualities not assumed equal across business types. Further, stipulating that

[4] 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.

expected patronage refunds (not included in the offers) are equal to the annualized value of a member's capital investment reduces the chance that participants include the cost of member investment and potential patronage refunds in making their decision (i.e., they net each other out). Combined, these assumptions shift participant views of handler business structures away from possible monetary benefits and towards factors related to a handler's distinct governance structure and ownership control rights. Instructions on page 2 further clarified handler characteristics to reduce considerations of outside factors not relevant to this study, in particular: (1) *All elements not specified within offers are assumed to be the same*, (2) *All handlers contract for milk hauling services*, and (3) *The sum of hauling costs charged to each farm equals the total costs charged by the transport firm to the handler*.

Demographic questions including farmer age, education level, dairy herd-size, and experience dairy farming (years) were incorporated at end of the survey. These questions allow for subject (interaction) effects to be included in the modeling of utility values. Understanding preferences toward cooperative membership, for example, toward certain volume premium structures may be influenced by these external defining characteristics. Incorporating these factors into the analysis of attribute levels can allow for more advanced interpretation. Implications from the results of this modeling can then be used to better inform governance issues across handler businesses. Premium structures that result in comparably reduced levels of extreme dissatisfaction, between farmers, can correlate to reduced conflict and thus improved management of heterogonous interests across producers, particularly in cooperative businesses.

The study was limited to active dairy farmers in the United States. Before the official online launch, several farmers pre-tested the survey to ensure respondents would understand survey components and to estimate the level of effort necessary to complete it effectively. It was determined that the time needed to complete the survey was between 10 and 15 minutes. 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 disseminate the survey across a number of handler organizations. State farm bureaus, farmer's unions, cooperative industry associations, and dairy related media outlets (e.g., Hoard's Dairyman, Progressive Dairyman) were also utilized to advertise the survey. Between the launch and close of the survey, reminders were sent to all contacts on January14, January 29, and March 5, 2020. The ability for the study to reach individual dairy farmers was limited by advertising costs, the use of an online platform, and time restrictions.

In designing DCEs, consensus on calculating optimal sample sizes is variable across software developers and statisticians. Qualtrics® suggests the Sawtooth Software® equation to calculate a minimum sample size for DCE:

3) $N = (m*c)/(t*a)$,

where N is the minimum sample size, 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. Using this equation with m = 500 provided a minimum sample size of (500*5)/(6*2) or 208 respondents. In our application, 218 completed responses were collected surpassing the minimum sample size suggestion under the large experiment multiplier (Qualtrics, 2020).

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. Response rates across these later questions varied. Questions placed directly after the generated choice sets had slightly higher responses rates than questions on the final pages of the survey. Table 5 summarizes the farm respondent pool over demographic characteristics collected. Survey distributions are compared with national averages based on the 2017 Ag Census, where comparable statistics exist (USDA, 2017).

Demographic Statistics

In total, responses from 24 states were received. Nine of the ten top dairy producing states are represented in the sample (less New Mexico). However, the fourth largest producer, New York, accounted for 40% of the sample, well above the national average. California, on the other hand, produces the most milk and contains the highest inventory of cattle (18.5% of U.S. total) but only accounts for 1.5% of sampled farmers. The use of Cornell University publicity resources and related farmer/industry affiliations (particularly in Wisconsin) favored survey responses from these areas. That said, reported handler type was fairly representative of the national average. Producers selling to independent handlers were slightly oversampled (21% of sample versus 15% nationally). Given our focus on valuing cooperative ownership, this is an appealing result.

Regarding herd size, small dairy farms with less than 100 cows were largely under sampled (40% of sample versus 74% nationally), while larger dairies were oversampled. Considering age, categories representing younger farmers (age < 35 and 35-64) were oversampled while farmers over 65 years old were under sampled. Administration and online/email advertisement of this survey via online platforms were likely a barrier to reaching older farmers.

Table 5. Demographic Statistics of Farm Respondents (N=218)

Demographic	Count	% of Sample	% of U.S.
Farm Location State*	(N=201)		
New York	80	39.8%	6.6%
Wisconsin	42	20.9%	13.7%
Pennsylvania	17	8.5%	5.5%
Ohio	11	5.5%	2.8%
Minnesota	8	4.0%	4.8%
Vermont	7	3.5%	1.4%
Michigan	5	2.5%	4.5%
Texas	4	2.0%	5.7%
Indiana	4	2.0%	2.0%
Virginia	3	1.5%	0.9%
Iowa	3	1.5%	2.3%
California	3	1.5%	18.5%
Tennessee	2	1.0%	0.4%
Georgia	2	1.0%	1.0%
Single respondent states	10	5.0%	9.9%
Handler Structure	(N=209)		
Cooperative	165	78.9%	85.0%
Independent	44	21.1%	15.0%
Dairy Herd Size	(N=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	(n=200)		
High School graduate or less	38	19.0%	NA
Some college, Associate's degree	66	33.0%	NA
Bachelor's degree	81	40.5%	NA
Master's or Doctoral degree	15	7.5%	NA
Years Dairy Farming	(n=203)		
< 10 years	29	14.3%	27.0%
10-30 years (> 10 years Census)	75	36.9%	73.0%
31+ years	99	48.8%	
Age of Primary Owner	(N=203)		
Age < 35	28	14.0%	8.0%
Age 35-64	153	75.0%	58.0%
Age 65+	22	11.0%	34.0%

* Only states with survey responses are listed. Single respondent states include CO, CT, ID, KY, MO, NH, NC, OR, UT, and WA. In total, responses were received from 24 states.
Note, NA = Comparable figure not available (USDA, 2017)

Additional information was collected 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 (Table 6). These questions were asked to better understand a farmer's ability to sell to alternative handler organizations.

Table 6. Handler Selection Characteristics

Characteristic	Count	% of Sample
Number of farms supplying to your handler (N=209)		
Under 250	66	31.6%
Between 250-750	30	14.4%
Over 750	69	33.0%
Not sure	44	21.1%
Opportunity to sell to other handler(s)? (N=209)		
Yes	78	37.3%
No	102	48.8%
Not Sure	29	13.9%
If currently sell to a co-op handler, did you previously sell to an independent handler in the last 10 years? (N=160)		
Yes	29	18.1%
No	131	81.9%
If currently sell to an independent handler, did you previously sell to a co-op handler in the last 10 years? (N=43)		
Yes	10	23.3%
No	33	76.7%

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, nearly 14% were unsure if they could sell to another handler or not. Lack of choice or awareness of choice in choosing a milk handler represents a sizable limitation to producers in handler choice and bargaining power.

Approximately, 33% of participants reported selling to a handler that buys from more than 750 farms, followed by 32% reporting their handler purchases from under 250 farms. and 21% unaware of how many farms their handler purchases from. Of those currently selling to a cooperative or independent handler, around 80% had not sold to a different handler type within the previous 10 years. While some of this surely a reflection of a lack of hander choice in their location, it may also reflect satisfaction with their current handler's operational and pricing practices.

Self-Reported Value of Ownership

Following our research objectives, the DCE design allows us to estimate the value the ownership in a cooperative explicitly. For comparison purposes, at the end of the survey (after choice set selections), we asked respondents to provide a numerical value of their ownership rights in a cooperative and of not having ownership rights, depending on which type of handler they currently sell to (Table 7). 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?"

Table 7. Self-Reported Value of Chosen Handler Business Structure

Farms selling to co-op, value of having ownership (N=115)	
Average ($/cwt)	$1.01
Standard Deviation	$7.57
Minimum	-$1.50
Maximum	$80.00
Farms selling to independent, value of not having ownership (N=28)	
Average ($/cwt)	$0.23
Standard Deviation	$0.43
Minimum	$0.00
Maximum	$2.00

While recognizing these are difficult questions to answer, establishing a baseline self-reported monetary 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 would do well to support or refute that assumption.

The number of respondents that answered this question (it was not required) 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 difficulty of the question and to the DCE 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 (Table 7). 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. Figure 12 displays the frequency and distribution of these self-reported values.

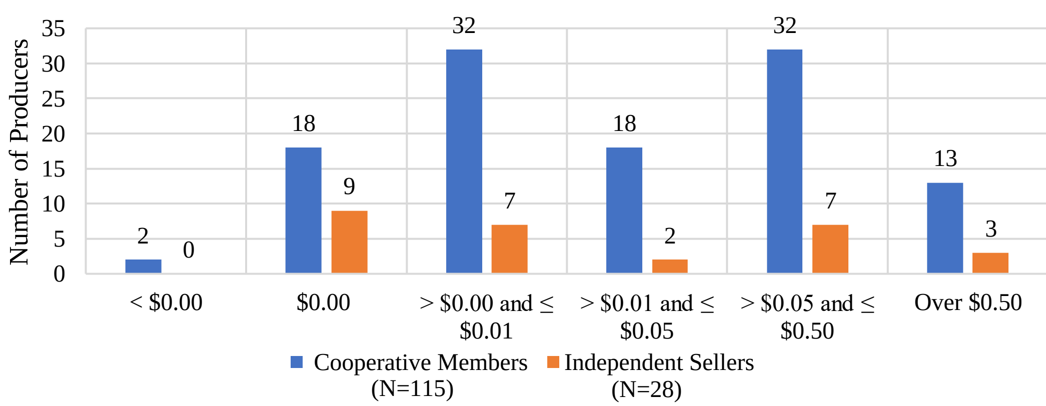


Figure 12. Distribution of Self-Reported Values ($/cwt) by Producer Type

In Figure 13, a histogram presents the average self-reported value of handler business structure by herd size category. Concerning cooperative members, there seems to be a clear downward sloping value of handler business structure as the herd-size increase. The larger the farm, the lower is the self-reported value of cooperative ownership. A trend is not clear for producers selling to independent handlers, albeit the sample size is substantially lower.

