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Producer preferences towards vertical coordination: The case of Canadian beef alliances

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A survey among cow-calf producers was conducted during 2006 in Western Canada, to assess producers' preferences towards participation in beef alliances. Producers' choices were analyzed by varying the degree of vertical coordination in hypothetical alliance participation, while controlling for producer and farm-specific characteristics to explore risk, transaction cost and incentive considerations in participation decisions. Estimates from the attribute-based choice experiments suggest that information sharing regarding animal performance, revenue-risk and residual claimancy are important factors for producers driving alliance choices. Overall, cow-calf producers are willing to move toward higher levels of vertical coordination based on individual animal performance. However, the estimates also suggest that producers consider the benefits from being able to access animal-specific yield and grade data to be smaller than the costs of bearing potentially greater revenue risk as a result of moving towards grid-based pricing, and the transaction costs associated with relationship-building in alliances.

Keywords: beef value chain, vertical coordination, Canada

JEL classification: Q12, Q13, C83, D22.

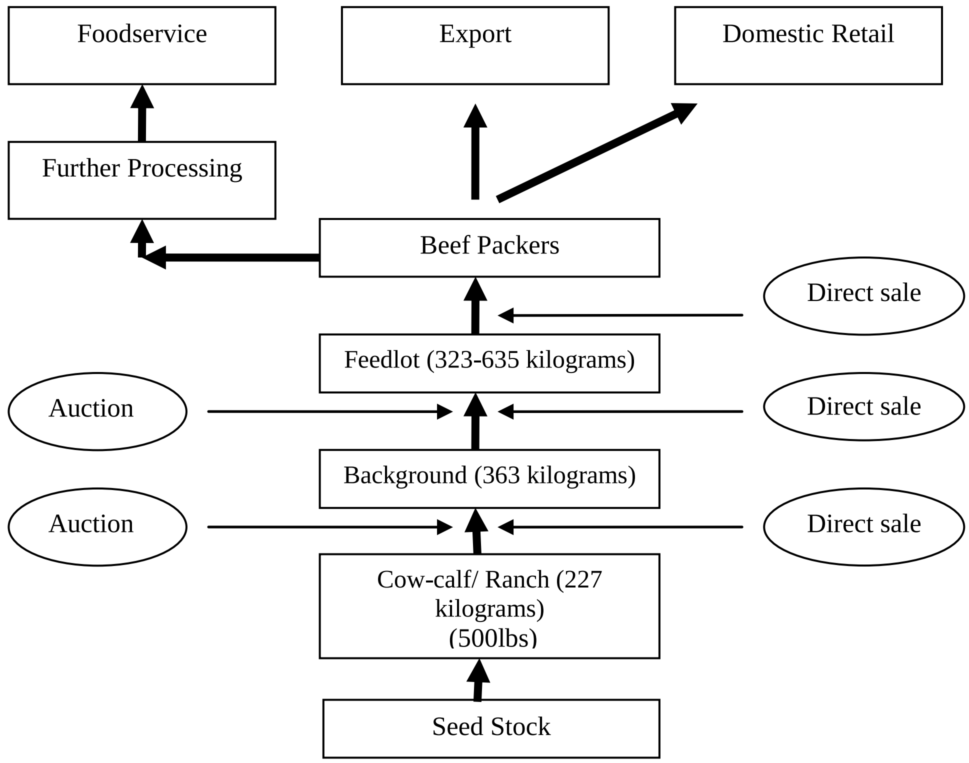
1. INTRODUCTION

North American beef production systems have evolved towards more closely coordinated supply (value) chains, in which information regarding individual animal and cutout pricing has become more valuable as a result of increasing consumer orientation and capital intensity in production (Brocklebank and Hobbs 2004; Hayenga et al. 2000; Steiner 2007). The trend towards closer vertical coordination in the Canadian agri-food sectors is similar to that observed in the U.S. (Brocklebank and Hobbs 2004; Hobbs and Young 2001). However, in contrast to the U.S., there are few empirical studies that have explored supply chain coordination and risk management issues in the Canadian beef sector. The present paper aims to contribute towards this Canadian literature.

Considering the variety of vertical coordination instruments available to agri-food supply-chain participants, formal contracts have become increasingly important to improve coordination in a variety of agricultural industries (MacDonald et al. 2004; Wysocki et al. 2003; Steiner 2011). Two major types of contracts have been distinguished largely for analytical reasons, marketing contracts and production contracts. These contracts vary in terms of product ownership, management responsibility, and the provision of product inputs. In marketing contracts, producers own the product, manage it, and provide most or all of the production inputs. Therefore, marketing contracts control market access and price risk, but may not address production loss or management risks. Production contracts involve increased processor provision of inputs, product ownership, and participation in management. In exchange, production loss and management risks are reduced for producers (Boland et al. 1999; MacDonald et al. 2004). Over time, the use of such marketing and production contracts has become more widespread in North America’s agricultural sector, although those vertical coordination mechanisms are less widespread in the beef industry, compared to poultry and pork (MacDonald et al. 2004; Steiner 2007). Furthermore, marketing contracts in the U.S. beef sector are mostly used between processors and feedlots, while their emergence has been less apparent between cow-calf producers and feedlots (Hayenga et al. 2000).

Little empirical evidence exists on the extent to which Canadian cow-calf producers use marketing contracts, choose to background or retain ownership using custom feeding agreements with feedlot operations (Figure 1).

Figure 1: Canadian beef supply chain



Most recent evidence suggests that only about 20% of fed cattle were sold under grid pricing and through alliances in Canada (Brocklebank and Hobbs 2004; Schroeder 2003). This is perhaps striking since increased information sharing among alliance members could be expected to improve the ability of alliance participants to respond more effectively to changing consumer demands, while potentially reducing coordination costs and distributing production and price risks more equitably. On the other hand, cow-calf producers can operate efficiently on a relatively small scale as a result of extensive land use and capital extensive vertical coordination, compared with other stages of the supply chain (Bailey 1998; Brocklebank and Hobbs 2004; Schroeder 2003). Furthermore, since cow-calf producers operate at the first stage in the supply chain they are furthest away from information that may flow from the consumer end. Also, cow-calf operations could be expected to lack sufficient incentives to participate in the process of vertical coordination with upper stream chain members due to problems of asymmetric information and bargaining power, the latter contributing towards lack of trust in more tightly designed coordination schemes such as beef alliances.

Previous Canadian evidence (Brocklebank and Hobbs 2004) suggests that, on average, cow-calf producers have a preference for a combination of live weight and carcass quality pricing, even though using this pricing method means that they incur some of the risk associated with variability in cattle quality. Further, Brocklebank and Hobbs (2004) found that, overall, the risk of opportunistic behavior as a result of investment in specific assets is minimal, and has not had a great impact on the degree of supply chain coordination. These results suggest that incentive and risk-management issues as part of beef alliance coordination schemes deserve further attention.

Our paper's analysis focuses on beef alliances, typically cooperation agreements between independent cow-calf producers, backgrounders and feedlots regarding common quality and quality goals, and asks to what extent there are risk, incentive and organizational issues related to producers' preferences for particular alliance sales types, types of data exchange, and production protocols. These issues are primarily explored through attribute-based choice experiments (Louviere et al. 2000) with cow-calf producers from four major beef-producing provinces, namely Alberta, Manitoba, Saskatchewan and British Columbia.[1]

We are interested in exploring two broad hypotheses. The first is that specific producer types can be associated with the likelihood of adopting beef alliances in principle, or not. Producer socio-demographics and farm characteristics, such as beef cowherd size, are hypothesized to have a significant impact on the decision to opt for participation in a beef alliance. In particular, we expect that education and beef cowherd size are positively related to the probability of participating in a beef alliance, while producer age and the extent of beef enterprise specialization is anticipated to be negatively related to their participation decision.

