ATTRIBUTE PREFERENCES FOR BEEF ALLIANCES: A BIVARIATE NESTED PANEL PROBIT APPROACH

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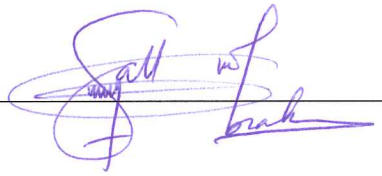
SIGNED: 

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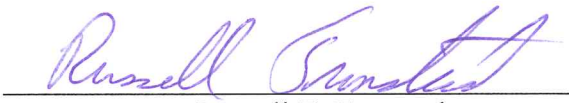 12-4-12

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Dedicated to my beloved Father who passed away on Tuesday, August 7, 2012 and to my Mother. Both have shown me what it is love and support under any circumstance and the importance of education even though my father never went to school.

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ABSTRACT

This study analyzes demographic and producers' characteristics on their willingness to participate in a beef alliance. It also investigates how attributes of a proposed beef alliance impacts producers' preferences for using one alliance over another. For this purpose a nested bivariate panel probit model is employed. Three similar surveys were conducted with Canadian producers, Arizona NASS producers and Arizona BQA producers. Results obtained suggest that cow-calf producers do have preferences when facing different alliances providing different attributes depending on their specific characteristics and their experiences. Our findings indicate that Arizona and Canadian cow-calf producers have preferences for some alliance attributes over others when asked to choose between different alliances attributes.

CHAPTER 1: INTRODUCTION

1.1 Background and Problem Statement

Since the late 1970s, the beef industry has been facing several challenges in both Canada and the United States. A substantial decrease in beef consumption and loss of market share to poultry and pork protein sources has occurred. That is, per capita consumption of beef decreased from 74.6 pounds in 1985 to 61.2 pounds in 2008, whereas during the same period per capita consumption of pork decreased slightly from 47.7 to 46.0 pounds and per capita consumption of chicken increased significantly from 36.4 to 58.8 (USDA/Economic Research Service, 2010). As Field and Taylor (2002) described, between 1980 and 1998, the market share of beef in per capita total meat expenditures fell from 53.9 percent to 39.8 percent, reducing consumer expenditures to the beef industry by $12.8 billion.

The reduction in beef consumption relative to poultry can be explained by different factors that include relative prices and changes in consumer preferences and tastes for poultry relative to beef (Gillespie et al., 2006). Health concerns associated with eating red meats and offering differentiated and more desirable products that meet the new expectations of the consumers relative to their tastes and preferences is also an issue for the beef industry (Gillespie et al. 2006; Schroeder and Kovanda, 2003). Relative improvements in the quality and consistency of chicken compared to beef products are also cited as important contributing factors (Purcell, 2000; Schroeder et al., 2000). On the other hand, increases in production efficiency and reductions in marketing costs through vertical integration for poultry and pork have allowed these industries to be price competitive with beef (Gillespie et al. 2006).

In contrast, the beef industry is characterized by a lack of coordination between its stages of production, making it difficult to convey consumer preferences from the retail market place to each link in the production chain (Lamb and Beshear, 1998). Ward (2002, P.1) argues that "the vertical beef production-marketing channel is complex and segmented" and "this segmentation potentially creates impediments to the efficient flow of information up and down the production-marketing channel." Challenges faced by the beef industry will be discussed in more details in chapter two.

To overcome challenges they are facing, beef industry stakeholders have considered several approaches that would make them more competitive. Some authors and researchers have suggested that better coordination in the beef industry would increase efficiency and reduce costs, thus provide more uniform products that are consistent with consumer preferences and more competitive prices (Gillespie et al., 2006; Lamb and Beshear, 1998). In that way the beef industry would be able to reduce their loss in market share and declining beef demand relative to competitors.

In response to meeting consumer preferences and the economic opportunities associated with it, strategic vertical alliances have started to take place among beef producers as an alternative way to come up with a better coordination in the beef industry (Purcell and Hudson. 2003). The beef industry has been interested in exploring strategic alliances and other types of formal vertical arrangements, which are considered by some to be "the beef industry's answer to a long-term decline in beef demand, unclear price signals, and lack of adequate profitability" (Ward, 2002). Strategic alliances that vertically integrate beef production and the marketing chain which enable cow-calf producers and/or stocker/grower operators to retain ownership of their cattle through slaughter are gaining

interest" (Schroeder and Mark, 2000).

One of the purposes of the formation of alliances among cow-calf producers is to provide members with information about products and markets that are not necessarily efficient in cash market transactions and to work for mutual benefits. This information sharing can lead to more efficient information flows and "alliance participants can respond more quickly and correctly to clearer market signals" (Ward, 2002).

1.2 Hypothesis

In line with the objectives of this study, specific hypothesis to be examined include:

(1) What are the characteristics of producers that are amenable to a more coordinated beef supply chain (Jorgensen, 2009)? Demographics such as beef income from operation, education, experiences, and age are hypothesized to have a significant impact on their decision on joining an alliance. For example it is hypothesized that larger producers who rely more on cattle for their household income are more likely to join an alliance and use recommended management practices than smaller producers who are less dependent on cattle income.

(2) Before committing to be part of an alliance, producers, have different motivations and incentives to choose a specific beef alliance as an alternative marketing organization. Producers' behavior decisions can be explained by their desire to reduce transaction costs and to look for better niches allowing more valued grid-prices. Attributes contained in different alliance arrangements (profit sharing, data sharing, production protocols and participation fees) are hypothesized to have significant impacts in the producers' choice when facing alternative alliances. For example, the presence of retained ownership or profit sharing in an alliance is

hypothesized to have an effect on the choice of one alliance versus another.

(3) The interaction between alliance participation fees with their type of operation (e.g. cow-calf only), how their calf crop is generally sold (e.g. sold as weaned calves, sold as preconditioned calves and retained ownership) and the cost of production information collected are hypothesized to have an impact in choice of an alliance for producers.

1.3 Objectives

The overall objective of this study is to extend of the work by Lan (2006) and Jorgensen (2009) regarding cow-calf producers in Alberta and Arizona on their willingness to join an alliance and the type of alliance they would chose. Further investigations will be done using different approaches that will take into account individual characteristics, some interaction terms and different estimation methods. Recommendations will be given based on results of the study.

Three steps will be taken to empirically test our different hypotheses:

1. A simple probit model will be used to address the question regarding the willingness of producers to join an alliance using demographic variables only.
2. A panel probit model will be used in a second step to take into account the individual decisions relative to the four choices they were given to choose between different attributes contained in two different alliances. In this stage, variables of demographics, alliance attributes and interaction terms between alliance participation fees and demographics are used to make inferences.
3. The last step in my modeling combines the two previous models using a bivariate nested panel probit model that simultaneously estimates the first stage and second

stage models above.

4. Finally, my thesis will compare and contrast the results obtained with prior analyses and different stages of the analyses. Inferences and recommendations will be made based on the results obtained.

1.4 Overview of Thesis

The subsequent parts of this thesis are organized as follow: Chapter Two discusses an overview of the beef industry in the United States and Canada in terms of performance and governance structure. Also a literature review of vertical coordination and beef alliances in the beef industry is provided. Finally, the chapter briefly reviews transaction cost theory, agency theory, incomplete contract and property rights theory and their links to beef alliances. Chapter Three resumes the theoretical approach used to analyze the hypotheses made in this thesis. The choice preferences theory (stated preferences and revealed preferences) is explored and linked with the random utility theory and discrete choices models (probit, panel probit and bivariate nested panel probit). Chapter Four discusses the survey used for the empirical study, its implementation, design and procedure. In addition, summary statistics and graphical interpretations of the data used in the models are provided. Chapter Five discusses the model specification, econometric estimation procedure and empirical results. Finally, Chapter Six consists of the summary of empirical results, concluding remarks, limitations and recommendations for further studies on the research topic.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Section 2.2 of this chapter provides a brief overview of North America's Beef Industry. Section 2.3 explores the governance structure of the beef industry. The following section of 2.4 focuses on an overview of strategic beef alliances. Section 2.5 explains the relationship between transaction theory and beef alliances and section 2.6 the connection between principal-agent theory and beef alliances. Finally, section 2.7 concludes the chapter.

2.2 Overview of the Performance of North America's Beef Industry

The beef industry is an important value added enterprise in both the United States and Canada. Beef cattle represent the largest single enterprise source of cash receipt for agriculture (USDA NASS 2007, Statistics Canada 2005). However despite this importance, the beef industry is facing challenges related to beef demand and market share with other competing meats. In this section we will provide a brief overview of the performance of beef industry in both the United States and Canada.

2.2.1 The United States

The United States in 2007, with 26.4 billion pounds of beef produced, added approximately $66 billion dollars to the United States economy (USDA ERS *Farm Income and Costs* 2009, Beef Market 2007). However this value even though is important represents a decrease 3.34% from 2005. The jump in U.S. dairy and poultry cash receipts in 2007 is cause for the percentage decrease of beef cash receipts compared to total farm cash receipts (Jorgensen 2009).

In 2007 1,431 million pounds of beef and veal were exported by the United States representing an increase of about 20% over 2006, with a total of 1,144 million pounds were

exported (USDA ERS *U.S. Beef and Cattle Industry* 2008). The United States is also a big importer of beef with 3,164 million pounds of beef and veal imported in 2007, representing 435 million pounds less than in 2005, but 79 million pounds more than in 2006.

As described in table 2.1 in 2007 there were 96.573 million head of cattle in the United States as of January 1, 2007. That inventory is divided into beef cows, milk cows, heifers (beef, milk and other), steers, bulls and calves.

Table 2.1: ***United States Cattle and Calves January 1st Inventory by Class, 2006-2011***

Cattle and Calves: Number by Class and Calf Crop, United States, January 1, 2006- 2011						
Class	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
	1,000 Head					
Cattle and Calves	96,341.5	96,573	96,034.5	94,521	93,881.2	92,582.4
Cows and Heifers That Have Calved	41,806.4	41,788.7	41,691.5	41,044.6	40,456.4	40,014.2
Beef Cows	32,702.5	32,644.2	32,434.5	31,711.8	31,370.9	30,864.6
Milk Cows	9,103.9	9,144.5	9,257	9,332.8	9,085.5	9,149.6
Heifers 500 Pounds and Over	19,949.9	20,074.1	19,854.2	19,575.5	19,745.8	19,532.8
For Beef Cow Replacement	5,863.5	5,835.4	5,646.6	5,531.2	5,451	5,157.6
For Milk Cow Replacement	4,298	4,324.9	4,415	4,409.5	4,526.2	4,557.2
Other Heifers	9,788.4	9,913.8	9,792.6	9,634.8	9,768.6	9,818
Steers 500 Pounds and Over	16,988.1	17,184.5	17,163.2	16,769.1	16,510.4	16,382
Bulls 500 Pounds and Over	2,257.8	2,214.4	2,207.2	2,184.1	2,190.1	2,153.1
Calves Under 500 Pounds	15,339.3	15,311.3	15,118.4	14,947.7	14,978.5	14,500.3
Calf Crop 1/	37,015.7	36,758.7	36,152.5	35,939	35,684.8	

1/ January to December calf crop.
Source: National Agricultural Statistics Service.
United States Cattle: Released February 17, 2011, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Department of Agriculture.

However, the number and size of beef cow operations have shown decline through the years, with the number of cowherds less than 100 cows accounting for 90% of herds (Table

2.2). These small herds represent about 45% of total beef cows. For large herds we can see that they are barely representative with less than one percent of total herds but accounting for 16% of total cow inventory (McGrann, J. 2010).

Table 2. 2 Number of Beef Cattle Operations, Herd Size and Percent of Inventory by Size

Year	Beef Cow Operations	Average Herd (Hd)	Percent of Operations by Herd Size (Head) 1 - 49	50 - 59	1 - 99	100 - 499	>500
1995	897,660	39.3	79.8	11.8	**91.6**	7.8	0.6
2000	831,270	40.2	78.8	12	**90.8**	8.5	0.7
2005	770,170	42.5	77.5	12.3	**89.8**	9.5	0.7
2007	766,350	42.3	79.1	11.2	**90.3**	8.9	0.8
			Percent of Inventory by Herd Size (Head)				
1995	897,660	39.3	31.2	19.2	**50.4**	35.3	14.3
2000	831,270	40.2	29.5	19.1	**48.6**	36.7	14.7
2005	770,170	42.5	28.0	18.9	**46.9**	38.5	14.6
2007	766,350	42.3	28.7	17.2	**45.9**	38.0	16.1

Source: USDA – Economic Research Service USDA – National Agricultural Statistics Service

2.2.2 Canada

According to Statistics Canada (2005), Canada's beef industry with sale calves representing $6.4 billion (17.34% of total farm cash receipts), is the largest single commodity source of farm cash receipts for Canada agriculture. In addition beef production addes about $25 billion to Canada's economy with a production of 3.5 billion pounds of beef (CanFax, 2006).

For cattle inventory, the Canadian beef industry produced 14.8 million head of cattle in late January 2006 (CanFax, 2006). The distribution of this inventory is shown in table 2.3 in addition to feeding operations.

Table 2.3 Canadian Beef Inventory by Province, Eastern & Western Canada and Canada January 2006

Location	Cow-calf Operations	Percentage of Total Inventory	Feeder, Stocker/Finish Operations	Percentage of Total Inventory	Feeding Operations	Percentage of Total Inventory
	1,000 Head		1,000 Head		1,000 Head	
Atlantic	93.1	1.02%	43.9	2.34%	25.3	1.60%
Québec	419.1	4.59%	72.8	3.89%	85.5	5.42%
Ontario	761.1	8.33%	222.9	11.90%	312	19.77%
British Columbia	448	4.90%	57.8	3.09%	21.5	1.36%
Manitoba	1154.6	12.63%	196.1	10.47%	61	3.86%
Saskatchewan	2592.9	28.37%	203.8	10.88%	98.5	6.24%
Alberta	3670.7	40.16%	1075.6	57.43%	974.5	61.74%
Eastern Province	1273.3	13.93%	339.6	18.13%	422.8	26.79%
Western Province	7866.2	86.07%	1533.3	81.87%	1155.5	73.21%
Canada	9139.5	100.00%	1872.9	100.00%	1578.3	100.00%

Source: CanFax, Statistics Canada (2006) taken from Lan (2006)

As we can see in Table 2.3, Alberta is the largest beef production province, followed by Ontario, Saskatchewan, Manitoba, and British Columbia. According to Steckle (2004), Alberta by itself accounted for over 40% of Canada's beef in contrast the three Prairie Provinces accounting for over 80% of the country's beef cowherd. Steckle (2004) explains this disparity shown by the geographic distribution mentioned above, is due essentially to climatic conditions.

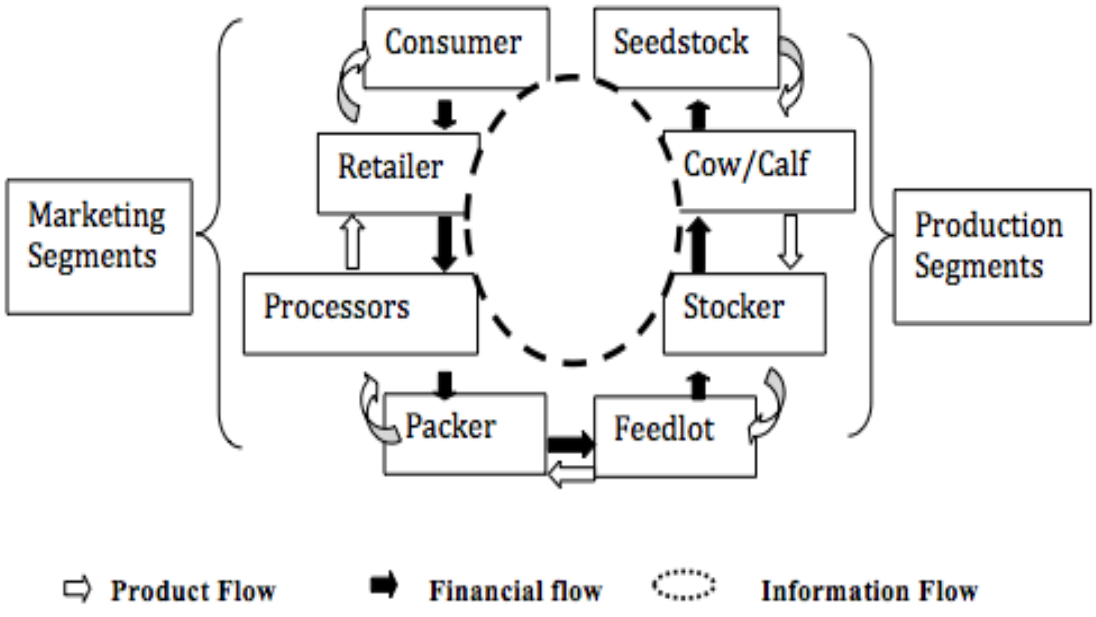
"Since 1986, Alberta's cattle industry has experienced steady growth …and could be paralleled with the sizeable investments made in the local cattle feeding industry and beef processing facilities" (Lan, 2006).

2.3 Governance Structure of the Beef Industry

According to Huang and Sheu (2005) the U.S. beef supply chain can be divided in eight distinct segments which are: seedstock breeders, cow/calf producers, stocker operators, feedlot operators, packers, processors, retailers, and consumers (Steckle 2004, Huang and Sheu. 2005). Each of the segments plays a specific role in the market.

Following Huang and Sheu (2005), Lan (2006) and Jorgensen (2009), this thesis reviewed the segments of production that represent an important part in the governance structure of the beef industry. This will help later to better understand the structure of the segments of production and the challenges faced. The different links in the beef industry constituting the structure of the beef supply chain are shown in the figure below (Figure 2.1).

Figure 2.1 Structure of Beef Supply Chain



Source: Huang and Sheu (2005) taken from Jorgensen (2009)

The study will focus on the following four stages of beef production where we have cow-calf or ranching operation, backgrounding (stocker operations), finishing (feedlot) and packing (processor).

Cow-calf or Ranching Operations:

Considered as the first stage of the beef production chain, cow-calf operations or ranchers have a principal role of keeping cowherds and then supplying weaned calves for production. The selections with regard to cows are made depending on their mothering ability, beef quality traits and other traits as well before they are mated in early summer and then be expected to be calved the next spring. Calves are weaned from their mothers when they reach about 500 pounds. Then they will be either retained on the ranch or sold to backgrounding/ feedlot operations (Steckle 2004, Lan 2006 and Jorgensen 2009).

Backgrounding/Stocker Operations:

Being the second stage in the beef production, backgrounding operations can be defined "as growing, feeding, and managing steers and heifers from weaning until they are ready for a high concentrated finishing ration" (Saskatchewan Agriculture and Food 2000). Backgrounding operators will keep grazing calves for 10 to 16 months. After that, they sell the calves directly to feedlot operations or they keep the calves and feed or finish them on grain (USDA ERS *Agricultural Outlook* 2002). Lan (2006) argued that backgrounding is a fundamental industry linking the cow-calf segment (producing weaned calves) to the finishing segment (producing slaughter cattle).

Feedlot Operations:

In this stage of production, the feedlot operators, will purchase cattle or weaned calves from cow-calf or backgrounding operations. Calves with a weaning weight varying between 600 and 800 pounds are fed with a high-energy finishing ration consisting of forages or grains until they a weight approximately 1,200 to 1,400 pounds. Depending on their weight, into the feedlot, steers and heifers are fed 4 to 6 months to finish them or fatten them before slaughter. After that they are slaughtered, they are sold to beef packers for processing. According to USDA ERS *Agricultural Outlook* (2002), feedlot operations are usually larger farms or full-time small farms.

Seedstock Breeders:

Seedstock breeders are crucial to the beef production chain. They are in charge of beef quality traits such as birthing weights, calving ease, and several other traits that could never be achieved. Seedstock breeders allow artificial insemination and/or the bull breeding animals by supplying the semen and embryos to be utilized for that purpose.

2.4 Overview Strategic Beef Alliances

Gillepsie et al. (2006) argued that the U.S beef industry could be described accurately to be producing a commodity product rather than a branded, differentiated product. Now we are assisting to the emergence of more branded bee products even though it remains limited by the different challenges that the beef industry is facing. Schroeder and Kovanda, (2003) emphasized that this situation is due to the lack of product differentiation and to the resistance operated by some retailers.

Many authors have agreed that these limitations could be addressed in the beef industry by implementing a better organization through greater vertical and horizontal

coordination. And they suggest strategic alliances to be a way through which the lack of coordination in the beef industry could be overcome (Gillespie et al. (2006), Schroeder Kovanda and (2003), Tronstad and Unterschultz (2005)). Sporleder (1992, p. 533) defines strategic alliances as "purposive strategic relationships between independent firms that share compatible goals, strive for mutual benefits, and acknowledge a high level of mutual dependence."

Strategic alliances have been formed in the beef industry to synchronize activities among producers, as well as among other industry segments. Several studies inquired about strategic alliances in the beef industry and among them, Schroeder and Kovanda (2003), who investigated the motivations and projections for strategic alliances. Also Tronstad and Unterschultz (2005), studied strategies of firms throughout the beef supply chain, and "assessed how coordination improved the ability to react to changing consumer tastes and preferences" (Gillespie et al (2006)).

Therefore, we can see that strategic alliances may be helpful to the beef industry in term of competitiveness by providing products that take into account consumers tastes and preferences.

In addition, cow-calf producers can benefit from strategic alliances since it may provide them "new calf market outlets, higher calf prices, and greater access to information that would help them make profit-maximizing decisions".

Gillespie et al. (2006) in their studies of different type of alliances concluded that alliance producers have greater access to data that contribute helping them make decisions that allow them to maximize their profit and also they can have the opportunities to access the markets through which their animals will be valued with the highest prices.

However as Raper et al. (2005), found in their study, joining an alliance does have some obstacles related to cattle genetics, cattle quality, production requirements, size of operation, and animal health restrictions. Table 2.4 below provides a summary of their findings when they conducted a survey asking producers what changes would need to be made before they would join an alliance.

TABLE 2.4 PRODUCER RESPONSES TO PRODUCTION CHANGES REQUIRED TO PARTICIPATE IN ALLIANCES

Ranking	Most Frequent Changes Required	Greatest Challenges	Most Help From Alliance
1	Animal health practices	Sorting methods	Feeding methods
2	Cattle tracking/information systems	Cattle tracking/information systems	Animal health practices
3	Marketing schedule	Marketing schedule	Cattle tracking/information systems
4	Feeding methods	Feeding methods	Type of performance data collected
5	Type of performance data collected	Type of performance data collected	New genetics
6	New genetics	New genetics	Marketing schedule
7	Sorting methods	Animal health practices	Sorting methods

Source: Ward and Raper (2008) taken from Jorgensen (2009)

2.5 Transaction Costs Economics (TCE) and Beef Alliances

Transaction cost theory refers to the behavioral assumption named bounded rationality and opportunism. The main idea of this theory is to minimize cost by organizing efficiently the transactions between the several stages in the beef production.

Child and Faulkner (1998), characterize transaction costs as those costs that arise when arranging, managing, and monitoring transactions across markets, including the negotiation cost, search and information costs.

As stated by Lan (2006), Hobbs (1997) has investigated transaction cost variables that have a significant effect on cattle-breeders' decision of whether to sell deadweight, direct-to-packer or live weight, including live-ring auctions. She used the transaction cost theory to investigate the reason pushing producers to choose one distribution channel over another in the United Kingdom. In another study relevant to the objectives of this present study, Brocklebank and Hobbs (2004) used the transaction cost theory framework to investigate the attributes of different types of beef supply chain alliance. They used conjoint analysis to analyze different product (service) attributes and their contribution in the appearance of specific transaction characteristics (assets specific investments, uncertainty and frequency). As we can see, one could expect the producers to be influenced by the presence of the named asset with regard to their willingness to join an alliance (Lan (2006), Jorgensen (2009)).

Another contribution of the transaction cost theory to beef alliance research would be the certainty producers may have to face and inherent to transactions. Thus from the transaction cost it could be implied that alliances would be better off if they operate with fewer partner involved. In contrast to the latter possible contribution of the transaction cost theory, Brocklebank and Hobbs (2004), in their study found that the number of buyers/sellers present in a particular market has no significant impact on the cow-calf producers' willingness to participate in the branded program and beef alliance. This shows that the transaction cost theory, even though it can provide some insights with regard to the possible motivations for beef producers to participate in an alliance, it has some limitations when it comes to measure or evaluate uncertainty related to prices.

2.6 Incomplete Contracts, Principal Agent Theory and Beef Alliances

Another theory that can help in beef alliance research to complement transaction cost is agency theory. In their study of crop production contracts, Lajili, et al. (1997), in addition to the transaction cost theory, used agency theory to investigate farmers' preferences for contract terms. They found that asset specificity and individual characteristics have a significant impact on the farmers' preferences for rates of cost sharing, price premiums, and financing arrangements.

This theory focused on principal and agent, a risk neutral principal (owner) and a risk-averse agent (user). Some authors suggest three inherent to principal-agent problem: adverse selection problem, moral hazard problem and signaling problem.

The signaling problem is a situation that is related to the adverse selection problem. In the former, the agent can send a signal that is observed by the principal after learning the characteristics of the agent (Macho-Stadler and Pérez-Castrillo 2001). Therefore, the agent can adopt actions before signing the contracts to influence the beliefs of principals about the agents' identity. The optimal contract scheme contains appropriate incentives for the agent to behave, or create output, in such a way that maximizes the returns to the principal and total surplus of both parties.

According to Brown and Vukina (2001), the principal- agent problem can be solved by supposing that the principal selects the reward function that maximize his expected profits, while the agent chooses his effort to maximize his expected utility, given the structure of his reward function. According to Lan (2006) and with regard to beef alliances, the theory of incomplete contracts approach is relevant to the beef alliance research, "since the issue of residual rights of control relates directly to the marketing problems of various

forms of formal beef alliances." This implies also that the boundaries of asset ownership and the incentives related to them can help distinguish beef alliances.

2.7 Conclusion

This chapter briefly examines the beef industry in the United States and Canada. It also highlighted the traditional beef supply chain showing the different production stages. It also provided some insights with regard transaction cost economics and agency theory and their use in strategic alliances.

CHAPTER 3: THEORETICAL MODELING AND APPROACH

3.1 Introduction

In this chapter, the theoretical approaches used to analyze the hypotheses made are presented. Section 3.2 provides an overview regarding revealed preference and stated preference models. In section 3.3 random utility theory framework is presented. Finally, section 3.4 describes and explains the binary choices analyzed and section 3.5 gives concluding remarks.

3.2 Revealed Preference and Stated Preference: An overview

As mentioned by Abley (2000), the term revealed preference is first attributed to Samuelson (1938) who implied that an individual's behavior is perceived as a series of choices. He also suggested that an individual's preferences (or utility function) are inferred when we compare available alternatives with observed behavior. Consequently, revealed preference theory has been developed for the purpose of allowing the estimation of choice models. The data obtained through this methodology (more details can be found in McFadden (1973)) are gathered using direct observation, or in surveys by asking respondents their actual behavior.

Revealed preference (RP) and the stated preference (SP) methods have been used in psychometric and market research modeling, respectively. The purpose of their use is to analyze individual preferences or choice studies (Hensher et al. 1988; Hensher et al. 1993; Batsell and Louviere 1991). The RP techniques, such as hedonic price analysis, use people's decisions to model their preferences and exploit those in both market and non-market contexts, the SP techniques on the other hand, such as contingent behavior and choice experiments, ask individuals questions in order to extract their preferences for a

good or service, without requiring their acts to correspond to their responses. (Loureiro et al. 2003, Abley 2000)

Based on actual behavior, the revealed preference data make the techniques limited when it comes to forecast demand for new services. This was one of the reason why "researchers looked for new methods of estimating consumer utility functions, and so forecast demand (Abley, 2000)". One of those new methods is the stated preference technique used in our study.

Following Loureiro et al. (2003), stated preference methods are generally criticized because they are based on questions that are hypothetical and the fact that the actual behavior cannot be observed (Cummings et al., 1986; Mitchell and Carson 1989). On the other hand, Adamowicz et al. (1994) had the same attitude with regard to RP methods pointing out that the hypothesis made may not be testable and also that the RP methods can be affected by colinearity among attributes.

According to Adamowicz et al. (1994), stated preference techniques referred to as "experimental or stated choice analysis" or "conjoint techniques," are widely used in the research literature of marketing and applied decision. The case of McFadden (1986) who used this approach in market research and economic analysis is an example of its application. Adamowicz et al. (1994) also indicated "stated preference approaches involve asking respondents to rank or judge attributes or products or asking respondents to choose from hypothetical choice sets." Also as mentioned by Lan (2006) and Jorgensen (2009) and concerning research on agricultural policies, Roe and Randall (2002) recommend the use of stated preference mechanisms to derive tradeoffs that famers are disposed to make between actual and future farm programs. The compromises and the welfare they are associated

with can be derived from econometric estimation of discrete choice data.

As stressed above, for this study the stated preference techniques were used to design a questionnaire and derive a comprehensive survey. Therefore the data, obtained following the hypothetical choice-based experiment, are used to parameterize the analysis of beef producers' characteristics, perceptions, and choices affecting their willingness to join an alliance and their attribute preferences of an alliance.