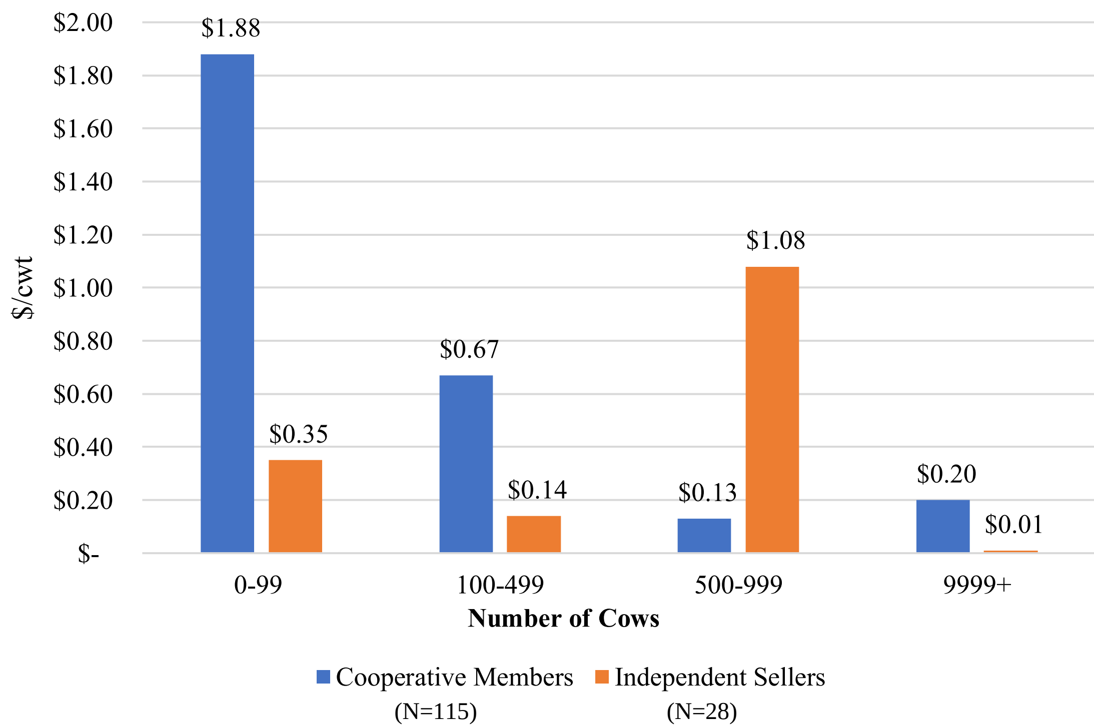


Figure 13. Average Self-Reported Value of Handler Business Structure by Herd Size

CHAPTER 5
Discrete Choice Experiment Results

Main Effects

Regression results of the main effect models using conditional logit (CL) and Hierarchical Bayesian adjusted (HB) approaches are presented below. Interactions effects among attributes (e.g., VOLPREM*HANDS) were also tested, but none were statistically significant and therefore excluded in the final main effect models presented. This was expected given the orthogonal structure of Balanced Overlap DCE design.

Conditional Logit Model Inference

Pooled (aggregate) logit is often used as an estimation approach for estimating partworth summary utility weights for a sample of respondents. In the aggregate effect summary, a vector of partworths is fit to all respondents' choices. An effect summary output utilizes the generated *p*-values and LogWorths to ascertain the relative importance of each attribute in the CL model (Table 8).

Confidence about the precision of a coefficient (or partworth utility weight in the case of effect coding) is often expressed in terms of a 95% confidence interval. The 95% confidence interval is calculated by taking the utility weight estimate plus or minus 1.96 standard errors. This interval can be interpreted as follows: if we were to draw new samples and repeat the discrete choice experiment hundreds or thousands of times and computed a new confidence interval each time based on our model, the confidence intervals would contain the true population mean 95% of the times (Orne and Howell, 2009).

To test if a coefficient (partworth utility) is different than zero, hypothesis testing can be performed via computing a critical value called the *t*-ratio (*t*-test). The *t*-ratio is calculated by dividing the effect (coefficient) by the standard error. In effect coding, *t*-values with absolute magnitudes beyond 1.96 give us at least a 95% confidence that the coefficient is different from their average (zero) while *t*-values with absolute magnitudes beyond 2.58 provide at least 99% confidence that the coefficient is different from their average (zero).

Hierarchical Bayesian Model Inference.

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 but is interpreted somewhat differently. 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. Posterior mean estimates and CI's are divided by 10 for comparison to CL estimates.

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. Additionally, when performing statistical tests on aggregate partworths for unordered attributes it is common that participants' differences of opinions on attributes can nearly cancel out, contributing to a partworth utility weight near zero.

Model Results

All attributes except hauling cost structure (HAUL) are statistically significant in the *All Producers* CL model (at the 95% significance level) to the decisions made between handler offers (Table 8). Given the stability in year to year deduction rates across producers, it is consistent to find hauling costs statistically insignificant towards producer's current choice making behavior (NYAM, 2018). As expected, the gross handler pay price (PRICE) was the most important attribute. The pay price was included for completeness relative to producer experience and to assess the relative values of the other attribute levels. Pay prices on a per cwt basis are much higher relative to actual premiums and hauling charges faced by producers.

Absent pay price, the most important attribute was handler business structure (HANDS), followed more distantly by quality premium (QUALPREM), volume premium (VOLPREM), and lastly hauling cost structure (HAUL). Analysis of CL parameter estimates and HB posterior means, *t*-values, and credible interval limits suggest statistical significance for attribute levels across all attributes except hauling cost structure (HAUL). Middle-level attributes show little statistical significance on their own, an expected result given those utilities are more likely to fall around the effect coding mean of zero (Table 9).

Table 8. Conditional Logit Effect Summary, Main Effects Models. (N=218)

	LogWorths[a]		
Attribute	**All Producers (N=218)**	**Co-op Producers (N=165)**	**Non-Co-op Producers (N=44)**
Gross Handler Pay Price (PRICE)	24.209 (0.000)	19.887 (0.000)	3.814 (0.000)
Handler Business Structure (HANDS)	8.200 (0.000)	16.503 (0.000)	3.485 (0.000)
Quality Premium (QUALPREM)	2.792 (0.002)	2.575 (0.003)	0.406 (0.393)
Volume Premium (VOLPREM)	1.659 (0.022)	1.715 (0.019)	0.534 (0.292)
Hauling Cost Structure (HAUL)	0.639 (0.230)	0.962 (0.109)	0.406 (0.393)

[a] LogWorth = (-log10(p-value)), P-values in parentheses

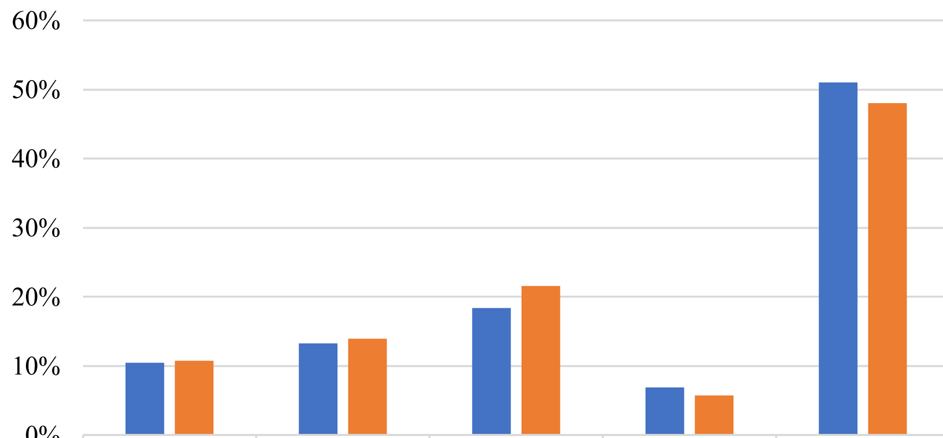
Unsurprisingly, given that cooperative members account for 80% of the sample, the *Co-op Producers* only CL model matches the attribute significance rankings of the aggregate model (Table 8). Regarding the *Non-Co-op Producers* CL model, HANDS is the only significant attribute besides PRICE, although the preferred level is switched; i.e., non-cooperative producers prefer an independent handler business structure. Although not significant, non-cooperative members preferred a farm-specific hauling cost structure compared to the regional-specific hauling cost structure preferred by cooperative members (HAUL 3 vs. HAUL 2, respectively). See APPENDIX tables 13 and 14 for full Co-op Producer only and Non-Co-op Producer model estimates.

An alternative representation of attribute importance is provided in Figure 14 comparing the CL and HB estimates. Here, the relative importance portrays how much difference each attribute makes in the total producer utility of the selected offer. The difference is the range in the attribute's utility levels (partworths). Notice that between the CL and HB model, the gross handler pay price becomes slightly less important. Across attributes, handler business structure experiences a higher degree of importance with the HB model compared to the CL model (22% vs 18%).

Table 9. Main Effect Model Results: Conditional Logit and Hierarchical Bayes. (N=218)

	Conditional Logit Model					Hierarchical Bayes		
Attribute Level	**Parameter Estimate**	**Std. Error**	**CI Lower 95%**	**CI Upper 95%**	**t-Value**	**Parameter Estimates**	**CI Lower 95%**	**CI Upper 95%**
Volume Premiums								
VOLPREM 1	**-0.110**	0.055	-0.218	-0.002	-2.002	**-0.101**	-0.186	-0.028
VOLPREM 2	**-0.037**	0.057	-0.150	0.075	-0.652	**-0.034**	-0.112	0.035
VOLPREM 3	**0.148**	0.057	0.036	0.259	2.590	**0.134**	0.063	0.271
Quality Premiums								
QUALPREM 1	**0.135**	0.056	0.026	0.244	2.420	**0.139**	0.061	0.244
QUALPREM 2	**0.062**	0.057	-0.050	0.174	1.078	**0.027**	-0.039	0.103
QUALPREM 3	**-0.196**	0.057	-0.308	-0.084	-3.433	**-0.166**	-0.316	-0.106
Handler Business Structure								
HANDS 1	**0.237**	0.042	0.155	0.318	5.682	**0.236**	0.154	0.405
HANDS 2	**-0.237**	0.042	-0.318	-0.155	-5.682	**-0.236**	-0.430	-0.201
Hauling Cost System								
HAUL 1	**-0.023**	0.057	-0.134	0.088	-0.410	**0.011**	-0.072	0.009
HAUL 2	**0.093**	0.057	-0.018	0.205	1.638	**0.058**	-0.008	0.143
HAUL 3	**-0.070**	0.057	-0.183	0.042	-1.224	**-0.069**	-0.217	-0.001
Gross Handler Pay Price								
PRICE 1	**-0.700**	0.085	-0.867	-0.534	-8.251	**-0.513**	-0.800	-0.347
PRICE 2	**-0.194**	0.079	-0.349	-0.038	-2.445	**-0.161**	-0.280	-0.063
PRICE 3	**-0.004**	0.079	-0.158	0.150	-0.049	**-0.027**	-0.128	0.069
PRICE 4	**0.309**	0.080	0.153	0.466	3.877	**0.164**	0.084	0.257
PRICE 5	**0.589**	0.083	0.425	0.752	7.057	**0.538**	0.462	0.889

CI = Confidence (Credible) Interval for Conditional Logit (Hierarchical Bayes) model.



	Volume Premium	Quality Premium	Handler Business Structure	Hauling Cost System	Gross Handler Pay Price
Coditional Logit	10.45%	13.23%	18.38%	6.89%	51.05%
Hierarchical Bayes	10.73%	13.94%	21.57%	5.76%	47.99%

Figure 14. Relative Importance of Milk Pricing Attributes (N=218)

Given the estimated partworths, an optimal offer based on attribute levels with the highest marginal utility values can be constructed. In a main effects model, the marginal utility is equal to sum of all direct effects for each attribute (the same as the partworths). Similar to partworths, the marginal utility represents the gain from "consuming" the attribute level of focus. As expected, the same optimal offer is applicable to both the CL and HB models since the partworth estimates favored the same optimal attribute levels. In this case, the optimal bundle includes no volume premium, the highest and strictest paying quality level, the cooperative handler type, and a region-specific hauling cost structure (Table 10).