Second, we expect that producers' willingness to participate in different types of beef alliances with varying contract specifications can be revealed through stated preference analysis, and can be explained not only from a transaction cost perspective (Williamson 1985), but also from a property rights theory (Grossman and Hart 1986; Unterschultz and Gurung 2002), an agency theory (Salanié 2005; Jensen and Meckling 1976) and a Resource-Based (Barney 1991; Wernerfelt 1984) perspective. These perspectives come into play since a move towards closer

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1. [1] Alberta is by far the largest beef production province, followed by Ontario, Saskatchewan, Manitoba, and British Columbia. In 2005, Alberta accounted for 69% of Canadian fed cattle production while Saskatchewan, Manitoba and British Columbia accounted for 9.4% of the country's fed cattle production (Canfax 2006; Statistics Canada 2005). In 2005, Canada exported about 45% of total beef and cattle produced in Canada. This was an increase of 10% over 2004, and has made Canada the third largest beef exporting country (CanFax 2006).

beef alliance coordination could be expected to increase coordination costs, relation-specific investment, the need for aligning incentives among alliance members and the pool of resources from which the alliance members may draw Ricardian rents from, respectively. We anticipate that producers' preferences for a well-designed (cost-effective and incentive compatible) information sharing system, preferences for increasing relationship-specific investments (e.g., production protocols), and preferences for certain elements of incentive compensation schemes (e.g., profit sharing, bonuses based on animal performance) can be at least partially revealed through producers' choices in an experimental setting.

2. METHODS

Our theoretical basis to explore the above two hypotheses is random utility theory (McFadden 1974, 1981). Before producers were asked to consider different types of beef alliances as part of an attribute-based choice experiment, we asked them whether or not they would consider future participation in a formal agreement between cow-calf producers and other members in a value chain, in principle.[2] For both decision problems, binary logit models are estimated via maximum likelihood, using Limdep©. Assume that U_a and U_b identify a cow-calf producer's utility under alliance participation and non-participation, respectively. Following Greene (2011), the linear random utility model could then be specified as,

$$U_a = \boldsymbol{w}'\boldsymbol{\beta}_a + \boldsymbol{z}_a'\boldsymbol{\gamma}_a + \varepsilon_a \text{ and } U_b = \boldsymbol{w}'\boldsymbol{\beta}_b + \boldsymbol{z}_b'\boldsymbol{\gamma}_b + \varepsilon_b \,. \tag{1}$$

The measured vector of producer characteristics (socio-demographics; farm characteristics) is denoted by $\boldsymbol{w}$, whereas the vectors $\boldsymbol{z}_a$ and $\boldsymbol{z}_b$ denote choice specific attributes which characterize the nature of vertical coordination considered by the cow-calf producer (e.g. the extent of ownership that producers wish to retain in regard to their calves as these move through the value chain; the extent of carcass, individual yield and grade data that is used by producers). The random terms ε_a and ε_b denote stochastic elements unobserved by the analyst, which are specific and known by the individual producer.

[2] "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."

When a producer chooses whether or not to participate in a formal agreement with other members in a beef alliance, the producer's preference ranking is revealed. Denoting $Y = 1$ as the choice of alternative a, the alliance participation, we assume that a producer's utility from alliance participation exceeds that from non-participation, hence $U_a > U_b$. Accounting for the random elements in the producer's utility function, we get (Greene 2011),

$$\begin{aligned} Prob\,[Y = 1|\boldsymbol{w}, \boldsymbol{z}_a, \boldsymbol{z}_b] &= Prob[U_a > U_b] \\ &= Prob[(\boldsymbol{w}'\boldsymbol{\beta}_a + \boldsymbol{z}_a'\boldsymbol{\gamma}_a + \varepsilon_a) - (\boldsymbol{w}\boldsymbol{\beta}_b + \boldsymbol{z}_b'\boldsymbol{\gamma}_b + \varepsilon_b) > 0|\boldsymbol{w}, \boldsymbol{z}_a, \boldsymbol{z}_b] \\ &= Prob[(\boldsymbol{w}'(\boldsymbol{\beta}_a - \boldsymbol{\beta}_b) + \boldsymbol{z}_a'\boldsymbol{\gamma}_a - \boldsymbol{z}_b'\boldsymbol{\gamma}_b + \varepsilon_a - \varepsilon_b) > 0|\boldsymbol{w}, \boldsymbol{z}_a, \boldsymbol{z}_b] \\ &= Prob[\boldsymbol{x}'\boldsymbol{\beta} + \varepsilon > 0|\boldsymbol{x}], \end{aligned} \tag{2}$$

where $\varepsilon = \varepsilon_a - \varepsilon_b$ and $\boldsymbol{x}'\boldsymbol{\beta}$ denotes the measurable elements of the difference of the two utility functions.

3. DATA AND EXPERIMENTAL DESIGN

The study surveyed beef producers from the four main beef producing western provinces, namely, British Columbia, Alberta, Saskatchewan and Manitoba. Based on membership lists that were made accessible from beef producers associations, 951 cattle producers were initially contacted by telephone, to inquire their willingness to participate in an online-survey or an equivalent on-site survey. No financial incentives were given for participation. A small team of University of Alberta students was trained and conducted the on-site interviews with laptops using an equivalent surveying platform that was accessible to those producers who completed the survey online. A total of 110 questionnaires were completed during spring of 2006 as valid samples (we also report results from a subsequently expanded sample of 151 producers). Considering the Canadian Census relevant to the surveying period (2001 Census), producers have a somewhat higher level of education, are younger and likely have a larger than Census average herd size (Table 1a).

Table 1a. Comparison of sample population to Canadian Census and previous beef alliance study

	Percentage in Category		
	Census of Agriculture (2001)	**Brocklebank and Hobbs (2004)**	**Cow-calf operator Survey (This study)**
Gross Revenues ('000' s)			
0-10	21.00%	6.00%	No Comparable Data Available
10-49	29.00%	11.00%	
50-99	14.00%	16.00%	
100-249	20.00%	30.00%	
250-499	10.00%	23.00%	
500+	6.00%	14.00%	
Farm Income from Beef			
Less than 25%	No Comparable Data Available	No Comparable Data Available	35.45%
Between 25% and 50%			11.82%
More than 50%			52.73%
Alliance Participation			
Yes	No Comparable Data Available	15.00%	76.36%
No		85.00%	23.64%
Herd Size			
0-50	Avg. Canadian Herd Size: 53 Head; Avg. Western Canadian Herd Size: 67 Head	20.00%	38.18%
50-100		18.00%	36.36%
100-150		20.00%	
150-200		21.00%	19.09%
200-300		10.00%	
300+		11.00%	6.36%
Education[3]			
High School	62.00%	29.00%	53.64%
College	27.00%	27.00%	28.18%
University	11.00%	11.00%	18.18%
Age[4]			
Less than 35	11.50%	35.00%	21.82%
35-60	53.60%	62.00%	62.72%
60+	34.90%	3.00%	15.45%

Source: Statistics Canada & Brocklebank and Hobbs (2004)

[3] The Census of Agriculture (2001) uses categories of "less than grade 9"; "grade 9-12"; 'post secondary (non-university"; and "post secondary (university)".
[4] The survey used in this study categorized respondents as " under 30"; "31-40"; "41-50"; "51-60" and "60+".

