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The Potential Response of Milk Consumers to the Use of Bovine Somatotrophin In Milk Production

by

PETER ANDREW KUPERIS

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirement for the degree of MASTER OF SCIENCE

IN

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The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled THE POTENTIAL RESPONSE OF MILK CONSUMERS TO THE USE OF BOVINE SOMATOTROPHIN IN MILK PRODUCTION submitted by PETER KUPERIS in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in AGRICULTURAL ECONOMICS.

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Abstract

This study attempted to measure the potential response of consumers to the identified use of Bovine Somatotrophin (BST), a hormone which stimulates milk production in dairy cows. Contingent behaviour methodology was used to examine the trade-offs consumers might be willing to make between BST use and the fat content, price and freshness of milk.

The data for the study were obtained through a mail survey of milk consumers. A multinomial logit model of consumers' milk choices was developed, and welfare impacts resulting from the use of BST were estimated.

The results show that the welfare of consumers may be decreased by the identified use of BST. Welfare losses to a representative consumer ranged from $0.26 to $1.53 per shopping trip. The highest welfare loss resulted when consumers could not purchase "BST-free" milk. These results suggest that consumers wish to avoid milk from cows that have been treated with BST.

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CHAPTER I: INTRODUCTION

A. Food Safety

Food safety is an important public policy issue. Food safety can be defined as the principle that food should be nutritious and free of bacterial contaminants and foreign or harmful substances. In more specific terms this implies that food not be adulterated with substances not ordinarily found in food, that foods not carry an unacceptably high level of chemical residues from production or processing, and that consuming food should not lead to illnesses caused by foodborne pathogens.

The safety of food is an issue of growing concern for consumers. A survey by the Consumers' Association of Canada found that 25 percent of consumers "worry a lot" about food safety. When queried about specific food safety issues, 42 percent indicated pesticide residues as a major source of concern. Preservatives and hormones were identified as concerns by 25 percent and 21 percent of the respondents, respectively. (Consumers' Association of Canada, 1990). More recently, a 1995 National Angus Reid poll of Canadians found that 41 percent of respondents had concerns about food safety that had "increased a great deal" over the past few years. Food safety concerns had increased slightly for 21 percent of the respondents. An increasing level of concern was seen in all provinces.

B. Bovine Somatotrophin (BST)

Bovine Somatotrophin (BST) is a naturally occurring hormone that stimulates increased milk production in dairy cows. This effect of BST has been known to researchers since the 1930's. Until the development of recombinant DNA techniques the large scale production and use of BST was not commercially feasible. Recently, commercial BST products have been developed which make it possible to treat cows with BST in order to increase milk production.

A proposal to license these BST products for use in Canada has met with significant opposition from dairy processors, consumers, some dairy producers and some scientists. Those in favor of licensing BST state that there may be significant gains to producers and consumers from reduced costs of milk production through the use of BST. They also emphasize that treating cows with BST does not cause any discernible change in the composition of milk so consuming milk from cows treated with BST should pose no human health risks. Those opposed to the use of BST argue that the long term human health effects of milk from cows treated with BST are not known, that the use of BST will lower the demand for dairy products and that the injection of cows with BST is inhumane. It is also claimed that BST use will reduce the number of family dairy farms.

The result of this debate was a decision to place a moratorium on the use of BST in Canada until July 1, 1995 to allow further review and study. This moratorium was extended and to date BST has not been licensed for use in Canada. As further developments in biotechnology occur, the number and frequency of these debates can be expected to increase.

Bovine Somatotrophin has been licensed for use in the United States. To date, it does not appear that fluid milk consumption has in fact been affected (AgBiotech Bulletin, 1994). It is not clear if this indicates that consumers' concerns about BST have been alleviated. It may be that U.S. consumers are concerned about BST but that this concern is not significant enough to affect their milk purchases.

C. Study Plan

This study is concerned with consumers' perceptions of milk from cows that have been treated with BST. More specifically, the trade-offs that consumers are willing to make between BST use, and the fat content, price and the freshness of milk are examined.

The consumer decision process is discussed in Chapter II. This is followed by a discussion of discrete choice theory and random utility models. Contingent valuation, a technique used in the valuation of non-marketed goods and services, such as environmental amenities, is discussed and applied to

consumer behaviour. A discussion of welfare theory is presented and Hanemann's (1982) method for calculating welfare measures from discrete choice data is discussed. This method places a monetary value on changes in utility arising from a change in the quality of a good. An examination of previous research on consumers' perceptions of milk from cows treated with BST is given.