Partworths can also be converted to willingness-to-accept (WTA) attribute 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 this experiment, the higher the WTA the lower per cwt gross handler pay price a farmer is willing to accept in return for that attribute level. These values are displayed in Table 11 (in $/cwt), whereby the attribute level with the lowest marginal utility (least

Table 10. Optimal Offer (Utility Maximizing Bundle), Main Effects Models. (N=218)

Attribute	**Optimal Level** (Abbreviation)	**Marginal Utility** Conditional Logit	**Marginal Utility** Hierarchical Bayes
Volume premium	No volume premium (VOLPREM 3)	0.1532	0.1344
Quality premium	≤200=30¢, ≤150=40¢, ≤100=50¢ (QUALPREM 1)	0.1379	0.1394
Handler business structure	Farmer-owned cooperative (HANDS 1)	0.2339	0.2363
Hauling cost structure	Region-specific rate (HAUL 2)	0.0995	0.0577
Gross handler pay price	$20.00 (PRICE 5)	0.5939	0.5381
	Total Utility	1.2184	1.1058

Table 11. Willingness to Accept, Main Effect Models (N=218)

Attribute Level	**Conditional Logit Model**			**Hierarchical Bayes Adjusted (20,000 iterations)**		
	WTA	**CI Lower 95%**	**CI Upper 95%**	**WTA**	**CI Lower 95%**	**CI Upper 95%**
Volume Premiums						
VOLPREM 1	**BASE**	BASE	BASE	**BASE**	BASE	BASE
VOLPREM 2	**$0.056**	$0.059	$0.052	**$0.064**	$0.079	$0.077
VOLPREM 3	**$0.205**	$0.212	$0.198	**$0.223**	$0.291	$0.185
Quality Premiums						
QUALPREM 1	**$0.259**	$0.269	$0.249	**$0.291**	$0.391	$0.218
QUALPREM 2	**$0.200**	$0.206	$0.194	**$0.183**	$0.241	$0.154
QUALPREM 3	**BASE**	BASE	BASE	**BASE**	BASE	BASE
Handler Business Structure						
HANDS 1	**$0.360**	$0.368	$0.352	**$0.449**	$0.611	$0.316
HANDS 2	**BASE**	BASE	BASE	**BASE**	BASE	BASE
Hauling Cost Structure						
HAUL 1	**$0.040**	$0.043	$0.037	**$0.076**	$0.097	$0.083
HAUL 2	**$0.135**	$0.143	$0.126	**$0.120**	$0.168	$0.100
HAUL 3	**BASE**	BASE	BASE	**BASE**	BASE	BASE

Note: base attribute levels assigned as least preferred (lowest marginal utility). CI = Confidence (Credible) Interval for Conditional Logit (Hierarchical Bayes) model.

preferred level) was used as the base (BASE). Since each attribute is separable in utility from the others, the expected WTA for a one unit change in each attribute can be calculated separately. To calculate, firstly, the aggregate marginal utility of all base level attributes with PRICE = $19/cwt is compared to the aggregate marginal utility of all base level attributes with PRICE= $20/cwt. This produces a change in aggregate marginal utility equivalent to a $1 increase in PRICE (i.e. a $1 to 1 unit utility equivalent). For instance, in the CL model, a one unit change in marginal utility is equivalent to a $0.77 increase in WTA. Next, PRICE is returned to its lowest level ($19) and the marginal utility change for each attribute level from its base level is recorded. This value, which represents the attribute specific marginal utility change is then multiplied by the $1 price equivalent for a WTA value. The same occurs using marginal utility HB estimates.

The WTA of $0.45/cwt for the cooperative attribute level over an independent handler (HB model), corresponds to a farmer willing to forgo $0.45/cwt in return for marketing milk through a cooperative relative to an independent handler. Put differently, an independent would need to offer a gross pay price of $0.45/cwt higher than a cooperative, ceterus paribus, for a producer to choose the independent offer. In other words, the value of cooperative ownership is $0.45/cwt. 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. In comparison to the Roe, Sporleder, & Belleville (2004) estimate of between $0.57 to $0.97/cwt WTA for hog producer cooperative value, $0.45 is quite a bit lower. However, on average, the WTA hog producer cooperative value corresponded to a 2.2% relative decrease in the base price of pork. Similarly, the $0.45/cwt value for dairy producer cooperative value corresponded to a 2.3% decrease in the average gross producer pay price of milk presented. That said, these values may not be directly comparable given the different set of attributes utilized between experiments.

Demographic Interaction Effects

Using farm demographics, interaction effects were incorporated into the CL model to assess differences in partworth utilities over demographic characteristics of producers. In preliminary models, operator age, farming experience (years), herd size (number of cows), and education (years of education) were considered.[5] However, as expected, age and experience were highly correlated (Pearson product moment correlation coefficient $r = 0.77$) so age was dropped from the final interaction models. Current handler choice was excluded given its overlap with the handler business structure attribute.

Table 12 summarizes the *p*-values and associated LogWorths for all main and interaction subject effects, arranged in order by statistical significance. PRICE, VOLPREM*HERDSIZE, HANDS, HAUL*HERDSIZE, QUALPREM*EDUCATION, VOLPREM*EXPERIENCE, HANDS*EDUCATION, and HANDS*EXPERIENCE were all significant at the 95% significance level or above. Figures 15 through 20 display the marginal utilities of both CL and HB model results for interactions with P-values ≤ 0.05. Marginal utilities in interaction models combine both the direct (main) effect utilities with the indirect effects of the demographic interactions. Full interaction results are viewable in the APPENDIX tables 15 and 16. In lieu of generating optimal bundles for each demographic group, these figures allow the most preferred attribute levels for statistically significant interactions to be analyzed in a simple manner.

[5] Education categories (Table 5) were condensed to three categories: a high school diploma or less, more than a high school diploma but less than a Masters degree, and a Masters degree or higher. These categories equate to the following years of education as included in the survey, respectively: ≤ 12 years, >12 and ≤ 16 years, and > 16 years.

Table 12. Conditional Logit Effect Summary, Interaction Effects Model (N = 200)

Model Effects	**LogWorth**	**P-value**
PRICE	23.688	0.000
VOLPREM*HERDSIZE	11.047	0.000
HANDS	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	0.869	0.135
VOLPREM*EDUCATION	0.416	0.384
VOLPREM	0.413	0.387
HANDS*HERDSIZE	0.366	0.431
QUALPREM*EXPERIENCE	0.338	0.460
HAUL*EXPERIENCE	0.270	0.537
HAUL	0.250	0.562
HAUL*EDUCATION	0.244	0.570
QUALPREM*HERDSIZE	0.199	0.633

[a] LogWorth = (-log10(p-value))

Figure 15 illustrates the effect of dairy farm herd size on preference for volume premium levels. Among smaller farms, volume premium 1, which provides incentives for increased milk production regardless of external market conditions is generally disliked, while volume premium 3, which provides no volume premium, is preferred. Not surprisingly, the opposite is true of larger farms where volume premium 3 is heavily disliked relative to volume premiums 1 or 2. Across the board, there is either positive or near zero (indifferent) preference regarding volume premium 2, which bases a volume premium conditional to a market signal (previous three-month average MO base price).

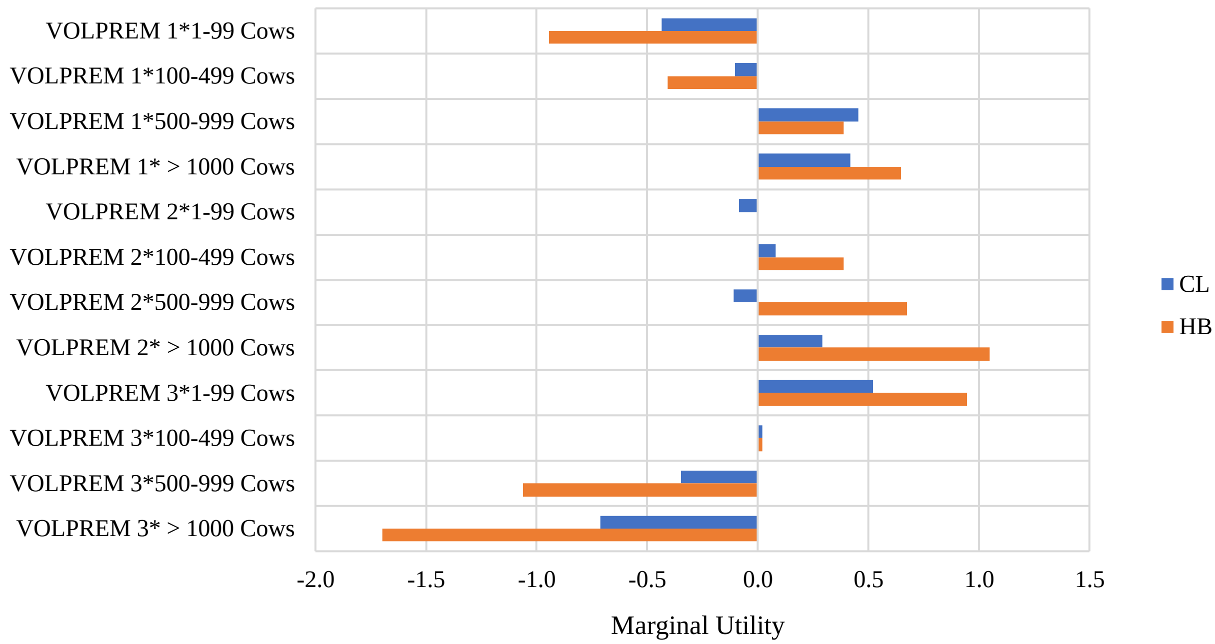


Figure 15. Marginal Utility: Volume Premium*Herd Size (N=200)

Figure 16 displays the effect of herd size on the choice of hauling cost structure. To reiterate, HAUL 1 refers to a cost per cwt rate that is the same across all farm suppliers, HAUL 2 is a region-specific rate across all farms supplying milk to a handler within a region, and HAUL 3 is a farm-specific rate based on milk volume and location to other supplying farms and processing plants. Larger farms tend to demonstrate clear preferences here relative to smaller farms which appear more indifferent. Of these larger farms, HAUL 1 and 2 result in extended negative marginal utility while HAUL 3 results in extended positive marginal utility. Large farms show a clear preference for the farm-specific rate, which is not surprising given that they likely translate in lower unit costs for hauling services to the handler.