The survey consisted of a number of rating and ranking questions, a question of whether or not a producer would consider future participation in a formal agreement between cow-calf producers and other members in a value chain in principle, while controlling for producer and farm-specific characteristics (Table 1b), and an unlabeled attribute-based choice experiment.[5] In the choice experiment, different beef alliance types were specified in terms of sale type, type of data sharing, production protocols and membership fee (see Tables 2 & 3 below):

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

The beef alliance attributes were selected from consulting previous literature and industry stakeholders. A pilot survey was pre-tested with the help of government officials (Alberta Agriculture Food & Rural Development) and by using six cow-calf producers from Alberta.[6]

Table 1b: Description of variables used in the beef alliance participation model

Variable	Descriptions
OPT	Operation Type (1= only cow-calf operation; otherwise 0)
BREED	Specialized in a particular breed (1= yes; otherwise 0)
DIVER	Farm Enterprises other than Beef Production (1= yes; otherwise 0)
AGE	Producer Age (1if $\leq$ 50;otherwise 0)
HERD	Beef Cowherd Size (1if $\leq$ 150 heads; otherwise 0)
EDU	Producer's Education (1 if $\leq$ high school; otherwise 0)
INCOME	Farm Income from Beef (1if $\leq$ 50%; otherwise 0)
INFOR	producer collects either data about beef production (e.g. birth weight), or cost of production data (e.g. operating costs), or processing data (slaughter) (1 = yes; otherwise 0)
RETAIN	Experiences of using retained ownership (1= yes; otherwise 0)

[5] We omit to report descriptive statistics here due to space limitations.
[6] Considering space limitations, we do not report details here on the representativeness of our survey here, except for emphasizing that compared to the 2001 Canadian Census of Agriculture, the producers in our sample have a larger beef cowherd, a higher level of education and are younger. Hudson and Lusk (2004) suggest that if the attributes of beef alliances considered are important for the producers in a specific sample, then the results can be still used to determine if they hold for a more representative sample.

AGREE	in 2005, did producer market calves and backgrounders through a formal or informal agreement (1= yes; otherwise 0)
AUCTION	sold cattle through an auction in the last five years (1= yes; otherwise 0)
EXPERFOR	use of forward contracts on the farm (1= yes; otherwise 0)

Table 2: Attributes and Attributes Levels of Choice Experiment

Beef Alliance Attributes				
Sale Type	Sell to alliance, NO profit sharing	Sell to alliance, bonuses based on animal performance	Retain ownership, NO profit sharing	Retain ownership, profit sharing
Information Sharing Scheme	live performance, pen	live performance, individual data	Carcass, group data	carcass, individual yield & grade data
Production Protocols	NO restrictions on vaccination and use of antibiotics & NO min. number of animals required	NO restrictions on vaccination and use of antibiotics & min. number of animals required	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	$10	$20

Table 3. Description of variables used in choice experiment

Variables		**Description**
Sales Type(Base=Retain Ownership, No profit Sharing)	**S1**	Sell to alliance, NO profit sharing
	S2	Sell to alliance, bonuses based on animal performance
	S3	Retain ownership, NO profit sharing
	S4	Retain ownership, profit sharing
Information Sharing Scheme (Base=live performance, pen)	**D1**	live performance, pen
	D2	live performance, individual data
	D3	Carcass, group data
	D4	carcass, individual yield & grade data
Production Protocols(Base=No restrictions on vaccination and use of antibiotics & No number of animals required	**P1**	NO restrictions on vaccination and use of antibiotics & NO min. number of animals required
	P2	NO restrictions on vaccination and use of antibiotics & min. number of animals required
	P3	Restrictions on vaccination and use of antibiotics & NO min. number of animals required
	P4	Restrictions on vaccination and use of antibiotics & min. number of animals required
Membership Fee	**FEE**	$0,$5,$10,$20
Individual-specific Variables	**SRT**	Survey Method (1= on-site interview; online = 0)
	AGE	Producer Age (1if $\leq$ 50; otherwise 0)
	EDU	Producer's Education (1 if $\leq$ highschool; otherwise 0)
	INCOME	Farm Income from Beef (1 if $\leq$ 50%; otherwise 0)
	HERD	Beef Cowherd Size (1 if $\leq$ 150 heads; otherwise 0)

Note: S3, D1 and P1 were employed as base level during estimation.

For the choice experiments, an orthogonal fractional factorial design was generated with SPSS© to obtain a sample of 32 treatments, using a balanced design with four attribute levels for each attribute (four beef alliance choice tables per questionnaire and individual). Using the choice experiments, we aimed in particular at identifying potential non-participants, who would not be willing to pay any specific investments (membership fee) for participating in a beef alliance.[7] The goal was to distinguish between participants and non-participants in a two-step approach, focusing on binary choice models as basic estimation approach. Therefore, non-participants "in principle" were, in a first stage, identified before respondents reached the choice experiment; hence only those respondents who were willing to participate in a beef alliance "in principle" were asked to complete the choice experiments with varying amounts of prices (participation fees) and other alliance specifications. Through this approach, both unconditional willingness-to-pay estimates (for the entire sample) and conditional willingness-to-pay estimates (for participants) were be derived, which may provide policy-makers with information about how important different beef alliance specifications are to the welfare of the (potential) participants.

4. ESTIMATION OF BINARY CHOICE MODELS

The first model ("beef alliance participation model") explores what types of cow-calf producers were willing (or not) to participate in a beef alliance in principle. The second model ("beef alliance choice model") analyzes what type of cow-calf producers were willing to opt for which types of beef alliances.

4.1. Beef alliance participation model

A number of individual-specific variables that could affect a producer's decision to participate in a beef alliance were classified into producers' individual characteristics and producers' alternative marketing and production practices. Following the basic binary choice model as outlined in equation (2), we explore the role of producers' individual characteristics, including the operation type, age, education level, percentage of net income from beef production, and beef cowherd size in terms of number of cows. A number of variables were included to account for alternative

[7] Slightly over 22 percent of the participants indicated they would not participate in any beef alliance.

marketing and production practices. These included dummy variables for enterprises that had other enterprises than beef production, for whether a specific breed was used in beef production, for whether the producer uses or has used retained ownership, and for whether the producer uses or has used contractual agreements before on his farm. Due to the relatively small sample size, it was necessary to reduce the number of variables included in final model specifications. Therefore, the variables for age, education level and farm income from beef production were pooled as dummies. The variable for beef cowherd size was also pooled and coded as dummy variable. In addition, a dummy variable was included for the survey method that identifies on-line and on-site interviews.

In order to account for producers' differences with regard to their risk management toolbox and the potential impact of these differences on producers' alliance participation decision, we controlled for the use of futures contracts, the use of formal marketing contracts and the extent to which producers collect marketing and production data (information on auction prices, contracts from other producers, cost of production, production management info such as birth weights, animal health, genetics). We were also interested in exploring the extent of enterprise diversification as a possible tool for risk management, thus we controlled for off-farm income and diversification with regards to production other than beef (dairy, pork, grain etc.). Furthermore, we attempted to control for the potential impact of differences in the extent of residual claimancy on the alliance participation decision, by accounting for the extent to which producers own the animals produced as they go through the value chain.

Since the respondents could complete the survey either on-line or on-site, a homogeneity test is first conducted to see if the two groups of respondents can be estimated jointly. The test for structural stability is a likelihood ratio test, $\chi 2 = [(\sum_{groups} \log$ likelihood for the group) - log likelihood for the pooled sample] (Greene 2012). The degrees of freedom are G-1 (G represents the number of groups) times the number of coefficients in the model. The chi-square for the model that includes the full version of selected variables is less than the critical value 18.31 at the 5% level of significance. Therefore, the two sub samples are considered homogeneous.