3.3 Random Utility Theory

Discrete choice models are known to be reliable for the analysis of choice experiments. According to Greene (2008), "the random utility model of discrete choice provides the most general platform for the analysis of discrete choice. The extension of the classical theory of utility maximization to the choice among multiple discrete alternatives provides a straightforward framework for analyzing discrete choice in probabilistic, statistical, ultimately econometric terms."

Schulz (2008) and Hensher et al (2005) argued respectively that the set of feasible alternatives the producers may choose when facing a set of choices can be identified using models based on random utility and the utility that one derives from a good or service is presumed to dependent on its characteristics or attributes. Following Lan (2006) and subsequent to Ben-Akiva and Lerman (1985), Kolstad and Braden (1991), Louviere (1994) and Adamowicz et al. (1994), a general random utility function can be expressed as;

$$U_{in} = V\left(X_{in}\right) + e_{in} \qquad \textbf{(3.1)}$$

Where, U_{in} is person n's utility of choosing alternative i, V_{in} is indirect utility, X_{in} is a vector of attribute values for alternative i as viewed by respondent n, and e_{in} is a random element. In general, if the utility of alternative i (U_{in}) is equal or greater than the utility of

alternative *j* (U_{jn}) in the choice sets, the choice probability of alternative *i* can be written as follows:

$$\Pr_n\left(i \mid C_n\right) = \Pr\left[U_{in} \geq U_{jn},\ "\ j \in C_n\right] \quad \textbf{(3.2)}$$

$$\Pr_n\left(i \mid C_n\right) = \Pr\left[V_{in} + e_{in} \geq V_{jn} + e_{jn},\ "\ j \in C_n\right] \quad \textbf{(3.3)}$$

Where C_n denotes the choice set for respondent *i*.

The use of a random utility framework allows the specification of utility functions that take into account the hypotheses made with regard to individual responses. We will use this framework in the following section to derive analyze and estimate our discrete choice models considering the beef alliance participation (Probit model) and the producers' alliance preferences (Panel_Probit model and Bivariate nested panel probit model).

3.4 Discrete choice Models

With regard to choice experiments, the two most commonly used forms specify the error term as either a normal distribution (probit model) or the Weilbull or Type I extreme value distribution (logit models) (Lan, 2006). Probit models, unlike logit models, can handle random taste variation since they allow for any pattern of substitution and are applicable to panel data with temporally correlated errors (Train, 2002).

3.4.1 Probit Models

Derived considering the assumption of jointly unobserved utility components, the probit model's first derivation by Thurstone (1927) used the terminology of psychological stimuli. This was later transformed by Marschak (1960) into economic terms as utility (Train, 2002).

Following Nakosteen and Zimmer (1980), an agent's utility of two choices can be denoted as U_j and U_{nj}. Greene (2000) explained that if alternative A has a greater utility

(U_j) for the respondents then $U_j > U_{nj}$ and we have the observed indicator equals 1 if $U_j > U_{nj}$ and 0 if $U_j \leq U_{nj}$. Where, *j* is joining an alliance and *nj* indicates not joining an alliance

$$Pr(Y = 1 | X) = \Pr(U_j > U_{nj}) \quad \textbf{(3.4)}$$

$$= Pr(X\beta_j + \varepsilon_j - X\beta_{nj} - \varepsilon_{nj} > 0 | X)$$

$$= Pr(X(\beta_j - \beta_{nj}) + \varepsilon_j - \varepsilon_{nj} > 0 | X)$$

$$= Pr(X\beta + \varepsilon > 0 | X)$$

As a result, the dependent variable for the first choice model (alliance participation model) is defined such that:

$$Y_i = \begin{cases} 1 & \text{Yes, I am willing to participate in an alliance under certain circumstances} \\ 0 & \text{No, I am not willing to participate in an alliance under any circumstances} \end{cases}$$

The probabilities associated with this choice are:

$$\Pr(\text{willing to participate in an alliance under certain circumstances}) = Pr(Y_i = 1)$$

$$\Pr(\text{not willing to participate in an alliance under any circumstances}) = Pr(Y_i = 0)$$

For the first stage or estimation of whether an individual is willing to consider joining an alliance under any circumstances or not, the probit model is specified and presented as follow:

$$Y_i^* = \beta_0 + \sum_{i=1}^{k} \beta_j X_{ij} + \mu_i \quad \textbf{(3.5)}$$

Where Yi* is the latent variable which is not observed, μi the distribution of the error assumed to be normally distributed and β' s are coefficients that will be estimated.

We observe Y_i defined by Y_i ={1 if Y_i*>0, 0 otherwise). Y_i indicates whether the producer

is willing or not to participate in an alliance (Maddala, 1992 and Wooldridge, 2003).

3.4.2 Panel Probit Models

The probit model with repeated choices is similar to the probit with one choice seen previously, with the only difference being the expansion of the dimension of the covariance matrix of the errors (Train, 2002). Following Train (2002) and considering our survey where the producer faces a choice among J alternative beef alliances (J = alliance A or alliance B) in each of T (T= 4) choice situations, the alternatives, being differentiated only by the attributes they contain and not by the labels, can change over the choice situations allowing the possibility for J and T to differ from a producer to another. We will use the random effects probit model to represent and analyze the choice experiment.

As mentioned by Maddala (1987), Heckman and Willis (1976) were the first to utilize an empirical application random effects probit model. Following their model, as well as Wooldridge (2002) and Yoo (2008), the specification below can be used to represent the producers' behavior with regard to the different sets of choice they are facing:

$$Y_{it}^{*} = \gamma' X_{it} + \alpha_i + \mu_{it}\ ; \qquad Y_{it} = \begin{cases} 1 & Y_{it}^{*} > 0 \\ 0 & Y_{it}^{*} \leq 0 \end{cases} \qquad \text{i = 1,2,....N and t = 1,....,4} \tag{3.6}$$

Y_{it} is a dichotomous variable indicating whether a producer selected alliance A or Alliance B. X_{it} represents the explanatory variables, and ε_{it} is a scalar error term controlling the effects not captured by the explanatory variables (Bertschek, 1998). Let $\varepsilon_{it} = \alpha_i + \mu_{it}$ where α_i are individual specific error term and μ_{it} is general error term. We also assume a mean of $E(\alpha_i \mid Xi) = E(\mu_{it} \mid Xi) = 0$ and variance of $Var(\varepsilon_{it} \mid Xi) = \sigma^2_{\alpha} + \sigma^2_{\mu}$

3.4.3 Nested Bivariate Probit Models

Considering our survey design where a cow-calf producer is asked the question: are you willing to join an alliance under certain circumstances? Respondents who answer "yes" are given T (T=4) more binary questions regarding which type of alliance they would choose knowing the attributes they contain. However, the respondents who answered "no" to the initial question are not asked additional questions. Therefore, for these latter respondents we have only one observation whereas for those who answered "yes" have four more observations.

The model could be considered as a combination of the two previous models using a bivariate nested panel probit model that simultaneously estimates the first stage and second stage models above. Following Aradhyula and Tronstad (2011), the resulting bivariate Probit model may be used to represent the producers' alliance choice behavior:

$$y_{1i}^{*} = \beta_1' X_{1i} + e_i \; ; \qquad y_{1i} = \begin{cases} 1 & y_{1i}^{*} > 0 \\ 0 & y_{1i}^{*} \le 0 \end{cases} \qquad i = 1,2,....N \qquad \textbf{(3.7)}$$

$$y_{2it}^{*} = \beta_2' X_{2it} + \eta_i + \varepsilon_{it} \; ; \qquad y_{2it} = \begin{cases} 1 & y_{2it}^{*} > 0 \\ 0 & y_{2it}^{*} \le 0 \end{cases} \qquad i = 1,2,....N \text{ and } t = 1,....,T \qquad \textbf{(3.8)}$$

where, N represents number of individuals, T represents number of choice sets given to producers, y_{1i}^{*} and y_{2it}^{*} are unobserved latent variables corresponding to y_{1i} and y_{2it}, e_i and η_i represent the individual specific error terms, and ε_{it} is general error term.

Let $e_{it} = \eta_i + \varepsilon_{it}$. The error terms are assumed to have the following distribution:

$$\begin{pmatrix} e_i \\ \eta_i \end{pmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho\sigma_\eta \\ \rho\sigma_\eta & \sigma_\eta^2 \end{bmatrix} \right) \qquad \textbf{(3.9)}$$

$$\varepsilon_{it} \sim N(0,1) \qquad \textbf{(3.10)}$$

We will assume that η_{it} is independent of ε_i and μ_i. ρ is the correlation coefficient between ε_i and μ_i. Because ε_i and μ_i are bivariate normal, the conditional distribution $\varepsilon_i \mid \mu_i$ is also normal and is given by:

$$\varepsilon_i \mid \mu_i \sim \mathrm{N}\left(\frac{\rho}{\sigma_m} \mu_i, \quad 1 - \rho^2 \right) \tag{3.11}$$

If $\rho = 0$ then equations **(3.7)** and **(3.8)** can be estimated separately with no loss of efficiency. Also, if $\sigma_m^2 = 0$ implying no random effects then parameters in **(3.8)** can be estimated as a standard pooled probit.

As in a standard probit model described above, the probability for a respondent to not join an alliance is $prob(y_{1i} = 0) = \Phi\left[-\beta_1' X_{1i} \right]$ and the probability for a respondent to join a alliance $prob(y_{1i} = 1) = \Phi\left[\beta_1' X_{1i} \right]$.

In our model we need to include the likelihood function of the respondents who answered they are not willing to join an alliance (with $y_{1i} = 0$) and were not asked further questions regarding the alliance preferences. For respondents who answered yes, they are willing to join an alliance under certain circumstances (with $y_{1i} = 1$), the joint probability $prob(y_{1i} = 1, Y_{2i1}, Y_{2i2}, Y_{2i3}, Y_{2i4})$ will be evaluated. The joint density for this probability is calculated as follow:

$$\begin{pmatrix} \varepsilon_i \\ \varepsilon_{i1} \\ \varepsilon_{12} \\ \varepsilon_{i3} \\ \varepsilon_{14} \end{pmatrix} = \begin{bmatrix} \varepsilon_i \\ \mu_i + \eta_{i1} \\ \mu_i + \eta_{i2} \\ \mu_i + \eta_{i3} \\ \mu_i + \eta_4 \end{bmatrix} \sim N \left(0, \begin{bmatrix} 1 & \rho\sigma_m & \rho\sigma_m & \rho\sigma_m & \rho\sigma_m \\ \rho\sigma_m & 1+\sigma_m^2 & \sigma_m^2 & \sigma_m^2 & \sigma_m^2 \\ \rho\sigma_m & \sigma_m^2 & 1+\sigma_m^2 & \sigma_m^2 & \sigma_m^2 \\ \rho\sigma_m & \sigma_m^2 & \sigma_m^2 & 1+\sigma_m^2 & \sigma_m^2 \\ \rho\sigma_m & \sigma_m^2 & \sigma_m^2 & \sigma_m^2 & 1+\sigma_m^2 \end{bmatrix} \right) \tag{3.12}$$

We will assume that η_{it} is independent of ε_i. Also $\varepsilon_i \mid \mu_i$, $\varepsilon_{i1} \mid \mu_i$, $\varepsilon_{12} \mid \mu_i$, $\varepsilon_{i3} \mid \mu_i$ and

$e_{14} \mid \eta_i$ are independent and the joint distribution they are associated with is as follow:

$$\begin{pmatrix} e_i \mid \eta_i \\ e_{i1} \mid \eta_i \\ e_{12} \mid \eta_i \\ e_{i3} \mid \eta_i \\ e_{14} \mid \eta_i \end{pmatrix} \sim N\left(\begin{bmatrix} \frac{r}{s_m}\eta_i \\ \eta_i \\ \eta_i \\ \eta_i \\ \eta_i \end{bmatrix}, \begin{bmatrix} 1 - \frac{s_{12}^2}{s_m^2} & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \right) \quad \textbf{(3.13)}$$

The probability of the joint distribution is $prob(y_{1i} = 1, Y_{2i1}, Y_{2i2}, Y_{2i3}, Y_{2i4}) =$

$$= prob(y_{1i} = 1, Y_{2i1}, Y_{2i2}, Y_{2i3}, Y_{2i4} \mid \eta_i) \times prob(\eta_i) \quad \textbf{(3.14)}$$

$$= prob(y_{1i} = 1 \mid \eta_i) \times prob(Y_{2i1} \mid \eta_i) \times prob(Y_{2i2} \mid \eta_i) \times prob(Y_{2i3} \mid \eta_i) \times prob(Y_{2i4} \mid \eta_i) \times prob(\eta_i)$$

From the expression above we can derive, like in a standard random effects probit model, the contribution of individual i to the likelihood function. This gives us the subsequent equation,

$$f(e_i, e_{i1}, e_{i2}, e_{i3}, e_{i4}) = \left[f(e_i \mid \eta_i) \times f(e_{i1} \mid \eta_i) \times f(e_{i2} \mid \eta_i) \times f(e_{i3} \mid \eta_i) \times f(e_{i4} \mid \eta_i) \right] \times f(\eta_i) \quad \textbf{(3.15)}$$

η_i being not observed, the goal is to write the log-likelihood L_i without η_i terms.

Consequently we will integrate them out from the expression of L_i.

$$f(e_i, e_{i1}, e_{i2}, e_{i3}, e_{i4}) = \int f(e_i \mid \eta_i) \times f(e_{i1} \mid \eta_i) \times f(e_{i2} \mid \eta_i) \times f(e_{i3} \mid \eta_i) \times f(e_{i4} \mid \eta_i) f(\eta_i)\, d\eta_i \quad \textbf{(3.16)}$$

where, $e_i \mid \eta_i$ is given by (5) and $e_{ij} \mid \eta_i \sim N[\eta_i, 1]$, j = 1, 2, 3, 4

Rewriting the log-likelihood function of the individual *i*,

$$L_i = \left[prob(y_{1i} = 0) \right]^{1 - y_{1i}} \left[prob(y_{1i} = 1, Y_{2i1}, Y_{2i2}, Y_{2i3}, Y_{2i4}) \right]^{y_{1i}} \quad \textbf{(3.17)}$$

$$= \left[prob(y_{1i} = 0) \right]^{1 - y_{1i}} \left[\int prob(y_{1i} = 1 \mid \eta_i) \cdot \left\{ \prod_{t=1}^{4} prob(Y_{2it} \mid \eta_i) \right\} \cdot f(\eta_i)\, d\eta_i \right]^{y_{1i}}$$

This expression of the log-likelihood cannot be evaluated in a closed form solution but this can be done using numerical methods like for the random effects probit model seen above. For the numerical method, we will start by evaluating each probability inside the integral.

$$prob\left(y_{1i}=1\mid \eta_i\right)=prob\left(e_i>-\beta_1'X_{1i}\mid \eta_i\right)=prob\left(e_i-\frac{\rho}{\sigma_\eta}\eta_i>-\beta_1'X_{1i}-\frac{\rho}{\sigma_\eta}\eta_i\mid \eta_i\right)$$

$$=prob\left(e_i-\frac{\rho}{\sigma_\eta}\eta_i>\frac{-\sigma_\eta\beta_1'X_{1i}-\rho\eta_i}{\sigma_\eta}\mid \eta_i\right)$$

$$=prob\left(\frac{1}{\sqrt{1-\rho^2}}\left[e_i-\frac{\rho}{\sigma_\eta}\eta_i\right]>\frac{-\sigma_\eta\beta_1'X_{1i}-\rho\eta_i}{\sigma_\eta\sqrt{1-\rho^2}}\mid \eta_i\right)$$

$$=\Phi\left[\frac{\sigma_\eta\beta_1'X_{1i}+\rho\eta_i}{\sigma_\eta\sqrt{1-\rho^2}}\right]$$

$$prob\left(y_{2it}=1\mid \eta_i\right)=prob\left(\nu_{it}>-\beta_2'X_{2it}-\eta_i\mid \eta_i\right)=\Phi\left[\beta_2'X_{2it}+\eta_i\right]=\Phi\left[q_{2it}\cdot\left(\beta_2'X_{2it}+\eta_i\right)\right]$$

$$prob\left(y_{2it}=0\mid \eta_i\right)=prob\left(\nu_{it}\le-\beta_2'X_{2it}-\eta_i\mid \eta_i\right)=\Phi\left[-\beta_2'X_{2it}-\eta_i\right]=\Phi\left[q_{2it}\cdot\left(\beta_2'X_{2it}+\eta_i\right)\right]$$

where, $q_{2it}=2\times y_{2it}-1$ and $q_{2it}=1$ or -1 whenever $y_{2it}=1$ or 0.

Substituting these expressions in **(3.17)** allows us to rewrite the log-likelihood function and to get:

$$L_i=\left[prob(y_{1i}=0)\right]^{1-y_{1i}}\left[\int prob(y_{1i}=1\mid \eta_i)\cdot\left\{\prod_{t=1}^{T}prob(Y_{2it}\mid \eta_i)\right\}\cdot f(\eta_i)\,d\eta_i\right]^{y_{1i}} \qquad \textbf{(3.18)}$$

$$=\Phi\left[-\beta_1'X_{1i}\right]^{1-y_{1i}}\left[\int\Phi\left[\frac{\sigma_\eta\beta_1'X_{1i}+\rho\eta_i}{\sigma_\eta\sqrt{1-\rho^2}}\right]\cdot\left\{\prod_{t=1}^{T}\Phi\left[q_{2it}\cdot\left(\beta_2'X_{2it}+\eta_i\right)\right]\right\}\cdot f(\eta_i)\,d\eta_i\right]^{y_{1i}}$$

$$L_i=\Phi\left[-\beta_1'X_{1i}\right]^{1-y_{1i}}\left[\int\Phi\left[\frac{\sigma_\eta\beta_1'X_{1i}+\rho\eta_i}{\sigma_\eta\sqrt{1-\rho^2}}\right]\cdot\left\{\prod_{t=1}^{T}\Phi\left[q_{2it}\cdot\left(\beta_2'X_{2it}+\eta_i\right)\right]\right\}\cdot\frac{1}{\sqrt{2\pi\sigma_\eta^2}}e^{\frac{\eta_i^2}{2\sigma_\eta^2}}d\eta_i\right]^{y_{1i}}$$

We rewrite the integral in the form of $\int_{-\infty}^{\infty} g(s)e^{-s^2}ds$ in order to use the numerical method Gauss-Hermite Quadrature (GHQ). Let, $s_i = \frac{\eta_i}{\sqrt{2}\sigma_m}$ which gives $\eta_i = \sqrt{2}\sigma_m s_i$ and $d\eta_i = \sqrt{2}\sigma_m ds_i$. Since we want an expression of the likelihood without η_i, we will substitute η_i and $d\eta_i$ in **(3.18)** using their values in term of s_i, σ_m and ds_i. Therefore the likelihood function is written as:

$$L_i = \Phi\left[-\beta_1' X_{1i}\right]^{1-y_{1i}} \left[\int \Phi\left[\frac{\sigma_m \beta_1' X_{1i} + \rho\sqrt{2}\sigma_m s_i}{\sigma_m\sqrt{1-\rho^2}}\right] \cdot \left\{\prod_{t=1}^{T} \Phi\left[q_{2it}\cdot\left(\beta_2' X_{2it} + \sqrt{2}\sigma_m s_i\right)\right]\right\} \cdot \frac{1}{\sqrt{\pi}} e^{-s_i^2} ds_i\right]^{y_{1i}}$$

Finally we have the following expression where we don't have η_i:

$$L_i = \Phi\left[-\beta_1' X_{1i}\right]^{1-y_{1i}} \left[\frac{1}{\sqrt{\pi}} \int g(s_i)\cdot e^{-s_i^2} ds_i\right]^{y_{1i}} \qquad \textbf{(3.19)}$$

where, $g(s_i) = \Phi\left[\frac{\beta_1' X_{1i} + \rho\sqrt{2}s_i}{\sqrt{1-\rho^2}}\right] \cdot \left\{\prod_{t=1}^{T} \Phi\left[q_{2it}\cdot\left(\beta_2' X_{2it} + \sqrt{2}\sigma_m s_i\right)\right]\right\}$.

Using GHQ, we have the following approximation: $\int g(s_i)\times e^{-s_i^2} ds_i \approx \sum_{j=1}^{M} w_j \times g\left(a_j\right)$ where M is the number of evaluation points, w_j is the weight given to the jth evaluation point, a_j is the jth evaluation point (simply called abscissas), and $g\left(a_j\right)$is $g(s_i)$evaluated at $s = a_j$. Weights and abscissas can be looked up in published sources. Hence, using GHQ, L_i in **(3.19)** can be approximated as,

$$L_i \approx \Phi\left[-\beta_1' X_{1i}\right]^{1-y_{1i}} \left[\frac{1}{\sqrt{\pi}} \sum_{j=1}^{M} w_j \cdot g\left(a_j\right)\right]^{y_{1i}} \qquad \textbf{(3.20)}$$

where, $$g(a_j) = \Phi\left[\frac{\beta_1' X_{1i} + r\sqrt{2}a_j}{\sqrt{1-r^2}}\right] \cdot \left\{\prod_{t=1}^{T} \Phi\left[q_{2it} \cdot \left(\beta_2' X_{2it} + \sqrt{2}\sigma_m a_j\right)\right]\right\}.$$

Finally, the log-likelihood is obtained by summing all individuals:

$$\ln L = \sum_{i=1}^{N} \ln L_i = \sum_{i=1}^{N} (1 - y_{1i}) \cdot \ln \Phi\left[-\beta_1' X_{1i}\right] + \sum_{i=1}^{N} y_{1i} \cdot \ln\left[\frac{1}{\sqrt{\pi}} \sum_{j=1}^{M} w_j \cdot g\left(a_j\right)\right] \quad \textbf{(3.21)}$$

Note that if $r = 0$, then $\beta_1' X_{1i}$ term inside the summation in **(3.20)** can be brought outside the summation resulting in a likelihood that is completely separable in β_1 (parameters estimates in equation **(3.7)**) and β_2 (parameters estimates in equation **(3.8)**). The log-likelihood function developed for the bivariate nested panel probit is completely separable in parameters β_1 in **(3.7)** and β_2 in **(3.8)**, enabling the estimation of equations **(3.7)** and **(3.8)** separately.

3.5 Summary and Conclusion

This chapter provides the theoretical methods used in the thesis. Since the main goal of this thesis is to investigate producers' preferences, the choice preferences theory is revisited and an overview of the stated and revealed preferences is explored in order to not only understand the reasoning behind their use but also to show their link with random utility theory. This latter theory was used to introduce the discrete choice models (probit, panel probit and bivariate nested panel probit) to emphasize why and how they are used in the thesis for econometric analysis purposes.

CHAPTER 4: SURVEY INSTRUMENT, DESIGN AND VARIABLES DESCRIPTION

4.1 Introduction

This chapter focuses on the survey design, modeling of the beef alliance choice experiment, and description of the sample data used in the thesis. Section 4.2 describes the survey design of the different study populations (Arizona Rancher BQA, Arizona NASS, and Canada ranchers) where the surveys were conducted. In section 4.3, the choice experiment design is presented and beef alliance attributes are discussed in detail. The description of the questionnaire is given in section 4.4 and the survey procedure in section 4.5. Finally, section 4.6 provides information on the descriptive statistics of the variables derived from the questionnaire.

4.2 Survey Design

4.2.1 Canada survey design

A survey was designed to capture some insights about Western Canadian beef producers' characteristics, their production practices and their willingness or not to join a beef alliance under certain circumstances (survey design in Appendix A). Respondents were chosen using membership lists obtained from beef producers associations. In addition, to ensure a good sampling for each province, the 2001 Agriculture consensus was used to identify the number of producers to be contacted. However an over sampling of the survey from Alberta is expected since the sampling method was not applied outside Alberta where producers could not be directly contacted.

The survey was comprehensive and data are used to parameterize the analysis of beef producers' characteristics, perceptions, and choices affecting their willingness to join an alliance and their attribute preferences of an alliance.

4.2.2 Arizona NASS

In order to capture the willingness for Arizona Beef producers to join an alliance (the original survey in Appendix B), the Arizona National Agricultural Statistics Service (NASS) was utilized to send a mailing out to Arizona ranchers. The producers were selected randomly within each herd size to receive the survey in order to have a sample regardless of demographics or beef organization affiliations. The Arizona NASS survey was similar to the Canadian survey, but had fewer questions than the Canadian one. It included questions related to beef producers characteristics, their production practices and the implementation of the choice experiment asking their willingness to join alliances with different attributes.

4.2.3 Arizona Rancher BQA

"The Arizona Beef Quality Assurance Program (AZBQA) provides hands-on training and education on BQA guidelines and technical assistance through the Arizona Cattlemen's Association, AZBQA certified veterinarians and Arizona Extension personnel." The program is helping Arizona cattle producers to produce healthy and wholesome cattle meeting FDA, USDA and EPA guidelines, rules and regulations (Arizona Rancher's Beef Quality Assurance 2009).

Indeed, the primary objective of the BQA program is to train in record keeping, proper product storage and administration, animal injection sites, animal handling techniques and treatment protocols. The second objective is the development of a certified pre-conditioning program. This program contributes to minimizing the incidence of animal health problems and at the same time convince the buyer about the adequate pre-shipment conditioning received by the animal (http://www.cals.arizona.edu/ans/bqa/objectives.html).

Interested in the survey and its results, the University of Arizona Beef Extension Specialist used a mailing list of Arizona Rancher Beef Quality Assurance (BQA) participants in the fall of 2008 and asked them to answer to the same questionnaire as the Arizona NASS participants (the survey in Appendix B).

4.3 Alliance Choice Experiment Design

A choice experiment design was implemented in line with the purpose of the research problem which focuses on investigating the decision making process of cow-calf producers when it comes to choose between different types of beef alliances according to the attributes they are associated with. Consequently a choice experiment was utilized following the design of Hensher, et al. (2005) using eight stages of the experimental design. As reported by Lan (2006), "the choice experiment adopted in this study follows an unlabeled orthogonal main effects design with four attributes levels for each attribute. For an unlabeled experiment design, the choice alternatives are normally labeled as "Alternative A" and "Alternative B," such that the labels attached to each choice alternative conveys no information beyond that provided by their attributes" (Louviere et al. 2000).

In the design of the survey, only the producers, who responded affirmatively to their willingness to join an alliance under certain circumstances, were asked to respond to the questions of the choice experiment. Those who responded no were prompted to skip the choice experiment questions (Figure 4.1). Following the choice experiment, beef producers were given a set of four different scenarios where they have to choose between alliance A and alliance B for each scenario.

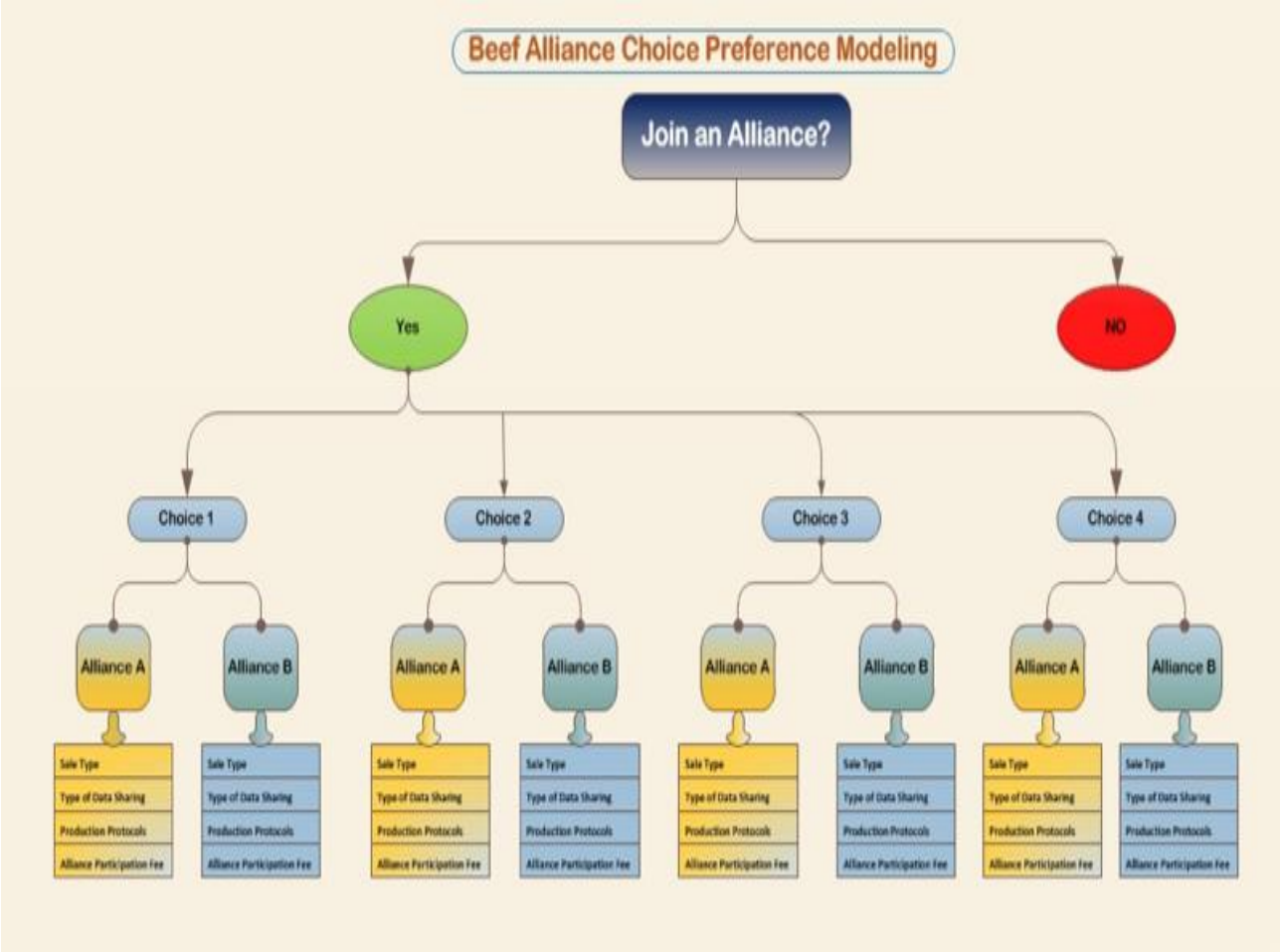


Figure 4.1 Choice Experiment Stages

In total, for the study, eight different versions of the survey questionnaires measuring the willingness to join an alliance were used for Canada, Arizona BQA and Arizona NASS. In summary, a total of 32 different types of alliances (8 x 4) were presented to the beef producers' respondents in Canada and Arizona. In order to help respondents understand clearly the meaning of each attribute, a definition for reference was given to them before they proceed to the choice experiment questions. The selected attributes for the study include 1) sales types, 2) data sharing types, 3) production protocols and 4) membership fee. A description of each attribute is given below.