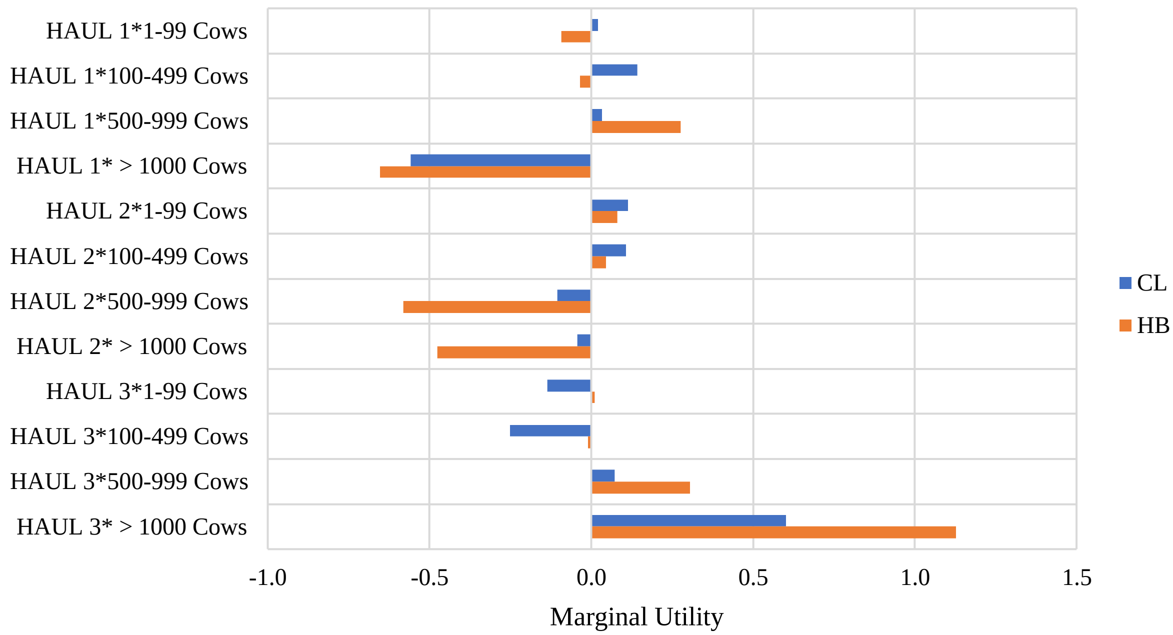


Figure 16. Marginal Utility: Hauling Cost Structure*Herd Size (N=200)

Figure 17 represents the impact of years of education on the preference of quality premium. Recall, quality premiums ranged in acceptable SCC thresholds with QUALPREM 1 being the strictest quality level followed by QUALPREM 2 and 3 which had progressively less strict standards in order to receive a particular quality premium. Interestingly, there is not a clear trend in preference between years of education and quality premium. Those with 0-12 years of education were generally indifferent towards all quality premiums, those with 12-16 years of education prefer quality premium 1, and those with 16+ years of education strongly dislike quality premium 2 and are more positive towards levels 1 and 3.

Figure 18 shows the effect of farming experience on preferred volume premium attributes. The significance in this effect appears to be driven by farmers with less than 10 years of experience who strongly dislike volume premium 3 (no volume premium) and prefer volume premium 2. More experienced groups appear to be less aligned or more indifferent on preference as their marginal utility is closer to zero. Notably, volume premium 2 results in positive marginal utility across all groups for the (preferred) HB model, and volume premium 3 is consistently negative.

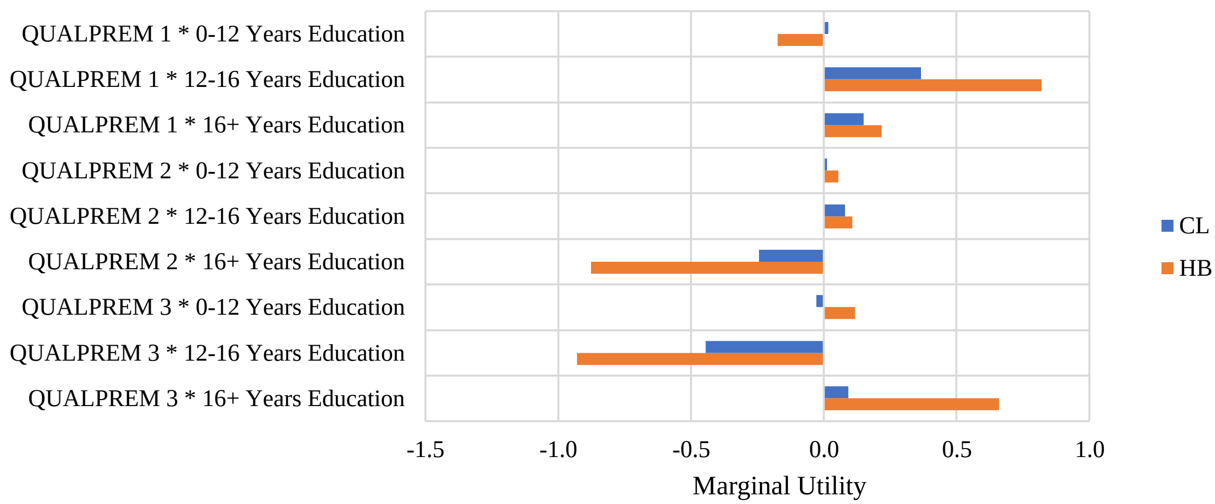


Figure 17. Marginal Utility: Quality Premium*Education (N=200)

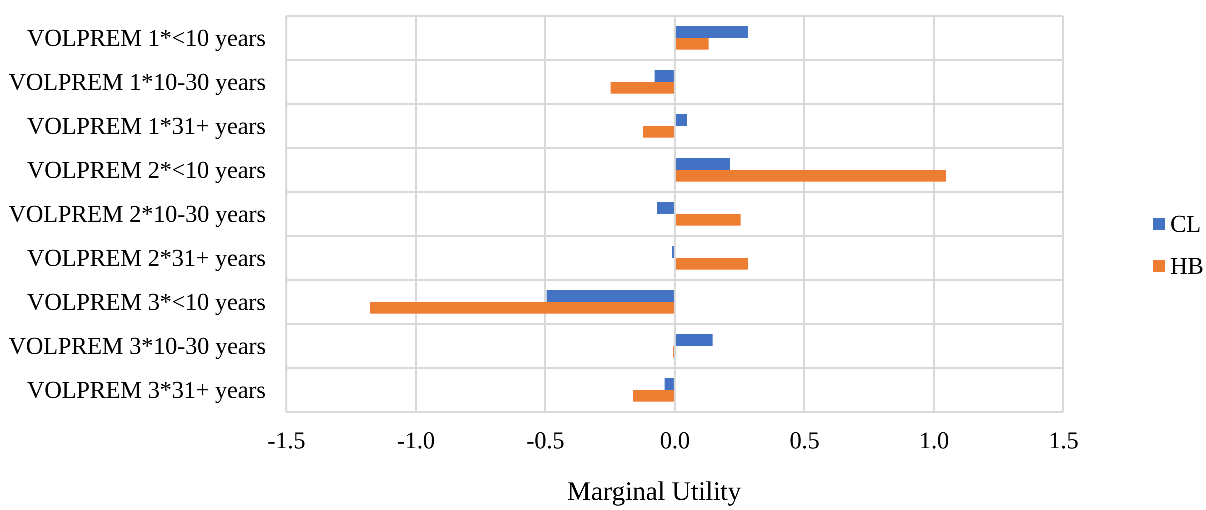


Figure 18. Marginal Utility: Volume Premium*Experience Dairy Farming (N=200)

Figure 19 illustrates the effect of years of education on the preference toward handler business structure. All groups prefer the cooperative handler business structure with increased preference for cooperative handlers by those with higher levels of education. HB model WTA values for the farmer-owned cooperative attribute level were also calculated based on the marginal utility estimated for each educational group. The monetary value a farmer with 0-12 years of education, between 12 and 16 years of education, and above 16 years of education is willing to forgo on their milk check to remain a cooperative member is $0.28, $0.47, and $0.43 per cwt respectively. Participant's that belong to the 12-16 years of education makeup 73.5% of the sample, providing aggregate consistency to the overall average WTA of $0.46 for the farmer-owned cooperative handler attribute level.

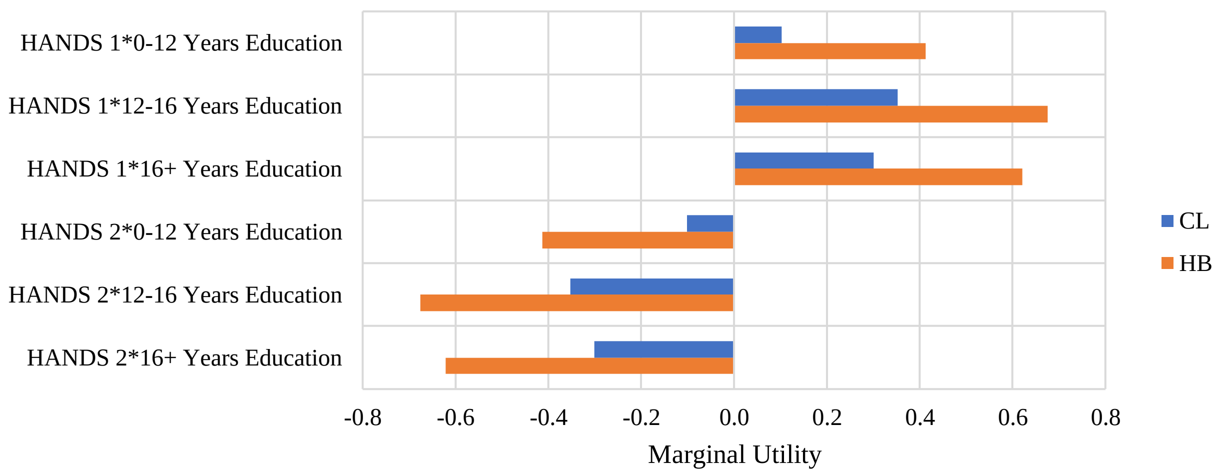


Figure 19. Marginal Utility: Handler Business Structure*Education (N=200)

Lastly, Figure 20 displays the effect of years of dairy farming experience on the preference toward handler business structure. Similarly, all experience level groups prefer the cooperative handler business structure. Between the two models, there appears to be a positive trend between increased marginal utility and having more dairy farming experience. Similar to Figure 19, HB model WTA values were calculated for the farmer-owned cooperative attribute level based on experience level groups. The WTA for those with less than 10 years of experience was estimated at $0.18/cwt, for those with 10 to 30 years of experience at $0.44/cwt, and for those with over 31 years of experience at $0.56/cwt. The WTA results align proportionally with the HB marginal utility estimates.