After pooling the two sub samples, several versions of the "beef alliance participation models" were estimated (Table 4, 5), focusing on likelihood-ratio tests to choose among them (null hypothesis: all slope coefficients zero). The overall model (joint χ^2) is highly significant at the 1% significance level (Table 6). The model has an McFadden Pseudo-R^2 statistic of 0.26, indicating a reasonably well-fitted model (Louviere et al. 2000). To judge the goodness-of-fit we also use a 2 x 2 predictive table that provides a measure of the model's predictive ability. As shown in Table 7, the model predicts 90 of 110, or 82.7%, of the observations correctly.

Table 4: Summary of Statistical Results for the Beef Alliance Participation Models

Variable	Model 1		Model 2		Model 3		Model 4	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Constant	4.66***	1.35	4.15**	1.24	4.27***	1.20	4.08**	1.17
Survey Type	-1.36**	0.69	-1.37**	0.67	-1.39**	0.68	-1.38**	0.67
OPT	-1.43**	0.71	-1.27*	0.68	-1.43**	0.70	-1.28*	0.68
BREED	0.01	0.03			0.01	0.03		
DIVER	-0.57	0.76	-0.11	0.70				
AGE	1.08*	0.60	1.12*	0.58	1.02*	0.59	1.11*	0.58
HERD	-2.45***	0.81	-2.30**	0.77	-2.44***	0.79	-2.30**	0.77
EDU	-1.01	0.64	-1.03*	0.63	-0.97	0.64	-1.02*	0.63
INCOME	-0.02	0.70	0.14	0.68	0.05	0.69	0.15	0.67
INFOR	1.00	0.71	0.71	0.66	0.89	0.69	0.69	0.65
RETAIN	-1.44*	0.84	-1.38*	0.81	-1.46*	0.83	-1.39*	0.81
AGREE	0.68	0.59	0.54	0.57	0.63	0.58	0.54	0.57
Log Likelihood	-42.19		-44.35		-42.47		-44.36	
Restricted Log Likelihood	-60.15		-60.15		-60.15		-60.15	
McFadden's R^2	0.30		0.26		0.29		0.26	
No. of Observations	110		110		110		110	

*Significant at the 10% significance level. ** Significant at the 5% significance level. ***Significant at the 1% significance level.

Table 5: Log Likelihood Ratio Tests - Beef Alliance Participation Model

Hypothesis	Unrestricted Model (L0)	Restricted Model (L1)	Degrees of Freedom	-2*(L1-L0)	χ^2	Result
$H_0: Breed = 0 \& Diver = 0$ $H_1: Breed \neq 0 \& Diver \neq 0$	-44.36	-42.19	2	4.34	5.99	Not Rejected
$H_0: Breed = 0 \& Diver \neq 0$ $H_1: Breed \neq 0 \& Diver \neq 0$	-44.36	-44.35	1	0.02	3.84	Not Rejected
$H_0: Diver = 0 \& Breed \neq 0$ $H_1: Breed \neq 0 \& Diver \neq 0$	-44.36	-42.47	1	3.78	3.84	Not Rejected

Table 6: Summary of Results - Final Beef Alliance Participation Model

	Coefficient	Standard Error	Partial Effects	Expected Sign
Constant	4.08**	1.17	0.51***	N/A
Survey Type	-1.38**	0.67	-0.17**	N/A
Producer Type	-1.28*	0.68	-0.15***	-
Age	1.11*	0.58	0.14*	+
Beef Cowherd Size	-2.30**	0.77	-0.35***	-
Education	-1.02*	0.63	-0.13*	-
Income	0.15	0.67	0.02	N/A
INFOR	0.69	0.65	-0.17	+
RETAIN	-1.39*	0.81	0.09*	+
AGREE	0.54	0.57	0.07	+
Log Likelihood	-44.36			
Restricted Log Likelihood	-60.15			
χ^2	31.58			
P-Value	0.00			
McFadden's R^2	0.26			
No. of Observations	110			

** Significant at the 5% significance level. ***Significant at the 1% significance level.

Table 7: Predicted Table of Beef Alliance Participation Model

		Predicted		
		D=0	***D=1***	Total
Actual	D=0	10	16	26
	D=1	4	80	84
	Total	14	96	110

Considering the binary nature of our independent variables, we are interested in computing the partial effects of these dummy variables for an average producer in the sample, E[y|$\boldsymbol{x}$, d=1] – E[y|$\boldsymbol{x}$, d=0]. More precisely, these partial effects are computed at the means of the independent variables (Greene 2011):

Marginal Effect $= \left[Prob\left(y_i = 1\middle|\overline{\boldsymbol{x}}_{(d)}, d_i = 1\right)\right] - [Prob(y_i = 1|\overline{\boldsymbol{x}}_{(d)}, d_i = 0)]$, where the means of all the other independent variables in the model are denoted as $\overline{\boldsymbol{x}}_{(d)}$. Considering Table 6, the estimation results are as following:

Survey Type

The negative and significant (5%) coefficient estimate suggests that producers who responded via on-site interviews are not likely to participate in any kind of beef alliance, in principle.

Producer Type

The negative and significant (10%) estimate indicates that farms which are specialized as cow-calf operations are less likely to participate in a beef alliance compared to mixed farm operations. This result may be explained from a resource-based, a transaction costs and a risk-management perspective. Specialized cow-calf operations likely have an established marketing infrastructure in place from which they derive their rents, and alliance participation likely also entails additional transaction costs associated with establishing new marketing relationships. These transactions costs may be only part of the equation for specialized producers, as their perceived loss in managerial control and autonomy likely fares high compared to mixed-farm operations, and compared to the gain they may perceive in terms of managing production and marketing risks through the beef alliance (see Key (2005) for U.S. evidence on estimated risk and autonomy premia by degree of risk aversion for hog farmers).

Producer Age

The anticipated effect of age on beef alliance participation is indeterminate. On the one hand, older (more experienced) cattle producers could perceive beef alliances as an effective alternative marketing instrument to their status quo, considering the potentially improved information flow and consumer orientation. On the other hand, considering the required investment in communication and information processing technologies that likely goes with alliance participation, we could expect that older producers are more reluctant to adopt new technology, hence we could anticipate that farmers’ risk aversion towards technology increases with age (Feder, Just and Zilberman 1985; Guan and Wu 2011). The significant and negative coefficient estimate (10%) suggests that the younger producers are, the more likely they are to participate in a beef alliance.

Education

Initially, we anticipated a negative correlation between age and education, and considering that older producers could be expected to be more averse towards the adoption of a novel marketing instrument we could thus anticipate that less educated producers are also less likely to participate in a beef alliance. What we actually observe is a Pearson product moment correlation of .13 between age and education, and a positive and significant coefficient estimate (10%) for education, which suggests that producers with lower levels of education are less likely to participate in a beef alliance. The relatively weak significance could be explained that the average level of education in our sample is higher compared to the level of education as it can be inferred from the 2001 Canadian Census of Agriculture.

Beef Cowherd Size

Previous studies have established a positive relation between farm size and technology adoption (e.g. Feder and Slade 1984; Dinar and Yaron 1990; Dorfman 1996). The negative and significant coefficient estimate (5%) is in line with this rationale, since it suggests that producers with smaller beef cow herds are less likely to participate in a beef alliance.

Retaining ownership

Considering the positive partial effect of retained ownership (10% significance), the estimate suggests that producers who have experience in using retained ownership are more likely to participate in a beef alliance (about 30% of producers in our sample indicated that they have experience with retaining ownership to background and/or slaughter). This was anticipated, if we can assume that a typical goal of a beef alliance is to increase the degree of vertical coordination through increasing the commitment of its alliance members in the alliance's final product. Retaining ownership until slaughter rather than ownership transfer to the next-higher member in the value chain could thus be in line with this rationale. On the other hand, increasing transaction costs in alliances could be expected as a result of retained ownership relative to ownership transfer, since higher levels of members' individual retained ownership implies lower levels of mutual ownership across the alliance, which likely increases conflicts of interest.