Sales Type

Sales type refers to the ways in which the cow-calf producer is willing to market their animals through an alliance. It includes different combinations of marketing strategies (i.e. selling animals to alliance or retaining ownership) and compensation schemes (profit sharing or no profit sharing among members of the alliance).

Type of Data Sharing (Information sharing schemes):

Data sharing type refers to the different levels at which a producer would want to share data with the alliance. It includes different combinations of collected information strategies and data sharing schemes (i.e. live performance, individual data, carcass, group data).

Production Protocols:

The attribute level of production protocols refers to the type of vaccine, weaning (specific restrictions or no restriction concerning vaccinations and use of antibiotics) and other production protocols that can be considered as quantity commitments (minimum or no minimum of number of animals required). The first production protocol was considered as being very important for playing a role in the quality control of beef producers. According to Jorgensen (2009) and Lan (2006), both referring to Ward (2001), a quantity commitment can be significant in three ways. First, volume may be of great significance for cost reductions if an alliance is connected with a processing entity. Second, if an alliance is pursuing a specific branded beef product program, volume may allow enhanced control over the supply of the product. Finally, producers will have an increased interest in the success of an alliance arrangement if they are willing to make a quantity commitment in the alliance.

Alliance Participation Fee:

This attribute level refers to the per head cost of participating in the proposed alliance. These fees are in addition to the producers' regular costs of production. The monetary commitment is of big importance as it is for the quantity commitment in the sense that a producer willing to pay to enter an alliance will also be expected to have a high interest for the success of that alliance. This is a key variable of this thesis and interacts with other demographics to gain insights into the effects that membership fees and other alliance attributes have on the producers' choices for one alliance over the other. In this study four levels of alliance participation fees were included. Details of the different levels for each attribute are described in the appendix.

4.4 The Questionnaire

In part one, questions focused on respondents' production practices in their beef operations and their beef marketing strategies. For example, producers were asked to categorize their current beef operations and farm activities. Also as an example the respondents were asked about what they did with their calf-crop born in 2004 and to allocate percentages across the following options: sold as weaned calves, sold as preconditioned calves, retained ownership, replacement heifers and other.

The second part of the survey, being the shortest one had only two questions focusing on the producer's willingness to join an alliance and the choice experiment. After they were briefly explained the opportunity to be part of a beef alliance, the first was asked if they are willing to participate in an alliance under certain circumstances and the second question was to choose four sets of beef alliance alternatives.

The third and final part of the survey consisted in asking about the producer's demographic characteristics like their age, education, income from on farm or off-farm activities, beef cowherd size, expectation about their net income and the market value of their cows sold, and other farm activities.

However it worth noting that because of the slight differences existing between the Canadian and Arizona surveys (Arizona NASS and Arizona Rancher BQA), some demographic questions asked in the Canadian survey may not be included in the Arizona surveys or obtained in exactly the same way.

4.5 The Survey Procedure

4.5.1 Canada survey

Initially, 951 Canadian cattle producers were contacted by phone during spring 2006 and were asked about their willingness to participate in an online-survey or an equivalent on-site survey. Explanation was given to participants that the same exact survey would be used in on-site interview and conducted by trained students using an electronic version of the survey on a laptop. No financial incentives were given for participation. Of the initial Canadian cattle producers contacted, 151 participated in the survey corresponding to a 16% of response rate with 100 completed on-site and 51 online. The survey consisted of 34 questions and took on average 15 to 20 minutes to complete.

4.5.2 Arizona NASS

In May 2007, the University of Arizona through NASS of Arizona conducted a similar mail survey (not online survey) in the state of Arizona but shorter than the Canadian survey (25 questions taking about 10 to 15 minutes to be completed).

With an initial 880 surveys mailed, 157 were returned yielding about a 20% response rate. However 72 questionnaires were lost in an express mail package before being entered. With this situation, the same survey was mailed out to producers that did not receive a principal survey or responded to a principal survey. In November 2005, out of 600 surveys mailed, only 61 were returned corresponding to a 10% response rate. Therefore when the two Arizona NASS surveys were combined, 146 surveys were useable.

4.5.3 Arizona Rancher BQA

A survey similar to the Arizona NASS survey was mailed out to all members of the Arizona Rancher Beef Quality Assurance program. Out of 457 surveys initially mailed (with 34 undeliverable) 107 surveys were returned resulting in a useable response rate of 25%.

It is possible that a few cattle producers sampled from Arizona survey could have been sampled again in the 2008 BQA survey, although we are quite confident that the overlap is minimal and that ranchers would not complete a second questionnaire unless they forgot about doing the earlier one.

4.6 The sample: Respondent Characteristics and Descriptive Statistics

This section will provide information about the descriptive statistics of the variables derived from the questionnaire. However, in this section the focus will be given to variables used in the thesis to explain the alliance choice preferences of cow-calf producers. First, variables describing the current operation are addressed.

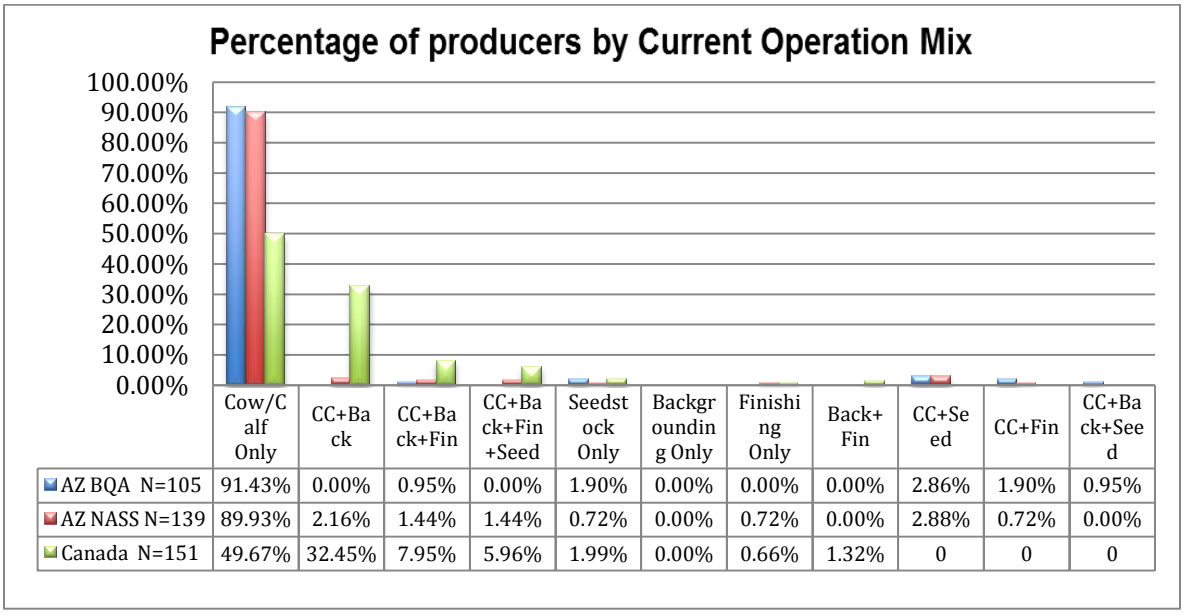
4.6.1 Current Operation Type

Survey respondents represent a range of beef operations from seedstock to backgrounding with some having mixed beef enterprises. Due to virtually no Arizona

public land ranches having farming operations, there was a difference between the Arizona and Canada surveys on the way the answer choices were given.

For the Canadian respondents, eight choices (see Appendix A) were given to them and they were asked to choose only one whereas Arizona respondents were given four operation types since cropping options are very limited (see Appendix B). This situation was the reason for modifying the Arizona data and adding new categories to fit the same questions asked in the Canadian survey.

As an example, notice in Figure 4.2 below that for all three surveys it is shown that cow-calf operation is a primary economic enterprise for the majority of Canadian respondents (49.67%) and almost the sale enterprise of most Arizona NASS (89.93%) and Arizona BQA (91.43%). The distribution of the beef operation of the remaining respondents is shown in detail in figure 4.2 for Canada, Arizona NASS and Arizona BQA. In this thesis we will only use the variable cow-calf operation only to do our analysis.



	Cow/Calf Only	CC+Back	CC+Back+Fin	CC+Back+Fin+Seed	Seedstock Only	Backgrounding Only	Finishing Only	Back+Fin	CC+Seed	CC+Fin	CC+Back+Seed
AZ BQA N=105	91.43%	0.00%	0.95%	0.00%	1.90%	0.00%	0.00%	0.00%	2.86%	1.90%	0.95%
AZ NASS N=139	89.93%	2.16%	1.44%	1.44%	0.72%	0.00%	0.72%	0.00%	2.88%	0.72%	0.00%
Canada N=151	49.67%	32.45%	7.95%	5.96%	1.99%	0.00%	0.66%	1.32%	0	0	0

Figure 4.2: Producers by Current Operation Mix

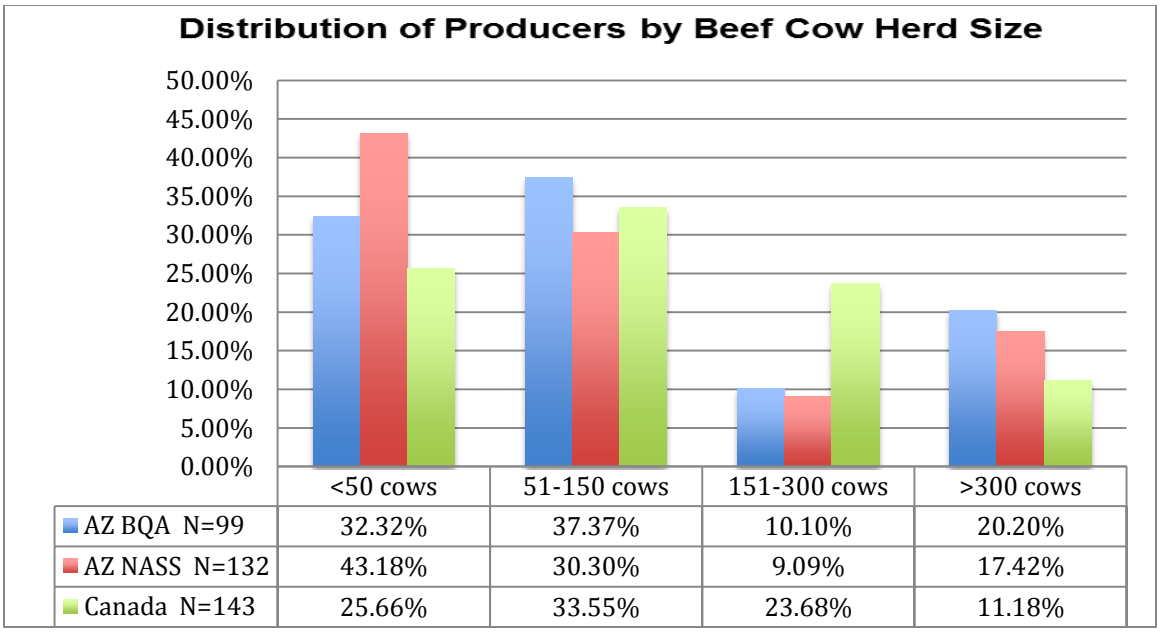
4.6.2 Beef Cowherd size

Respondents were given the option to choose from the following five categories of cowherd size (1. none; 2. less than 50 head; 3. 51-150 head; 4. 151-300 head; 5. greater than 300 head). While the Arizona Rancher BQA respondents were asked to indicate the number of their cows at the end of 2007, those for Canada and Arizona NASS were asked the number of their beef cows at the end of 2005.

The distribution of beef cowherds can be seen in Figure 4.3. For Arizona BQA respondents, their herd size is the following: 32.32 % have less than 50 head; 37.37 % reported having between 51 and 150 head; 10.1 % between 151 and 300 head; and the remaining 20.20% of respondents indicated having more than 300 head. For the Canadian respondents': 25.66 % have less than 50 head; 33.55% between 51 and 150 head; 23.68% between 151 and 300 head; and the remaining 11.18 % of reported they have more than 300 head

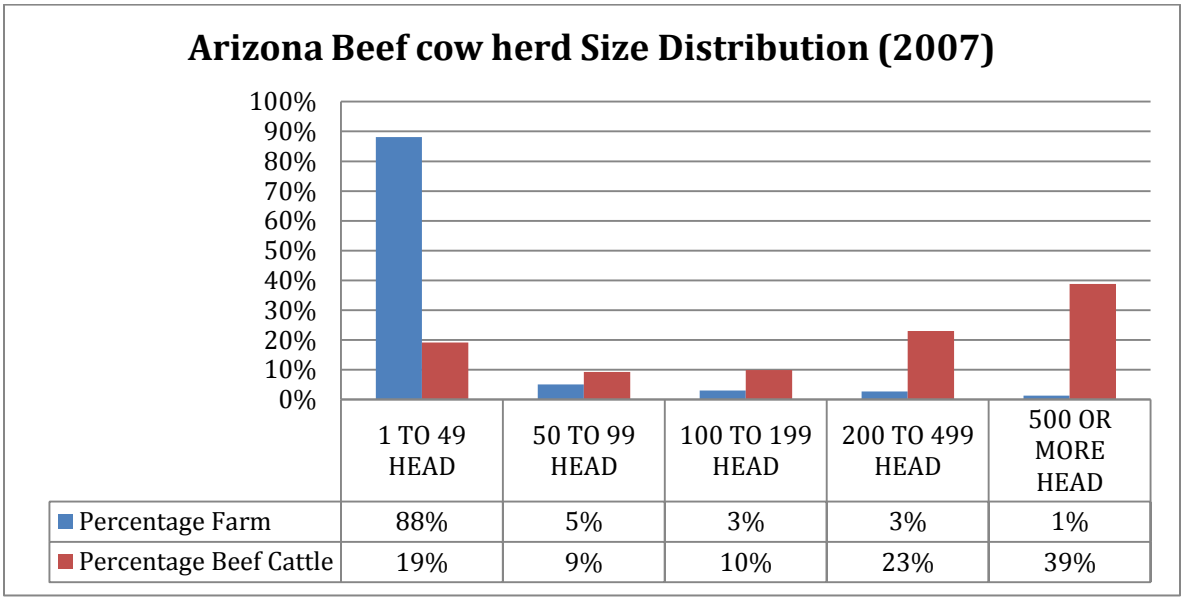
Arizona NASS respondents distribution for cattle numbers at the end of 2005 are shown in Figure 4.4: the majority (43.18 %) indicated that their herd size was less than 50 head; 30.30% between 51 and 150 head; only a small number of respondents (9.09 %) have between 151 and 300 head; and for the rest (17.42 %) of respondents indicated more than 300 head.

In sum, we can see as shown in Figure 4.3 that the large majority of Arizona BQA (69.69%), Arizona NASS (73.48 %) and Canada respondents have a cowherd size of 150 head or less. This variable was combined with total income received from their beef operation to create new variable categories called larger producer and smaller producer.



	<50 cows	51-150 cows	151-300 cows	>300 cows
AZ BQA N=99	32.32%	37.37%	10.10%	20.20%
AZ NASS N=132	43.18%	30.30%	9.09%	17.42%
Canada N=143	25.66%	33.55%	23.68%	11.18%

Figure 4.3: Distribution of Producers by Beef Cow Herd Size



	1 TO 49 HEAD	50 TO 99 HEAD	100 TO 199 HEAD	200 TO 499 HEAD	500 OR MORE HEAD
Percentage Farm	88%	5%	3%	3%	1%
Percentage Beef Cattle	19%	9%	10%	23%	39%

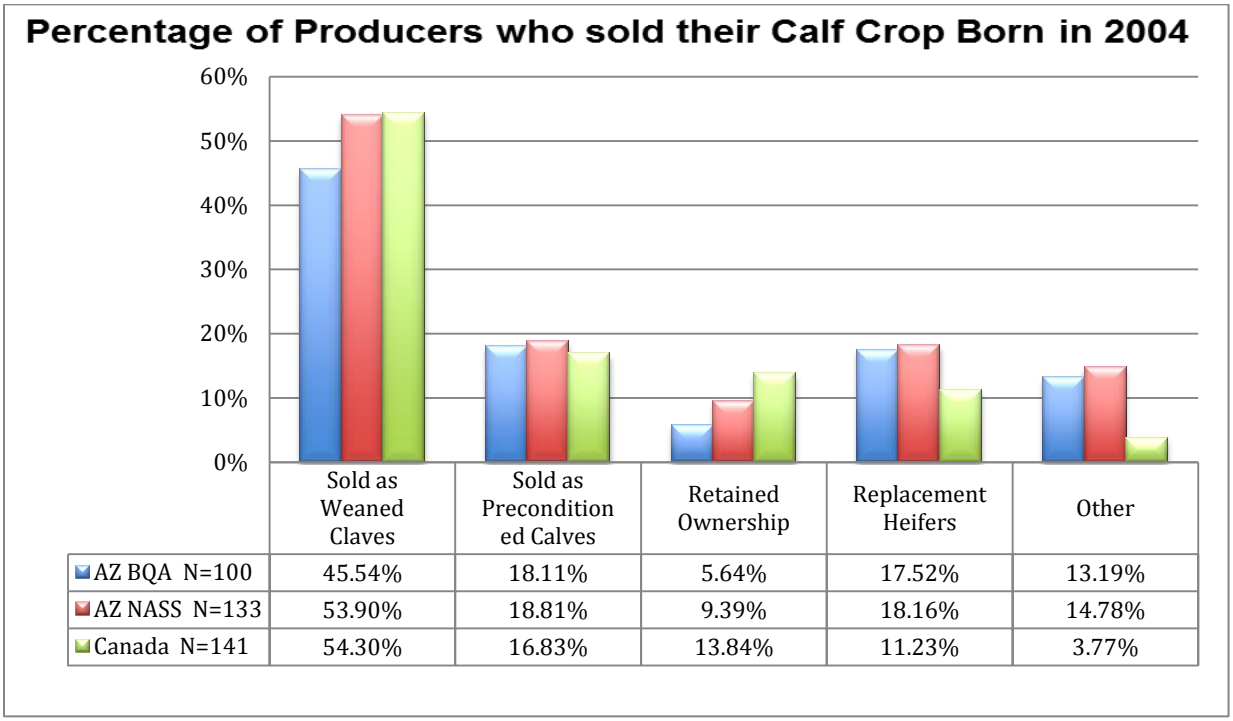
Figure 4.4: Distribution of farms by Beef Cow Herd Size in Arizona (2007)

4.6.3 Calf crop born in 2004 sold

To the question regarding how ranchers marketed their calf crop born in 2004, the majority of Arizona BQA respondents said they sold those as weaned calves (45.54%). Approximately 18.11% sold their calf crop as preconditioned calves while 5.6% retained

ownership. The remaining methods are distributed as follows: replacement Heifer (17.52 %) and other (13.19 %). For Arizona NASS, the distribution of how producers marketed their calf crop is shown in figure 4.5 as: sold as weaned calves (53.90%), sold as preconditioned calves (18.81%), retained ownership (9.39%), replacement heifers (18.16%) and other (14.78%).

Among Canadian respondents, 54.30% indicated they sold their calf crop as weaned calves, 16.83% said they sold as preconditioned calves, 13.84% retained ownership, 11.23% did replacement heifers and 3.77 % did other marketing strategies to deal with their calf crop born in 2004.



	Sold as Weaned Claves	Sold as Preconditioned Calves	Retained Ownership	Replacement Heifers	Other
AZ BQA N=100	45.54%	18.11%	5.64%	17.52%	13.19%
AZ NASS N=133	53.90%	18.81%	9.39%	18.16%	14.78%
Canada N=141	54.30%	16.83%	13.84%	11.23%	3.77%

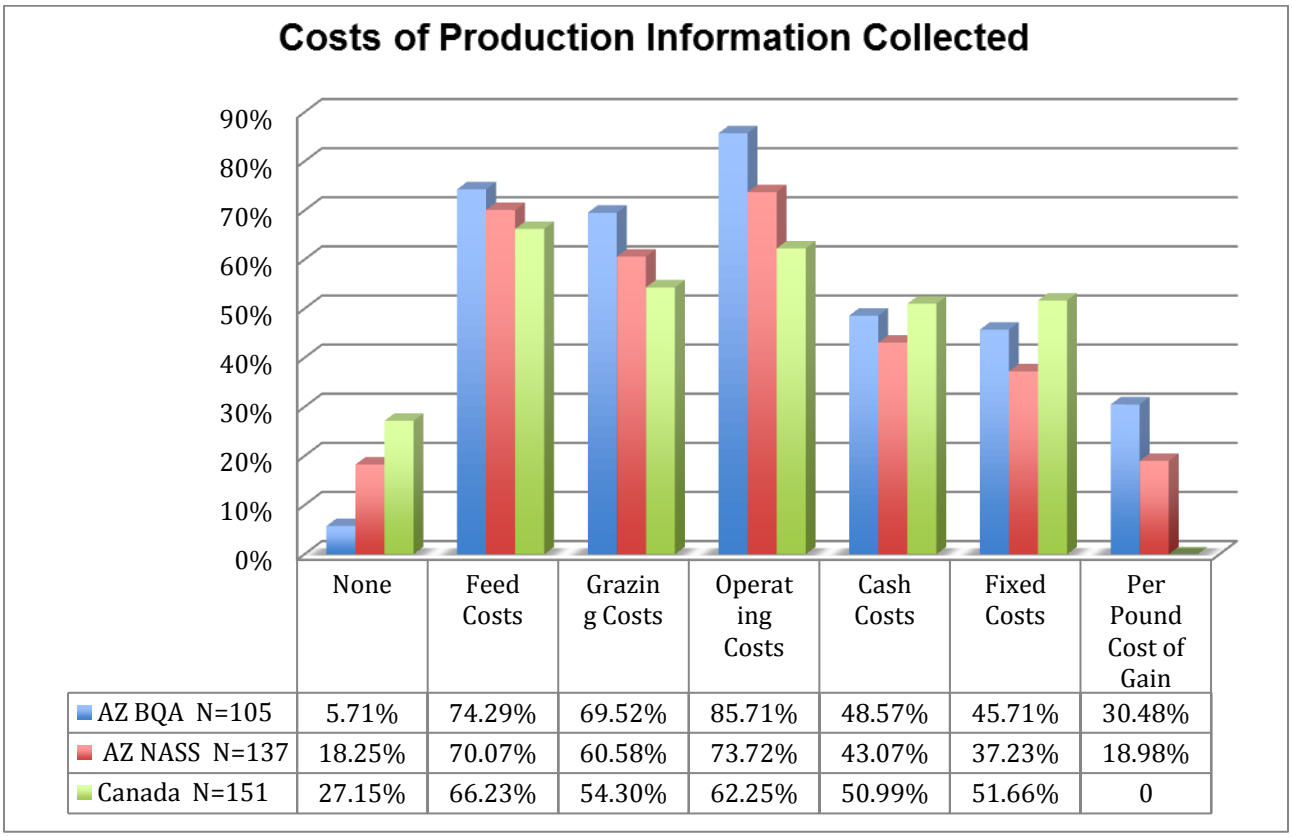
Figure 4.5: Calf crop born in 2004 sold

4.6.4 Information on Cost of Production Collected

Respondents were asked to indicate what type of information they collect for their beef operations regarding their costs of production. Options given for producers to choose from

checking all that apply were: none, feed costs, grazing cost, operating costs, cash costs, fixed costs and per pound cost of gain etc.

As shown in Figure 4.6, we can see that for all three groups (Arizona BQA, Arizona NASS and Canada) of respondents most of them collected information about cost of production for their beef operation. As an example, 85.71% of Arizona BQA respondents collected information about operating costs, 74.2% collected feed costs, 69.52% collected grazing costs, and so on. The same information was collected and the respondents' distributions are shown in Figure 4.6 below for Arizona NASS and Canada.



	None	Feed Costs	Grazing Costs	Operating Costs	Cash Costs	Fixed Costs	Per Pound Cost of Gain
AZ BQA N=105	5.71%	74.29%	69.52%	85.71%	48.57%	45.71%	30.48%
AZ NASS N=137	18.25%	70.07%	60.58%	73.72%	43.07%	37.23%	18.98%
Canada N=151	27.15%	66.23%	54.30%	62.25%	50.99%	51.66%	0

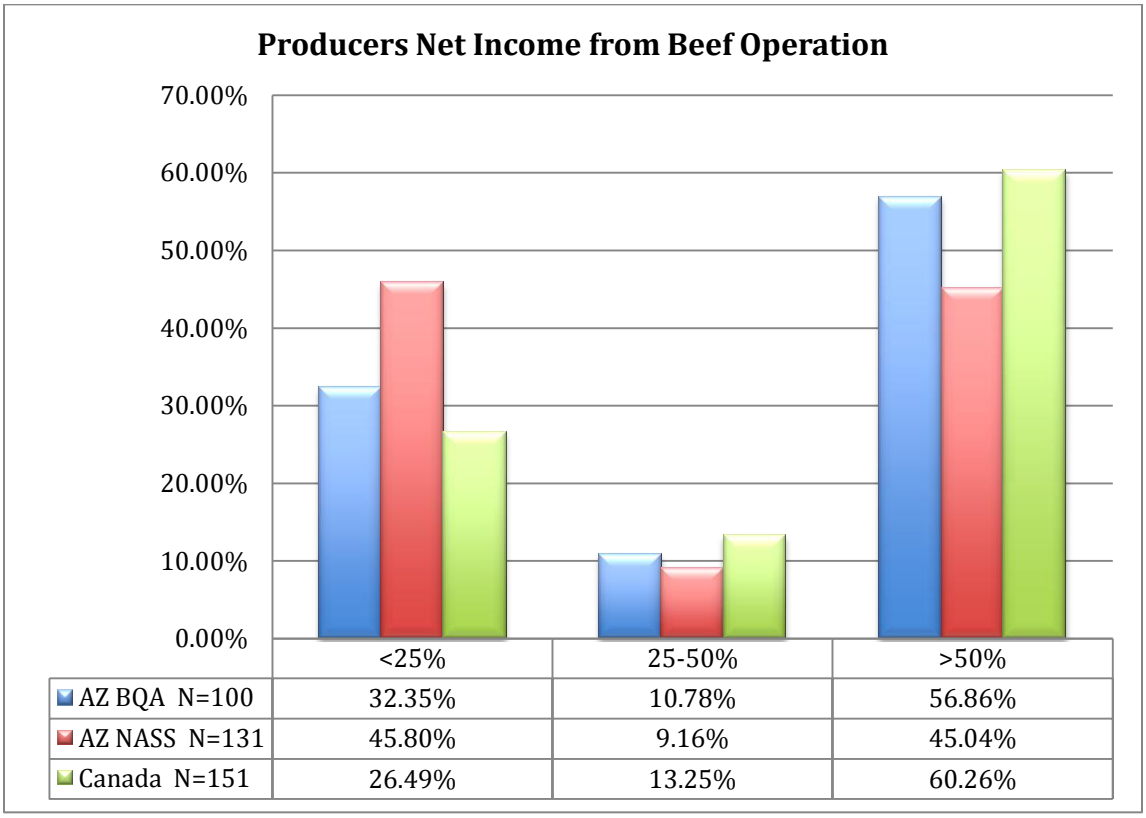
Figure 4.6: Costs of Production Information Collected

4.6.5 Income (Net farm and off-farm income)

To measure respondents' incomes, their net farm income from beef and off-farm incomes are used.