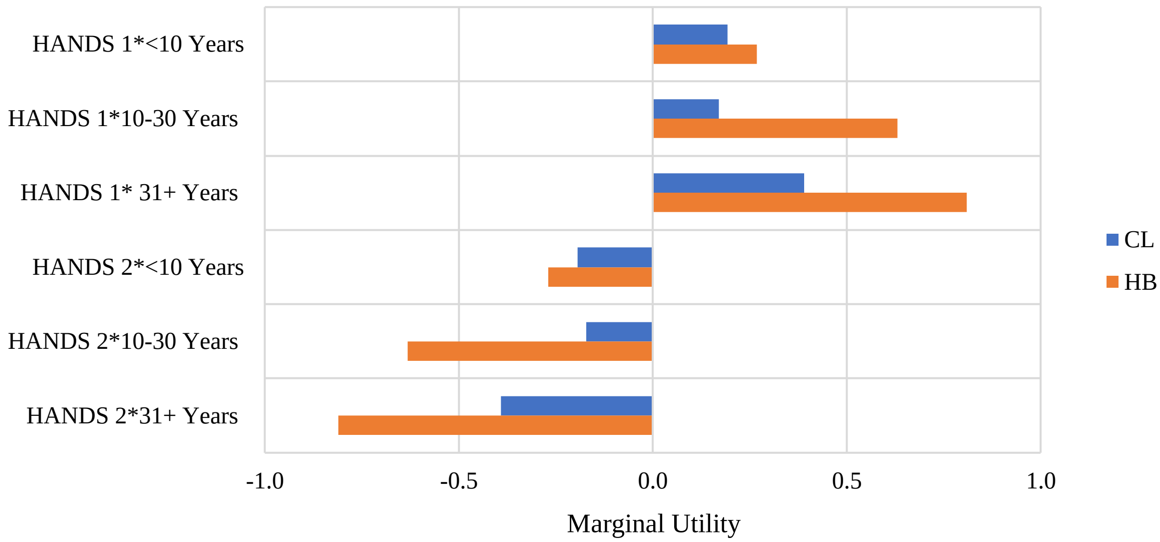


Figure 20. Marginal Utility: Handler Business Structure*Experience Dairy Farming (N=200)

CHAPTER 6
Discussion and Conclusions

The 2017 Census of Agriculture reports that approximately 85% of milk produced in the United States is handled by dairy marketing cooperatives. This proportion has only grown in favor of cooperative handlers as the number of licensed dairy farms drops, the supply of milk in the market grows, and consumer preferences toward dairy products shift. The increased role cooperatives play in the management of milk markets is therefore ever so prominent. Each year that the number of independent dairy marketing cooperatives shrinks, the governance responsibilities and jurisdiction over farmer members for the remaining firms grows. Dairy farms are defined by their distinct-individual production qualities, diversity in management techniques, and business goals. Cook (1996) suggests clearly that within cooperative businesses, heterogeneous interests, a common product of diverse populations, become more prevalent and costly the longer a cooperative progresses in its life cycle. 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 defining member property rights- a vital factor in ownership. Furthermore, the cooperative advantages associated with efficiency such as reduced transaction costs and internalized information asymmetries diminish. The overall functionality of a cooperative organizational structure is put at risk. This research took the abstract market dynamics of the dairy industry to define the current state of member ownership in agricultural cooperatives. DCEs allow researchers to measure preferences among individuals for specific attributes comparatively. As a result, aggregate levels of preferences can be inferred from a population. The inclusion of demographic filters allows for the analysis of preferences conditional to specific population subsets. As we describe the conclusions from our assessments of cooperative membership it is important to think from the perspective of both member and director in the context of coherent organizational functionality.

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 then 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. This is especially relevant given our finding 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.

Before jumping into our central focus of cooperative ownership, it is pertinent to summarize the importance and implications of the selected non-business type attributes. In estimating underlying preferences towards handler business types the approach must incorporate external market characteristics as a control to more accurately isolate the utility values. It is important to clarify the following results are from the main effects model which aggregated participating farmers' preferences. The results concerning volume premiums suggest farmers consider external market status in their own farm level decisions. No volume premium was the preferred attribute level in the volume premium category. This result may well be reflective of current oversupply conditions in the industry. Regarding quality premiums, producers preferred the strictest and highest value of quality payments. This suggests farmers are confident in their ability to reach the highest standards of quality and reap the monetary benefits of the strictest quality level. Given the costly nature of increasing milk quality, this is an interesting result. Perhaps, the preference for no volume premium introduces increased demand for premiums through other channels. If a farmer knows volume premiums will negatively impact milk prices in the long run, shifting focus to increasing quality may be a better bet for improving farm level profitability. Lastly, although not statistically significant, 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 farms option (HAUL 1) and the farm-specific rate option (HAUL 3).

These non-business attribute results have their own connections to cooperative ownership dynamics. Notably, farmers are considering the aggregate success of dairy farmers and the dairy industry in their personal preferences. This is apparent in favored options that, on an individual farm level may not be the most profitable but are seen as positive for dairy farmers as a whole in the long run. Offering no volume premium is a drastic hit to farms who have invested to improve production efficiency rates. 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 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.

Now we move towards the direct discussion of the handler business structure attribute. As expected from their revealed preference (i.e., current handler type), cooperative producers strongly preferred the farmer-owned handler structure, while independent producers strongly preferred the independent handler structure. Although a much smaller proportion of farmers sell to independent handlers (21% of those sampled) this result likely reflects satisfaction in farmers' current handler business relationships. This satisfaction is further supported, across both producer categories, by the statistic that approximately 80% of producers had not sold to a different handler type in the last 10 years. Though limited by the fact that 50% of respondents reported no opportunity to sell to a different handler than they currently do, farmers generally expressed positive preferences for the handlers they currently sell to. This reveals a segmentation in the producer market that contains a subset of farmers that are inherently more satisfied with selling through an independent handler.

In line with existing literature, 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. Within the handler attribute itself, the farmer-owned cooperative business structure was preferred to the independent handler on the aggregate level. Put differently, the cumulative perceived benefits of the farmer-owned cooperative handler attribute was favored to the cumulative perceived benefits of the independent seller attribute, everything else equal. 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 related to a handler' governance structure and ownership control rights. Given the ownership focus of this research, the significance of the farmer-owned handler attribute to farmers' decisions implies cooperative governance structures and ownership are advantageous to that of independent handlers. The extent to which respondents disassociated possible monetary benefits of cooperatives in choice decisions is, however, unclear. At the very least, there is an aggregate satisfaction implied towards farmer-cooperatives. Farmers who are unhappy with the governance dynamics of a cooperative, such as accurate representation, should have been motivated to express preference towards independent handlers. Irrespective, farmers strongly considered the HANDS attribute across choice decisions. It is likely that known advantages of cooperatives including bargaining power, access to a secured market, and reduced transaction costs also played a strong role in this outcome.

In the design of this DCE, the ability to calculate a WTA dollar equivalency for the cooperative businesses attribute was of primary focus. Considering the HB WTA results, on aggregate, farmers were willing to forgo \$0.45/cwt on their milk check to remain a cooperative handler over the independent handler option. Dairy farmers would be willing to take up to a \$0.45 hit on their per cwt revenue before they decide to switch to an independent handler. This is a significant result that exposes a level of rigidity in farmers' commitment towards cooperative business structures. It also provides the basis for an inherent competitive advantage for cooperative organizations. Independent handlers, need to provide a level of monetary incentive at least equivalent to \$0.45/cwt to attract additional producer interest. In other words, members need to be comfortably compensated to give up their member-ownership rights.

This \$0.45/cwt value corresponds to an average 2.3% decrease from the presented gross handler pay price of milk levels. This relative percentage value is nearly identical to the 2.2% decrease in regional price observed by Roe, Sporleder, & Belleville (2004) in estimating hog producer cooperative value. Though the difference in experimental designs limits the connectedness of the values, perhaps the value of agricultural membership is relatively constant across business sectors.

The \$0.45/cwt WTA value is also higher than all per cwt values provided by individual premium categories collected in NYAM data and across all other attribute WTA values. This suggests cooperative membership rivals the importance of any individual pricing premium type to dairy farmers. Additionally, \$0.45/cwt is more than three times the average annual \$0.12/cwt paid by cooperative handlers through patronage refunds in NYS. The \$0.33 difference implies a variety of non-monetary benefits are experienced by retaining ownership in a cooperative.

The WTA values from the DCE experiment can also be compared with the self-reported values of handler business structure. The average per cwt self-reported value for those selling to cooperatives was \$1.01 and the self-reported value of those selling to independent handlers was \$0.23/cwt. Subtracting the latter from the former generates a value of \$0.78 to account for the independent handler level. In both cases, the monetary equivalency for ownership rights, responsibilities, and risks is positive. Clearly, the self-reported value is much higher (by \$0.33) than the DCE estimate. This suggests dairy farmers may evaluate their preference for cooperative ownership more when considered independently of other factors, which are purposely included within the designed hypothetical handler offers. Importantly, a self-reported value varies from that of a WTA figure. The complexity of the self-reported question combined with low response rates limits the connectivity between the two values.

Having discussed the implications of our main effect results, which parallels the aggregate representation of a diverse farmer member base, we move on to the inclusion of demographic interactions. These inclusions provide us the opportunity analyze based on factors that differentiate farmers thus informing improved governance techniques. At first glance, the most significant model interactions were those that included the size of a dairy farm. Measured by number of cows, farm size fundamentally dictates a slew of farm level production and management approaches. In regards to volume premiums, the 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. Large farms are generally opposed to eliminating volume premiums while small farms generally are opposed to handlers paying them. This is reasonable given that large farms inherently produce the most milk and would experience increased losses if a volume premium is reduced or eliminated. Small farms wouldn't normally benefit from volume premiums due to lower overall production rates. This is expressed in the severity of marginal utility differences between the demographic groups. Interestingly, volume premium two, which bases a volume premium conditional to a market signal (previous three-moth average MO base price), has positive or near zero marginal utility appeal. In fact, among larger farmers, volume premium two is 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. It suggests, all farm size categories would accept a volume premium conditional to a market signal with minimal impact on marginal utility or overall satisfaction. Avoiding preferences that expose certain demographics to increased negative utility implies reduced conflict and more broadly reduced effects of heterogeneous interests.

In the case of hauling cost structure preferences differentiated by herd size, we observe a case where large farms (the ones with presumably the lowest unit costs of hauling to the handler) express clear levels of preference for provided options; i.e., farm specific rates. Large farms (>1,000 cows) have large negative marginal utilities for hauling based on overall equal pricing (per cwt) or on equal pricing rates within regions. This is also reasonable as large farms within a cooperative would take on the bulk of monetary impact of the more equity based (subsidized) hauling options and would experience the most cost savings under a farm-specific rate. However, given the collective nature of a cooperative organization the representation of all members is important. Given that small farms (0-99 cows) make up the largest segment of dairy farms it is probable that a region-specific hauling structure would provide the most equitable solution given these options.

The third significant interaction weighted choice of quality premium with education level. As described, there is not a clear trend in preference between years of education and quality premium. Those with 0-12 years of education were generally indifferent towards all quality premiums, those with 12-16 years of education prefer quality premium one to the alternatives, and those with 16+ years of education strongly dislike quality premium two and are more positive towards levels one and three. The lack of a trend could result from distinct approaches to choices between quality premiums. Lower education could be associated with ignoring the quality premium attribute and or the implications strictness of SCC levels has. The interpretation of the provided quality premium levels is complex, deeply considering the aspects surrounding the alterative levels is difficult. Correspondingly, those with 12-16 years of education (73% of sample) favored option one, which from a quick glance provides the highest monetary incentive. Not deeply considering the levels could result in a quick reaction to decisions based on the highest monetary level. Those with the highest levels of education, though a small segment (7.5% of sample) showed preferences for the least strict and most strict quality levels. Perhaps the ones who most deeply considered the implications of reaching higher levels of quality via taking on increased production costs saw the least strict option as the most viable. Irrespective, this interaction is another example of one where all three options result in negative utility for at least one demographic group. Subsets of farmers have alternate perspectives on what deserves the most focus and how they approach making decisions. Some of which is based on prior access to education. BoD decision making that is sensitive towards a member base with varying understanding of complex issues is necessary. This sensitivity should take the form of educational initiatives to help teach member owners what business choices are in their best interest. A BoD that ignores the importance to member education is situating itself to be more susceptible to gridlock and decreased organizational efficiency.