Overall, the insignificance of a number of variables was at least in part unexpected. Considering the low level of use of futures contracts, the insignificance of this estimate as a potential driver for alliance participation was perhaps not too surprising. However, factors like off-farm employment and whether or not producers were using management information only internally by themselves rather than use outside consultation and extension advice (in breeding, feeding, business management or animal health management) was anticipated to make a difference in producers' alliance participation decision.

Nevertheless, an expanded sample (n = 151) that emerged after the originally scheduled project completion date, confirmed similar findings as above, and provided further insights with regard to two additional variables: whether or not a producer sold cattle through auction markets over the past five years (AUCTION), and whether or not forward contracts were currently used on the farm (EXPERFOR) (Table 8). It was anticipated that the use of auction markets and marketing animals through beef alliances would be considered as marketing substitutes rather than complements by producers. As a result, we anticipated a negative coefficient estimate, hence the positive and significant (1%) estimate is surprising. One explanation could be that producers who have used auction markets previously were dissatisfied with this marketing channel, thus producers' increasing level of dissatisfaction might explain the positive impact on beef alliance participation. Considering producers' current use of forward contracts as predictor for participation behaviour, we anticipated the negative sign, assuming that both forward contracts and formal coordination through beef alliances could be regarded as competing coordination mechanisms by producers towards higher levels of vertical coordination (such that increasing the intensity in using more forward contracts is unlikely to increase the attractiveness of alliance participation due to anticipated reductions in transaction costs).

Table 8: Extracts from estimation results for expanded beef alliance participation model (*n* = 151)

	Coefficient	**Standard error**	**Partial effects**	**Expected sign**
AUCTION	2.57 ***	.79	.028	-
EXPERFOR	-1.98 *	1.11	-.0167	+
Log-likelihood	-69.65			
Restricted log-likelihood	-79.28			
χ^2	19.27			
P-value	0.00			
McFadden Pseudo R^2	0.22			
Efron	.23805			
Cramer	.23512			

		Predicted value		
		D=0	***D=1***	Total
Actual value	D=0	13	20	33
	D=1	7	111	118
	Total	20	131	151

Analysis of Choice Model Predictions Based on Threshold = .5000

Prediction Success

Sensitivity = actual 1s correctly predicted	94.07%
Specificity = actual 0s correctly predicted	39.39%
Positive predictive value = predicted 1s that were actual 1s	84.73%
Negative predictive value = predicted 0s that were actual 0s	65.00%
Correct prediction = actual 1s and 0s correctly predicted	82.12%

Prediction Failure

False pos. for true neg. = actual 0s predicted as 1s	60.61%
False neg. for true pos. = actual 1s predicted as 0s	5.93%
False pos. for predicted pos. = predicted 1s actual 0s	15.27%
False neg. for predicted neg. = predicted 0s actual 1s	35.00%
False predictions = actual 1s and 0s incorrectly predicted	17.88%

Note: the above interpretation of success measures for predictions and fit measures should be interpreted with caution, since our sample consists of a rather unbalanced sample [zeros/ ones] (Cramer's measure addresses this though).

4.2. Beef alliance choice model

This "beef alliance choice model" aims to explore which types of cow-calf producers were willing to opt for which types of beef alliances. The estimation results for the attribute-based choice experiments are presented in two models (Table 9). Model 2 includes a dummy variable to explore the extent to which the self-selection of producers into different surveying methods (on-site vs. online) can be related to their preferences for different types of beef alliances.[8] The log-likelihood ratio statistics of 32.64 (model 1) and 46.58 (model 2) suggest that the factors examined in the model are jointly important. Nevertheless, the relatively low McFadden Pseudo R^2 is striking (0.10).

Overall, and before discussing the key estimates for beef alliance attributes individually, two findings are highlighted here. The dummy variable which denotes the survey method is significant at the 1% level, and none of the attributes that represent "production protocols" (e.g. vaccination, use of antibiotics) are significant at the 10% level. The remaining coefficient estimates are as following:[9]

[8] Almost 90% of those producers participating in the on-line version of survey chose to participate in a beef alliance.
[9] Alternative-specific constants (ASCs) are not employed because producers are choosing between generic alternatives (unlabelled choice experiment).

4.2.1. Sales type (marketing methods S1-S4)

The coefficient estimate of S4 (retain ownership, profit sharing) is not significant at the 10% level. The negative and significant estimate of S1 (1%) suggests that producers do not value this marketing strategy as part of a beef alliance. Taking the estimate for the base level that was dropped for estimation (S3) into consideration, the following order of producers' preferences for the attribute of sales type (from high to low) can be derived: "sell to the alliance, bonuses based on animal performance", "retain ownership, profit sharing", " retain ownership, No profits sharing" and "sell to alliance, No profit sharing", respectively. The above difference in preference between "sell to alliance" and "retain ownership" suggests that cow-calf producers are risk-averse with regard to delayed revenue streams, since a potential risk-shifting would be involved with the time-delayed cash gain from retaining ownership and maintaining residual control and residual claimancy (Fama and Jensen 1983), compared to the immediate cash flow that would likely result from selling animals to the partner in the beef alliance.

4.2.2. Data sharing

Estimation results from the basic model (Table 9) suggest that this category of attributes is highly valued by producers, very much irrespective of the organizational shape of a beef alliance. All coefficients have a positive sign except for D3 (carcass, group data), indicating a positive attitude away from the base ("live performance, pen": D1) toward these data sharing schemes. The coefficients of both D2 (live performance, individual data) and D3 (carcass, group data) are significant at the 5% level. The only insignificant attribute in this category is D4 (carcass, individual yield & grade data). The above results suggest that producers have the following preference for data sharing schemes in a beef alliance scheme, in declining order: D2 (live performance, individual data), D4 (carcass, individual yield & grade data), D1 (live performance, per pen), and then D3 (carcass, group data). Similar to our findings regarding producers' preference for sales type (direct sale to beef alliance, no retaining of ownership), cow-calf producers' preference for the information sharing scheme based on live animals (instead of carcass) suggests that producers are concerned with the potential shifting of price (revenue) risks from processor to producer (and/or with the increase in transaction costs) which are likely to emerge as a result of switching towards grid-based pricing (Harri et al. 2009).

At the same time, however, producers signal their preference for an alliance with a closer level of coordination over information, where individual data is being shared rather than data about pens of animals. This result appears to be in line with findings from Schroeder et al. (1998), which suggest that live performance data based on group (pen) animals inhibits information flow from beef consumers to cattle producers, and findings from Raper et al. (2008) who's study reveals that particularly specialized cow-calf producers rate the desire to access carcass information highly.

4.2.3. Production protocols

All coefficient estimates in this group are insignificant (at the 10% level), suggesting that producers' likelihood of choosing a particular organizational form of beef alliance is not significantly affected by the type and presence of production protocol specifications. To some extent, this is surprising since we anticipated that tighter coordination requirements that could potentially lead to hold-up as a result of relation-specific investment requirements would be critically assessed by producers, leading to a significant and negative coefficient estimates for production protocols. The fact that this is not the case reinforces the conclusions from Brocklebank and Hobbs (2004), namely that the risk of opportunistic behaviour as a result of investment in specific assets has not had a great impact on the degree of beef supply chain coordination.

4.2.4. Membership fee

As anticipated, the coefficient estimate for the fee attribute is negative (and significant at the 5% level), suggesting that the presence of a higher membership fee decreases producers' utility. At the margin, an increase in the membership fee is anticipated to decrease the probability for participating this organizational type of alliance by 0.004, *ceteris paribus*.