4.6.5.1 Producers Net Income from Beef Operation

As shown in Figure 4.7, most of Canadian (60.26 %) and Arizona BQA (56.86 %) respondents said they earned more than 50% of their taxable farm income from their beef operation whereas fewer (45.08%) indicated this level of income for Arizona NASS respondents. The distribution of respondents who said they earned between 25% and 50% of their taxable farm income from their beef operation is: 10.78% for Arizona BQA, 9.16% for Arizona BQA and 13.25% for Canada. For respondents saying that they are earning less than 25% of taxable farm income from their beef operation, we have for Arizona BQA 32.35%, Arizona NASS 45.80% and Canada 26.49%.



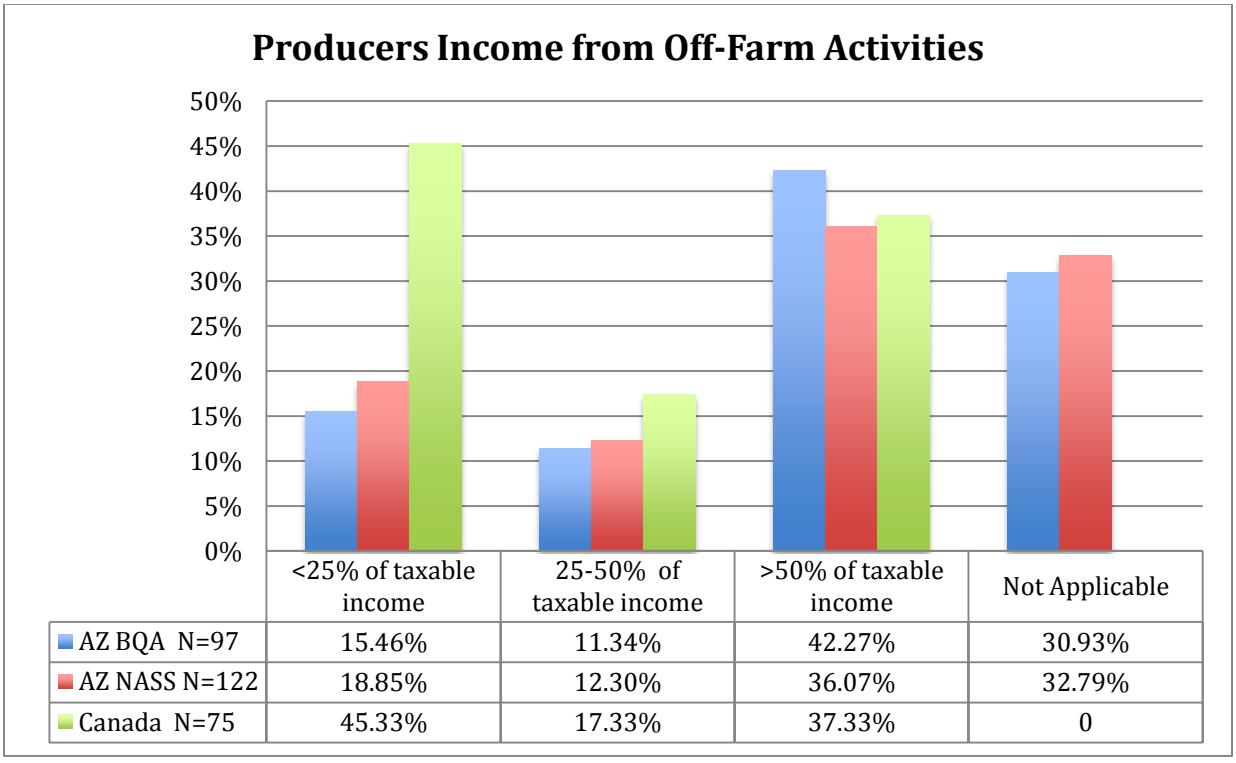
	<25%	25-50%	>50%
AZ BQA N=100	32.35%	10.78%	56.86%
AZ NASS N=131	45.80%	9.16%	45.04%
Canada N=151	26.49%	13.25%	60.26%

Figure 4.7: Producers Net Income from Beef Operation

4.6.5.2 Income from Off-farm Activities

To investigate respondents' secondary sources of income, a question was asked to indicate if they or their beef business partners have off-farm employment. Four categories to choose from were: 1) less than 25% of net taxable income; 2) between 25-50% of net taxable income; 3) more than 50% of net taxable income; and 4) not applicable.

Results shown in Figure 4.8 can be interpreted the same way as for Figure 4.6 with net income from their beef operation. As an example, 42.27% of Arizona BQA respondent said they earned more than 50% of their net taxable income from off-farm employment. Also 36.07% of Arizona NASS respondents and 37.33% of Canadian respondents reported earning more than 50% of taxable income from off-farm employment.



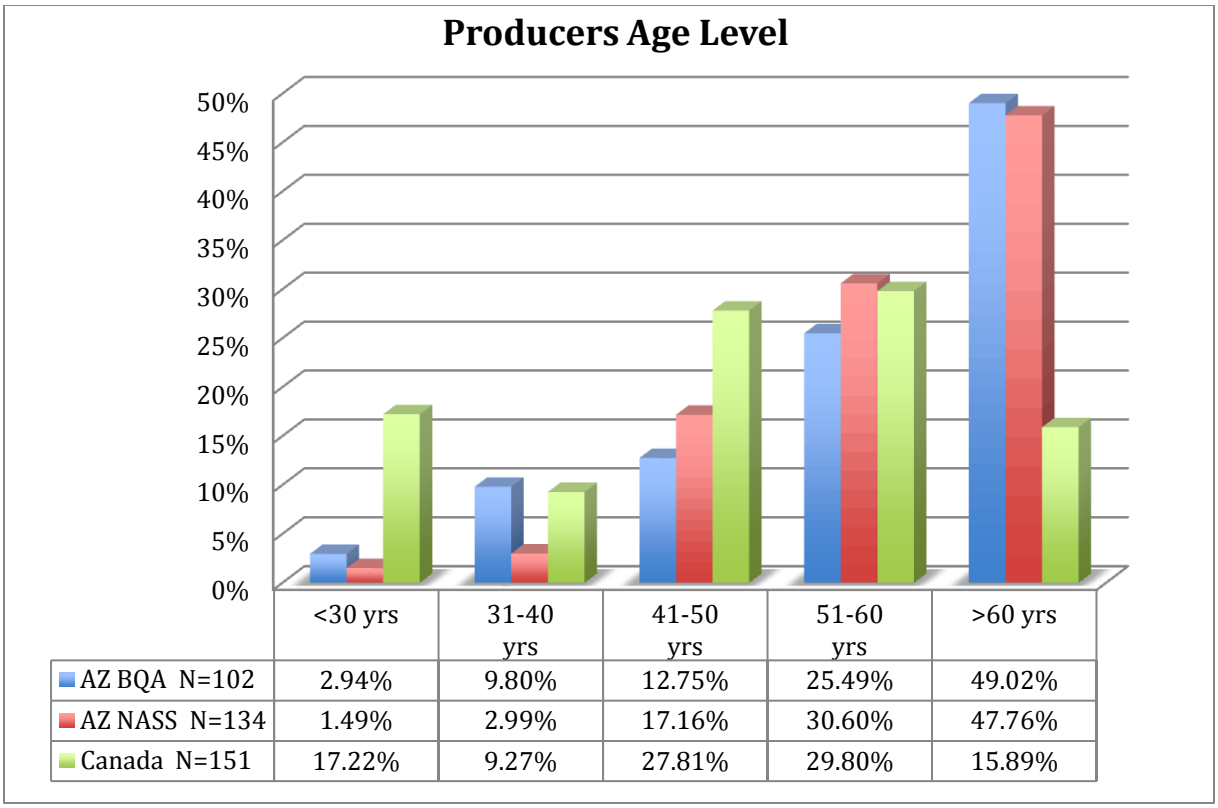
	<25% of taxable income	25-50% of taxable income	>50% of taxable income	Not Applicable
AZ BQA N=97	15.46%	11.34%	42.27%	30.93%
AZ NASS N=122	18.85%	12.30%	36.07%	32.79%
Canada N=75	45.33%	17.33%	37.33%	0

Figure 4.8 Producers Income form Off-farm Activities

4.6.6 Age Level

Rather than asking their exact age, respondents were prompted to indicate from five age range categories shown in Figure 4.9 below and where we have the age distribution of respondents. Arizona BQA and Arizona NASS respondents have respectively 84.52% (25.49% between age 51-60 and 49.02% greater than 60 years) and 78.36% (30.60% between age 51-60 and 47.76% greater than 60 years) of the respondents older than 50 years. In contrast, only 12.74% (2.94% were under 30 and 9.80% between 31 and 40 years old) of Arizona BQA respondents have an age equal or less than 40 years and they are even less for Arizona NASS where only 4.48% (1.49% were under 30 years old and 2.99% between 31 and 40 years old). For the remaining age categories, 12.75% and 17.16% of Arizona BQA and Arizona NASS respondents are between 41 and 50 years old, respectively.

For Canada respondents, the age distribution is quite different. 45.69% (29.80% between age 51-60 and 15.89% greater than 60 years) of respondents have an age greater than 50 years old. Approximately 17.22% are under 30 years old and 9.27% are between 31 and 40 years old. The remaining 27.81% of respondents have an age falling between 41 and 50 years old. In summary, we can see that Arizona respondents tend to be quite older than those from Canada (Figure 4.9).



	<30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	>60 yrs
AZ BQA N=102	2.94%	9.80%	12.75%	25.49%	49.02%
AZ NASS N=134	1.49%	2.99%	17.16%	30.60%	47.76%
Canada N=151	17.22%	9.27%	27.81%	29.80%	15.89%

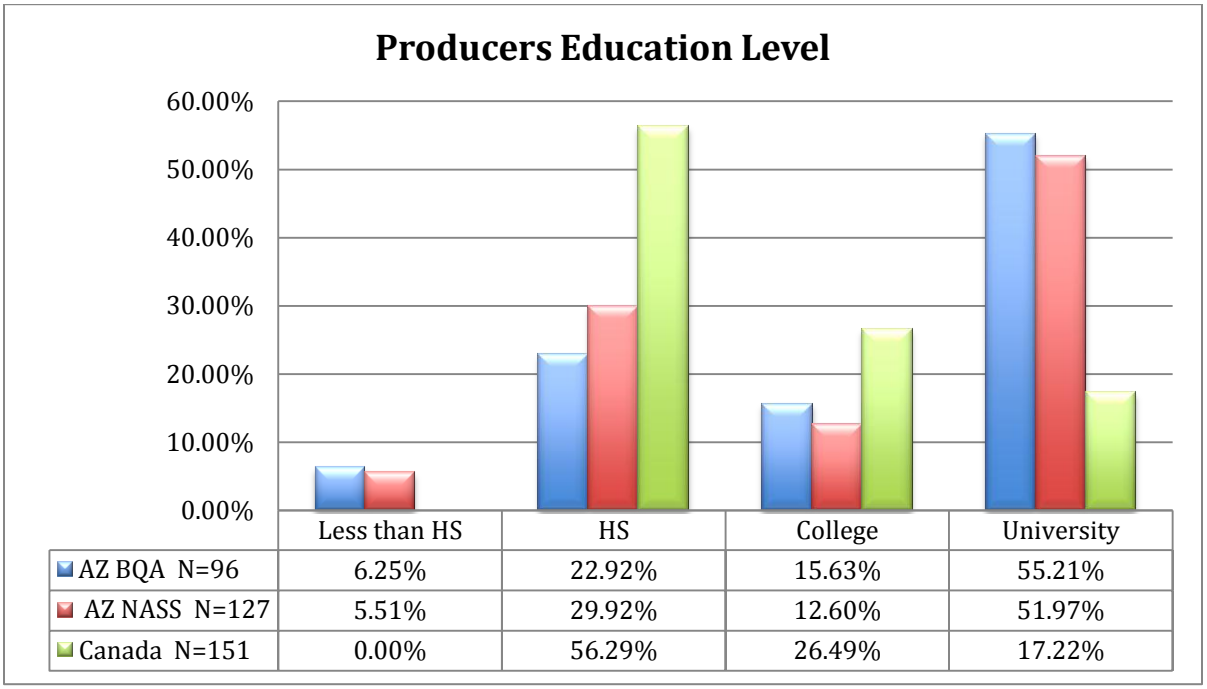
Figure 4.9: Age of AZ BQA, AZ NASS, and Canadian respondents

4.6.7 Education Level

For the respondents' educational levels, we have a slight difference on the categories for Arizona and Canada. Arizona respondents had four levels of education to choose from (less than high school graduate, high school, technical/vocational degree and university) whereas only three categories represented Canada producers (high school, college and university). Therefore, a recoding of Arizona data was made to match the Canadian categories.

The distribution of the education level for both Arizona and Canada are shown in Figure 4.10. As an example we can see that the majority (56.29 %) of Canadian respondents have a high school diploma and the remaining respondents (43.71%) have a higher education level (college (26.49%) and university (17.22%)).

For Arizona NASS and Arizona BQA respondents, they have very similar education levels (Figure 4.10).



	Less than HS	HS	College	University
AZ BQA N=96	6.25%	22.92%	15.63%	55.21%
AZ NASS N=127	5.51%	29.92%	12.60%	51.97%
Canada N=151	0.00%	56.29%	26.49%	17.22%

Figure 4.10: AZ BQA, AZ NASS, and Canadian Producer Education Levels

4.6.8 Beef Alliance Participation Choice

When asked about their willingness to participate in an alliance under certain circumstances, most of the Canadian respondents (78.15 %) said yes (Figure 4.11). With the same question asked to Arizona NASS and Arizona Rancher BQA respondents a large majority (82.35%) of Arizona Rancher BQA respondents said yes whereas for Arizona NASS respondents less than half (44.03%) were of the same disposition.

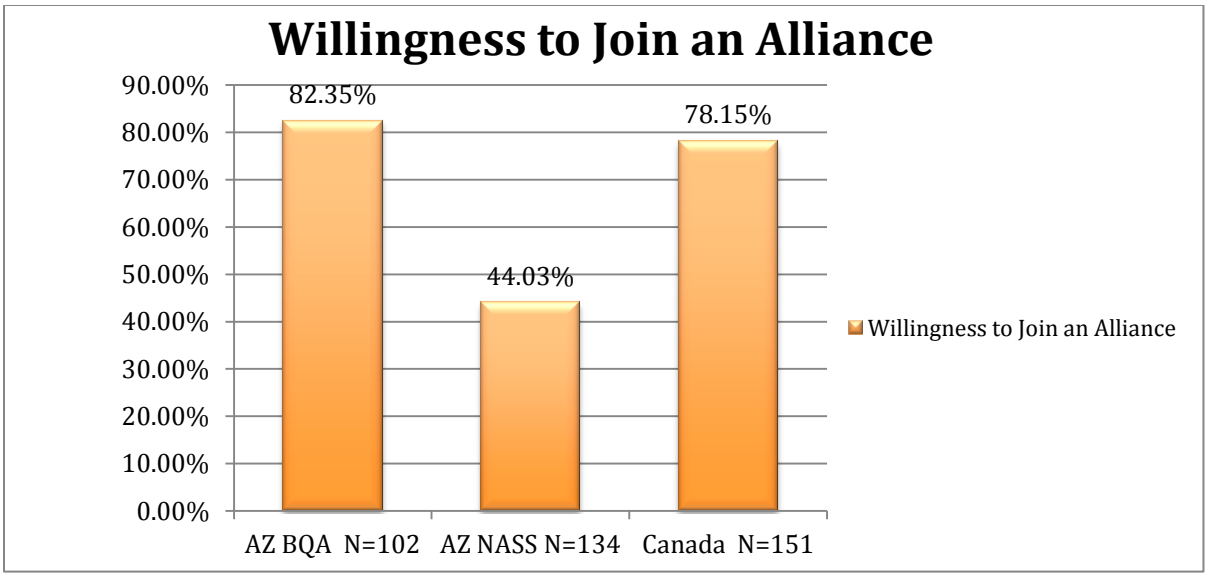


Figure 4.11: Producers' Willingness to Join an Alliance

In Appendix C (Tables C.4.1 to C.4.16) the eight different versions of the survey questionnaire with the alliance characteristic questions are provided. Also statistics of Arizona NASS beef producers, Arizona Rancher Beef Quality Assurance members and Canadian beef producers with regards to preferred alliance characteristics are shown.

4.7 Conclusion

In this chapter, a development of the survey instrument was introduced and the choice experiment design presented. The descriptive statistics of the variables used in the thesis were provided and commented and will be used for further econometric estimation and analysis.

CHAPTER 5: RESULTS AND IMPLICATIONS

5.1 Introduction

Section 5.2 focuses on model development and results of the three models using both Arizona and Canada. Empirical results and their presentation are provided in section 5.3. Section 5.4 presents results of the joint tests for the different models. Finally, concluding remarks are given in section 5.5.

5.2 Model Development

5.3.1 Model Development for Model 1

For the first stage or estimation of whether an individual is willing to consider joining an alliance under any circumstances or not, the probit model specified in chapter 3 is utilized and presented as follow:

$$Y_i^* = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ij} + \mu_i \qquad \textbf{(5.1)}$$

Where Y_i^* is the latent variable which is not observed, μ_i the distribution of the error assumed to be normally distributed and β' s are coefficients that will be estimated.

We observe Y_i defined by Y_i = {1 if Y_i^*>0, 0 otherwise). Y_i indicates whether the producer is willing or not to participate in an alliance. (Maddala, 1992 and Wooldridge, 2003)

The econometric specification of equation (5.1) with selected variables is as follows:

$$Y_1^* = \beta_0 + \beta_1 cowcalf + \beta_2 smaller + \beta_3 larger + \beta_4 cl150 + \beta_5 cg300 + \beta_6 formal + \beta_7 written + \beta_8 weaned + \beta_9 precond + \beta_{10} retainedo + \beta_{11} pcost + \beta_{12} age + \beta_{13} educ + \mu_1 \qquad \textbf{(5.2)}$$

Where Y_1 = 1 if a producer responded Yes about his willingness to join an alliance and Y_1= 0 if the producer responded No. The variables are described below (Table 5.1).

Table 5.1: Description of variables used in Model 1(Beef alliance Participation)

Variable	Description
Dependent Variable	Beef Alliance Participation (1=yes; 0=no)
Independent Variable	
cowcalf	Cow-calf operation (1=yes; 0=otherwise)
smaller	small producers(yes=1 if cowherd<= 150 & income from beef <= 50%; 0=otherwise)
larger	larger producers(yes=1 if cowherd > 150 & income from beef > 50%; 0=otherwise)
Cl150	Cow herd equal or less than150 head (1=yes; 0=otherwise)
cg300	Cow herd size greater than 300 head (1=yes; 0=otherwise)
formal	Market Calves through Formal Agreement (1=yes; 0=otherwise)
written	Have written contracts if you custom feed your calves (1=yes; 0=otherwise)
weaned	Sold as Weaned Calves (percentage)
precond	Sold as Preconditioned Calves (percentage)
retainedo	Retained Ownership of Calves (percentage)
pcost	Collected at least one piece of information Production cost (1=yes; 0=otherwise)
age	Age(0=under 30, 1=31-40, 2=41-50, 3 =51-60 and 4= 61 and older)
educ	Education (2=high school graduate, 3=college [2-yr degree], 4=university [4-yr degree])
azbqa	Dummy variable for Arizona BQA respondents
canada	Dummy variable for Canadian respondents

A dummy variable, for Arizona NASS respondents, Arizona Rancher BQA respondents and Canadian respondents, is included in the model to account for regional effect.

5.3.2 Model Development for Model 2

A panel probit model (I estimated the random effects probit) is presented to evaluate the attribute characteristics ranchers willing to join an alliance prefer. Decisions are relative to four choices (t =1,2,3 and 4) where ranchers select between a hypothetical alliance A and B with different attributes. In this stage, variables of demographics, alliance attributes and interaction terms between alliance participation fees and demographics are used as explanatory variables.

As stated by Jorgensen (2009) and shown in chapter 4, "the purpose of having eight different versions of the alliance choice question (smaller sized questionnaire with greater diversity of responses) is to help determine which alliance characteristics a respondent prefers". The attributes are classified with regard to their characteristics, and defined as most to least like an alliance. Table 5.2 below shows the 16 possible alliance characteristics and their classification order.

Table 5.2 Possible Survey Alliance Characteristics

Sale Type		**Profit Sharing**	
Retain Ownership	Least Like an Alliance Arrangement	No Profit Sharing	Least Like an Alliance Arrangement
	—		—
Sell to Alliance	More Like an Alliance Arrangement	Profit Sharing	More Like an Alliance Arrangement
Live performance Data Sharing		**Individual Data Sharing**	
Live Performance, Pen Data	Least Data Sharing	Pen/Group Data	Least Data Sharing
	—		—
Carcass Data	More Data Sharing	Individual Yield & Grade Data	More Data Sharing
Restriction Protocols		**Animal Required Protocols**	
No Restrictions	Least Restricted Protocols	No Minimum # Animals Required	Least Restricted Protocols
	—		—
Restrictions	More Restricted Protocols	Restrictions	More Restricted Protocols
Participation Fee			
$0	Least Expensive Fee		
$5	—		
$10			
$20	More Expensive Fee		

Source: Jorgensen, Q. (2009)

As an example, we would consider with regard to the sale type that the attributes Sale cattle to alliance and profit sharing with other members of an alliance denotes an arrangement most like an alliance, whereas when it comes to retained ownership of cattle

and no profit sharing we can consider the arrangement least like an alliance. The classification follows the same idea for the remaining attributes as shown in Table 5.2 (Jorgensen, 2009).

With the new classification having the purpose to isolate and identify preferences for alliance attributes, the previous four categories are split into seven variables types: retain ownership, profit sharing, live performance data sharing, individual data sharing, restriction protocol, animal number required, and alliance participation fee.

After having those variables, the next step is to create new variables on the difference. For example, if alliance A requires profit sharing (with value 1) whereas alliance B require no profit sharing (with value 0), the new difference variable called profit sharing difference type would be equal to profit sharing type in alliance A minus profit sharing type in alliance B. The value of the difference variable profit sharing type would equal 1 (alliance 'A' – alliance 'B' ➔ 1 – 0 = 1). Table 5.3 below provides the difference variables for the seven new attribute characteristics that will be used to estimate Model 2 (panel probit) and Model 3 (Nested bivariate panel probit).

Table 5.3 Difference Variable for Model Two and Model Three

Variable	Differences
Retain ownership Difference	Retain ownership 'A' – Retain ownership 'B'
Profit Sharing Difference	Profit Sharing 'A' – Profit Sharing 'B'
Live performance Sharing Difference	Live performance Data 'A' – live performance Data 'B'
Individual Data Sharing Difference	Individual Data 'A' – Individual Data 'B'
Restriction Protocol Difference	Restrictions 'A' – Restrictions 'B'
Animal Required Difference	Animal # Required 'A' – Animal Required 'B'
Alliance Participation Fee Difference	Fee 'A' – Fee 'B'

Taken and adapted from Jorgensen (2009)

With the setting of the variable difference above, for example we can derive from our estimation that a producer is x% more likely to participate in an alliance if profit sharing exists compared to an alliance where we have no profit sharing. This holds for the remaining difference variables.

Following Jorgensen (2009), a rearrangement is made to efficiently compare alliance 'A' to alliance 'B', rather than having one variable x representing all four tables, we have variable x representing four observations. "Within the four observations, the independent variables remain the same, but the responses would change to adequately address which alliance was chosen within each table. Therefore, in each data set for model 2, all number of observations was multiplied by 4".

It is worth noting that for a particular respondent, age and education variables remain the same for all four observations and the dependent variable represents the respondent choosing alliance A over alliance B (see Table 5.4)

Table 5.4 Example 2 Data Coding used in Model 2 (Panel Probit)

Respondent	Dependent Variable (Alliance 'A' = 1)	Alliance 'A'	Alliance 'B'	Retain Ownership	Alliance 'A'	Alliance 'B'	Profit Difference
X	1	Sell to Alliance	Sell to Alliance	1 - 1 = 0	Profit Sharing	No Profit Sharing	1 - 0 = 1
X	1	Sell to Alliance	Retain Ownership	0 - 1 = -1	Profit Sharing	Profit Sharing	1 - 1 = 0
X	1	Retain Ownership	Retain Ownership	0 - 0 = 0	No Profit Sharing	Profit Sharing	0 - 1 = -1
X	1	Retain Ownership	Sell to Alliance	1 - 0 = 1	No Profit Sharing	No Profit Sharing	0 - 0 = 0

Taken and adapted from Jorgensen (2009)

In line with the model structure presented in Chapter 3, I present in Equation **(5.4)** the full version of the model with the variables selected in model 2.

Following Wooldridge (2002) and Yoo (2008), the following specification is employed:

$$Y^*_{it} = \gamma^{o} X_{it} + \varepsilon_{ib},\ i = 1,\ldots N\ ;\ t = 1,\ldots 4 \qquad \textbf{(5.3)}$$

Where Y_{it} is defined by $Y_{it} = \{1 \text{ if } Y^*it > 0, 0 \text{ else}\}$. Y_{it} is a dichotomous variable indicating whether a producer selected alliance A or Alliance B. X_{it} represents the explanatory variables, and ε_{it} is a scalar error term controlling the effects not captured by the explanatory variables (Bertschek, 1998). Let $\varepsilon_{it} = \alpha_i + \mu_{it}$ where α_i are individual specific error term and μ_{it} is general error term. We also assume a mean of $E(\alpha_i \mid Xi) = E(\mu_{it} \mid Xi) = 0$ and variance of $Var(\varepsilon_{it} \mid Xi) = \sigma^2_{\alpha} + \sigma^2_{\mu}$.

The statistical software package of **STATA version 11.2** was utilized to estimate this model**.** The specific econometric model specification is:

$$Y_{it} = \gamma_0 + \gamma_{1t}cowcalf + \gamma_{2t}smaller + \gamma_{3t}larger + \gamma_{4t}weaned + \gamma_{5t}precond + \gamma_{6t}retainedo + \gamma_{7t}pcost + \gamma_{8t}cl150 + \gamma_{9t}cg300 + \gamma_{10t}formal + \gamma_{11t}written + \gamma_{12t}age + \gamma_{13t}educ + \gamma_{14t}s1ab_t + \gamma_{15t}s_2ab_t + \gamma_{16t}d1ab_t + \gamma_{17t}d2ab_t + \gamma_{18t}p1ab_t + \gamma_{19t}p2ab_t + \gamma_{20t}fab_t + \gamma_{21t}(fab_t)(cowcalf) + \gamma_{22t}(fab_t)(weaned) + \gamma_{23t}(fab_t)(precond) + \gamma_{24t}(fab_t)(\ retained) + \gamma_{24t}(fab_t)(\ pcost) + \varepsilon_{it} \quad \textbf{(5.4)}$$

Where $Y_{it} = 1$ if a producer selects alliance A and $Y_{it} = 0$ if the producer chooses alliance B. The definitions of the explanatory variables are provided in more detail in Table 5.5 below.

Table 5.5: Description of variables used in Model 2 and Model 3 (Alliance choice preferences)

Variable Name	Description
Dependent variable	Choose alliance A (yes=1, no=0)
constant c	constant
s1ab	retain ownership difference between alliance A and B
s2ab	difference in profit sharing between alliance A and B
d1ab	live performance difference between alliance A and B
d2ab	individual data difference between alliance A and B
p1ab	restriction on vaccination and use of antibiotics difference between alliance A and B
p2ab	minimum number of animals required difference between alliance A and B
fab	participation fee difference between alliance A and B
(fab)(cowcalf)	interaction between fab and cow-calf operation only
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves
(fab)(retaindo)	interaction between fab and retained ownership
(fab)(pcost)	interaction between fab and collected at least one variable information cost
(fab)(azbqa)	interaction between fab and dummy variable for Arizona BQA
(fab)(Canada)	interaction between fab and dummy variable for Canada
constan b	constant b
cowcalf	cowcalf operation only
smaller	small producers(smaller=1 if cowherd <= 150 & income from beef<= 50%)
larger	large producers(larger=1 if cowherd > 150 & income from beef > 50%)
weaned	Calf crop sold as weaned calves
precond	Calf crop sold as preconditioned calves
retainedo	Calf crop retained ownership
pcost	Producer collected at at least one variable information cost
cl150	herd size less than 150 heads
cg300	herd size greater than 300 heads
formal	market animal through formal(contractual) agreements
written	Have written contracts if you custom feed your calves
age	age
educ	education
azbqa	dummy variable for Arizona BQA respondents
canada	dummy variable for Canadian respondents

5.3.3 Development for Model 3

The bivariate nested panel probit model could be considered as a combination of the two

previous models that simultaneously estimates both first and second stage models above. Following Aradhyula, S. V and Tronstad, R. (2011), I used (as explained in more detail in Chapter 3) the resulting bivariate Nested panel Probit model to represent the producers' alliance choice preferences:

$$y^*_{1i} = \boldsymbol{\beta}' \boldsymbol{x}_{1i} + e_i \,;\; y_{1i} = \{1 \text{ if } y^*_{1i} > 0, \text{ 0 otherwise}\} \quad i = 1,2,\ldots, N \qquad \textbf{(5.5)}$$

$$y^*_{2it} = \boldsymbol{\gamma}' \boldsymbol{x}_{2it} + \mu_i + \nu_{it} \,; \quad y^*_{2it} = \{1 \text{ if } y^*_{2it} > 0, \text{ 0 otherwise}\} \; i = 1,\ldots N \text{ and } t = 1,\ldots 4 \qquad \textbf{(5.6)}$$

where, N represents number of individuals, T represents number of choice sets given to producers, y^*_{1i} and y^*_{2it} are unobserved latent variables corresponding to y_{1i} and y_{2it}, e_i and μ_i represent the individual specific error terms, and ν_{it} is general error term.