Another important farmer level characteristic in the dairy industry is farming experience. Farmers with more experience tend to understand milk market behavior more thoroughly and the associated dos and the don’ts of the business. The effect of dairy farming experience on the preferred volume premium attributes yielded significant results. As mentioned, the significance in this effect appears to be driven by farmers with less than 10 years of experience who strongly dislike volume premium three (no volume premium) and prefer volume premium two. Beginning farmers may be less aware of the farm-level effects of external market dynamics such as over-supply and may more strongly consider the impact a no volume premium would have, monetarily, in the short term. Similar to the implications of herd size on volume premium, volume premium two appears to show the most shared frequency of positive marginal utility across experience level categories. Likewise, it suggests, all experience levels would accept a volume premium conditional to a market signal with minimal impact on aggregate marginal utility or overall satisfaction. Again, this is valuable insight given conflict that can ensue between farmers with different experience levels. A BoD that offers compromise options resulting in the least level of severe dissatisfaction will likely reduce the negative implications of internal organizational disputes. More experienced members should also serve as a form of information and advice for new farmers. The success of a cooperative is limited to the success of its members. The structure of a cooperative implies members have no reason to act opportunistically towards each other implying that that sharing of ideas can only be beneficial. Cooperation can only work positively towards improving the collectively shared brand of a firm.

The final two significant interactions explicitly involve our business structure attribute. The first estimates the affect education categories have on preferences toward handler business structure. Matching the determination of our main effect model, the farmer-owned cooperative results in positive marginal utility across all categories while the opposite is true of independent handlers. Those with 0-12 years of education expressed a slightly reduced marginal utility when compared to those with higher levels of education. This small discrepancy could relate to the assumptions of bounded rationality whereas cooperative members need to be able to comprehend the complex issues surrounding firm governance in order to best determine value. Less consideration on this front can shift decision focus from attributes like HANDS to the PRICE attribute which requires a simple decision between a higher and lower price. Finding that farmers with higher levels of education express more satisfaction towards cooperatives may relate to better comprehension of the abstract benefit's cooperatives provide to the milk market. It also lends itself to support of the many non-monetary cooperatives exhibit. More education could be associated with more participation within the governance aspects of a cooperative firms (i.e., voting rights and strategic decision making). If those who more actively express their ownership rights experience higher satisfaction rates it provides validation of the democratic components of cooperative businesses.

The final significant interaction weighted the effect experience dairy farming has on preference toward handler business structure. Interestingly, between the two models there appears to be a positive trend between increased marginal utility and having more dairy farming experience. The more experience a farmer has in the dairy industry, by number of years, the higher marginal utility expressed for the farmer-owned handler attribute level. 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. Notably, experience level could also be reflected in the ability to obtain management roles in handler organizations. The longer you have been farming is likely associated with more connections in the industry and a higher reputation in understanding the interworkings of dairy markets. Therefore, farmers with the most experience may have more influential roles within dairy cooperative, possibly as an elected director, thus increasing satisfaction with the cooperative handler type. Regardless, this increase of marginal utility based on experience parallels the increased role cooperatives play in the dairy industry and, more broadly, in the dynamics of managing milk markets.

Combined, these results paint a picture highlighting the significance of cooperative membership to dairy farmers. Not only are farmers, on aggregate, willing to accept lower per cwt compensation to retain ownership rights, but, many are actively considering the industry wide impacts of their decisions in their satisfaction. The community-focused dynamic of these implications establishes an industry commitment towards economic improvement. Dairy farmers are aware of the importance of cooperation to combat changing consumer preferences, market oversupply, and a diminishing number of farms among other negative economic trends. It is clear that farmers not only see cooperatives as a tool to reach farm level economic stability but as an opportunity to work together to represent the collective interests of all farmers for the good of the individual member and the good of the cooperative.

Limitations and Direction for Further Research

The handler business structure attribute included in this choice experiment consisted simply of two levels: an independent handler versus a farmer-owned cooperative handler. The farmer-owned cooperative level was specified to represent a dairy marketing cooperative that provided marketing functions to members. This includes the collection and processing of raw dairy ingredients and any actions leading up to and beyond the sale of the products. Hybrid types of firms that exist across global agricultural markets, firms that offer non-marketing based functions, and other structural diversity are not accounted for in this approach. As implied by Hannsman (1996) and Staatz (1987), the benefits of cooperatives appear to be sector specific and most applicable to the agricultural industries. Employing similar research methodologies to better understand the value of non-agricultural cooperatives or cooperatives with non-marketing functions would allow for validation of this expectation. Research that answer questions such as: do cooperatives provide ownership benefits to members in other industries?

Dissemination and advertisement of the survey and the associated ability to obtain a demographically representative sample size of U.S. was also limited in scope. Significant producer states (e.g., California) and farmers over 65 years of age were less represented which may impact the robustness and scope of implications across the entire nation. While utilization of an online software program simplified the collection of surveys and allowed for the employment of more advanced analysis techniques (like HB) it also contributed toward these sample diversity issues. Perhaps our New York weighted sample overstates or understates aggregate cooperative value. It would be useful to expand the respondent pooling order to test for regional differences in cooperative value. Furthermore, additional research is necessary to venture more deeply into understanding the complexities surrounding the worth of specific cooperative benefits. This DCE allowed us to quantify the monetary value of cooperative membership through a singular cumulative WTA rate. Further research can allow for the separation of values based on individual benefits. For example, what is the WTA for voting rights versus access to a stable market? Do voting rights specifically matter more to small farmers than big farmers?

APPENDIX
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 not 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!

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]

DAIRY PRODUCER SURVEY
Demographic & General Questions Post Choice Set Handler Offers

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.

Table 13. Main Effect Parameter Estimates (Cooperative Producers) (N=44)

Attribute Level	Conditional Logit Model Parameter Estimates	Std. Error	CI Lower 95%	CI Upper 95%	T-Value	Hierarchical Bayes Adjusted Posterior Mean	(20,000 iterations) CI Lower 95%	CI Upper 95%
Volume Premiums								
VOLPREM 1	-0.133	0.066	-0.262	-0.004	-2.025	-1.620	-3.882	-0.443
VOLPREM 2	-0.047	0.067	-0.178	0.085	-0.695	-0.654	-1.907	0.342
VOLPREM 3	0.180	0.068	0.046	0.313	2.643	2.275	0.813	4.572
Quality Premiums								
QUALPREM 1	0.139	0.065	0.011	0.267	2.127	2.132	0.868	4.654
QUALPREM 2	0.086	0.068	-0.048	0.219	1.260	0.435	-0.523	1.533
QUALPREM 3	-0.225	0.067	-0.357	-0.092	-3.330	-2.567	-4.971	-0.960
Handler Business Structure								
HANDS 1	0.400	0.050	0.303	0.498	8.034	5.237	3.234	11.098
HANDS 2	-0.400	0.050	-0.498	-0.303	-8.034	-5.237	-11.098	-3.234
Hauling Cost System								
HAUL 1	0.026	0.067	-0.105	0.157	0.384	0.505	-0.651	1.764
HAUL 2	0.107	0.068	-0.025	0.240	1.588	0.692	-0.284	2.444
HAUL 3	-0.133	0.068	-0.266	0.000	-1.963	-1.197	-2.850	-0.208
Gross Handler Pay Price								
PRICE 1	-0.747	0.101	-0.945	-0.549	-7.401	-7.061	-15.518	-4.127
PRICE 2	-0.163	0.094	-0.346	0.020	-1.745	-1.472	-3.589	-0.036
PRICE 3	-0.081	0.094	-0.265	0.103	-0.865	-0.543	-2.087	0.869
PRICE 4	0.346	0.094	0.161	0.531	3.664	1.994	0.457	4.627
PRICE 5	0.645	0.101	0.448	0.843	6.411	7.083	2.914	11.876

Dropped attribute levels were calculated as minus the sum of the estimates for the other levels of that attribute.
CI, Confidence Interval (CL) or CI, Credible Interval (HB)

Table 14. Main Effect Parameter Estimates (Independent Producers) (N=165)

	Conditional Logit Model					**Hierarchical Bayes Adjusted (20,000 iterations)**		
Attribute Level	**Parameter Estimates**	**Std. Error**	**CI Lower 95%**	**CI Upper 95%**	**T-Value**	**Posterior Mean**	**CI Lower 95%**	**CI Upper 95%**
Volume Premiums								
VOLPREM 1	-0.136	0.124	-0.378	0.107	-1.097	-2.383	-6.047	1.542
VOLPREM 2	-0.043	0.133	-0.304	0.217	-0.324	1.327	-2.694	5.422
VOLPREM 3	0.179	0.127	-0.070	0.427	1.410	1.056	-2.602	6.515
Quality Premiums								
QUALPREM 1	0.159	0.129	-0.095	0.413	1.228	2.837	-1.267	7.379
QUALPREM 2	-0.021	0.126	-0.267	0.225	-0.164	-0.048	-4.455	4.283
QUALPREM 3	-0.138	0.131	-0.394	0.118	-1.059	-2.789	-5.507	2.140
Handler Business Structure								
HANDS 1	-0.340	0.101	-0.538	-0.142	-3.361	-8.185	-12.160	-4.427
HANDS 2	0.340	0.101	0.142	0.538	3.361	8.185	4.427	12.160
Hauling Cost System								
HAUL 1	-0.184	0.130	-0.439	0.071	-1.416	-3.546	-7.952	0.750
HAUL 2	0.039	0.133	-0.222	0.300	0.295	2.154	-2.349	6.504
HAUL 3	0.145	0.135	-0.120	0.410	1.073	1.392	-3.854	5.940
Gross Handler Pay Price								
PRICE 1	-0.715	0.194	-1.096	-0.335	-3.684	-10.258	-16.594	-4.559
PRICE 2	-0.250	0.184	-0.611	0.111	-1.357	-6.941	-12.599	-0.835
PRICE 3	0.163	0.177	-0.184	0.509	0.919	-1.670	-7.786	4.630
PRICE 4	0.273	0.182	-0.084	0.630	1.497	7.711	2.723	13.984
PRICE 5	0.530	0.183	0.425	0.888	2.898	11.159	6.217	19.127

Dropped attribute levels were calculated as minus the sum of the estimates for the other levels of that attribute.