4.2.5. Survey method

To examine the potential effect of producers' responding online vs. on-site, the dummy was normalized following the methods introduced by Ben-Akiva and Lerman (1985) and Hensher et al. (2005). The coefficient estimate for survey methods (Table 9) is positive and significant at the 1% level. Although this result has no economic meaning in the basic model, it may help to explain the relatively low McFadden Pseudo R^2. Considering the significance of the dummy, we explore the interaction effect between survey method and demographic variables further. A series of four 'trials' were run, where a single demographic variable was interacted in each case with all attribute level variables and a dummy for survey method from the basic model (Model 2 in Table 9). Across these four trials, all four demographic variables produced at least one interaction coefficient that was significant at the 10% level (Table 11). In order to test whether a demographic variable significantly affected producers' preferences for beef alliances types, a joint test of each trial's interaction terms was performed. Table 11 summarizes the results of the interaction trials. Of the four trials, only HERD and INCOME passed the joint test with a Wald statistic significant at the 10% level.

Examining the significant interaction terms in the two trials that passed the joint Wald test offers potentially some information about the relationship between demographic characteristics and producers' preferences for alliance types. In the first trial, the coefficient estimate for D2 (live performance, individual data) is 0.154 whereas the coefficient estimate for the interaction term HERD* D2 was estimated at 1.628. Together, these terms have a cumulative effect on a producer's utility. The HERD term describes a producers' beef cowherd size, with categories ranging from 1 (small beef cowherd size) to 0 (large beef cowherd size > 150). As the HERD variable moves from 0 to 1, the interaction term becomes larger. This suggests that smaller beef producers prefer an information sharing scheme using individual live performance data. Considering the coefficient estimate of D4 (carcass, individual yield & grade data) at 0.42, and the coefficient estimate for the interaction term HERD* D4 at -0.93, the positive sign on the coefficient of D4 indicates a positive attitude toward information sharing scheme that uses carcass, individual yield and grade data. However, the cumulative effect suggests that smaller beef producers do not prefer a beef alliance with an information sharing scheme of D4. This result is thus in line with the predictions from section *4.2.2*.

In a second trial, the INCOME variable was interacted with HERD. Considering the estimate for S4 (0.32) and the coefficient estimate for the interaction term INCOME* S4 (-0.84), the cumulative effect suggests that low income beef producers are not showing a preference for a beef alliance with a sales type of S4 (retain ownership, profit sharing). Finally, the INCOME variable was expected to have an impact with regard to producers' preferences for membership fees. Although the negative sign on the coefficient estimate of INCOME*FEE suggests that low income beef producers perceive disutility as membership fees increase, the interaction term is not significant at the 10% level.

4.3. Willingness-to-pay

Using the results from model 1 and 2, insights into producers' marginal willingness to pay (MWTP) can be obtained by taking the ratio of the coefficient of interest, and using the coefficient for cost as the numeraire (Hanemann 1984). The marginal WTP is the marginal rate of substitution between one of the attributes in the choice experiment and the cost attribute, which is the membership fee in this study. However, this is the *conditional* marginal WTP since it is the WTP given that the respondent is willing to participate in a beef alliance. In order to obtain the sample marginal WTP, the non-participants which by definition have a zero WTP must be taken into account. The sample WTP can be defined as (Carlsson and Kataria 2006):

$$\mathrm{E}[\mathrm{WTP}] = \mathrm{P}[\mathrm{Participant}] \cdot \mathrm{E}[\mathrm{WTP} | \mathrm{Participant}] + \mathrm{P}[\mathrm{Non-participant}] \cdot \mathrm{E}[\mathrm{WTP} | \mathrm{Non-participant}],$$

where E [WTP | Non - participant] = 0.

Following the rationale of Carlsson and Kataria (2006), the zero MWTP associated with beef alliance non-participants implies that non-participants experience neither utility nor disutility from the beef alliance (since the cost implication for them is zero). Hence, the non-participants would get disutility if asked to pay for participating in a beef alliance alternative, regardless of what attribute levels the alternative has to offer. Furthermore, the sample WTP of the attributes is restricted to be non-negative as long as the participants on average have a positive WTP for the attribute in question. Using the results presented in Table 9 (the basic model 2), both the conditional MWTP and the unconditional MWTP are estimated as shown in Table 12.

The estimates in Table 12 are instructive for comparing the ranking among attributes and levels. For both samples of respondents (unconditional and conditional), the most important attribute of a beef alliance is the *information sharing* scheme. In such a scheme, producers associate higher MWTP with "live performance, individual data" rather than "carcass, individual yield & grade data". In this attribute category, the level of "Carcass, group data" was not preferred by the producers in this sample. The second most important attribute is *sales type*. Producers are willing to pay between \$15.26/ head and \$6.43/head for the attribute of "sale to alliance, bonus on the animal performance" and "retain ownership, profit sharing". However, producers are not willing to pay for the attribute of "sale to alliance, No profit sharing". The least important attribute is related to the production protocols; producers are willing to pay only \$5.06/head for the attribute of "No restrictions on vaccination and use of antibiotics & minimum number of animals required" while they are not willing to pay for the attributes “restrictions on vaccination and use of antibiotics & No minimum number of animals required” and “restrictions on vaccination and use of antibiotics & minimum number of animals required”.

5.4 Alternative Beef Alliance Scenarios and Policy Implications

Insights from the following scenarios may be used to explore producers’ preferences for choosing novel types of beef alliances that may be currently absent from the marketplace.

5.4.1. Alternative Beef Alliance Scenario (S2 vs. S4)

The first scenario assumes that there are only two alternatives, Alliance A and B. Both of these alternatives have the same attributes except for the sales type in alternative A is “sell to alliance, bonuses based on animal performance” while the one in alternative B is “retain ownership, profit sharing”. Given the estimated results reported in Table 9, the probability of choosing alternative A is 54.08% and the probability of choosing the “retain ownership, profit sharing” (alternative B) is 47.83%. The scenario suggests that it would require a cost reduction of 58% in membership fee to equalize the probability of choosing between these two sales types (Table 13).

5.4.2. Alternative Beef Alliance Scenario (D2 vs.D4)

The second scenario assumes that there are only two alternatives, Alliance A and B. Both of these alternatives have the same attributes except for the information sharing scheme in alternative A, which is “live performance, individual data” while the one in alternative B is “carcass, individual yield & grade data”. In this case, the probability of choosing alternative A is 59.22% and the probability of choosing the “retain ownership, profit sharing” (alternative B) is 47.06%. It would require a cost reduction of 66% in membership fee to equalize the probability of choosing between these two alternatives (Table 14).

5.4.3. Alternative Beef Alliance Scenario 3 (P2 vs. P4)

Considering the scenario where beef alliance A has the same attributes as B, except that the production protocols in alternative A is “No restriction and min. number of animals required” and the one in alternative B is “Restriction and minimum number of animals required”, the probability of choosing alternative A is 75.42% and the probability of choosing the alternative B is 68.06 %. In this case, it requires a cost reduction of 55% in terms of the membership fee to equalize the probability of choosing between these two productions protocols (Table 15).

These scenarios were designed by shifting producers’ preference structure from the most preferred attributes, toward the attribute level with the highest degree of vertical coordination in the choice experiment (based on the ordinal ranking of coefficient estimates and MWTP). These results suggest that a significant fee reduction has to be associated with the shifts in a single category of attributes to make this shift incentive compatible from a producer's perspective. Considering the magnitude of the price factor (i.e., membership fee) considered in the experiments (range from $0 to $20 per animal), the above scenarios suggest that the incentive problem of inducing producers to participate in alliances toward a higher degree of vertical coordination cannot be solved only by reducing the financial commitment that goes along with beef alliance participation. As expected, monetary and non-monetary incentives have to be jointly considered when designing a beef alliance as an incentive system (Holmström and Milgrom 1994).