Let $\varepsilon_{it} = \mu_i + \nu_{it}$

The log-likelihood function developed for the bivariate nested panel probit is completely separable in parameters β in (5.5) and γ in (5.6) (see Chapter 3), enabling the ability to estimate equations (5.5) and (5.6) simultaneously.

My econometric specification model using simultaneously equations 5.5 and 5.6 with my chosen variables is:

$$Y_1^* = \beta_0 + \beta_1 cowcalf + \beta_2 smaller + \beta_3 larger + \beta_4 weaned + \beta_5 precond + \beta_6 retainedo + \beta_7 pcost + \beta_8 cl150 + \beta_9 cg300 + \beta_{10} formal + \beta_{11} written + \beta_{12} age + \beta_{13} educ + \mu_1 \qquad \textbf{(5.7)}$$

$$Y_{2t} = \gamma_0 + \gamma_1 s1ab_t + \gamma_2 s_2 ab_t + \gamma_3 d1ab_t + \gamma_4 d2ab_t + \gamma_5 p1ab_t + \gamma_6 p2ab_t + \gamma_7 fab_t + \gamma_8 (fab_t)(cowcalf) + \gamma_9 (fab_t)(weaned) + \gamma_{10} (fab_t)(precond) + \gamma_{11} (fab_t)(retained) + \gamma_{12} (fab_t)(pcost) + \varepsilon_{it} \qquad t = 1,2,3,4 \qquad \textbf{(5.8)}$$

where, $Y_1 = 1$ if a producer responded Yes about his willingness to join an alliance and $Y_1 = 0$ if the producer responded No, $Y_{2t} = 1$ if a producer choose alliance A and $Y_{2t} = 0$ if the producer choose alliance B. The definitions of the explanatory variables are already

provided in Table 5.5 above.

5.3 Empirical Results

5.3.1 Model 1: Beef Alliance Participation

For this this step, the following five different populations were utilized to estimate model 1: Arizona NASS respondents only, Arizona BQA respondents only, Arizona respondents where we combined Arizona NASS and Arizona BQA respondents, Canadian respondents only and the lastly we combined all Arizona and Canadian respondents. For this model we will only focus on summarizing the results of the variables that are significant. The results are shown in detail in Tables D.5.1.1 – D.5.1.5 in Appendix D.

5.3.1.1 Arizona NASS Model 1 results

For Arizona NASS respondents', four variables are significant at 10%. The variables are: small producers (define as producers who have a herd size equal or less than 150 head and who have less than 50% of their income coming from beef operation), beef producers who have less than 150 cows, beef producers who have more than 300 cows and producers who collected at least one piece of cost information for their beef operation. The first three variables display a negative sign indicating that they are less likely to consider joining an alliance under any conditions. However producers who collected at least one piece of cost information for their beef operation are more likely to join an alliance than those who do not collect any cost information. Results are shown in detail in Table D.5.1.1.

5.3.1.2 Arizona BQA Model 1 Results

Two variables are significant when looking at just Arizona BQA respondents' willingness to join an alliance. The variables are: small producers and respondents who sold a percentage of their crop calf as weaned calves respectively. Being a small producer

has a negative effect on a rancher's willingness to join an alliance under any conditions. A negative effect is seen for the producers who sold their crop calf as weaned calves. Detailed results can be found in Table D.5.1.2.

5.3.1.3 Arizona (Arizona NASS and Arizona BQA combined) Model 1 Results

When Arizona NASS and Arizona BQA are combined, results show that three variables of 1) cow-calf operation only, 2) 2006 calf crop sold as weaned and 3) education level are significant at 1%, 10% and 5% levels, respectively. If the operation is limited to only a cow-calf operation, the producer is less likely to join an alliance. In contrast, producers who sold their calf crop as weaned calves and have a higher education level display a greater willingness to join an alliance under certain circumstance. These results are shown in detail in table D.5.1.3.

5.3.1.4 Canada Model 1 Results

Results for Canadian producer in model 1 show that five variables are significant. These variables are: small producers, beef producers who have more than 300 cows, producers who collected at least one information cost for their beef operation, age level and education level and they are significant at 1%, 5%, 1%, 5% and 5%, respectively.

Small producers, producers who have more than 300 cows and age level display a negative sign, they are unlikely willing to join an alliance. In contrary, producers who collected at least one piece of cost information for their beef operation and education level display a positive sign implying they are likely to participate in an alliance under certain circumstances. **Table D.5.1.4** shows the results in detail.

5.3.1.5 All combined (Arizona and Canada) Model1 results

If all the data are combined, results show more variables are significant, as expected. There are a total of eight variables including cow-calf operation only (5%), small producers (10%), age (5%), producers who sold their calf crop as preconditioned calves (10%), producers who collected at least one cost information item for their beef operation (10%), education level (1%), Arizona BQA respondents (5%) and Canadian respondents (5%). Percentages in parentheses indicate the respective significance level of each variable.

Producers with a cow-calf operation only, small scale producers (defined as producers who have a herd size equal or less than 150 head and who have less than 50% of their income coming from beef operation) and education level have a negative effect on a producer's willingness to join an alliance. However, producers who collect at least one piece of cost information for their beef operation, education level, Arizona BQA respondents and Canadian respondents are more likely to join an alliance than Arizona NASS respondents under certain circumstances. For more details about the results see Table D.5.1.5.

5.3.2 Model 2 Results: Beef Alliance Preference: Panel Probit

The panel probit model was estimated using the statistical software **STATA** version **11.2**. The procedure xtprobit, using the Gauss-Hermite Quadrature (GHQ) as explained in the model development in **Chapter 3 (section 3.4.3)**, was implemented to get the results presented in the following sections.

As in model 1, a short summary of the variables that are significant in model 2 is provided below.

5.3.2.1 Arizona NASS Model 2 Results

The results for model 2 regarding Arizona NASS respondents show that five variables are significant. Those variables are: difference in individual data (5%), difference in vaccination restrictions and use of antibiotics (5%), difference in alliance participation fee (10%), interaction between the difference in alliance participation and producers who sold a percentage of their crop calf as weaned calves (1%), and producers who have a herd size less than 150 cows (10%).

Differences of individual data show a positive sign meaning that a producer is more willing to choose an alliance where individual data are present in comparison to an alliance where group or pen data are present. Similarly, producers are more likely to join an alliance where restrictions on vaccination and use of antibiotics are imposed in comparison to an alliance where restrictions are not imposed.

The difference in alliance participation having a positive sign indicates that producers are more likely willing to join an alliance where higher participation fees are imposed in comparison to an alliance with lower alliance participation fees. The interaction between the difference in alliance participation and producers who sold a percentage of their crop calf as weaned, has a negative sign. Results are shown in more detail in Table D.5.2.1.

5.3.2.2 Arizona BQA Model 2 Results

The results for Arizona BQA indicate that only three variables are significant. The variables are difference in restrictions in vaccination and use of antibiotics (1%), difference in minimum number of animals required (1%) and interaction between alliance participation fee and cow-calf operation only (1%).

Producers are more likely to join an alliance where restrictions on vaccination and use

of antibiotics are imposed in comparison to an alliance where restrictions are not imposed. In contrary, they are less willing to join an alliance where a minimum number of animals is required, in comparison to an alliance where no minimum is required. More results can be found in Table D.5.2.2.

5.3.2.3 Arizona (Arizona NASS and Arizona BQA combined) Model 2 Results

The results of Model 2 in Arizona show that seven variables are significant. Those variables are difference in live performance (10%), difference in individual data (5%), difference in restriction in vaccination and use of antibiotics (1%), interaction between alliance participation fee and cow-calf operation only (5%), interaction between the difference in alliance participation and producers who sold a percentage of their calf crop as weaned calves (5%), producers who sold a percentage of their crop calf as weaned calves (10%) and producers who have a herd size less than 150 cows (10%). Arizona producers are less likely to join an alliance where live performance is present in contrast to an alliance where carcass data are present. Also they are more likely to join an alliance individual data or individual yield are present than an alliance where group or pen data are present. In the same order the producers are more likely to choose an alliance where restrictions in vaccination and use of antibiotics are enforced than an alliance where there is no restriction on that attribute. The significant interaction terms have a negative sign. Results of all parameter estimates are shown in Table D.5.2.3.

5.3.2.4 Canada Model 2 results

For eight variables, results are significant with regards to model 2 for Canada (Table AC.5.2.4). These variables are: difference in profit sharing (10%), difference in live

performance data (5%), difference in individual data (10%), interaction between alliance participation fee and producers who collected at least one information cost for their beef operation (10%), large producers (1%), producers who collect at least one information cost item for their beef operation (1%), producers who have a herd size less than 150 cows (1%) and education level (1%).

For Canadian producers they are more likely to join an alliance with profit sharing existing than an alliance with no profit sharing. Also they are more willing to join an alliance where individual data is provided than group or pen data sales. In contrast, they are less willing to join an alliance where live performance sales are utilized rather than carcass sales.

5.3.2.5 All combined (Arizona and Canada) Model 2 Results

When all data are combined, results show that more variables that are significant, as we would expect (see Table D.5.2.5). These variables are thirteen and include difference in profit sharing (5%), difference in individual data (1%)[1], difference in individual data (5%), difference in restriction of vaccinations and use of antibiotics (1%), interaction between alliance participation fee and producers who collected at least one piece of cost information on their beef operation (5%), interaction between the difference in alliance participation and Canadian respondents (5%), large producers(1%), producers who collected at least one information cost for their beef operation(1%), producers who have a herd size less than 150 cows (5%), producers who used written contracts (10%), age level (5%) and education level (1%).

The producers all combined are more willing to join an alliance when profit sharing

[1] The percentage in parentheses represent the significance level

(respectively individual data and restriction in vaccination and use of antibiotics) is present than an alliance where no profit sharing (respectively group data or pen and no restriction in vaccination and use of antibiotics) is present. In contrast they are less willing to join an alliance having live performance than an alliance with carcass present.

5.3.3 Model 3: Beef Alliance Preference: Bivariate Nested Panel Probit

For this model we will only report and discuss the results of Arizona and All data combined. Results for the data of Arizona NASS (Table D.5.3.1), Arizona BQA (Table D.5.3.2) and Canada (Table D.5.3.3) are provided in Appendix D.

5.3.3.1 Arizona (Arizona NASS and Arizona BQA combined) Model 3 Results

Results show that eight variables are significant for Arizona (Table 5.7) comprising; difference in individual data (10%), difference in restriction in vaccination and use of antibiotics (1%), interaction between alliance participation fee and cow-calf operation only (5%), interaction between the difference in alliance participation and producers who sold a percentage of their crop calf as weaned calves (1%), small producers (5%), producers who collected at least one information cost for their beef operation (1%), age level (10%) and education level (5%).

Difference in individual data, difference in restriction in vaccination and use of antibiotics, producers who collected at least one cost item for their beef operation and education level have a positive sign whereas the other significant variables have a negative sign.

Arizona producers are more likely to join an alliance when individual data are present than an alliance where group or pen data are present. Similarly, they are more likely

to choose an alliance where restrictions in vaccinations and use of antibiotics are enforced than an alliance where there is no restriction on that attribute.

Table 5.7: Arizona (AZ NASS and BQA combined) Bivariate Random Effect Results (Model 3)

Variable Names	Description	Estimate	Std. Err.
constant c	constant	-0.1378	0.2504
s1ab	retain ownership difference alliance A vs B	-0.3019	0.2342
s2ab	difference in profit sharing alliance A vs B	0.1035	0.2903
d1ab	live performance difference alliance A vs B	-0.3306	0.2307
d2ab	individual data difference between alliance A vs B	0.3569*	0.2027
p1ab	restriction vaccine and antibiotics difference alliance A vs B	0.4619***	0.1186
p2ab	Min. animals required difference alliance A vs B	-0.1563	0.1426
fab	participation fee difference alliance A vs B	0.0264	0.0458
(fab)(cowcalf)	interaction fab and cow-calf operation only	-0.0562**	0.0249
(fab)(weaned)	interaction fab and weaned calves	-0.0007***	0.0002
(fab)(precond)	interaction fab and preconditioned calves	-0.0004	0.0003
(fab)(retained)	interaction fab and retained ownership	0.0004	0.0006
(fab)(pcost)	interaction fab and collected at least one info. cost	0.0331	0.0369
constant b	constant b	0.6619	1.0301
cowcalf	cowcalf operation only	-0.1641	0.4641
smaller	small producers	-0.6327**	0.2513
larger	large producers	-0.0391	0.5265
weaned	Calf crop sold as weaned calves	-0.0029	0.0040
preconditioned	Calf crop sold as preconditioned calves	0.0032	0.0053
retainedo	Calf crop retained ownership	-0.0002	0.0061
pcost	Producer collected at least one variable information cost	0.9732***	0.3700
cl150	herd size less than 150 heads	-0.4973	0.5074
cg300	herd size greater than 300 heads	-0.9414	0.5777
formal	market animal through formal(contractual) agreements	-0.1442	0.2571
age	age	-0.2381*	0.1370
educ	education	0.2700**	0.1267
RHO	Rho	0.4798	0.4973
SIGMAU	Sigma	0.7432***	0.1751
Numb. Obs.			

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.

Signs of the parameter estimates show only the direction, but the marginal effects provide insight into the magnitude and actual significance of the results. We will base our analysis on different levels of alliance participation fees for the following variables:

5.3.3.2.1 Sale Type (marketing methods)

Results in Table 5.8 show that as the difference in participation fee (FAB[2]= Fee A – Fee B) increases, Arizona producers are less likely to choose alliance A when retained ownership is present in comparison to alliance B when sell to alliance in present.

As an example, if the participation fee in Alliance A is $20 greater than the participation fee in Alliance B, producers are 22% less likely to choose alliance A where retained ownership is present. We have the same results regarding their willingness to join and the presence of profit sharing, but the results are not significant at the 10% level for this attribute. In other words, producers are less likely to choose an alliance where profit sharing is present than no profit sharing.

If there is no difference in the participation fee between Alliance A and Alliance B, the same result holds regarding retained ownership but not for profit sharing. However the results are not significant at the 10% level for both attributes.

5.3.3.2.2 Type of Data Sharing

As the difference in participation fee increases between alliance A and alliance B, Arizona producers are less and less likely to choose Alliance A where live performance is present. As an example if there is no difference between the alliances in terms of alliance participation fee, producers are 8% less likely to choose alliance A where live performance is present (not significant at the 10% level). As the difference become greater, the percentage increases. As we can see in Table 5.8, we have 11.57% if FAB=$5, 15.38% if FAB=$10, 18.99% if FAB=$15 and 22.38% if FAB=$20 and the results are significant respectively at the 10%, 5%, 1% and 1% level.

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[2] FAB= participation fee alliance A - participation fee alliance B

For the attribute individual data or individual and yield, the signs are not consistent and vary. The result is significant at the 10% level only when FAB=$0 (no fee difference between alliance A and alliance B) and the results show that the producers are 9.15% more likely to join an alliance where individual data or individual and yield is present. Also when FAB=$5, the producers are 4.98% more likely to join but the result is not significant at the 10% level.

In contrast, when FAB=$10 (respectively FAB=$15 and $20) producers are 7.57% (respectively 3.37% and 7.46%) less likely to choose alliance A where individual data or individual and yield are present. However these latter results are not significant at the 10% level.

5.3.3.2.3 Production Protocols

With a difference in alliance participation fee of $0, $5, and $10, the producers are 11.81%, 7.67% and 3.48% respectively, more likely to join alliance A where a restriction in vaccination and use of antibiotics is enforced. The results are significant at the 1% when there is no difference in alliance participation fee and 5% when the alliance participation fee in alliance A is $5 greater than the alliance participation fee in alliance B. However, when the difference in alliance participation fee is equal to $10 the results are not significant at the 10% level.

With the participation fee in alliance A greater than alliance B for about $15 or beyond, Arizona producers are less likely to join Alliance A having restrictions in vaccination and the use of antibiotics enforced. With or without a difference in alliance participation fees, producers are less likely to join alliance A where a minimum number of animals are required. Results are significant at the 10% level when the participation fee in alliance A is

greater than the participation fee in alliance B. In Table 5.8, we can see that if the participation fee in alliance A is $5 (respectively, $10, $15 and $20) greater than the participation fee in alliance B, the producers are 8.05% (respectively, 11.99%, 15.78% and 19.36%) less likely willing to choose alliance A where a minimum number of animals are required.

5.3.3.2.4 Operation Type and Use of Information for Beef Operation

a Operation Type

Arizona producers limited to cow-calf operation only are less likely to join an alliance if the participation fee is greater. The larger the difference in participation fee is, the more unlikely the rancher is to join the alliance. As we can see in Table 5.8, if the difference in participation fee is $5 producers are only 0.16% less likely to join alliance A. However if the difference is $10 (respectively, $15 and $20), the producers are 30.24% (respectively, 50.38% and 74.61%) less likely to join the alliance. These results are significant at least at the 5% level.

For producers limited to only cow-calf operation, the difference in alliance participation fee is the primary determinant for their choice in joining an alliance.

b Use of Information for Beef Operation

Results in Table 5.8 show that Arizona producers who collected at least one cost item for their beef operation are more likely to choose the beef alliance with the highest participation fee in comparison to an alliance having a lower participation fee. The bigger the difference in participation is, the more they are likely to join the alliance. The results are all significant at least at the 10% level. Looking at Table 5.8 we can see that when the participation fee in alliance A is $5 (respectively $10, $15 and $20) greater than in alliance

B, the producers who collected at least one information cost for their beef operation are 8.27% (respectively 16.04%, 23% and 28.99%) more likely to join alliance A.

5.3.3.2.5 Marketing Strategies of Calf Crop in 2004

For the producers who have sold their calf crop as preconditioned calves and for those who retained ownership the difference in alliance participation fee is not significant for their choice of a an alliance. For those who sold their calf crop as preconditioned calves when the difference is $5, the sign is positive showing they are likely to choose the alliance with a greater participation fee. In contrast, if the difference in participation fee is $10 or more, they are less likely to choose the alliance with the highest participation fee. Producers who retained ownership of their calf crop are more likely to join an alliance with the highest alliance participation fee in contrast to the alliance with a lower alliance participation fee. Results are not significant at the 10% level. When it comes to the producers who sold their calf crop as weaned calves, they are less likely to join an alliance with a higher participation fee. As we can see in Table 5.8, the signs are all negative and significant unless when the difference in participation is $5 where the coefficient is not significant at the 10% level. It worth noting that the percentage is very low showing a slight influence in their choice for the alliance that has the lower participation fee.

Table 5.8: Arizona (AZ NASS and BQA combined): Marginal Effects Bivariate Panel Probit

Variable Names	Difference in participation fee (fab)				
	fab=0	**fab=5**	**fab=10**	**fab=15**	**fab=20**
Depend variable: Alliance 'A" (yes=1,no=0)	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)
Discrete variables					
Difference in retained ownership	-0.0761 (0.0616)	-0.1157* (0.0607)	-0.1538** (0.0619)	-0.1899*** (0.0644)	-0.2238*** (0.0675)
Difference in profit sharing	0.0265 (0.0749)	-0.0152 (0.0770)	-0.0565 (0.0799)	-0.0967 (0.0832)	-0.1356 (0.0864)
Difference in live performance	-0.0832 (0.0567)	-0.1226** (0.0562)	-0.1603*** (0.0575)	-0.1960*** (0.0601)	-0.2295*** (0.0631)
Difference in individual data or individual and yield	0.0915* (0.0543)	0.0498 (0.0556)	-0.0757 (0.0971)	-0.0337 (0.0643)	-0.0746 (0.0705)
Difference in restriction protocol	0.1181*** (0.0336)	0.0767** (0.0334)	0.0348 (0.0372)	-0.0070 (0.0439)	-0.0484 (0.0522)
Difference in animal minimum requirement	-0.0398 (0.0357)	-0.0805** (0.0401)	-0.1199** (0.0464)	-0.1578** (0.0533)	-0.1936*** (0.0599)
Information cost collected		0.0827* (0.0480)	0.1604* (0.0884)	0.2300** (0.1171)	0.2899** (0.1322)
Continuous variables					
Difference Alliance participation fee		-0.0158*** (0.0055)	-0.0176*** (0.0065)	-0.0195** (0.0077)	-0.0217** (0.0091)
Cow-calf operation only		-0.0016*** (0.0006)	-0.3024** (0.1418)	-0.5038** (0.2401)	-0.7461** (0.3626)
Sold as weaned calves		-0.0010 (0.0009)	-0.0036*** (0.0013)	-0.0060*** (0.0023)	-0.0089** (0.0035)
Sold as preconditioned calves		0.0009 (0.0013)	-0.0023 (0.0019)	-0.0038 (0.0032)	-0.0056 (0.0048)
Retained ownership		0.0801 (0.0904)	0.0019 (0.0029)	0.0032 (0.0049)	0.0047 (0.0072)

* Denotes significance level p<0.1, ** denotes significance level p<0.05 and *** denotes significance level p<0.01

5.3.3.2 All combined (Arizona and Canada) Model 3 results

The three datasets combined show that twelve variables impact significantly producers' choices for a specific of alliance. These variables are difference in live performance (1%; negative), difference in restriction of vaccination and use of antibiotics (1%; positive), interaction between the difference in alliance participation and producers who sold a percentage of their crop calf as weaned calves (1%; negative), interaction between the difference in alliance participation and producers who collected at least one information cost for their beef operation (10%; positive), interaction between the difference in alliance participation and Canadian respondents (5%; positive), producers with cow-calf operation only (5%; negative), small producers (5%; negative), producers who collected at least one information cost for their beef operation (10%; positive), age level (5%; negative), education level (1%; positive), Arizona BQA respondents (1%; positive) and Canadian respondents (5%; positive). The parentheses show respectively the significance level and the sign of the parameter estimate. Detailed results of the parameter estimates are shown in Table 5.9 below.

Table 5.9: All Data combined: Bivariate Random Effect Results (Model 3)

Variable	Description	Estimate	Std. Err.
constant c	constant	0.0145	0.1620
s1ab	retain ownership difference between alliance A and B	-0.0201	0.1656
s2ab	difference in profit sharing between alliance A and B	0.0938	0.1971
d1ab	live performance difference between alliance A and B	-0.3957***	0.1479
d2ab	individual data difference between alliance A and B	0.2321	0.1430
p1ab	restriction on vaccination and use of antibiotics difference between alliance A and B	0.2695***	0.0714
p2ab	minimum number of animals required difference between alliance A and B	-0.0049	0.0991
fab	participation fee difference between alliance A and B	-0.0248	0.0229
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.0006	0.0112
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0005***	0.0002
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0003	0.0002
(fab)(retained)	interaction between fab and retained ownership	-0.0001	0.0003
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0242*	0.0133
(fab)(azbqa)	interaction between fab and dummy variable for Arizona BQA	-0.0003	0.0153
(fab)(canada)	interaction between fab and dummy variable for Canada	0.0364**	0.0145
constan b	constant b	-0.0710	0.5983
cowcalf	cowcalf operation only	-0.5528**	0.2501
Smaller	small producers(smaller=1 if cowherd <= 150 & income from beef<= 50%)	-0.4234**	0.2075
Larger	large producers(larger=1 if cowherd > 150 & income from beef > 50%)	-0.0319	0.3389
weaned	Calf crop sold as weaned calves	0.0024	0.0031
precond	Calf crop sold as preconditioned calves	0.0060	0.0043
retainedo	Calf crop retained ownership	-0.0013	0.0045
pcost	Producer collected at at least one variable information cost	0.4776*	0.2490
cl150	herd size less than 150 heads	-0.2787	0.3126
cg300	herd size greater than 300 heads	-0.2792	0.3417
formal	market animal through formal(contractual) agreements	-0.1849	0.2137
written	Have written contracts if you custom feed your calves	0.2186	0.2684
age	age	-0.1529**	0.0758
educ	education	0.3111***	0.1036
azbqa	dummy variable for Arizona BQA respondents	0.9219***	0.2381
canada	dummy variable for Canadian respondents	0.5909**	0.2881
RHO		0.4810*	0.2827
SIGMAU		0.8866***	0.1174
Numb. Obs.		312	

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.

Similarly to Arizona producers, we will provide further analyses using marginal effects (see more detail in Table 5.10 at the end of this section (5.3.3.2)) and basing our analysis on the different levels of alliance participation fee difference for the following variables:

5.3.3.2.1 Sale Type (Marketing Methods)

Investigating the influence of sale type in their choice of an alliance, results show that producers are consistently and significantly (when the difference in participation fee is $10 or more) less likely to join an alliance where retained ownership is present no matter the level of participation fee difference. As an example, if the participation fee in alliance A is $15 higher, producers are 11.25%less likely to join alliance A where retained ownership is imposed in comparison to sell to alliance. The same interpretation holds for the results of the other levels of difference in participation fee (Table 5.10). Results show (significant at the 10% level) that if an alliance A has a participation fee $20 greater, all producers combined are 12.31% less likely to join alliance A where the profit sharing is implemented.

5.3.3.2.2 Type of Data Sharing

With regard to the data sharing type, producers are less likely to join an alliance where live performance exists no matter the level of participation fee difference. In other terms, with or without difference in alliance participation fee they are less likely to join an alliance where live performance is present in comparison to an alliance where carcass data or pen are present. All the results are significant at the 1% level. In addition, the percentage of their likelihood to not join the alliance A (with live performance present) increases with the increase of the difference in alliance participation fee.

As shown in Table 5.10, if there is no difference in alliance participation fee, they are only 8.78% less likely to choose alliance A whereas if the participation fee of alliance A is

$20 greater they are 22.22% less likely to choose or join alliance A where live performance is present.

Producers seem not to be significantly influenced in their choices by the attribute individual data or individual and yield, as all the results are not significant. However, the results suggest that if is equal or less than $5 they are more likely to choose alliance A where individual data or individual and yield are present. In contrast, they are less likely to join alliance A with an alliance participation fee $10 or more and where individual data or individual and yield are implemented.

5.3.3.2.3 Production Protocols

In general, producers are not significantly influenced by restriction in vaccination and use of antibiotics in their choice of an alliance. However, if there is no difference in alliance participation fee, they are 5.99% significantly more likely to join alliance A where a restriction in vaccination and use of antibiotics is imposed.

When it comes to choose alliance A where a minimum number of animals is required, producers are significantly less likely to join the named alliance if the participation fee of alliance A is $10 or greater. As shown in Table 5.10, if the difference in alliance participation fee is $10 (respectively $15 and $20), Arizona and Canadian producers combined are 7.37% (respectively 10.93% and 14.40%) less likely to choose alliance A where a minimum number of animals is required. Details results are provided in Table 5.10.

5.3.3.2.4 Operation Type and Use of Information for Beef Operation

a Operation Type

Like in Arizona, when all data are combined we see in Table 5.10, that the producers who are limited to cow-calf operation only, are less likely to join alliance A if its participation fee is greater. However the results are not significant at the 10% level no matter the level of difference in terms of participation fee. In addition, the estimates are very low going form 0.12 % to 0.64% which means they are less than 1%.

b Use of Information for Beef Operation

As in Arizona, when all data are combined we still see that producers who collected at least one information cost for their beef operation are more likely to join an alliance with the highest participation fee. As shown in Table 5.10, as the difference in alliance participation fee increases, the percentage of their likelihood to join the alliance with the highest participation fee increases. With a difference of $5 in alliance participation fee they are only 6.33% more likely to choose alliance A whereas with a $20 difference they are 23.84% more likely to join alliance A that has the highest participation fee.

5.3.3.2.5 Marketing Strategies of Calf Crop in 2004

Table 5.10 shows that the producers who sold their calf crop in 2004 as weaned and those who did retained ownership are less likely to choose alliance A if the participation for alliance A is greater. However, the results are not significant at the 10% level.

For those who sold their calf crop in 2004 as weaned calves the same pattern hold meaning that they are less willing to join the alliance with the highest participation fee. The results are highly significant but the percentages are low. This shows that the difference in

alliance participation slightly influences their choice for an alliance over another.