The design of the survey used to gather the data for this study and the data used to estimate the model are discussed in Chapter III. Model development and estimation are examined in Chapter IV and the results of the analysis are presented. Welfare estimates are calculated based on the estimates from the model and these are used to assess the effects on consumers' welfare from the licensing and use of BST. In Chapter V conclusions drawn from this study are presented, as are directions for future research.

CHAPTER II: THEORETICAL APPROACH

A. Consumer Choice Behaviour

1. Introduction

The purpose of this chapter is to review the theory of consumer choice decisions. Consumer choice is examined in a random utility framework. This is followed by a discussion of the application of random utility theory to econometric models of consumer choice. This discussion is based on Ben-Akiva and Lerman (1985), pages 31-58; and on Train (1986), pages 3-18. A discussion of a specific application of contingent valuation methods, contingent behaviour, is described. Contingent behaviour was the basis of the methodology applied to gather the data for this study. The strengths and weaknesses of the contingent valuation method are outlined. The calculation of welfare measures using data from discrete choice experiments is examined. The chapter ends with a discussion of previous studies examining consumer response to the use of BST.

2. Consumer Choice Decisions

Consumers face a multitude of choices. During a visit to a grocery store a consumer might choose between apples and nectarines, grapefruit juice or orange juice, white or whole wheat bread, steak or chicken, and skim or homogenized milk. Traditionally, economists have been concerned with consumers' expenditures to purchase specific *quantities* of goods. More

recently, the *process* followed by consumers in choosing between competing products or services has become a subject of interest to many economic researchers. Although there are several theories of consumer choice, they share a common framework which is described below.

Ben-Akiva and Lerman(1985) state that a choice can be viewed as the result of a decision making process that includes four steps:

1. definition of the choice problem;

2. generation of alternatives;

3. evaluation of the attributes of the alternatives; and

4. choice.

An example of a choice problem would be a consumer deciding between two restaurants. Trips to restaurants are mutually exclusive because a person cannot visit two restaurants simultaneously. In steps one and two, the consumer decides whether to eat at a restaurant or not and chooses which two restaurants to consider. In the third step, the consumer collects the available information about the attributes of the two restaurants. These attributes might be: type of food served (Italian or seafood), location, cost and the ease of making reservations. The consumer evaluates the information and chooses one of the restaurants. For this purpose, the consumer employs a decision rule.

A choice theory is a collection of procedures that defines the following elements:

1. a decision maker;

2. alternatives;

3. attributes of alternatives; and

4. a decision rule.

The Decision Maker

The decision maker can be an individual or a group of people such as a family or household. The decision maker can also be an organization, such as a firm or a government department. By considering groups of people as a single decision maker, it is possible to abstract from the interactions that may exist within a household or firm.

Individuals have different tastes and face different choice situations. Although aggregate behaviour is the object of interest, a choice theory must explicitly examine individual differences in decision making processes. Consider again the choice of restaurants. It can be assumed that the choice made will depend on income, preferences for seafood and Italian food, and willingness to travel to a particular restaurant away from one's neighborhood. Preferences for seafood and Italian food will differ across individuals. Income will also vary across individuals and will affect the consumer's willingness to patronize an expensive restaurant.

The Alternatives

The environment of the decision maker determines the *universal set* of alternatives. This includes all the existing alternatives in the environment. The decision maker considers a subset of the universal set, known as the *choice set*.

The choice set includes the alternatives that are feasible for the decision maker and that are known by the decision maker. The feasibility of an alternative is determined by constraints such as availability, income, and informational constraints. Imagine that there is a third type of restaurant that has opened in the consumer's neighborhood. If the consumer is not aware of this alternative it is not part of his or her choice set even though it is physically available to him or her.

To this point, the discussion of choice sets has focused on choice sets where the consumer's choices are discontinuous. That is, the individual must choose one alternative from a set of alternatives. In another type of choice set the consumer can choose between "commodity bundles". As an example, the consumer could choose between varying amounts of apples, oranges and pears. All the economically feasible bundles of apples, oranges and pears available to the consumer make up this choice set. The difference between these types of choice sets is discussed further in Section 4.