Table 9: Summary of Statistical Results of Basic Models: Choice Experiment

Variables	Descriptions	Model 1		Model 2	
		Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
S1	Sell to alliance, NO profit sharing	-0.34**	0.15	-0.42***	0.16
S2	Sell to alliance, bonuses based on animal performance	0.37	0.24	0.43*	0.25
S3	Retain Ownership, No profit sharing	-0.18	0.20	-0.19	0.21
S4	Retain ownership, profit sharing	0.15	0.17	0.18	0.17
D1	Live performance, per pen	-0.21	0.14	-0.23	0.14
D2	live performance, individual data	0.70***	0.21	0.43**	0.22
D3	Carcass, group data	-0.53***	0.18	-0.41**	0.18
D4	carcass, individual yield & grade data	0.04	0.16	0.20	0.17
P1	No restrictions on vaccination and use of antibiotics & No min. number of animals required	-0.12	0.16	-0.10	0.17
P2	No restrictions on vaccination and use of antibiotics & min. number of animals required	0.08	0.16	0.14	0.16
P3	Restrictions on vaccination and use of antibiotics & No min. number of animals required	0.05	0.17	-0.01	0.17
P4	Restrictions on vaccination and use of antibiotics & min. number of animals required	0.00	0.18	-0.04	0.18
FEE	$0,$5,$10,$20	-0.02**	0.01	-0.02**	0.01
SRT	Survey Method:1=on-site;otherwise,0			0.75***	0.20
	Log-likelihood	-215.05		-208.08	
	Restricted Log-likelihood	-231.37		-231.37	
	-2LL	32.64		46.58	
	McFadden R^2	0.07		0.10	

*Significant at the 10% significance level. ** Significant at the 5% significance level. ***Significant at the 1% significance level.

Table 10: Partial effects on the Attributes of Beef Alliances

Variables	Descriptions	Coefficient	Marginal Effect
S1	Sell to alliance, NO profit sharing	-0.42***	-0.09
S2	Sell to alliance, bonuses based on animal performance	0.43*	0.09
S3	Retain Ownership, No profit sharing	-0.19	-0.04
S4	Retain ownership, profit sharing	0.18	0.04
D1	Live performance, per pen	-0.23	-0.05
D2	live performance, individual data	0.43**	0.09
D3	Carcass, group data	-0.41**	-0.09
D4	carcass, individual yield & grade data	0.20	0.04
P1	NO restrictions on vaccination and use of antibiotics & No min. number of animals required	-0.10	-0.02
P2	NO restrictions on vaccination and use of antibiotics & min. number of animals required	0.14	0.03
P3	Restrictions on vaccination and use of antibiotics & NO min. number of animals required	-0.01	0.00
P4	Restrictions on vaccination and use of antibiotics & min. number of animals required	-0.04	-0.01
FEE	$0,$5,$10,$20	-0.02**	0.00
SRT	Survey Method:1=on-site;otherwise,0	0.75***	0.16

*Significant at the 10% significance level. ** Significant at the 5% significance level. ***Significant at the 1% significance level.

Table 11: Summary of Statistical Results of Trials: Choice Experiment

Variable	Descriptions	Age Trials		Education Trials		Herd Trials		Income Trials	
		Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
S1	Sell to alliance, No profit sharing	-0.59	0.27	-0.29	0.23	-0.58***	0.19	-0.55**	0.22
S2	Sell to alliance, bonuses based on animal performance	1.03**	0.46	0.97**	0.39	0.72**	0.30	0.38	0.35
S4	Retain ownership, profit sharing	0.01	0.31	-0.19	0.27	0.20	0.22	0.32	0.25
D2	live performance, individual data	0.41	0.37	0.25	0.31	0.15	0.25	0.05	0.29
D3	Carcass, group data	-0.12	0.29	-0.45*	0.26	-0.45**	0.22	-0.53*	0.29
D4	carcass, individual yield & grade data	0.06	0.26	0.46*	0.25	0.42**	0.21	0.92***	0.27
P2	No restrictions on vaccination and use of antibiotics & min. number of animals required	-0.03	0.27	0.38	0.24	0.15	0.20	0.19	0.27
P3	Restrictions on vaccination and use of antibiotics & No min. number of animals required	-0.09	0.28	-0.08	0.27	0.00	0.21	0.04	0.26
P4	Restrictions on vaccination and use of antibiotics & min. number of animals required	0.17	0.33	-0.24	0.26	-0.15	0.22	-0.12	0.23
FEE	$0,$5,$10,$20	0.00	0.02	-0.04*	0.02	-0.02	0.01	-0.03	0.02
SRT	Survey Method:1=on-site;otherwise,0	0.68**	0.30	0.00	0.28	0.18	0.33	0.41	0.27
AS1	AGE*S1	0.21	0.34						
AS2	AGE*S2	-1.06*	0.57						
AS4	AGE*S4	0.27	0.38						
AD2	AGE*D2	0.09	0.47						
AD3	AGE*D3	-0.55	0.39						
AD4	AGE*D4	0.28	0.36						
AP2	AGE*P2	0.08	0.36						
AP3	AGE*P3	0.19	0.36						
AP4	AGE*P4	-0.23	0.40						
FAGE	AGE*FEE	-0.05*	0.02						
S11	AGE*SRT	-0.01	0.42						
ES1	EDU*S1			-0.32	0.34				
ES2	EDU*S2			-0.84	0.56				
ES4	EDU*S4			0.65*	0.38				
ED2	EDU*D2			0.84*	0.48				
ED3	EDU*D3			0.02	0.41				
ED4	EDU*D4			-0.76**	0.37				
EP2	EDU*P2			-0.42	0.36				
EP3	EDU*P3			0.17	0.36				
EP4	EDU*P4			0.38	0.39				
FEDU	EDU*FEE			0.01	0.02				
S22	EDU*SRT			1.35***					
HS1	HERD*S1					0.64	0.46		
HS2	HERD*S2					-0.78	0.72		
HS4	HERD*S4					-0.29	0.50		
HD2	HERD*D2					1.63**	0.67		
HD3	HERD*D3					-0.52	0.49		

Continued Table 11: Summary of Statistical Results of Trials: Choice Experiment

HD4	HERD*D4					-0.93**	0.46		
HP2	HERD*P2					0.08	0.48		
HP3	HERD*P3					0.18	0.44		
HP4	HERD*P4					0.38	0.53		
FHERD	HERD*FEE					-0.02	0.03		
S33	HERD*SRT					3.00	0.41		
IS1	INCOME*S1							0.39	0.35
IS2	INCOME*S2							0.86	0.61
IS4	INCOME*S4							-0.84*	0.43
ID2	INCOME*D2							1.12**	0.52
ID3	INCOME*D3							0.11	0.39
ID4	INCOME*D4							-1.36***	0.38
IP2	INCOME*P2							-0.34	0.36
IP3	INCOME*P3							-0.33	0.38
IP4	INCOME*P4							0.64	0.43
FINC	INCOME*FEE							-0.01	0.02
S44	INCOME*SRT							1.29***	0.44

Statistic	**Age Trials**	**Education Trials**	**Herd Trials**	**Income Trials**
McFadden's R^2	0.13	0.18	0.19	0.17
Wald Statistic	1.00	1.90	3.98	3.27
Sig. Level	0.32	0.17	0.05	0.07
Log-likelihood	-200.70	-190.78	-188.18	-190.98

*Significant at the 10% significance level. ** Significant at the 5% significance level. ***Significant at the 1% significance level.