Table 5.10: All Data Combined: Marginal Effects Bivariate Panel Probit

Variable Names	Difference in participation fee (fab)				
	fab=0	**fab=5**	**fab=10**	**fab=15**	**fab=20**
Depend variable: Alliance 'A"	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)	Estimate (Std. Err.)
Discrete variables					
Difference in retained ownership	-0.0045 (0.0370)	-0.0409 (0.0369)	-0.0770* (0.0412)	-0.1125** (0.0482)	-0.1471*** (0.0564)
Difference in profit sharing	0.0209 (0.0439)	-0.0155 (0.0479)	-0.0519 (0.0545)	-0.0878 (0.0625)	-0.1231* (0.0709)
Difference in live performance	-0.0878 *** (0.0337)	-0.1230*** (0.0355)	-0.1573*** (0.0408)	-0.1904*** (0.0477)	-0.2220*** (0.0549)
Difference in individual data or individual and yield	0.0517 (0.0328)	0.0154 (0.0353)	-0.0211 (0.0420)	-0.0574 (0.0510)	-0.0933 (0.0609)
Difference in restriction protocol	0.0599*** (0.0164)	0.0237 (0.0206)	-0.0128 (0.0307)	-0.0492 (0.0424)	-0.0852 (0.0542)
Difference in animal minimum requirement	-0.0011 (0.0221)	-0.0375 (0.0269)	-0.0737** (0.0359)	-0.1093** (0.0462)	-0.1440** (0.0564)
Information cost collected		0.0633*** (0.0199)	0.1250*** (0.0384)	0.1838*** (0.0544)	0.2384*** (0.0668)
Continuous variables					
Difference Alliance participation fee		-0.0142** (0.0059)	-0.0155** (0.0070)	-0.0170** (0.0082)	-0.0186* (0.0095)
Cow-calf operation only		-0.0012 (0.0242)	-0.0027 (0.0530)	-0.0044 (0.0872)	-0.0064 (0.1274)
Sold as weaned calves		-0.0011*** (0.0004)	-0.0025*** (0.0008)	-0.0041*** (0.0014)	-0.0060*** (0.0021)
Sold as preconditioned calves		-0.0006 (0.0005)	-0.0013 (0.0011)	-0.0021 (0.0017)	-0.0030 (0.0025)
Retained ownership		-0.0003 (0.0006)	-0.0005 (0.0013)	-0.0009 (0.0022)	-0.0013 (0.0032)

* Denotes significance level p<0.1, ** denotes significance level p<0.05 and *** denotes significance level p<0.01

5.4 Additional testing

To determine if three data sets (Arizona NASS sample, the Arizona BQA sample and Canadian sample) used in this study can be pooled together to represent the same sample, different joint tests are performed for all three models (see Table 5.11).

Table 5.11: Joint Testing for Beef Alliance Preferences Models

Hypothesis	Full Model (LL_{full})	Restricted Model (LL_{rest})	Degrees of Freedom (Test)	Test Statistic -2*(LL_{full} - LL_{rest})	$C^2_{.05}$	Results
Model Two: Alliance Preferences (Panel Probit)						
H_0: Arizona NASS sample = Arizona BQA sample	-227.90	-210.58	24	34.64	36.42	Not Reject
H_0: Arizona Combined = Canada	-503.60	-466.19	24	74.82	36.42	Reject
H_0: BQA = Arizona = Canada	-503.60	-448.87	48	109.46	55.76	Reject
Model Two: Alliance Preferences (bivariate nested Probit)						
H_0: Arizona NASS sample = Arizona BQA sample	-333.53	-299.48	26	68.1	36.42	Reject
H_0: Arizona Combined = Canada	-682.27	-660.13	26	44.28	36.42	Reject
H_0: BQA = Canada	-513.86	-496.175	26	35.364	36.42	Not Reject
H_0: BQA = Arizona = Canada	-682.27	-626.08	52	112.38	55.76	Reject

As we would expect and as it can be seen in Table 5.11, the joint test corroborates that Arizona NASS sample and the Arizona BQA sample are statistically different from each other for model 1 (probit) and model 3(Nested bivariate panel probit). However, for model 2(panel probit) the test couldn't be rejected meaning that for this models the two samples could be pooled as a single sample.

Also from the joint test we can infer that the three data sets (Arizona NASS sample, the Arizona BQA sample and Canadian sample) are statistically different from each other when combined together. This was expected since these samples have demographic differences in addition to their geographic differences.

Regardless, test results of the three datasets were combined and utilized to estimate and analyze the different models used in this study. However, dummy variables are included to account for difference in Arizona BQA, Canadian and Arizona NASS respondents.

5.5 Concluding Remarks

This chapter discussed the model specification, econometric estimation procedure and empirical results for each of the three binary probit models presented. The first model (probit) provided some insight regarding the willingness of producers to join or not an alliance. The results showed, as an example if we combine all the dataset, that the type of beef operation (cow-calf operation only), type of producer (small producer), Marketing Strategies of Calf Crop in 2004 (sold as weaned calves), producer's age and producer's education level have a significant impact on the producer's willingness to join an alliance. Also whether or not a producer used at least one information cost for beef operation impacted significantly his decision to participate in an alliance under certain circumstances. Finally, as already stated by Jorgensen (2009), being from Arizona BQA or Canada sample impacted significantly the producers to join an alliance.

For the two remaining models (panel probit and bivariate nested panel probit) investigating the choice preference of producers with regard to alliance attributes, the results showed more insights. In general the difference in alliance participation fee level in combination with sales type, data sharing and production protocols affected significantly the choice of the producer with regard to alliance preference.

CHAPTER 6: SUMMARY AND CONCLUSION

6.1 Introduction

This chapter provides a summary of the empirical results regarding this study. In addition some limitations are highlighted and recommendations for further studies on the research topic are provided. Lastly, concluding remarks are provided.

6.2 Summary of Empirical Results

A key motive behind this study was to investigate how attributes of a proposed beef alliance impacts producers' preferences for using one alliance over another. To investigate this question a nested bivariate panel probit model is employed. Three similar surveys were conducted with Arizona NASS producers (2007), Arizona BQA producers (fall 2008)) and Canadian producers (Spring 2006). The surveys were designed to capture insights regarding beef producers' characteristics, their production practices and their willingness or not to join a beef alliance under certain circumstances.

An unlabeled choice experiment design (the choice alternatives are normally labeled as "Alliance A" and "Alliance B," such that the labels attached to each choice alliance conveys no information beyond that provided by their attributes) was implemented. The study investigated the decision making process of cow-calf producers about joining an alliance and choosing between different types of beef alliances according to the attributes associated with the alliance. Three different binary probit models are estimated to evaluate the robustness of a producers' willingness to join an alliance (probit model) and their alliance choice preferences (Panel Probit model and bivariate nested panel probit model).

Our results show that for a producers willingness to join a beef alliance, producers' choices are significantly affected by the following variables: cow-calf operation only, smaller producers (defined as producers who have a herd size equal or less than 150 head and who have less than 50% of their income coming from beef operation), selling a percentage of their crop calf as preconditioned calves, producers who collected at least one piece of cost information on their operation, age, education level, and population of producers (i.e., Arizona NASS, Arizona BQA, and Canadian). Producers from only a cow-calf operation and smaller in size (producers with a cowherd equal or less than 150 head and having the percentage of their income coming from beef operation less than 50%) are unlikely to join an alliance.

On the other hand, producers who collected at least one piece of cost information for their beef operation and those who sold their crop calf as preconditioned calves, are more likely to join an alliance under certain conditions. Furthermore, producers with more education are more likely to join an alliance than those with less education (high school and less) whereas younger producers are found to be less likely to join an alliance compared to older producers.

Most of these results are consistent with the findings of Jorgensen (2009) and prior studies (Gillespie et al. (2004) and Lan (2006)) except that for larger producers (not significant at the 10% level for this study results). Our definitions are different with regard to small and large producers. They used cowherd size only to define larger and smaller producers whereas I combined cowherd size and percentage of income from beef operation to define those categories.

Our findings indicate that Arizona and Canadian cow-calf producers have preferences for some alliance attributes over others when asked to choose between different alliances attributes. To investigate the producers' attribute preferences a panel probit (model 2 which does not including in the analysis the respondents who answered no they are not willing joining an alliance) and a nested bivariate panel probit (model 3 which includes in the analysis the producers who said they are not willing to join an alliance) are used.

The bivariate nested panel probit model was used to simultaneously estimate the decision of willingness to join an alliance with selection of desired attributes of an alliance because this will allow to incorporate the respondents who responded they are not willing to join an alliance and for whom we don't have information about their attribute choices. This was due by the fact they were asked to skip the question related to the choice experiment. Hence, with the bivariate nested panel probit model we can make inferences including those respondents.

Results of the bivariate panel probit show for all data combined that the following variables are significant with regard to producers' choice for alliance A: difference in live performance data, difference in restriction on vaccination and use of antibiotics, interaction between alliance participation fee and producers who sold their calf crop as weaned calves, interaction between the difference in alliance participation and producers who collected at least one piece of cost information on their beef operation, interaction between the difference in alliance participation and Canadian respondents, cow-calf operation only, smaller producers, producers who collected at least one information cost for their beef

operation, age level, education level, AZ NASS ,Arizona BQA respondents and Canadian respondents.

Further investigation was made using the marginal effect of the attributes and some demographic variables. The difference in participation fee (financial commitments) was used to get some insight regarding cow-calf attribute preferences.

Results of the bivariate nested panel probit imply that the difference in alliance participation fee plays a determinant role on producers' preferences for an attribute choice. Regarding the sale type, no matter the difference in alliance participation fee, producers are less likely to choose an alliance where retained ownership is present in comparison to sell to alliance. However, this result is significant only when the difference in participation fee is $10 or greater.

When the difference in alliance participation fee is $20, producers are less likely to join the alliance with the highest participation fee and when profit sharing is present versus no profit sharing. In other words producers are not willing to join an alliance having a fee of $20 per head more when the profit will be shared among alliance members. The other levels of difference in participation fee are not significant.

If there is no difference in participation fee between the two alliances, producers clearly show that they are not willing to choose the alliance where information on live performance is present in comparison to the one with carcass data. If the difference in participation is $5 or more, the same choice holds for the alliance with the highest participation fee.

For the attribute difference in individual data or individual and yield, the sign is not consistent as the difference in participation fee changes and the results are not significant at

the 10% level. If the difference is equal or less than $5, producers are more likely to join the alliance with the highest participation fee and where individual data or individual yield is present. However, if the difference is $10 or more, it's the opposite decision.

Regarding production protocols, if there no difference in participation fee, producers are more like to join an alliance where a restriction in vaccination and use of antibiotics is imposed. When the difference in participation fee is $10 or more the results are not conclusive.

Producers do not embrace an alliance where a minimum number of animals is required when the participation fee is $10 or more. This result is consistent with previous studies (Jorgensen (2009)); however, the differences arise when the difference in participation fee is $10 or more.

Producers limited to only a cow-calf operation, producers who sold their calf crop as weaned calves, those who sold their calf crop as preconditioned, and those who retained ownership are less likely to choose the alliance with the highest participation fee. However, it worth noting that the results are significant only for those who sold their calf crop as weaned calves.

Producers, who collected at least one piece of cost information for their beef operation, are more likely to join the alliance with the highest alliance participation fee. Summary tables (Tables E.6.1 to E.6.5) are provided in Appendix E where, results for the panel probit, the pooled probit and the bivariate nested panel probit are shown in the same table for the different variables used. This will allow to see the different results reported in this study simultaneously.

6.3 Limitations and Further Research

The limitations of this study have been mostly reported in the previous works of Lan (2006) and Jorgensen (2009). This study being an analysis of the same data, therefore I will mention those that are also limitations for my study.

The small sample sizes used in this study can be considered as being the main limitation. As reported by Jorgensen (2009) and reproduced in this study, for Canada only 150 valid samples were used representing 16% rate of response. Similarly, for Arizona NASS we had 146 useable samples when the two Arizona NASS surveys were combined with the 1st sample having 85 useable samples (157 were returned but 72 questionnaires were lost in an express mail package before being entered) and the 2nd sample 61 were returned) representing about 11% response rate and for Arizona BQA the number of valid samples returned was 107 resulting in a useable response rate of 25%.

This demonstrates how fairly small the different samples were. This situation may cause large variance in choice modeling occasioning the coefficient estimate to be insignificant and the model fit to be low (Hensher et al.(2005), Lee et al.(2000), Lan(2006) and Jorgensen(2009)).

Also because of the sample sizes, the number of variables to be included in the analysis was limited. I couldn't use all the variables that I wanted in my different models to avoid the risk to over fit them. For example it would have been interesting to include to see how the expected performance of the beef operation, net income (increase or decrease of net income) and value of cowherd wintered (increase or decrease of market value of cows sold) would affect the producer's choice. In addition, the different categories of ages and education levels are not used in the models.

Another limitation is related to the oversampling of Alberta respondents caused by the impossibility to contact cow-calf producers who are not in the area of Alberta. This situation is due by the fact that the regional beef associations are not allowed to provide access to their membership lists. This could have helped to get a more diverse and more representative sample of the region allowing more distinct transaction characteristics resulting varied attitudes toward alternative marketing arrangements. (Lan (2006) and Jorgensen (2009)).

A supplementary limitation to this study is related to problems arising with stated preference method and called hypothetical biases presented in the paper of Bishop and Heberlein (1979). This situation occurs if there is a lack of realism or the producers found the survey too complex or lengthy (Lan, 2006 and Jorgensen, 2009).

This situation could have happened both in Arizona and Canada. If we take the case of Canada, the presence of trained students on site to help producers fill out the survey could have created a bias. The time constraint could have also lead producers to bias their responses to get rid of the survey by completing it quickly. The same thing could also apply to Arizona NASS and Arizona BQA surveys where we have noticed that producers did not fill the survey completely meaning that they skipped through the questions to just get the survey completed (Lan (2006) and Jorgensen (2009)).

Because no revealed data are used in this study (access denied), for further research, it would be more interesting to combine revealed preference data and stated preferences data (discussion provided earlier in chapter 3). This is due to the fact that revealed preference data provide actual information about respondents' choice behavior.

In addition investigating specific information[3] related to cost of production, production data and processing data collected by producer and their effect on the producer's preferences, could be of a big help of understanding and designing an alliance that fits their needs in harmony to other attributes they identify being the one they are interested in.

From the results we can see that for some attributes, only cow-calf producers are willing to pay more than a diversified producer for the participation fee to join a specific alliance. If they are willing to do so, it's because they believe that what they will gain later will be greater than what they have invested. For this reason, for future alliance designs, one should think of showing clearly what are the excepted benefits (give quantified ranges) according to the different attributes (sale type, data sharing, and production protocols) proposed in the alliance in addition to the participation fee.

6.4 Conclusion

This study has inspected the effect of demographic and producers' characteristics on the willingness to participate in a beef alliance. A first model (binary probit) was used to investigate beef alliance participation and two models (panel probit and bivariate panel probit) were implemented to look at the producers' attribute preferences for an alliance. The results of the binary probit show that only cow-calf operations, smaller producers (define as producers who have a herd size equal or less than 150 head and who have less than 50% of their income coming from beef operation), those that sold a percentage of their crop calf as preconditioned calves, producers who collected at least one piece of cost information for their beef operation, age, education, AZ NASS respondents, Arizona BQA

[3] See Appendices A and B for more detail regarding cost of production, production data and processing data they were asked to choose from.

respondents and Canadian respondents influence considerably the willingness for producers to join an alliance under certain circumstances.

The nested bivariate panel probit model by combining simultaneously the binary probit (participation model) and the panel probit (attribute choice model), provided more insights with regard to attribute choice preferences. Most of the results are consistent with previous studies (Brocklebank and Hobbs (2004), Lan (2006) and Jorgensen (2009)).

Using the difference in beef alliance participation fee as base of our analyses, the results show that it has a significant impact on the producers' choice with regard to the sales type, the data sharing type and the production protocols. The different levels of difference in participation fee provided more detailed results (significance and sign) about producers' preference for alliance attributes.

In conclusion, we can imply that according to the results obtained in this study using the nested bivariate panel probit model, that cow-calf producers from Arizona and Canada are aware about the importance of joining an alliance for better niches of their beef operations. It suggests also that according to their specific characteristics and their experiences, cow-calf producers do have preferences when facing different alliances providing different attributes. Thus, this model provided new updates in beef alliance preferences and can serve as a base for further investigations or for helping evaluate the impact of new designed alliances by allowing a wide array of attribute combinations.

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APPENDIX A: SURVEY INSTRUMENT USED FOR CANADA

Dear Industry participant,

The National Beef Industry Development Fund (NBIDF) is supporting our research project "Formal beef alliances and alignment challenges: issues in contracting, pricing and quality". This interview is an important part of the project. Our research efforts have two main objectives. First, to design better contracts between the cow-calf sector and other sectors in the beef industry supply chain. Second, to evaluate the feasibility of using market based tools to manage price risk in the cattle industry.

You are part of a carefully selected sample that has been asked to assist with this interview, and we appreciate your assistance. As with all interviews we conduct your responses are confidential. Thank you for your participation and support!

PART I

1. Please indicate which of the following best describes your current operation (please choose one option only)?

   - cow-calf operation only
   - cow-calf + backgrounding
   - cow-calf + backgrounding + finishing
   - cow-calf + backgrounding + finishing + seedstock
   - seedstock producer
   - backgrounding only
   - finishing only
   - backgrounding + finishing

2. How many years has your business been producing beef cattle?

   ___ years

3. What did you do with your calf crop born in 2004? Please allocate percentages across the following options:

   - Sold as weaned calves ..... ____ %
   - Sold as preconditioned calves ..... ____ %
   - Retained ownership ..... ____ %
   - Replacement heifers ..... ____ %
   - Other: please describe; please use zero if not applicable. ____ %

   = 100 %

4. Do you specialize in a particular breed?
   A. Yes, _____
   B. No
5. Please specify your December 2005 herd inventory in terms of the following size categories (please check the following boxes):

	Number of head:				
	None	Less than 50 head	51-150 head	151-300 head	300 and more
Cows					
Replacement heifers					
Stockers/ Yearlings					
Bulls					

6. How did you market your weaned calves in 2005? If multiple options apply, please rank the options in declining order (1 being the most frequently (or largest by head) used marketing option):
   - Sold through auctions ..... ___
   - Retained ownership .... ___
   - Sold directly to backgrounder ..... ___
   - Sold directly to feeder ..... ___
   - Other:
7. If you used auction markets in 2005 **to sell your weaned calf crop**, what percentage of your calf crop was sold by the following public auctions:

   - Regional auction markets .... ___
   - Pre-sort auction ..... ___

   = 100%
8. If you used auction markets in 2005 **to sell your feeders/backgrounders**, what percentage of your cattle was sold by the following public auctions:

   - Regional auction markets .... ___
   - Pre-sort auction ..... ___

   = 100%
9. If you have used auction markets in the past, how would you judge the performance of those markets (in terms of competitive prices, rewarding qualities, handling), (a) for regular auctions and (b) for pre-sort auctions? Please place one mark in each column.

   (a) Performance of regular auction markets:

	… in terms of achieving a competitive price	… in terms of rewarding the qualities of my cattle	… in terms of professional livestock handling
They perform extremely well			
Very well			
Quite well			
Not very well			
Extremely poor			
Have not used regular auction			

(b) Performance of pre-sort auctions:

	… in terms of achieving a competitive price	… in terms of rewarding the qualities of my cattle	… in terms of professional livestock handling
They perform extremely well			
Very well			
Quite well			
Not very well			
Extremely poor			
Have not used a presort auction			

10. If you have retained ownership in the past, what type of financing of feeding and yardage was involved?
    - No financing of living expenses provided by backgrounder/feedlot __
    - I deposited __ % of the backgrounding costs with the backgrounder/feedlot upfront
    - Feed, yardage and other costs are settled at the end of the feeding period __
    - Feed, yardage and other costs are settled monthly __
    - Other (please specify):
11. In 2005, have you marketed cattle through an existing relationship agreement between producers and other members in a value chain (e.g. livestock cooperative/alliance)?
    - No __
    - Yes, __ less than 10%, ___ more than 25%, ___ more than 50% ___ 100%
12. Do you retain ownership of some of your calves **to background**?
    - No: __ then please skip to question 13.

- Yes: __then please consider the following questions:

If you sold at the backgrounding stage, could you please indicate whether the following specifications hold in dealing with your buyer. If these specifications are not exactly matching those that apply to you, please choose what is closest to what you use in practice.

a) An average price based on regional auction markets is used in determining the final price
   1. yes __
   2. no __

b) Price premiums and discounts for not meeting specified characteristics are in place.
   No __: please skip to question 13
   Yes __

These premiums/discounts are associated with:
   1. your breed __ yes
      __ no
   2. a regional average price that is directly factored into your payment scheme
      __ yes
      __ no
   3. other quality-related specifications (please specify): _____

13. Do you retain ownership of some of your cattle **until slaughter**?
    - No: __ then please skip to question 14!
    - Yes: __ then please consider the following questions:

In considering the payment method and the associated price level for your finished cattle sold in private sales, could you please indicate whether the following specifications hold in dealing with your buyer. If these specifications are not exactly matching those that apply to you, please choose what is closest to what you use in practice.

c) A regional average price is used in determining the final price
   1. yes __
   2. no __

d) Discount scales apply for carcasses over _____ lbs.

e) Price premiums and discounts for not meeting specified characteristics are in place.
   No __, then please go to question 14.
   Yes __

These premiums/discounts are associated with
   1. quality grade __ yes__ no
   2. yield grade __ yes__ no
   3. regional average price__ yes__ no
   4. other specifications related to carcass weight: _____

f) The premiums and discounts associated with your above choices are as following:

__ -20% __ -15% __ -10% __ -5% __ +5% __ +10% __ +20%

PART II

Please let us know whether, in principle, you would consider future participation in a formal agreement between cow-calf producers and other members in a value chain. You have the opportunity to be part of a beef alliance that is developing niche markets. There is the potential for generating extra margins for your business if the alliance is able to produce animals of suitable qualities based on genetics and specific production protocols. Your animals are close to or ready to qualify for participating in this alliance.

() Yes, I am willing to participate in an alliance under certain circumstances
() No, I am not willing to participate in an alliance under any circumstances

Next you will be asked to choose between different types of alliances (with different specifications). You will vote four times between two alternative options. Please choose only one option on each screen. Assume that the options on each page are the only ones available. Each time, please vote independently from the other votes - please do not compare options on different screens.

1. Sale type refers to the ways in which you are willing to market your animals with the alliance (e.g. sell animals to alliance, retain ownership)
2. Type of data sharing refers to the different levels at which you would want to share data with the alliance.
3. Production protocols refers to the type of production protocols you would agree to related to vaccines, weaning and other production practices.

Example of Choice Experiment

Attributes	Alliance A	Alliance B
Sale Type	Sell to alliance, bonuses based on animal performance	Sell to alliance, No profit sharing
Information Sharing Scheme	live performance, individual data	live performance, individual data
Production Protocol	Restrictions on vaccination and use of antibiotics & No min. number of animals Required	Restrictions on vaccination and use of antibiotics & min. number of animals Required
Membership Fee	$0	$5
I would choose	□	□

PART III

1. In the future, feedlots (backgrounders) may opt to require specific production protocols from cow-calf producers. Therefore, written contracts may include more explicit cost sharing arrangements between feedlots and cow-calf producers/feedlots and backgrounders.

   Do you currently bear the costs for production protocols **fully** or **partially** in your operation? Please check all options that apply:

   - No, I don't bear any costs related to production protocols __ (then please proceed to question 2)

   Yes, I **fully** bear costs related to:

   - Herd health (vaccination/ vet visits) __
   - Genetics__
   - Unanticipated increases/decreases in feed costs __
   - Unanticipated death rates __

   Yes, I **partially** bear costs related to:

   - Herd health (vaccination/ vet visits) __
   - Genetics__
   - Unanticipated increases/decreases in feed costs __
   - Unanticipated death rates __

2. Please consider how market prices for cows have moved during the past few years. When replacement cow prices are very low, in your experience, how many years does it take for market prices for cows to return to the long run average price?

   - Never ..... __
   - Prices change too much to determine a length of time __
   - 1 year __
   - 2 years __
   - 3 years __
   - 4 years __
   - Other (number of years): __

3. What type of information do you collect for your beef enterprise? Please check all the categories that apply to your business.

   Market data from the beef industry

   a. auction prices ..... __
   b. information on contracts from other producers ..... __
   c. other: _____

   Beef production data:

   d. birth weights ___
   e. genetics __

PART III

1. In the future, feedlots (backgrounders) may opt to require specific production protocols from cow-calf producers. Therefore, written contracts may include more explicit cost sharing arrangements between feedlots and cow-calf producers/feedlots and backgrounders.

   Do you currently bear the costs for production protocols **fully** or **partially** in your operation? Please check all options that apply:

   - No, I don't bear any costs related to production protocols __ (then please proceed to question 2)

   Yes, I **fully** bear costs related to:

   - Herd health (vaccination/ vet visits) __
   - Genetics__
   - Unanticipated increases/decreases in feed costs __
   - Unanticipated death rates __

   Yes, I **partially** bear costs related to:

   - Herd health (vaccination/ vet visits) __
   - Genetics__
   - Unanticipated increases/decreases in feed costs __
   - Unanticipated death rates __

2. Please consider how market prices for cows have moved during the past few years. When replacement cow prices are very low, in your experience, how many years does it take for market prices for cows to return to the long run average price?

   - Never ..... __
   - Prices change too much to determine a length of time __
   - 1 year __
   - 2 years __
   - 3 years __
   - 4 years __
   - Other (number of years): __

3. What type of information do you collect for your beef enterprise? Please check all the categories that apply to your business.

   Market data from the beef industry

   a. auction prices ..... __
   b. information on contracts from other producers ..... __
   c. other: _____

   Beef production data:

   d. birth weights ___
   e. genetics __

f. animal health __
g. open cows (dry cows) __
h. birth rate __
i. $ spent per wintered cow
j. Pounds of calf weaned per cow wintered
k. Other: _____

Beef processing data:

l. carcass grading data on feeder cattle ___
m. genetic tracking (parenting) __
n. other: _____

4. How do you use the information that you collect for your enterprise? Please check all options that apply:

- I use it internally, without outside advice ___
- If you use outside (consulting/extension) advice, please rank the following options in the order of importance to your business (1 being most important, 4 least important):

	Rank
I use outside advice in my feeding program	
I use outside advice in my breeding program	
I use outside advice for my business management	
I use outside advice in my health management	

5. **How many**, and **which** cattle *and* business-related magazines/regular publications do you subscribe to (both related to your beef as well as your other businesses)?

I regularly subscribe to ___ publications.

Names of publications: _____

6. How do you manage risk outside of your beef business (crops, etc.)?
   - I'm using forward cash contracts yes __ no __
   - Yes, I'm hedging commodity futures yes __ no __
   - I have insurance for: _____
   - Other: .....
7. If marketing your weaned calves with written contracts, do you
   - use forward cash contracts ..... yes __ no __
   - use other pre-pricing contractual arrangements ..... yes __ no __
     - if yes, please specify: _____

8. If you custom feed your calves (either from your own operation or purchased), do you have written or oral contracts in place for most of your business?
   - Oral contracts __ (then please proceed to question 9)
   - Written contracts __

   8. a. Consider your written contracts for custom feeding,
   - they apply to the calves placed with the custom feeder for a single production cycle: Yes __ no __
   - they carry over to following years,
     and the contract terms are re-negotiated annually __
     and the contract terms remain fixed for multiple production cycles __

   8.b. Have you had your own cattle custom fed in the past?

   NO __ please proceed to question 8.c.

If YES, please consider your written contracts for custom feeding. What features were (are) contained in those contracts? Please select all those options that apply:

1. Maximum cost of gain __
2. Safeguards against lower prices __
3. Known minimum price __
4. Safeguard against price variability __
5. Grid-based pricing __
6. Deferred compensation until after processing __
7. Electronic information exchange on animal performance __
8. Type of feed __
9. Markup for feed __
10. Yardage fee (overhead, maintenance) __
11. Death loss
12. Manual exchange of information on animal performance (printout) __
13. Financing as part of retained ownership through cattle feeder association __
14. Financing is arranged through the feedlot as part of retained ownership __
15. Margin sharing according to ownership proportion __
16. Margin sharing according to cost allocation __
17. Other (please specify):

Out of these 17 contract features, what are the **three most important ones** to you, and how would you rank these in terms of their ability to positively affect your business success (1 being most important, 5 least important)?:

- Rank 1: Number __
- Rank 2: Number __
- Rank 3: Number __

Consider those **three** contract features above (and the corresponding numbers), which ones are open for negotiation with your backgrounder/feedlot, **before** or **after** you signed the contract? Please check all options that apply:

	Contract terms that are open for negotiation **before** signing the contract	Contract terms that are open for negotiation **after** signing the contract
Number ___		
Number __		
Number __		

8.c. If in the future, you were to custom feed your calves, what would be important features that you would want to be included in those contracts?