CI, Confidence Interval (CL) or CI, Credible Interval (HB)

Table 15. Parameter Estimates: Main Effects, Experience, Herd-size, Education (Conditional Logit Model) (N=200)

Attribute Level	Marginal Utility	Parameter Estimates	Std. Error	CI Lower 95%	CI Upper 95%	T-Value
Gross Handler Pay Price						
PRICE 1	-0.714	-0.714	0.090	-0.891	-0.538	-7.938
PRICE 2	-0.189	-0.189	0.084	-0.354	-0.024	-2.243
PRICE 3	0.010	0.010	0.084	-0.156	0.175	0.114
PRICE 4	0.272	0.271	0.085	0.105	0.438	3.188
PRICE 5	0.622	0.622	0.089	0.447	0.797	6.976
Volume Premium* Herd Size						
VOLPREM 1*1-99 Cows	-0.435	-0.519	0.101	-0.716	-0.321	-5.146
VOLPREM 1*100-499 Cows	-0.104	-0.187	0.104	-0.391	0.016	-1.808
VOLPREM 1*500-999 Cows	0.455	0.371	0.146	0.085	0.658	2.539
VOLPREM 1* > 1000 Cows	0.418	0.335	0.156	0.028	0.641	2.141
VOLPREM 2*1-99 Cows	-0.086	-0.131	0.103	-0.332	0.070	-1.277
VOLPREM 2*100-499 Cows	0.082	0.037	0.106	-0.170	0.245	0.352
VOLPREM 2*500-999 Cows	-0.109	-0.154	0.158	-0.463	0.155	-0.977
VOLPREM 2* > 1000 Cows	0.293	0.248	0.125	0.004	0.492	1.990
VOLPREM 3*1-99 Cows	0.521	0.650	0.105	0.444	0.855	6.201
VOLPREM 3*100-499 Cows	0.021	0.150	0.105	-0.056	0.356	1.428
VOLPREM 3*500-999 Cows	-0.346	-0.217	0.155	-0.521	0.087	-1.397
VOLPREM 3* > 1000 Cows	-0.711	-0.583	0.127	-0.831	-0.334	-4.594
Handler Business Structure						
HANDS 1	0.252	0.252	0.075	0.105	0.398	3.372
HANDS 2	-0.252	-0.252	0.075	-0.398	-0.105	-3.372
Hauling Costs* Herd Size						
HAUL 1*1-99 Cows	0.021	0.112	0.101	-0.087	0.310	1.103
HAUL 1*100-499 Cows	0.142	0.233	0.106	0.026	0.441	2.203
HAUL 1*500-999 Cows	0.032	0.123	0.140	-0.152	0.398	0.876
HAUL 1* > 1000 Cows	-0.559	-0.475	0.138	-0.746	-0.204	-3.438
HAUL 2*1-99 Cows	0.114	0.095	0.102	-0.106	0.296	0.929
HAUL 2*100-499 Cows	0.108	0.090	0.105	-0.117	0.296	0.849

HAUL 2*500-999 Cows	-0.105	-0.123	0.141	-0.399	0.152	-0.878
HAUL 2* > 1000 Cows	-0.042	-0.061	0.124	-0.304	0.182	-0.493
HAUL 3*1-99 Cows	-0.135	-0.207	0.105	-0.412	-0.002	-1.978
HAUL 3*100-499 Cows	-0.251	-0.323	0.106	-0.531	-0.114	-3.037
HAUL 3*500-999 Cows	0.072	0.000	0.147	-0.288	0.289	0.003
HAUL 3* > 1000 Cows	0.601	0.529	0.129	0.276	0.782	4.093
Quality Premium* Education						
QUALPREM 1 * 0-12 Years Education	0.017	-0.160	0.103	-0.362	0.041	-1.559
QUALPREM 1 * 12-16 Years Education	0.365	0.187	0.100	-0.008	0.382	1.882
QUALPREM 1 * 16+ Years Education	0.150	-0.027	0.099	-0.221	0.166	-0.274
QUALPREM 2 * 0-12 Years Education	0.012	0.062	0.109	-0.151	0.275	0.568
QUALPREM 2 * 12-16 Years Education	0.081	0.131	0.105	-0.076	0.337	1.243
QUALPREM 2 * 16+ Years Education	-0.243	-0.193	0.088	-0.365	-0.020	-2.187
QUALPREM 3 * 0-12 Years Education	-0.029	0.099	0.126	-0.149	0.346	0.781
QUALPREM 3 * 12-16 Years Education	-0.446	-0.318	0.088	-0.491	-0.146	-3.617
QUALPREM 3 * 16+ Years Education	0.092	0.220	0.125	-0.025	0.465	1.758
Volume Premium* Experience						
VOLPREM 1*<10 years	0.282	0.198	0.105	-0.009	0.405	1.879
VOLPREM 1*10-30 years	-0.079	-0.162	0.089	-0.337	0.012	-1.823
VOLPREM 1*31+ years	0.048	-0.036	0.095	-0.221	0.150	-0.376
VOLPREM 2*<10 years	0.213	0.168	0.106	-0.040	0.376	1.585
VOLPREM 2*10-30 years	-0.068	-0.113	0.088	-0.286	0.060	-1.280
VOLPREM 2*31+ years	-0.010	-0.055	0.092	-0.234	0.125	-0.600
VOLPREM 3*<10 years	-0.495	-0.366	0.098	-0.558	-0.175	-3.749
VOLPREM 3*10-30 years	0.147	0.276	0.099	0.082	0.470	2.784
VOLPREM 3*31+ years	-0.038	0.091	0.093	-0.092	0.273	0.974
Handler Business Structure* Education						
HANDS 1*0-12 Years Education	0.102	-0.150	0.078	-0.304	0.004	-1.909
HANDS 1*12-16 Years Education	0.352	0.100	0.077	-0.051	0.251	1.303
HANDS 1*16+ Years Education	0.301	0.050	0.086	-0.118	0.217	0.579
HANDS 2*0-12 Years Education	-0.102	0.150	0.070	0.013	0.287	2.140
HANDS 2*12-16 Years Education	-0.352	-0.100	0.063	-0.225	0.024	-1.581
HANDS 2*16+ Years Education	-0.301	-0.050	0.088	-0.222	0.123	-0.561
Handler Business Structure* Experience						
HANDS 1*<10 Years	0.193	-0.059	0.080	-0.216	0.098	-0.736
HANDS 1*10-30 Years	0.171	-0.080	0.068	-0.214	0.053	-1.185

HANDS 1* 31+ Years	0.391	0.140	0.071	0.000	0.279	1.964
HANDS 2*<10 Years	-0.193	0.059	0.059	-0.056	0.174	1.002
HANDS 2*10-30 Years	-0.171	0.080	0.072	-0.060	0.221	1.120
HANDS 2*31+ Years	-0.391	-0.140	0.067	-0.271	-0.008	-2.072
Quality Premiums						
QUALPREM 1	0.178	0.178	0.095	-0.009	0.364	1.863
QUALPREM 2	-0.050	-0.050	0.103	-0.253	0.152	-0.485
QUALPREM 3	-0.127	-0.127	0.088	-0.300	0.045	-1.447
Volume Premium* Education						
VOLPREM 1*0-12 Years Education	0.221	0.138	0.106	-0.071	0.346	1.293
VOLPREM 1*12-16 Years Education	0.037	-0.047	0.106	-0.254	0.160	-0.443
VOLPREM 1*16+ Years Education	-0.007	-0.091	0.099	-0.284	0.103	-0.918
VOLPREM 2*0-12 Years Education	0.036	-0.009	0.103	-0.212	0.193	-0.091
VOLPREM 2*12-16 Years Education	-0.008	-0.053	0.103	-0.256	0.149	-0.517
VOLPREM 2*16+ Years Education	0.108	0.063	0.121	-0.174	0.300	0.519
VOLPREM 3*0-12 Years Education	-0.257	-0.128	0.087	-0.298	0.042	-1.478
VOLPREM 3*12-16 Years Education	-0.029	0.100	0.088	-0.071	0.272	1.144
VOLPREM 3*16+ Years Education	-0.101	0.028	0.123	-0.214	0.270	0.226
Volume Premiums						
VOLPREM 1	0.084	0.084	0.103	-0.118	0.285	0.813
VOLPREM 2	0.045	0.045	0.103	-0.156	0.246	0.441
VOLPREM 3	-0.129	-0.129	0.090	-0.305	0.048	-1.428
Handler Business Structure* Herd Size						
Hands 1* 0-99 Cows	0.255	0.003	0.074	-0.143	0.148	0.039
Hands 1* 100-499 Cows	0.309	0.057	0.080	-0.100	0.213	0.712
Hands 1* 500-999 Cows	0.342	0.090	0.110	-0.125	0.305	0.823
Hands 1* 999+ Cows	0.102	-0.150	0.100	-0.347	0.047	-1.496
Hands 2* 0-99 Cows	-0.255	-0.003	0.081	-0.162	0.156	-0.036
Hands 2* 100-499 Cows	-0.309	-0.057	0.080	-0.213	0.099	-0.714
Hands 2* 500-999 Cows	-0.342	-0.090	0.109	-0.303	0.123	-0.830
Hands 2* 999+ Cows	-0.102	0.150	0.088	-0.023	0.323	1.702
Quality Premium* Experience						
QUALPREM 1 * <10 Years	0.231	0.053	0.105	-0.151	0.258	0.512
QUALPREM 1 * 10-30 Years	0.202	0.024	0.089	-0.150	0.198	0.272
QUALPREM 1 * 31+ Years	0.100	-0.078	0.097	-0.267	0.112	-0.803
QUALPREM 2 * <10 Years	0.072	0.123	0.109	-0.091	0.337	1.123

QUALPREM 2 * 10-30 Years	-0.145	-0.095	0.092	-0.276	0.086	-1.031
QUALPREM 2 * 31+ Years	-0.078	-0.028	0.090	-0.204	0.149	-0.306
QUALPREM 3 *<10 Years	-0.303	-0.176	0.097	-0.366	0.014	-1.812
QUALPREM 3 * 10-30 Years	-0.056	0.071	0.097	-0.118	0.260	0.735
QUALPREM 3 * 31+ Years	-0.022	0.105	0.091	-0.074	0.284	1.152
Hauling Costs* Experience						
HAUL 1 * <10 Years	0.047	0.138	0.107	-0.071	0.347	1.293
HAUL 1 * 10-30 Years	-0.209	-0.118	0.092	-0.300	0.063	-1.282
HAUL 1 * 31+ Years	-0.110	-0.019	0.089	-0.194	0.156	-0.216
HAUL 2 * <10 Years	-0.113	-0.132	0.094	-0.317	0.053	-1.398
HAUL 2 * 10-30 Years	0.148	0.129	0.089	-0.045	0.303	1.452
HAUL 2 * 31+ Years	0.022	0.003	0.104	-0.202	0.208	0.028
HAUL 3 *<10 Years	0.066	-0.006	0.090	-0.182	0.171	-0.064
HAUL 3 * 10-30 Years	0.061	-0.011	0.096	-0.198	0.177	-0.111
HAUL 3 * 31+ Years	0.088	0.016	0.090	-0.159	0.192	0.183
Hauling Costs						
HAUL 1	-0.091	-0.091	0.097	-0.281	0.099	-0.937
HAUL 2	0.019	0.019	0.101	-0.180	0.218	0.186
HAUL 3	0.072	0.072	0.085	-0.095	0.239	0.845
Hauling Costs* Education						
HAUL 1*0-12 Years Education	-0.134	-0.044	0.103	-0.245	0.158	-0.424
HAUL 1*12-16 Years Education	-0.029	0.062	0.101	-0.136	0.261	0.613
HAUL 1*16+ Years Education	-0.109	-0.019	0.118	-0.249	0.212	-0.157
HAUL 2*0-12 Years Education	-0.027	-0.046	0.109	-0.260	0.168	-0.419
HAUL 2*12-16 Years Education	0.081	0.062	0.107	-0.147	0.272	0.583
HAUL 2*16+ Years Education	0.002	-0.017	0.123	-0.258	0.224	-0.135
HAUL 3*0-12 Years Education	0.161	0.089	0.087	-0.081	0.260	1.028
HAUL 3*12-16 Years Education	-0.052	-0.124	0.088	-0.297	0.048	-1.416
HAUL 3*16+ Years Education	0.107	0.035	0.123	-0.207	0.277	0.285
Quality Premium* Herd Size						
QUALPREM 1*1-99 Cows	0.065	-0.113	0.101	-0.310	0.085	-1.119
QUALPREM 1*100-499 Cows	0.143	-0.035	0.102	-0.235	0.165	-0.339
QUALPREM 1*500-999 Cows	0.386	0.208	0.142	-0.071	0.487	1.463
QUALPREM 1* > 1000 Cows	0.117	-0.061	0.104	-0.265	0.144	-0.583
QUALPREM 2*1-99 Cows	0.075	0.125	0.102	-0.076	0.325	1.219
QUALPREM 2*100-499 Cows	0.039	0.089	0.105	-0.117	0.294	0.847