Table 12: Marginal Willingness to Pay for Attributes

Attributes: Category	Code	Descriptions	Conditional WTP($/head)	Unconditional WTP($/head)
Sales Type(Base=Retain Ownership, No profits Sharing)	S1	Sell to alliance, NO profit sharing	-19.47*	-14.87*
	S2	Sell to alliance, bonuses based on animal performance	19.99*	15.26*
	S3	Retain Ownership, No profit sharing	-9.50	-7.25
	S4	Retain ownership, profit sharing	8.42	6.43
Information Sharing Scheme (Base=live performance, pen)	D1	Live performance, per pen	-11.50	-8.78
	D2	live performance, individual data	19.92*	15.21*
	D3	Carcass, group data	-18.73*	-14.30*
	D4	carcass, individual yield & grade data	9.31	7.11
Production Protocols(Base= NO restrictions on vaccination and use of antibiotics & No number of animals required	P1	No restrictions on vaccination and use of antibiotics & No min. number of animals required	-5.00	-3.82
	P2	No restrictions on vaccination and use of antibiotics & min. number of animals required	6.62	5.06
	P3	Restrictions on vaccination and use of antibiotics & No min. number of animals required	-0.40	-0.30
	P4	Restrictions on vaccination and use of antibiotics & min. number of animals required	-1.72	-1.31

*Significant coefficient estimates of attributes in Table 9.

Table 13: Alternative Beef Alliance Scenario 1

Attributes	Alliance A	Alliance B
Sales Type	Sell to alliance, bonuses based on animal performance	Retain ownership, profit sharing
Information Sharing Scheme	carcass, individual yield & grade data	carcass, individual yield & grade data
Production Protocol	Restrictions on vaccination and use of antibiotics & min. number of animals Required	Restrictions on vaccination and use of antibiotics & min. number of animals Required
Membership Fee	$20	$20
Probability of choice	54.08%	47.83%
Price change required for indifference	-	-58%

Table 14: Alternative Beef Alliance Scenario 2

Attributes	**Alliance A**	**Alliance B**
Sales Type	Sell to alliance, bonuses based on animal performance	Sell to alliance, bonuses based on animal performance
Information Sharing Scheme	live performance, individual data	carcass, individual yield & grade data
Production Protocol	Restrictions on vaccination and use of antibiotics & min. number of animals Required	Restrictions on vaccination and use of antibiotics & min. number of animals Required
Membership Fee	$20	$20
Probability of choice	59.22%	47.06%
Price change required for indifference	-	-66%

Table 15: Alternative Beef Alliance Scenario 3

Attributes	**Alliance A**	**Alliance B**
Sale Type	Sell to alliance, bonuses based on animal performance	Sell to alliance, bonuses based on animal performance
Information Sharing Scheme	live performance, individual data	live performance, individual data
Production Protocol	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
Membership Fee	$20	$20
Probability of choice	75.42%	68.06%
Price change required for indifference	-	-55%

5. CONCLUDING REMARKS

Vertical coordination in the North American beef industry has shifted significantly over the past decades towards governance structures that have aimed at improving performance through better management of information and product flows. Beef alliances, which frequently consist of independent firms producing, processing and marketing beef through cooperation agreements regarding the delivery of common quality and quantity goals, are one example of such governance structures.

This study provides an empirical analysis of Canadian beef producers' preferences towards participating in such beef alliances. An online- and on-site survey instrument, which contained an attribute-based choice experiment (Louviere et al. 2000), was used during 2006 to explore farmer and firm-specific drivers for participating in alliances with different degrees of vertical coordination regarding sale type, type of data sharing and use of production protocols. Our choice experiment results may be used to infer to what extent certain organizational design characteristics of beef alliances are important to beef producers. Considering the experimental design constraints, our analysis has focused on a subset of possible design features of existing beef alliances, while it aims to contribute towards exploring producers' preferences for beef alliance specifications that are unlikely to exist in the current marketplace (e.g. Tronstad and Unterschultz 2005; Schroeder and Kovanda 2003).

The estimation results suggest that producers regard the nature of information sharing to be pivotal when moving towards higher levels of vertical coordination through a beef alliance. Overall, producers signal their preference for alliances with closer levels of coordination over information, where data regarding individual and live animal performance would be shared rather than performance data about pens of animals. This result, derived from marginal willingness to pay estimates, is in line with previous evidence from Raper et al. (2008) and Schroeder et al. (1998), the latter suggesting that live performance data based on group (pen) animals inhibits information flow from beef consumers to cattle producers. Producer preference for an information sharing scheme based on live animals (instead of carcass) suggests that producers are averse towards the potential shifting of revenue risks from processor to producer (and/or with the change in transaction costs) that would likely result from switching towards grid-based pricing (Harri et al. 2009). Producer preferences for data sharing of live animal performance rather than carcass also suggests that although cattle feeders and packers may be better off by applying a value-based (grid pricing) system outside of an alliance, if cow-calf producers are not effectively involved in a grid pricing system as part of a beef alliance, the grid pricing scheme is likely to have a reduced impact in achieving common quality goals.

The estimation results further suggest that none of the alliance attributes which represent requirements regarding production protocols (restrictions on vaccination, use of antibiotics, minimum number of animals required for alliance participation) significantly affect producers' likelihood of choosing a particular organizational form of beef alliance. We anticipated that tighter coordination requirements, which could be regarded as relationship-specific investments, would be critically assessed by producers as their quasi-rents from such investments could be under threat from hold-up behaviour by other alliance members (Grossman and Hart 1986), being reflected in a significant and negative coefficient estimate for such production protocols. The fact that this is not the case suggests that our results concur in part with those from an earlier Canadian study by Brocklebank and Hobbs (2004), namely that the risk of opportunistic behaviour as a result of investment in specific assets does not appear to have a great impact on the degree of beef supply chain coordination.

Considering that producers in our sample show a preference against bearing more revenue risk - as they prefer to sell animals directly to the next alliance member, rather than retaining ownership - our choice experiment results provide evidence and support for the notion that risk considerations likely drive alliance formation decisions (Schroeder and Kovanda 2003). More specifically, our estimation results likely identify producers' aversion towards risks associated with delayed and possibly more volatile revenue streams, considering the delayed cash flow that goes along with retaining ownership. Put differently, the preference against retaining ownership and thus maintaining residual control and residual claimancy (Fama and Jensen 1983) may be an additional indication that producers perceive the size of the anticipated residual claims from retaining ownership relatively small compared to the perceived gains resulting from selling animals to the beef alliance. Further, if producers signal their preference not to have residual control rights assigned through retained ownership, it also suggests that relation-specific investments and thus the extraction of quasi-rents as a result of hold-up are not major issues in the mind of the producer, supporting the same rationale in the context of production protocol requirements above. However, without more information about producers' costs (of efforts) and expected compensation, the acceptance of a particular alliance contract likely only reveals that the certainty equivalent utility from alliance participation satisfies the producer's required reservation level, without providing more information regarding the size of the risk-premium.

Our estimation results further suggest that producers not only have a preference for participation in profit sharing as part of the alliance, but also that a significant membership fee reduction has to be associated with shifts within a given category of coordination attributes to make this shift incentive compatible from a producer's perspective. Considering the magnitude of the price factor (i.e., membership fee) considered in the experiments (range from $0 to $20 per animal), the estimation scenarios suggest that the incentive problem of inducing producers to participate in alliances toward a higher degree of vertical coordination cannot be solved merely by reducing the financial commitment that goes along with beef alliance participation. As expected, monetary and non-monetary incentives (type of information sharing, sale type) have to be jointly considered in the design of an alliance-based farm as part of a larger incentive system called beef alliance (Holmström and Milgrom 1994).

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