Please select all those options that apply:

18. Maximum cost of gain __
19. Safeguards against lower prices __
20. Known minimum price __
21. Safeguard against price variability __
22. Grid-based pricing __
23. Deferred compensation until after processing __
24. Electronic information exchange on animal performance __
25. Type of feed __
26. Markup for feed __
27. Yardage fee (overhead, maintenance) __
28. Death loss
29. Manual exchange of information on animal performance (printout) __
30. Financing as part of retained ownership through cattle feeder association __
31. Financing is arranged through the feedlot as part of retained ownership __
32. Margin sharing according to ownership proportion __
33. Margin sharing according to cost allocation __
34. Other (please specify):

Out of these 17 contract features, what are the **three most important ones** to you, and how would you rank these in terms of their ability to positively affect your business success (1 being most important, 5 least important)?:

- Rank 1: Number __
- Rank 2: Number __
- Rank 3: Number __

Please indicate to what extent you agree that the reference price (base price?) should be tied to the following criteria:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

The reference price should be tied to boxed beef cutout value					
The reference price should be					

8.d. If in the future, you were to retain ownership of your calves and place them with a custom feeder, what would be important features that you would want to be included in those contracts?

Please select all those options that apply:

35. Maximum cost of gain __
36. Safeguards against lower prices __
37. Known minimum price __
38. Safeguard against price variability __
39. Grid-based pricing __
40. Deferred compensation until after processing __
41. Electronic information exchange on animal performance __
42. Type of feed __
43. Markup for feed __
44. Yardage fee (overhead, maintenance) __
45. Death loss
46. Manual exchange of information on animal performance (printout) __
47. Financing as part of retained ownership through cattle feeder association __
48. Financing is arranged through the feedlot as part of retained ownership __
49. Margin sharing according to ownership proportion __
50. Margin sharing according to cost allocation __
51. Other (please specify):

Out of these 17 contract features, what are the **three most important ones** to you, and how would you rank these in terms of their ability to positively affect your business success (1 being most important, 5 least important)?:

- Rank 1: Number __
- Rank 2: Number __
- Rank 3: Number __

9. If you retain ownership, what means of monitoring the performance of your animals at the feedlot/backgrounder level do you use? Please rank these monitoring schemes in order of significance to your business success (1 for most important, 3 for least important):
   - Rank __: I contact the feedlot (backgrounder) to view my animals (average frequency in weeks: ___)
   - Rank __: I ask for to see the printed records of my animals periodically
   - Rank __: I have 24hrs real-time access to electronic data of my cattle

10. How do the buyers of your cattle (backgrounders/feedlots) verify your own quality efforts as related to your cattle, before it leaves the farmgate?
    - There is no verification going on,
        - because my buyer simply trusts me
        - because my buyers doesn't care about auditing me
    - The buyer requests documentation (on health practices etc.)
        - No __
        - Yes, he requests:
            - Verbal documentation __
            - Written documentation __
            - On-farm inspection

11. What percentage of your net income from farming comes from your beef enterprise?
    - Less than 25% of my net income from farming comes from beef
    - Less than 50% of my net income from farming comes from beef
    - More than 50% of my net income from farming comes from beef

12. Please consider the following statements regarding two performance measures for your beef operation, net income and value of cow herd wintered. Considering my expectation (average) for these measures in 2007,

    - I think it is extremely unlikely that my net income in 2007 will be __ % **above** my **average net income**
    - I think it is extremely unlikely that my net income in 2007 will be __ % **below** my **average net income**

    - I think it is extremely unlikely that the value of my cows wintered in 2007 will be __ % **above** the **average value** of cows wintered.
    - I think it is extremely unlikely that the value of my cows wintered in 2007 will be __ % **below** the **average value** of cows wintered.

13. Considering all your farm activities outside of your cow-calf operation, could you please rank them in order of financial contribution to your overall farm income (1 being the most important activity):
    - Grain & oilseeds ___
    - Pork ___
    - Dairy ___
    - Sheep ___
    - Horses ___
    - Diversified livestock ___
    - Other: ……..

14. Are you or your family partner employed off the farm?

1. Myself: __ yes __ no
2. Partner: __ yes __ no

15. If you or your family partner work off the farm, do you work full or part-time?

1. Myself: __ full-time __ part-time
2. Partner: __ full-time __ part-time

16. If you or your partner work off the farm, your total off-farm income is:
    - Less than 25% of your farm income
    - Less than 50% of your farm income
    - More than 50% of your farm income

17. Please indicate your age

    - Under 30 __
    - 31-40 __
    - 41-50 __
    - 51-60 __
    - 61 and older __

18. Please indicate your level of education

    - High school __
    - College __
    - University __

Thank you for completing this survey! If you have further comments on the survey, or specific questions, please enter them in the following box:

APPENDIX B: ARIZONA NASS AND ARIZONA BQA LETTERS AND QUESTIONNAIRE

November 24, 2008

<first last>
<address #1>
<address #2>
<City, AZ zip code>

Dear <First Last>,

The Arizona Beef Quality Assurance (BQA) program is designed to assure the production of a safe, wholesome product produced in a humane manner that is en vironmentally sustainable. Marketing alliances have been formed in other regions that utilize established production protocols to improve the marketability of their cattle. Please find enclosed a questionnaire to help assess the feasibility of a marketin g alliance for Arizona's beef cattle. We are sending this to present and former BQA certified ranches. Production and marketing alliances can help bolster prices through rewarding better production efficiencies at the feed lot and more consumer desirable beef attributes. Alliances can also provide information back to producers on how their calves performed in the feedlot (daily gains and pen feed efficiency) and the carcass yield and grade attained for individual animals or pens of animals. Through this questionnaire, we hope to find common interests among producers in Arizona for improving the competitive position of our beef industry.

Questions asked regarding your marketing and management choices are strictly voluntary and it is not expected that bein g a part of this study will harm you in any way. Your input is completely anonymous as we have no way of linking your responses to a given questionnaire. Please use the enclosed envelope with postage to return your questionnaire.

We greatly appreciate your support in completing this questionnaire and we look forward to identifying how Arizona's beef industry can be most supported in this area given your responses. Please note the questionnaire is shorter than is appears since some questions are skipped depending on your answers.

Sincerely,

Robert Kattnig
Associate Livestock Specialist
The University of Arizona

Russell Tronstad
Specialist and Professor
The University of Arizona

THE UNIVERSITY OF ARIZONA
TUCSON ARIZONA

Arizona Cattle Growers' Association

August 20, 2007

<first last>
<address #1>
<address #2>
<City, AZ zip code>

Dear <First Last>,

Although calf prices have been relatively strong in recent years, it is also important for our industry to be proactively exploring different avenues for increasing the competitive position of beef. Production and marketing alliances are a tool to help bolster prices through rewarding better production efficiencies at the feed lot and more consumer desirable beef attributes. Alliances can also provide information back to producers on how their calves performed in the feedlot (daily gains and pen feed efficiency) and the carcass yield and grade attained for individual animals or pens of animals.

Enclosed is a survey we ask for you to complete so that producer preferences regarding alliances can be properly identified. The primary purpose of this survey is to identify alliance preferences between cow-calf producers, yearling operations, feedlots, and processors so that improved genetics, more efficient production protocols, and desirable product attributes can be achieved by Arizona's beef industry. Questions asked regarding your marketing and management choices are strictly voluntary and it is not expected that being a part of this study will harm you in any way. You can be assured that your answers are confidential and will not be released to anyone. The survey is being conducted by the Arizona Field Office of USDA/NASS and data they supply to university researchers will in no way have your name or other identifiers attached to your responses. Your name will never be associated with the final data analysis and results will only be published in aggregate form.

We greatly appreciate your support in completing this questionnaire and we look forward to identifying how Arizona's beef industry can be most supported in this area given your responses. Please note the survey instrument is shorter than is appears since some questions are skipped depending on your answers.

Sincerely,

Russell Tronstad
Specialist and Professor
University of Arizona

C. B. 'Doc' Lane
Arizona Cattle Growers' Association

1. Please indicate which of the following best describes your current operation? (**Please check all that apply**).

- ☐ Cow-calf operation
- ☐ Backgrounding operation
- ☐ Finishing operation
- ☐ Seedstock producer

2. What other important farm activities do you have? (**Please check all that apply**)

- ☐ Grain and oilseeds
- ☐ Pork
- ☐ Dairy
- ☐ Sheep
- ☐ Horses
- ☐ Diversified livestock
- ☐ None of the above options
- ☐ Other, please specify:_____

3. What did you do with your calf crop born in 2004? Please allocate percentages across the following options **(total should add up to 100%, Please use zero if not applicable):**

Sold as weaned calves _____%
Sold as preconditioned calves _____%
Other, _____%
please describe: _____
Retained ownership _____%
Replacement heifers _____%

4. Please specify your December 2005 herd inventory in terms of the following size categories :

	none	**< 50**	**51 - 150**	**151 - 300**	**> 300**
Cows	○	○	○	○	○
Replacement heifers	○	○	○	○	○
Stockers/Yearlings	○	○	○	○	○

5. How did you market your weaned calves in 2005? If multiple options apply, please rank the options in declining order, with 1 being the option where you sold the most head.

Sold through auctions _____
Retained ownership _____
Other, _____
please describe: _____
Sold directly to backgrounder _____
Sold directly to feeder _____

6. Considering your calves and backgrounders that you marketed in 2005, did you:

No	**Yes**	
○	○	Market **25% to 50%** of your animals through formal (contractual) agreements?
○	○	Market **more than 50%** of your animals through formal (contractual) agreements?

7. Do you use futures contracts in your business?

- ○ No
- ○ Yes

8. In the past, have you retained ownership of some of yo ur calves **to background**?

- ○ No **(Please proceed to Question 10)**
- ○ Yes, they have typically been fed on my farm
- ○ Yes, they have typically been fed in a custom establishment

9. If you sold at the **backgrounding stage**, could you please indicate if premiums/discounts hold in dealing with your buyer for the following characteristics:

No	**Yes**	
○	○	Your breed
○	○	A regional average price that is directly factored into your payment scheme
○	○	Other quality-related specifications:

(please specify)_____

10. In the past, have you retained ownership of some of your cattle **until slaughter**?

- ○ No **(Please proceed to Page 2, Question 12)**
- ○ Yes

11. In considering the sale of your **finished cattle** sold in private sales, could you please indicate if premiums/discounts hold in dealing with your buyer for the following characteristics:

No	Yes	
○	○	Quality grade
○	○	Yield grade
○	○	Regional average price
○	○	Discount scales apply for carcasses over ____ lbs
○	○	Other specifications related to carcass weight, please specify:_____

12. What types of information do you collect for your beef operation? **Please check all that apply**.

Costs of production:

- ☐ none
- ☐ feed costs
- ☐ grazing costs
- ☐ operating costs
- ☐ cash costs
- ☐ fixed costs
- ☐ per pound cost of gain
- ☐ other:_____

Beef production data:

- ☐ none
- ☐ birth weights
- ☐ genetics
- ☐ animal health
- ☐ weaning weights (and/or average daily gain)
- ☐ birth rate
- ☐ pounds of calf weaned per cow wintered
- ☐ other:_____

Beef processing data:

- ☐ none
- ☐ carcass grading data on feeder cattle
- ☐ other: _____
- ☐ dressing percentage of live weight

13. Suppose you have the opportunity to be part of a beef alliance that is developing niche markets. There is the potential for generating extra margins for your business if the alliance is able to produce animals of suitable qualities. Supposing your animals are close to or ready to qualify for participating in this alliance, would you be willing to participate in such an alliance?

- ○ Yes, I am willing to participate in an alliance under certain circumstances
- ○ No, I am not willing to participate in an alliance under any circumstances **(Please proceed to Page 5, Question 14)**

On the following two pages you will be asked to choose between different types of alliances (with different specifications). You will see four tables. In each table you will be asked to choose between two different alliances.

- Please choose only **one option** in each table.
- Assume that the **options in each table** are the **only** ones available.
- **Please do not compare** the options across tables.

Through the four tables, the following definitions will be used:

Sale type refers to the ways in which you are willing to market your animals with the alliance (e.g. sell animals to alliance, retain ownership)

Type of data sharing refers to the different levels at which you would want to share data with the alliance.

Production protocols refers to the type of production protocols you would agree to related to vaccines, weaning and other production practices.

Alliance Participation Fee refers to the per head cost of participating in the proposed alliance (these costs are in addition to your regular costs of production)

Table 1: Please choose between the following two types of alliances (choose only one option)

	Alliance A	Alliance B
Sale Type	Sell to alliance, NO profit sharing	Sell to alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & min. number of animals required	Restrictions on vaccination and use of, antibiotics & min. number of animals required
Alliance Participation Fee	$5 /head	$5 /head

	Alliance A	Alliance B
I would choose	◯	◯

Table 2: Please choose between the following two types of alliances (choose only one option)

	Alliance A	Alliance B
Sale Type	Sell to alliance, NO profit sharing	Sell to alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Carcass, group data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & min. number of animals required	Restrictions on vaccination and use of, antibiotics & min. number of animals required
Alliance Participation Fee	$5 /head	$20 /head

	Alliance A	Alliance B
I would choose	◯	◯

Table 3: Please choose between the following two types of alliances (choose only one option)

	Alliance A	Alliance B
Sale Type	Sell to alliance, NO profit sharing	Sell to alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Carcass, individual yield & grade data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & min. number of animals required	NO restrictions on vaccination and use of, antibiotics & NO min. number of animals required
Alliance Participation Fee	$5 /head	$10 /head

	Alliance A	Alliance B
I would choose	○	○

Table 4: Please choose between the following two types of alliances (choose only one option)

	Alliance A	Alliance B
Sale Type	Sell to alliance, bonuses based on animal performance	Sell to alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, pen data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & min. number of animals required	Restrictions on vaccination and use of, antibiotics & min. number of animals required
Alliance Participation Fee	$5 /head	$20 /head

	Alliance A	Alliance B
I would choose	○	○

14. Please consider how market prices for bred cows have moved during the past few years.

When replacement cow prices are very low, in your experience, how many years does it take for market prices for bred cows to return to the long run average price?

- ○ 1 year
- ○ 2 years
- ○ Never
- ○ 3 years
- ○ 4 years
- ○ Other (number of years):_____
- ○ Prices change too much to determine a length of time

15. If you custom feed your calves (either from your own operation or purchased), do you have written or oral contracts in place for most of your business?

- ○ I do not custom feed **(Proceed to question 17)**
- ○ Oral contracts
- ○ Written contracts

16. Consider your most commonly used contracts for custom feeding,

- ○ contracts apply to the calves placed with the custom feeder for a single production cycle
- ○ contracts carry over to following years, and the contract terms are re-negotiated annually
- ○ contracts carry over to following years, and the contract terms remain fixed for multiple production cycles
- ○ Other, please specify: _____

17. Please consider the following statements regarding two performance measures for your beef operation, net income and value of cow herd wintered. Considering your **average farm income from cattle** over the past 5 years:

a. What is the maximum **increase** in your **net income** that you think is possible in 2007? _____%

What is the maximum **decrease** in your **net income** that you think is possible in 2007? _____%

b. What is the maximum **increase** in **market value of your cows sold** that you think is possible in 2007? _____%

What is the maximum **decrease** in **market value of your cows sold** that you think is possible in 2007? _____%

18. What percentage of your net income from farming comes from beef?

- ○ Less than 25%
- ○ Between 25% and 50%
- ○ More than 50%

19. If you or your partner work off the farm, your total off-farm taxable net income is:

- ○ Less than 25% of your net taxable income
- ○ Between 25% and 50% of your net taxable income
- ○ More than 50% of your net taxable income
- ○ Not applicable

20. Please indicate your age:

- ○ Under 30
- ○ 31-41
- ○ 41-50
- ○ 51-60
- ○ 61 and older

21. Please indicate your level of education:

- ○ Less than high school graduate
- ○ High school graduate
- ○ Technical/Vocational Degree
- ○ Bachelors Degree (or further)

Thank you for your time and participation!
Please share any other comments with us below

_____
_____
_____

APPENDIX C: VERSIONS OF THE SURVEY QUESTIONNAIRE AND RESPONDENTS' PREFERENCES TOWARDS CHOOSING ALLIANCE TYPE "A"

TABLE C.4.1 SURVEY BEEF ALLIANCE VERSION ONE

TABLE ONE	**Alliance A**	**Alliance B**
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$5 /head	$5 /head

TABLE TWO	**Alliance A**	**Alliance B**
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Carcass, group data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$5 /head	$20 /head

TABLE THREE	**Alliance A**	**Alliance B**
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Carcass, individual yield & grade data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$5 /head	$10 /head

TABLE FOUR	**Alliance A**	**Alliance B**
Sale Type	Sell to Alliance, bonuses based on animal performance	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, pen data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$5 /head	$20 /head

TABLE C.4.2 VERSION ONE: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE "A"

Version One	**% Selecting Alliance Type "A"**			
	BQA N=6	1st Arizona Sample N=10	2nd Arizona Sample N=*	Canada N=11
Table One	33.30%	40.00%	*	54.60%
Table Two	42.90%	60.00%	*	54.60%
Table Three	33.30%	42.90%	*	45.50%
Table Four	60.00%	100.00%	*	36.40%

* Denotes 2nd Arizona Sampling had no surveys returned with this alliance question type.

TABLE C.4.3 SURVEY BEEF ALLIANCE VERSION TWO

TABLE ONE	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Sell to Alliance, NO profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$20 /head	$0 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$20 /head	$10 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, individual data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$20 /head	$10 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, pen data	Live performance, pen data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$0 /head	$10 /head

TABLE C.4.4 VERSION TWO: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE “A”

Version Two	% Selecting Alliance Type "A"			
	BQA N=10	1st Arizona Sample N=6	2nd Arizona Sample N=7	Canada N=14
Table One	50.00%	50.00%	28.60%	50.00%
Table Two	30.00%	50.00%	42.90%	28.60%
Table Three	70.00%	33.30%	50.00%	28.60%
Table Four	20.00%	50.00%	33.30%	35.70%

TABLE C.4.5 SURVEY BEEF ALLIANCE VERSION THREE

TABLE ONE	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$20 /head	$0 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$20 /head	$5 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$20 /head	$5 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Carcass, individual yield & grade data	Carcass, group data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$5 /head

TABLE C.4.6 VERSION THREE: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE “A”

Version Three	% Selecting Alliance Type "A"			
	BQA N=9	1st Arizona Sample N=7	2nd Arizona Sample N=4	Canada N=18
Table One	22.20%	28.60%	50.00%	66.70%
Table Two	11.10%	28.60%	25.00%	66.70%
Table Three	12.50%	50.00%	25.00%	55.60%
Table Four	44.40%	50.00%	50.00%	22.20%

TABLE C.4.7 SURVEY BEEF ALLIANCE VERSION FOUR

TABLE ONE	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Live performance, pen data	Live performance, pen data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$20 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$5 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, NO profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$0 /head	$20 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, pen data	Carcass, individual yield & grade data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$20 /head	$5 /head

TABLE C.4.8 VERSION FOUR: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE “A”

Version Four	% Selecting Alliance Type "A"			
	BQA N=12	1st Arizona Sample N=5	2nd Arizona Sample N=7	Canada N=20
Table One	83.30%	80.00%	100.00%	65.00%
Table Two	58.30%	80.00%	57.10%	85.00%
Table Three	90.90%	75.00%	71.40%	65.00%
Table Four	27.30%	20.00%	33.30%	75.00%

TABLE C.4.9 SURVEY BEEF ALLIANCE VERSION FIVE

TABLE ONE	Alliance A	Alliance B
Sale Type	Sell to Alliance, bonuses based on animal performance	Sell to Alliance, NO profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, individual data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$0 /head	$5 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Sell to Alliance, bonuses based on animal performance	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$0 /head	$10 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Sell to Alliance, bonuses based on animal performance	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Live performance, individual data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$0 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$5 /head	$10 /head

TABLE C.4.10 VERSION FIVE: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE "A"

Version Five	% Selecting Alliance Type "A"			
	BQA N=11	1st Arizona Sample N=*	2nd Arizona Sample N=*	Canada N=12
Table One	100.00%	*	*	16.70%
Table Two	100.00%	*	*	41.70%
Table Three	90.90%	*	*	41.70%
Table Four	75.00%	*	*	33.30%

* Denotes 1st and 2nd Arizona samplings did not include this alliance type in the distributed surveys.

TABLE C.4.11 SURVEY BEEF ALLIANCE VERSION SIX

TABLE ONE	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Sell to Alliance, NO profit sharing
Type of Data Sharing	Live performance, individual data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$10 /head	$20 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$10 /head	$20 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Live performance, individual data	Live performance, pen data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$10 /head	$5 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Carcass, individual yield & grade data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$20 /head	$20 /head

TABLE C.4.12 VERSION SIX: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE “A”

Version Six	% Selecting Alliance Type "A"			
	BQA N=11	1st Arizona Sample N=2	2nd Arizona Sample N=1	Canada N=15
Table One	54.60%	50.00%	100.00%	53.30%
Table Two	70.00%	50.00%	100.00%	20.00%
Table Three	60.00%	50.00%	100.00%	40.00%
Table Four	60.00%	50.00%	100.00%	33.30%

TABLE C.4.13 SURVEY BEEF ALLIANCE VERSION SEVEN

TABLE ONE	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Carcass, group data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$10 /head	$0 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Sell to Alliance, NO profit sharing
Type of Data Sharing	Carcass, group data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$10 /head	$10 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Sell to Alliance, NO profit sharing	Retain Ownership, profit sharing
Type of Data Sharing	Carcass, group data	Live performance, individual data
Production Protocols	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$10 /head	$20 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Sell to Alliance, NO profit sharing
Type of Data Sharing	Carcass, group data	Carcass, group data
Production Protocols	NO restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$10 /head

TABLE C.4.14 VERSION SEVEN: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE "A"

Version Seven	% Selecting Alliance Type "A"			
	BQA N=5	1st Arizona Sample N=2	2nd Arizona Sample N=1	Canada N=13
Table One	100.00%	0.00%	100.00%	79.60%
Table Two	80.00%	0.00%	100.00%	53.90%
Table Three	80.00%	50.00%	0.00%	84.60%
Table Four	20.00%	100.00%	100.00%	38.50%

TABLE C.4.15 SURVEY BEEF ALLIANCE VERSION EIGHT

TABLE ONE	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Carcass, group data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & minimum number of animals required
Alliance Participation Fee	$0 /head	$0 /head

TABLE TWO	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Carcass, group data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$10 /head

TABLE THREE	Alliance A	Alliance B
Sale Type	Retain Ownership, profit sharing	Retain Ownership, NO profit sharing
Type of Data Sharing	Carcass, group data	Carcass, group data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	NO restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$5 /head

TABLE FOUR	Alliance A	Alliance B
Sale Type	Retain Ownership, NO profit sharing	Sell to Alliance, bonuses based on animal performance
Type of Data Sharing	Carcass, individual yield & grade data	Carcass, individual yield & grade data
Production Protocols	Restrictions on vaccination and use of, antibiotics & minimum number of animals required	Restrictions on vaccination and use of, antibiotics & NO minimum number of animals required
Alliance Participation Fee	$0 /head	$10 /head

TABLE C.4.16 VERSION EIGHT: RESPONDENTS PREFERENCE TOWARDS CHOOSING ALLIANCE TYPE “A”

Version Eight	% Selecting Alliance Type "A"			
	BQA N=16	1st Arizona Sample N=5	2nd Arizona Sample N=1	Canada N=15
Table One	43.80%	0.00%	0.00%	60.00%
Table Two	31.30%	20.00%	0.00%	53.30%
Table Three	64.70%	50.00%	100.00%	13.30%
Table Four	35.30%	25.00%	0.00%	53.30%

APPENDIX D: TABLES OF RESULTS FOR MODEL 1(PROBIT), MODEL 2(PANEL PROBIT) AND MODEL 3 (BIVARIATE NESTED PANEL PROBIT)

Table D.5.1.1: Arizona NASS data only, where $Y_i = 1$ if producer is willing to participate in an alliance under certain circumstances (Model 1)

Variable names	Description	Coef.	Std. Err.
cowcalf	Cow-calf operation	-0.2171	0.5587
smaller	small producers	-0.6225*	0.3723
larger	larger producers	-0.4419	0.5865
cl150	Cow herd equal or less than150 head	-0.9407*	0.5478
cg300	Cow herd size greater than 300 head	-1.1305*	0.5814
written	Have written contracts if you custom feed your calves	-0.2757	0.8375
formal	Market Calves through Formal Agreement	-0.1631	0.3486
weaned	Sold Calf Crop born in 2004 as Weaned Calves	0.0020	0.0053
precond	Sold Calf Crop born in 2004 as Preconditioned Calves	0.0113	0.0073
retainedo	Retained Ownership Calf Crop born in 2004	0.0057	0.0068
pcost	Collected at least one information Production cost	0.8628*	0.4417
age	Age	-0.2850	0.1756
educ	Education	0.2133	0.1691
_cons		0.7867	1.2569

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation= 92

TABLE D.5.1.2: Arizona BQA data only, where $Y_i = 1$ if producer is willing to participate in an alliance under certain circumstances (Model 1)

Variable names	Description	Coef.	Std. Err.
cowcalf	Cow-calf operation	0.0316	0.8906
smaller	small producers	-1.2128**	0.5057
larger	larger producers	0.2992	1.2173
cl150	Cow herd equal or less than150 head	0.2341	1.0739
cg300	Cow herd size greater than 300 head	-0.9756	1.1646
formal	Market Calves through Formal Agreement	-0.2034	0.4095
weaned	Sold Calf Crop born in 2004 as Weaned Calves	-0.0119*	0.0070
precond	Sold Calf Crop born in 2004 as Preconditioned Calves	-0.0064	0.0082
retainedo	Retained Ownership Calf Crop born in 2004	0.0030	0.0176
pcost	Collected at least one information Production cost	0.9181	0.6634
age	Age	-0.1961	0.1985
educ	Education	0.3083	0.2263
constant	Constant	1.2351	2.0902

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation = 81

TABLE D.5.1.3: Arizona data combined (AZ BQA and AZ NASS), where $Y_i = 1$ if producer is willing to participate in an alliance under certain circumstances (Model 1)

Variable names	Description	Coef.	Std. Err.
cowcalf	Cow-calf operation	-0.2382	0.3837
smaller	small producers	-0.7369***	0.2508
larger	larger producers	0.0213	0.4799
cl150	Cow herd equal or less than150 head	-0.3213	0.4539
cg300	Cow herd size greater than 300 head	-0.9911**	0.4851
formal	Market Calves through Formal Agreement	-0.1415	0.2412
written	Have written contracts if you custom feed your calves	0.1051	0.5799
weaned	Sold Calf Crop born in 2004 as Weaned Calves	-0.0027	0.0035
precond	Sold Calf Crop born in 2004 as Preconditioned Calves	0.0047	0.0046
retainedo	Retained Ownership Calf Crop born in 2004	-0.0002	0.0053
pcost	Collected at least one information Production cost	0.9671***	0.3398
age	Age	-0.2586**	0.1177
educ	Education	0.2438**	0.1192
constant	Constant	0.7861	0.9286

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation = 170

TABLE D.5.1.4: Canada data only, where $Y_i = 1$ if producer is willing to participate in an alliance under certain circumstances (Model 1)

Variable names	Description	Coef.	Std. Err.
cowcalf	Cow-calf operation	-0.9563***	0.3114
smaller	small producers	0.3003	0.3346
larger	larger producers	0.1238	0.5112
cl150	Cow herd equal or less than150 head	-0.1763	0.4169
cg300	Cow herd size greater than 300 head	0.2250	0.6328
written	Have written contracts if you custom feed your calves	0.3483	0.2813
formal	Market Calves through Formal Agreement	-0.0857	0.4186
weaned	Sold Calf Crop born in 2004 as Weaned Calves	0.0088*	0.0047
precond	Sold Calf Crop born in 2004 as Preconditioned Calves	0.0115	0.0071
retainedo	Retained Ownership Calf Crop born in 2004	-0.0012	0.0066
pcost	Collected at least one information Production cost	0.3364	0.3249
age	Age	-0.1305	0.1085
educ	Education	0.4003**	0.1889
constant	Constant	-0.2902	0.7077

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation = 170

TABLE D.5.1.5: All data combined (AZ NASS, AZ BQA and Canada), where $Y_i = 1$ if producer is willing to participate in an alliance under certain circumstances (Model 1)

Variable names	Description	Coef.	Std. Err.
cowcalf	Cow-calf operation	-0.5381**	0.2230
smaller	small producers	-0.3453*	0.1898
larger	larger producers	-0.0920	0.3352
cl150	Cow herd equal or less than150 head	-0.3532	0.2948
cg300	Cow herd size greater than 300 head	-0.3271	0.3229
formal	Market Calves through Formal Agreement	-0.1901	0.2052
written	Have written contracts if you custom feed your calves	0.3393	0.2375
weaned	Sold Calf Crop born in 2004 as Weaned Calves	0.0018	0.0027
precond	Sold Calf Crop born in 2004 as Preconditioned Calves	0.0064*	0.0038
retainedo	Retained Ownership Calf Crop born in 2004	-0.0019	0.0040
pcost	Collected at least one information Production cost	0.3918*	0.2197
age	Age	-0.1732**	0.0742
educ	Education	0.2734***	0.0982
azbqa	Dummy variable for Arizona BQA respondents	0.9932**	0.2243
canada	Dummy variable for Canadian respondents	0.5262**	0.2663
constant	Constant	0.2143	0.5821