QUALPREM 2*500-999 Cows	-0.185	-0.135	0.146	-0.421	0.152	-0.921
QUALPREM 2* > 1000 Cows	-0.129	-0.079	0.127	-0.327	0.169	-0.623
QUALPREM 3*1-99 Cows	-0.140	-0.012	0.144	-0.295	0.271	-0.084
QUALPREM 3*100-499 Cows	-0.182	-0.054	0.105	-0.259	0.151	-0.519
QUALPREM 3*500-999 Cows	-0.201	-0.073	0.143	-0.353	0.206	-0.515
QUALPREM 3* > 1000 Cows	0.012	0.140	0.126	-0.107	0.387	1.109

CI, Confidence Interval (CL) or CI, Credible Interval (HB)

Table 16. Parameter Estimates: Main Effects, Experience, Herd-size, Education (Hierarchical Bayes Adjusted) (N=200)

Attribute Level	Marginal Utility	(10,000 iterations) Posterior Mean	CI Lower 95%	CI Upper 95%
Gross Handler Pay Price				
PRICE 1	-1.151	-1.151	-1.501	-0.835
PRICE 2	-0.482	-0.482	-0.882	-0.114
PRICE 3	-0.052	-0.052	-0.417	0.340
PRICE 4	0.458	0.458	0.147	0.847
PRICE 5	1.227	1.227		
Volume Premium* Herd Size				
VOLPREM 1*1-99 Cows	-0.944	-0.865	-1.424	-0.368
VOLPREM 1*100-499 Cows	-0.408	-0.329	-0.860	0.274
VOLPREM 1*500-999 Cows	0.387	0.467	-0.479	1.245
VOLPREM 1* > 1000 Cows	0.647	0.726		
VOLPREM 2*1-99 Cows	-0.001	-0.529	-1.010	0.016
VOLPREM 2*100-499 Cows	0.389	-0.139	-0.915	0.621
VOLPREM 2*500-999 Cows	0.675	0.147	-0.960	1.146
VOLPREM 2* > 1000 Cows	1.050	0.522		
VOLPREM 3*1-99 Cows	0.945	1.393		

VOLPREM 3*100-499 Cows	0.020	0.468		
VOLPREM 3*500-999 Cows	-1.062	-0.614		
VOLPREM 3* > 1000 Cows	-1.696	-1.248		
Handler Business Structure				
HANDS 1	0.570	0.570	0.207	1.020
HANDS 2	-0.570	-0.570		
Hauling Costs* Herd Size				
HAUL 1*1-99 Cows	-0.092	0.034	-0.499	0.517
HAUL 1*100-499 Cows	-0.035	0.091	-0.501	0.912
HAUL 1*500-999 Cows	0.276	0.402	-0.360	1.137
HAUL 1* > 1000 Cows	-0.652	-0.526	-0.175	0.845
HAUL 2*1-99 Cows	0.081	0.314	-0.232	0.851
HAUL 2*100-499 Cows	0.045	0.277	-1.076	0.270
HAUL 2*500-999 Cows	-0.582	-0.349		
HAUL 2* > 1000 Cows	-0.476	-0.243		
HAUL 3*1-99 Cows	0.011	-0.348		
HAUL 3*100-499 Cows	-0.010	-0.368		
HAUL 3*500-999 Cows	0.306	-0.053		
HAUL 3* > 1000 Cows	1.128	0.769		
Quality Premium* Education				
QUALPREM 1 * 0-12 Years Education	-0.173	-0.462	-0.998	0.298
QUALPREM 1 * 12-16 Years Education	0.821	0.532	-0.173	1.065
QUALPREM 1 * 16+ Years Education	0.218	-0.070		
QUALPREM 2 * 0-12 Years Education	0.055	0.293	-0.309	0.999
QUALPREM 2 * 12-16 Years Education	0.108	0.346	-0.363	0.944
QUALPREM 2 * 16+ Years Education	-0.877	-0.639		
QUALPREM 3 * 0-12 Years Education	0.118	0.169		
QUALPREM 3 * 12-16 Years Education	-0.929	-0.878		
QUALPREM 3 * 16+ Years Education	0.659	0.709		
Volume Premium* Experience				
VOLPREM 1*<10 years	0.132	0.211	-0.306	0.833
VOLPREM 1*10-30 years	-0.249	-0.169	-0.670	0.344
VOLPREM 1*31+ years	-0.122	-0.042		
VOLPREM 2*<10 years	1.046	0.518	-0.233	1.171
VOLPREM 2*10-30 years	0.255	-0.274	-0.710	0.213
VOLPREM 2*31+ years	0.283	-0.245		

VOLPREM 3*<10 years	-1.178	-0.730		
VOLPREM 3*10-30 years	-0.006	0.443		
VOLPREM 3*31+ years	-0.161	0.287		
Handler Business Structure* Education				
HANDS 1*0-12 Years Education	0.413	-0.157	-0.665	0.407
HANDS 1*12-16 Years Education	0.676	0.106	-0.439	0.576
HANDS 1*16+ Years Education	0.621	0.051		
HANDS 2*0-12 Years Education	-0.413	0.157		
HANDS 2*12-16 Years Education	-0.676	-0.106		
HANDS 2*16+ Years Education	-0.621	-0.051		
Handler Business Structure* Experience				
HANDS 1*<10 Years	0.268	-0.302	-0.838	0.207
HANDS 1*10-30 Years	0.632	0.062	-0.374	0.571
HANDS 1* 31+ Years	0.810	0.240		
HANDS 2*<10 Years	-0.268	0.302		
HANDS 2*10-30 Years	-0.632	-0.062		
HANDS 2*31+ Years	-0.810	-0.240		
Quality Premiums				
QUALPREM 1	0.289	0.289	-0.168	0.814
QUALPREM 2	-0.238	-0.238	-0.700	0.308
QUALPREM 3	-0.051	-0.051		
Volume Premium* Education				
VOLPREM 1*0-12 Years Education	0.192	0.271	-0.218	0.835
VOLPREM 1*12-16 Years Education	0.101	0.181	-0.461	0.751
VOLPREM 1*16+ Years Education	-0.532	-0.452		
VOLPREM 2*0-12 Years Education	0.274	-0.255	-0.821	0.224
VOLPREM 2*12-16 Years Education	0.245	-0.283	-0.889	0.328
VOLPREM 2*16+ Years Education	1.066	1.514		
VOLPREM 3*0-12 Years Education	-0.465	-0.017		
VOLPREM 3*12-16 Years Education	-0.346	0.102		
VOLPREM 3*16+ Years Education	-0.534	-0.086		
Volume Premiums				
VOLPREM 1	-0.080	-0.080	-0.637	0.392
VOLPREM 2	0.528	0.528	0.150	0.882
VOLPREM 3	-0.448	-0.448		
Handler Business Structure* Herd Size				

Hands 1* 0-99 Cows	0.616	0.046	-0.503	0.524
Hands 1* 100-499 Cows	0.341	-0.229	-0.811	0.500
Hands 1* 500-999 Cows	1.053	0.483	-0.281	1.114
Hands 1* 999+ Cows	0.271	-0.300		
Hands 2* 0-99 Cows	-0.616	-0.046		
Hands 2* 100-499 Cows	-0.341	0.229		
Hands 2* 500-999 Cows	-1.053	-0.483		
Hands 2* 999+ Cows	-0.271	0.300		
Quality Premium* Experience				
QUALPREM 1 * <10 Years	0.526	0.237	-0.255	0.816
QUALPREM 1 * 10-30 Years	0.244	-0.044	-0.431	0.293
QUALPREM 1 * 31+ Years	0.096	-0.193		
QUALPREM 2 * <10 Years	-0.215	0.023	-0.453	0.496
QUALPREM 2 * 10-30 Years	-0.405	-0.167	-0.548	0.228
QUALPREM 2 * 31+ Years	-0.094	0.144		
QUALPREM 3 *<10 Years	-0.312	-0.261		
QUALPREM 3 * 10-30 Years	0.160	0.211		
QUALPREM 3 * 31+ Years	-0.001	0.050		
Hauling Costs* Experience				
HAUL 1 * <10 Years	-0.033	0.093	-0.430	0.546
HAUL 1 * 10-30 Years	-0.244	-0.118	-0.680	0.459
HAUL 1 * 31+ Years	-0.101	0.025		
HAUL 2 * <10 Years	-0.381	-0.148	-0.771	0.543
HAUL 2 * 10-30 Years	-0.038	0.194	-0.334	0.676
HAUL 2 * 31+ Years	-0.279	-0.046		
HAUL 3 *<10 Years	0.414	0.055		
HAUL 3 * 10-30 Years	0.282	-0.077		
HAUL 3 * 31+ Years	0.380	0.021		
Hauling Costs				
HAUL 1	-0.126	-0.126	-0.677	0.464
HAUL 2	-0.233	-0.233	-0.689	0.215
HAUL 3	0.359	0.359		
Hauling Costs* Education				
HAUL 1*0-12 Years Education	-0.118	0.008	-0.642	0.544
HAUL 1*12-16 Years Education	0.265	0.391	-0.239	0.977
HAUL 1*16+ Years Education	-0.525	-0.399		

HAUL 2*0-12 Years Education	-0.130	0.103	-0.551	0.790
HAUL 2*12-16 Years Education	0.091	0.323	-0.253	0.843
HAUL 2*16+ Years Education	-0.659	-0.426		
HAUL 3*0-12 Years Education	0.248	-0.111		
HAUL 3*12-16 Years Education	-0.356	-0.714		
HAUL 3*16+ Years Education	1.184	0.825		
Quality Premium* Herd Size				
QUALPREM 1*1-99 Cows	0.331	0.042	-0.543	0.594
QUALPREM 1*100-499 Cows	0.245	-0.044	-0.646	0.715
QUALPREM 1*500-999 Cows	0.435	0.146	-0.731	0.916
QUALPREM 1* > 1000 Cows	0.145	-0.144		
QUALPREM 2*1-99 Cows	-0.172	0.066	-0.476	0.589
QUALPREM 2*100-499 Cows	0.151	0.389	-0.292	1.107
QUALPREM 2*500-999 Cows	-0.903	-0.666	-1.355	0.072
QUALPREM 2* > 1000 Cows	-0.027	0.211		
QUALPREM 3*1-99 Cows	-0.159	-0.108		
QUALPREM 3*100-499 Cows	-0.396	-0.345		
QUALPREM 3*500-999 Cows	0.469	0.520		
QUALPREM 3* > 1000 Cows	-0.118	-0.067		

*HB Models including mulitple interactions are much more sensitive across iterative process- limiting the ability to obtain CI ranges for all variables.

CI, Confidence Interval (CL) or CI, Credible Interval (HB)

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