*Significance level at $p<0.1$ ** significance level at $p<0.05$ and *** significance level at $p<0.01$.
Number of observation= 315

TABLE D.5.2.1 Arizona NASS data only, where $Y_i = 1$ if the producer chose Alliance A (Model 2)

Variable Names	Description	Coef.	Std. Err.
cowcalf	cowcalf operation only	0.0573	0.8774
smaller	small producers	0.3052	0.6815
larger	large producers	0.1465	0.7488
weaned	Calf crop sold as weaned calves	-0.0110	0.0081
precond	Calf crop sold as preconditioned calves	-0.0041	0.0096
retainedo	Calf crop retained ownership	-0.0106	0.0135
pcost	Producer collected at least one variable information cost	-0.8648	0.9743
cl150	herd size less than 150 heads	1.3029*	0.7624
cg300	herd size greater than 300 heads	-0.3632	0.6019
formal	market animal through formal(contractual) agreements	0.0044	0.4852
age	age	0.1433	0.1801
educ	education	-0.0906	0.2748
s1ab	retain ownership difference between alliance A and B	-0.4188	0.3306
s2ab	difference in profit sharing between alliance A and B	-0.2366	0.2963
d1ab	live performance difference btw alliance A and B	-0.5655	0.3598
d2ab	individual data difference between alliance A and B	1.1143**	0.4327
p1ab	restriction on vaccine difference between alliance A and B	0.6413**	0.2826
p2ab	minimum number of animals difference between alliance A and B	-0.0342	0.2361
fab	participation fee difference between alliance A and B	0.1373*	0.0819
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.0630	0.0566
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0023***	0.0008
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0008	0.0010
(fab)(retaintedo)	interaction between fab and retained ownership	0.0013	0.0010
(fab)(pcost)	interaction between fab and collected at least one variable information cost	-0.0140	0.0587
constant	Constant	0.0872	1.5373
sigma_u	sigma	0.5974	0.3133
rho	rho	0.2630	0.2033

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation= 156

TABLE D.5.2.2: Arizona BQA Data Only, where Y_i = 1 if the producer chose Alliance A (Model 2)

Variable names	Description	Coef.	Std. Err.
cowcalf	cowcalf operation only	0.2681	0.4523
smaller	small producers	0.3154	0.2974
larger	large producers	-0.1886	0.5901
weaned	Calf crop sold as weaned calves	-0.0034	0.0033
precond	Calf crop sold as preconditioned calves	-0.0005	0.0042
retainedo	Calf crop retained ownership	0.0024	0.0089
pcost	Producer collected at least one variable information cost	-0.1219	0.7191
cl150	herd size less than 150 heads	0.0000	0.5964
formal	market animal through formal(contractual) agreements	0.0276	0.2483
age	age	-0.1753	0.1078
educ	education	-0.0815	0.1521
s1ab	retain ownership difference between alliance A and B	-0.3070	0.1983
s2ab	difference in profit sharing between alliance A and B	0.2523	0.2156
d1ab	live performance difference btw alliance A and B	-0.2229	0.2527
d2ab	individual data difference between alliance A and B	0.3619	0.2297
p1ab	restriction on vaccine difference between alliance A and B	0.4767***	0.1486
p2ab	minimum number of animals difference between alliance A and B	-0.4273***	0.1607
fab	participation fee difference between alliance A and B	0.0636	0.0762
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.1353***	0.0492
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0002	0.0003
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0004	0.0004
(fab)(retaintedo)	interaction between fab and retained ownership	-0.0016	0.0011
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0473	0.0552
constant	constant	0.9383	1.2772
sigma_u	Sigma	0.4929	0.1973
rho	Rho	0.1954	0.1259

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation= 264

TABLE D.5.2.3: Arizona Data Combined (AZ BQA and AZ NASS), where $Y_i = 1$ if the producer chose Alliance A (Model 2)

Variable Names	Description	Coef.	Std. Err.
cowcalf	cowcalf operation only	0.1022	0.3268
smaller	small producers	0.1202	0.2493
larger	large producers	0.2665	0.4151
weaned	Calf crop sold as weaned calves	-0.0053*	0.0030
precond	Calf crop sold as preconditioned calves	-0.0026	0.0038
retainedo	Calf crop retained ownership	0.0005	0.0056
pcost	Producer collected at least one variable information cost	-0.5291	0.5192
cl150	herd size less than 150 heads	0.7991*	0.4622
cg300	herd size greater than 300 heads	0.2224	0.3477
formal	market animal through formal(contractual) agreements	0.0603	0.2078
age	age	-0.0508	0.0922
educ	education	-0.1401	0.1201
s1ab	retain ownership difference between alliance A and B	-0.2481	0.1624
s2ab	difference in profit sharing between alliance A and B	0.1154	0.1633
d1ab	live performance difference btw alliance A and B	-0.3225*	0.1842
d2ab	individual data difference between alliance A and B	0.4740**	0.1914
p1ab	restriction on vaccine difference between alliance A and B	0.4702***	0.1218
p2ab	minimum number of animals difference between alliance A and B	-0.2039	0.1244
fab	participation fee difference between alliance A and B	0.0299	0.0482
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.0638**	0.0282
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0006**	0.0002
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0002	0.0003
(fab)(retaintedo)	interaction between fab and retained ownership	0.0005	0.0005
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0237	0.0367
constant	Constant	0.6732	0.9300
sigma_u	Sigma	0.6161	0.1439
rho	Rho	0.2752	0.0932

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation used = 420

TABLE D.5.2.4: Canada Data Only, where Y_i = 1 if the producer chose Alliance A (Model 2)

Variable Name	Description	Coef.	Std. Err.
cowcalf	cowcalf operation only	-0.3507	0.2139
smaller	small producers	0.1889	0.2382
larger	large producers	-1.4075***	0.4228
weaned	Calf crop sold as weaned calves	0.0000	0.0045
precond	Calf crop sold as preconditioned calves	0.0054	0.0053
retainedo	Calf crop retained ownership	-0.0034	0.0053
pcost	Producer collected at least one variable information cost	-0.7542***	0.2417
cl150	herd size less than 150 heads	-1.2933***	0.3829
cg300	herd size greater than 300 heads	-0.5182	0.3256
formal	market animal through formal(contractual) agreements	0.2251	0.3524
written	Have written contracts if you custom feed your calves	0.3196	0.2011
age	age	-0.1061	0.0904
educ	education	-0.3624***	0.1240
s1ab	retain ownership difference between alliance A and B	0.1587	0.1732
s2ab	difference in profit sharing between alliance A and B	0.3352*	0.1747
d1ab	live performance difference btw alliance A and B	-0.4151**	0.1736
d2ab	individual data difference between alliance A and B	0.3190*	0.1772
p1ab	restriction on vaccine difference between alliance A and B	-0.0081	0.1075
p2ab	minimum number of animals difference between alliance A and B	0.1410	0.1278
fab	participation fee difference between alliance A and B	-0.0282	0.0273
(fab)(cowcalf)	interaction between fab and cow-calf operation only	0.0197	0.0151
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0001	0.0003
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	0.0000	0.0004
(fab)(retaintedo)	interaction between fab and retained ownership	0.0000	0.0004
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0329*	0.0171
constant	Constant	3.2360***	0.7189
sigma_u	Sigma	0.5579	0.1310
rho	Rho	0.2374	0.0850

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation used = 444

TABLE D.5.2.5: All data combined (AZ NASS, AZ BQA and Canada), where $Y_i = 1$ if the producer chose Alliance A (Model 2)

Variable Names	Description	Coef.	Std. Err.
cowcalf	cowcalf operation only	-0.1857	0.1828
smaller	small producers	0.2120	0.1793
larger	large producers	-0.7725***	0.2936
weaned	Calf crop sold as weaned calves	-0.0030	0.0025
precond	Calf crop sold as preconditioned calves	0.0010	0.0031
retainedo	Calf crop retained ownership	-0.0057	0.0037
pcost	Producer collected at least one variable information cost	-0.6769***	0.2282
cl150	herd size less than 150 heads	-0.5902**	0.2888
cg300	herd size greater than 300 heads	-0.2691	0.2433
formal	market animal through formal(contractual) agreements	0.0058	0.1809
written	Have written contracts if you custom feed your calves	0.3686*	0.1911
age	age	-0.1394**	0.0648
educ	education	-0.2294***	0.0875
s1ab	retain ownership difference between alliance A and B	-0.0538	0.1184
s2ab	difference in profit sharing between alliance A and B	0.2461**	0.1196
d1ab	live performance difference btw alliance A and B	-0.3647***	0.1268
d2ab	individual data difference between alliance A and B	0.3347**	0.1302
p1ab	restriction on vaccine difference between alliance A and B	0.2257***	0.0795
p2ab	minimum number of animals difference between alliance A and B	-0.0436	0.0877
fab	participation fee difference between alliance A and B	-0.0362	0.0260
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.0008	0.0130
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0005***	0.0002
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0002	0.0002
(fab)(retaintedo)	interaction between fab and retained ownership	0.0000	0.0003
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0336**	0.0153
(fab)(azbqa)	interaction between fab and dummy variable for Arizona BQA	0.0007	0.0158
(fab)(canada)	interaction between fab and dummy variable for Canada	0.0396**	0.0153
azbqa	Dummy variable for Arizona BQA respondents	0.2561	0.2132
canada	Dummy variable for Canadian respondents	-0.3857	0.2575
constant	Constant	2.7637***	0.6039
sigma_u	Sigma	0.6944	0.0957
rho	Rho	0.3253	0.0605

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Number of observation used = 852

TABLE D.5.3.1 Arizona NASS data only, where $Y_i = 1$ if the producer chose Alliance A (Model 3)

Variable names	Description	Estimate	Std. Err.
constant c	constant	-0.8854	0.5596
s1ab	retain ownership difference between alliance A and B	-0.2033	0.5998
s2ab	difference in profit sharing between alliance A and B	-0.4462	0.6765
d1ab	live performance difference btw alliance A and B	-0.6804	0.7096
d2ab	individual data difference between alliance A and B	0.8289*	0.5023
p1ab	restriction on vaccine difference between alliance A and B	0.4965	0.3196
p2ab	minimum number of animals difference between alliance A and B	0.0163	0.3625
fab	participation fee difference between alliance A and B	0.0970	0.0875
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.0467	0.0518
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0020*	0.0012
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0015	0.0017
(fab)(retaintedo)	interaction between fab and retained ownership	0.0003	0.0011
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0427	0.0739
constant b	constant	0.5035	1.4214
cowcalf	cowcalf operation only	-0.1435	0.7896
smaller	small producers	-0.4957	0.4081
larger	large producers	-0.4235	0.5708
weaned	Calf crop sold as weaned calves	0.0047	0.0067
precond	Calf crop sold as preconditioned calves	0.0118	0.0091
retainedo	Calf crop retained ownership	0.0071	0.0093
pcost	Producer collected at least one variable information cost	0.8685	0.7083
cl150	herd size less than 150 heads	-1.1972*	0.7073
cg300	herd size greater than 300 heads	-0.9880	0.6687
formal	market animal through formal(contractual) agreements	-0.2097	0.3757
age	age	-0.2850	0.2164
educ	education	0.2518	0.1913
RHO	Rho	0.9799***	0.0856
SIGMAU	Sigma	0.9615	0.5335

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Numb. Observation 94

TABLE D.5.3.2: Arizona BQA Data Only, where Y_i = 1 if the producer chose Alliance A (Model 3)

Variable Names	Description	Estimate	Std. Err.
constant c	constant	-0.0420	0.1907
s11ab	retain ownership difference between alliance A and B	-0.4035	0.3180
s21ab	difference in profit sharing between alliance A and B	0.3468	0.4336
d11ab	live performance difference btw alliance A and B	-0.1935	0.2609
d21ab	individual data difference between alliance A and B	0.2578	0.2422
p11ab	restriction on vaccine difference between alliance A and B	0.5000***	0.1461
p21ab	minimum number of animals difference between alliance A and B	-0.3939*	0.2035
fab	participation fee difference between alliance A and B	0.0539	0.0859
(fab)(cowcalf)	interaction between fab and cow-calf operation only	-0.1398**	0.0628
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0002	0.0003
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	-0.0003	0.0005
(fab)(retaintedo)	interaction between fab and retained ownership	-0.0014	0.0014
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0564	0.0560
constant b	constant	-0.1159	5.0443
cowcalf	cowcalf operation only	-0.1062	1.5409
smaller	small producers	-1.4612	0.8929
large	large producers	0.2379	4.8576
weaned	Calf crop sold as weaned calves	-0.0078	0.0090
precond	Calf crop sold as preconditioned calves	-0.0047	0.0108
retainedo	Calf crop retained ownership	-0.0044	0.0309
pcost	Producer collected at least one variable information cost	0.9091	0.7858
cl150	herd size less than 150 heads	0.9539	4.5630
formal	market animal through formal(contractual) agreements	-0.3000	0.5819
age	age	-0.0585	0.2288
educ	education	0.3701	0.4726
RHO	Rho	-0.9963***	0.0560
SIGMAU	Sigma	-0.7438***	0.2372

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.
Numb. Observation 81

TABLE D.5.3.3: Canada Data Only, where $Y_i = 1$ if the producer chose Alliance A (Model 3)

Variable Names	Description	Estimate	Std. Err.
constant c	constant	0.6092***	0.2129
s11ab	retain ownership difference between alliance A and B	0.1983	0.2941
s21ab	difference in profit sharing between alliance A and B	0.0805	0.3639
d11ab	live performance difference btw alliance A and B	-0.2531	0.2601
d21ab	individual data difference between alliance A and B	0.1319	0.2626
p11ab	restriction on vaccine difference between alliance A and B	-0.0760	0.1171
p21ab	minimum number of animals difference between alliance A and B	0.0912	0.1692
fab	participation fee difference between alliance A and B	-0.0170	0.0272
(fab)(cowcalf)	interaction between fab and cow-calf operation only	0.0194	0.0199
(fab)(weaned)	interaction between fab and calf crop sold as weaned calves	-0.0002	0.0003
(fab)(precond)	interaction between fab and calf crop sold as preconditioned calves	0.0000	0.0006
(fab)(retaintedo)	interaction between fab and retained ownership	-0.0002	0.0005
(fab)(pcost)	interaction between fab and collected at least one variable information cost	0.0233	0.0177
constant b	constant	0.9230	0.6960
cowcalf	cowcalf operation only	-1.1029**	0.4911
smaller	small producers	-0.0645	0.4241
weaned	large producers	0.0115**	0.0055
precond	Calf crop sold as preconditioned calves	0.0074	0.0103
retainedo	Calf crop retained ownership	-0.0080	0.0075
pcost	Producer collected at least one variable information cost	-0.0801	0.4496
cl150	herd size less than 150 heads	-0.3038	0.3729
cg300	herd size greater than 300 heads	-0.2917	1.1669
formal	market animal through formal(contractual) agreements	0.2731	0.4602
written	Have written contracts if you custom feed your calves	0.8039*	0.4504
none	No other activities	-0.7436	0.5178
age	age	-0.2039	0.1475
educ	education	0.2280	0.2787
RHO	Rho	-0.9867***	0.0593
SIGMAU	Sigma	1.0419***	0.2096

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01
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APPENDIX E: TABLES COMPARING THE RESULTS OF ALLIANCE PREFERENCES MODELS FOR EACH DATASET

Table E.6.1: Arizona NASS data only: Alliance Preferences Models Comparison

Variable names	Pooled probit		Panel probit		Bivariate Panel Probit	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
constant c	-0.1689	0.2251	0.0872	1.5373	-0.8854	0.5596
s1ab	-0.3231	0.4259	-0.4188	0.3306	-0.2033	0.5998
s2ab	-0.3178	0.4499	-0.2366	0.2963	-0.4462	0.6765
d1ab	-0.6402	0.4810	-0.5655	0.3598	-0.6804	0.7096
d2ab	0.8096**	0.3495	1.1143**	0.4327	0.8289*	0.5023
p1ab	0.4325**	0.2167	0.6413**	0.2826	0.4965	0.3196
p2ab	0.0175	0.2841	-0.0342	0.2361	0.0163	0.3625
fab	0.0853	0.0635	0.1373*	0.0819	0.0970	0.0875
(fab)(cowcalf)	-0.0442	0.0359	-0.0630	0.0566	-0.0467	0.0518
(fab)(weaned)	-0.0019**	0.0007	-0.0023***	0.0008	-0.0020*	0.0012
(fab)(precond)	-0.0016*	0.0010	-0.0008	0.0010	-0.0015	0.0017
(fab)(retaintedo)	0.0002	0.0007	0.0013	0.0010	0.0003	0.0011
(fab)(pcost)	0.0561	0.0512	-0.0140	0.0587	0.0427	0.0739
constan b	0.7918	1.5152			0.5035	1.4214
cowcalf	-0.2650	0.7354	0.0573	0.8774	-0.1435	0.7896
smaller	-0.5337	0.4073	0.3052	0.6815	-0.4957	0.4081
larger	-0.3865	0.7190	0.1465	0.7488	-0.4235	0.5708
weaned	0.0021	0.0065	-0.0110	0.0081	0.0047	0.0067
precond	0.0096	0.0082	-0.0041	0.0096	0.0118	0.0091
retainedo	0.0057	0.0092	-0.0106	0.0135	0.0071	0.0093
pcost	0.7696	0.6414	-0.8648	0.9743	0.8685	0.7083
cl150	-0.9834	0.7280	1.3029*	0.7624	-1.1972*	0.7073
cg300	-1.0803	0.7565	-0.3632	0.6019	-0.9880	0.6687
formal	-0.2058	0.3919	0.0044	0.4852	-0.2097	0.3757
age	-0.2784	0.2323	0.1433	0.1801	-0.2850	0.2164
educ	0.2270	0.1900	-0.0906	0.2748	0.2518	0.1913
RHO			0.2630	0.2033	0.9799***	0.0856
SIGMAU			0.5974	0.3133	0.9615	0.5335

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01

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TABLE E.6.2: Arizona BQA data only: Alliance Preferences Models Comparison

Variable names	Pooled probit		Panel probit		Bivariate Panel Probit	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
constant c	0.1145	0.1224	0.9383	1.2772	-0.0420	0.1907
s1ab	-0.4445*	0.2574	-0.3070	0.1983	-0.4035	0.3180
s2ab	0.2981	0.3277	0.2523	0.2156	0.3468	0.4336
d1ab	-0.2395	0.2342	-0.2229	0.2527	-0.1935	0.2609
d2ab	0.2768	0.1881	0.3619	0.2297	0.2578	0.2422
p1ab	0.4078***	0.1264	0.4767***	0.1486	0.5000***	0.1461
p2ab	-0.3510*	0.1908	-0.4273***	0.1607	-0.3939*	0.2035
fab	0.0663	0.0869	0.0636	0.0762	0.0539	0.0859
(fab)(cowcalf)	-0.1105**	0.0450	-0.1353***	0.0492	-0.1398**	0.0628
(fab)(weaned)	-0.0003	0.0002	-0.0002	0.0003	-0.0002	0.0003
(fab)(precond)	-0.0006*	0.0004	-0.0004	0.0004	-0.0003	0.0005
(fab)(retaintedo)	-0.0013	0.0012	-0.0016	0.0011	-0.0014	0.0014
(fab)(pcost)	0.0293	0.0721	0.0473	0.0552	0.0564	0.0560
constan b	0.9094	3.3914			-0.1159	5.0443
cowcalf	-0.0186	1.4950	0.2681	0.4523	-0.1062	1.5409
smaller	-1.1590	0.7169	0.3154	0.2974	-1.4612	0.8929
larger	-0.1845	2.4808	-0.1886	0.5901	0.2379	4.8576
weaned	-0.0110	0.0104	-0.0034	0.0033	-0.0078	0.0090
precond	-0.0063	0.0133	-0.0005	0.0042	-0.0047	0.0108
retainedo	0.0022	0.0278	0.0024	0.0089	-0.0044	0.0309
pcost	0.9083	0.6201	-0.1219	0.7191	0.9091	0.7858
cl150	0.4877	2.2608	0.0000	0.5964	0.9539	4.5630
formal	-0.2448	0.6258	0.0276	0.2483	-0.3000	0.5819
age	-0.1754	0.2531	-0.1753	0.1078	-0.0585	0.2288
educ	0.2952	0.3317	-0.0815	0.1521	0.3701	0.4726
RHO			0.1954	0.1259	-0.9963***	0.0560
SIGMAU			0.4929	0.1973	-0.7438***	0.2372

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01.

TABLE E.6.3: Arizona combined (AZ NASS AND BQA) data: Alliance Preferences Models Comparison

Variable names	Pooled probit		Panel probit		Bivariate Panel Probit	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
constant c	0.0588	0.0908	0.6732	0.9300	-0.1378	0.2504
s1ab	-0.3578**	0.1773	-0.2481	0.1624	-0.3019	0.2342
s2ab	0.1234	0.2190	0.1154	0.1633	0.1035	0.2903
d1ab	-0.3205*	0.1848	-0.3225*	0.1842	-0.3306	0.2307
d2ab	0.3766***	0.1449	0.4740**	0.1914	0.3569*	0.2027
p1ab	0.4186***	0.0947	0.4702***	0.1218	0.4619***	0.1186
p2ab	-0.1525	0.1246	-0.2039	0.1244	-0.1563	0.1426
fab	0.0278	0.0409	0.0299	0.0482	0.0264	0.0458
(fab)(cowcalf)	-0.0524***	0.0198	-0.0638**	0.0282	-0.0562**	0.0249
(fab)(weaned)	-0.0007***	0.0002	-0.0006**	0.0002	-0.0007***	0.0002
(fab)(precond)	-0.0005**	0.0002	-0.0002	0.0003	-0.0004	0.0003
(fab)(retaintedo)	0.0003	0.0004	0.0005	0.0005	0.0004	0.0006
(fab)(pcost)	0.0346	0.0351	0.0237	0.0367	0.0331	0.0369
constan b	0.7879	1.0337			0.6619	1.0301
cowcalf	-0.2032	0.4548	0.1022	0.3268	-0.1641	0.4641
smaller	-0.6154**	0.2510	0.1202	0.2493	-0.6327**	0.2513
larger	-0.0055	0.5526	0.2665	0.4151	-0.0391	0.5265
weaned	-0.0038	0.0039	-0.0053*	0.0030	-0.0029	0.0040
precond	0.0028	0.0050	-0.0026	0.0038	0.0032	0.0053
retainedo	-0.0003	0.0059	0.0005	0.0056	-0.0002	0.0061
pcost	0.9547***	0.3499	-0.5291	0.5192	0.9732***	0.3700
cl150	-0.3908	0.5256	0.7991*	0.4622	-0.4973	0.5074
cg300	-0.9034	0.5902	0.2224	0.3477	-0.9414	0.5777
formal	-0.1478	0.2619	0.0603	0.2078	-0.1442	0.2571
age	-0.2540*	0.1350	-0.0508	0.0922	-0.2381*	0.1370
educ	0.2526**	0.1254	-0.1401	0.1201	0.2700**	0.1267
RHO			0.2752	0.0932	0.4798	0.4973
SIGMAU			0.6161	0.1439	0.7432***	0.1751

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01

TABLE E.6.4: Canada data only: Alliance Preferences Models Comparison

Variable names	Pooled probit		Panel probit		Bivariate Panel Probit	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
constant c	0.1303	0.1151	3.2360***	0.7189	0.6092***	0.2129
s1ab	0.1673	0.1888	0.1587	0.1732	0.1983	0.2941
s2ab	0.0292	0.2463	0.3352*	0.1747	0.0805	0.3639
d1ab	-0.2924*	0.1599	-0.4151**	0.1736	-0.2531	0.2601
d2ab	0.3330**	0.1528	0.3190*	0.1772	0.1319	0.2626
p1ab	-0.0058	0.0892	-0.0081	0.1075	-0.0760	0.1171
p2ab	0.0567	0.1425	0.1410	0.1278	0.0912	0.1692
fab	-0.0126	0.0194	-0.0282	0.0273	-0.0170	0.0272
(fab)(cowcalf)	0.0187	0.0145	0.0197	0.0151	0.0194	0.0199
(fab)(weaned)	-0.0002	0.0002	-0.0001	0.0003	-0.0002	0.0003
(fab)(precond)	0.0002	0.0003	0.0000	0.0004	0.0000	0.0006
(fab)(retaintedo)	-0.0002	0.0003	0.0000	0.0004	-0.0002	0.0005
(fab)(pcost)	0.0165	0.0117	0.0329*	0.0171	0.0233	0.0177
constan b	0.0011	0.7868			0.9230	0.6960
cowcalf	-1.0266**	0.5031	-0.3507	0.2139	-1.1029**	0.4911
smaller	-0.2016	0.4673	0.1889	0.2382	-0.0645	0.4241
larger	0.0110*	0.0061	-1.4075***	0.4228	0.0115**	0.0055
weaned	0.0089	0.0119	0.0000	0.0045	0.0074	0.0103
precond	-0.0020	0.0084	0.0054	0.0053	-0.0080	0.0075
retainedo	0.1414	0.4759	-0.0034	0.0053	-0.0801	0.4496
pcost	-0.0779	0.4258	-0.7542***	0.2417	-0.3038	0.3729
cl150	-0.1232	1.3975	-1.2933***	0.3829	-0.2917	1.1669
cg300	0.0962	0.5613	-0.5182	0.3256	0.2731	0.4602
formal	0.6933	0.4541	0.2251	0.3524	0.8039*	0.4504
written	-0.5863	0.5261	0.3196	0.2011	-0.7436	0.5178
age	-0.2337	0.1722	-0.1061	0.0904	-0.2039	0.1475
educ	0.5046*	0.2663	-0.3624***	0.1240	0.2280	0.2787
RHO			0.2374	0.0850	-0.9867***	0.0593
SIGMAU			0.5579	0.1310	1.0419***	0.2096

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01

TABLE E.6.5: All data combined (AZ NASS, AZ BQA and Canada): Alliance Preferences Models Comparison

Variable names	Pooled probit		Panel probit		Bivariate Panel Probit	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
constant c	0.0776	0.0636	2.7637***	0.6039	0.0145	0.1620
s1ab	-0.0531	0.1169	-0.0538	0.1184	-0.0201	0.1656
s2ab	0.0407	0.1402	0.2461**	0.1196	0.0938	0.1971
d1ab	-0.3308***	0.1044	-0.3647***	0.1268	-0.3957***	0.1479
d2ab	0.3537***	0.0919	0.3347**	0.1302	0.2321	0.1430
p1ab	0.2282***	0.0556	0.2257***	0.0795	0.2695***	0.0714
p2ab	-0.0234	0.0877	-0.0436	0.0877	-0.0049	0.0991
fab	-0.0136	0.0153	-0.0362	0.0260	-0.0248	0.0229
(fab)(cowcalf)	0.0018	0.0081	-0.0008	0.0130	-0.0006	0.0112
(fab)(weaned)	-0.0005***	0.0001	-0.0005***	0.0002	-0.0005***	0.0002
(fab)(precond)	-0.0004**	0.0002	-0.0002	0.0002	-0.0003	0.0002
(fab)(retaintedo)	-0.0001	0.0002	0.0000	0.0003	-0.0001	0.0003
(fab)(pcost)	0.0255***	0.0090	0.0336**	0.0153	0.0242*	0.0133
(fab)(azbqa)	-0.0110	0.0104	0.0007	0.0158	-0.0003	0.0153
(fab)(canada)	0.0323***	0.0096	0.0396**	0.0153	0.0364**	0.0145
constan b	0.2294	0.6069			-0.0710	0.5983
cowcalf	-0.6056**	0.2501	-0.1857	0.1828	-0.5528**	0.2501
smaller	-0.3818*	0.2116	0.2120	0.1793	-0.4234**	0.2075
larger	-0.1328	0.3479	-0.7725***	0.2936	-0.0319	0.3389
weaned	0.0022	0.0031	-0.0030	0.0025	0.0024	0.0031
precond	0.0065	0.0042	0.0010	0.0031	0.0060	0.0043
retainedo	-0.0020	0.0045	-0.0057	0.0037	-0.0013	0.0045
pcost	0.4005	0.2484	-0.6769***	0.2282	0.4776*	0.2490
cl150	-0.3178	0.3111	-0.5902**	0.2888	-0.2787	0.3126
cg300	-0.2872	0.3608	-0.2691	0.2433	-0.2792	0.3417
formal	-0.1843	0.2180	0.0058	0.1809	-0.1849	0.2137
written	0.3002	0.2724	0.3686*	0.1911	0.2186	0.2684
age	-0.1781*	0.0754	-0.1394**	0.0648	-0.1529**	0.0758
educ	0.2815**	0.1074	-0.2294***	0.0875	0.3111***	0.1036
azbqa	0.9943***	0.2397	0.2561	0.2132	0.9219***	0.2381
canada	0.5506*	0.2955	-0.3857	0.2575	0.5909**	0.2881
RHO			0.3253	0.0605	0.4810*	0.2827
SIGMAU			0.6944	0.0957	0.8866***	0.1174

*Significance level at p<0.1 ** significance level at p<0.05 and *** significance level at p<0.01