The Attributes

The attributes of an alternative are those features, characteristics or qualities of the alternative that a consumer considers when making a choice. The attractiveness of an alternative to a consumer is viewed to be a function of a vector of attribute values. Conceptually, attribute values can be measured on an ordinal scale (Italian food is "tastier") or a cardinal scale (the average cost of a

meal at a seafood restaurant is $12.00). A group of decision makers may assign differing values to the same attribute of the same alternative. As an example, a consumer with a low income may place a high importance on the cost of a meal in a restaurant while a more affluent consumer may give this attribute a smaller value.

The Decision Rule

A choice from a set of alternatives requires a decision rule. The decision rule describes the process used by a decision maker to process the information about the alternatives and arrive at a unique choice. There are several types of decision rules. This study employs a decision rule based on *utility*.

Decision rules based on utility assume that the attractiveness of alternatives can be ranked or measured. This defines an objective function that typically expresses the attractiveness (to the decision maker) of an alternative in terms of its attributes. The resulting index of attractiveness is referred to as utility. A consumer attempts to maximize his or her utility through the choices he or she makes. This index is based on the explicit or implicit trade-offs that a consumer uses in comparing different attributes. Subject to his or her limited resources, the consumer selects the restaurant with the highest utility--that is, the restaurant with the best combination of cost, location, food type and ease of making reservations. A more expensive restaurant may be chosen if it has a preferred food type.

Utility can be defined in cardinal or ordinal terms. Ordinal utility is a mathematical expression of a preference ranking of alternatives. One alternative is chosen over others if the utility gained by choosing it exceeds the utility of choosing any one of its alternatives. A cardinal utility scale requires specific measures of numerical value and is a more restrictive concept than ordinal utility. Cardinal utilities are most often used in theories of decision making under uncertainty. Such theories assume that consumers maximize a measure of expected utility. The utility functions defined in this study are based on concepts of ordinal utility. A more formal treatment of consumer choice as defined in consumer theory and discrete choice theory is given below in Sections 3 and 4.

3. Consumer Theory

Consumer theory is an explanation of how an individual allocates the limited resource of available income to the numerous commodities available. It is assumed that consumers are rational, meaning that their preferences are consistent and transitive. Consumer theory can be summarized as follows:

i) The individual chooses a consumption bundle

$$Q = \{q_1,\ldots,q_L\}, \qquad (1)$$

where $q_1,\ldots,q_L$ are quantities of each of the L goods and services. These quantities are assumed to be continuous variables.

ii) The individual's income, I, is fixed. This limits consumption possibilities. Prices are exogenously determined at $p_1,...,p_L$. Thus the budget constraint is:

$$\sum_{i=1}^{L} p_i q_i \leq I. \qquad \textbf{(2)}$$

iii) The individual compares all relevant consumption bundles, expressing preferences for these through his or her utility function:

$$U = U\{q_1,...,q_L\}. \qquad \textbf{(3)}$$

This utility function expresses the individual's preference ordering for various consumption bundles. He or she prefers consumption bundle Q_i to Q_j if $U(Q_i) \geq U(Q_j)$.

iv) The individual chooses the consumption bundle that maximizes his or her utility subject to the budget constraint. The indirect utility function expresses the maximum utility the individual can achieve, given prices and income. The indirect utility function is expressed as:

$$U = V(p_1,...,p_L,I). \qquad \textbf{(4)}$$

A further refinement of classical consumer theory is given by Lancaster (1966) in which he points out that consumers typically purchase attributes which are embodied in goods rather than purchasing goods for their own sake. An example is the desire to obtain a healthy diet, which is reflected in the purchase of foods that contain relatively low fat levels, and other nutritive attributes. Thus, a consumer might purchase a low fat yogurt to satisfy this desire, rather than for the yogurt itself.

4. Discrete Choice Theory

Discrete choice theory follows the major concepts of consumer theory but allows for the consumption of discrete quantities of goods and services in a manner that allows consumption of one or more goods to be zero. That is, consumer choice $Q_i = q_1,\ldots,q_L$ outlined in section 3i may not involve continuous variables, but may be a *discrete* variable. Discrete choice theory maintains the assumptions of a rational consumer and the concept of indirect utility functions.

Consider again the example of restaurant choice. In any one time period a consumer will choose only one restaurant from the set of all restaurants. Individual n chooses restaurant i over restaurant j only if the utility of choosing i exceeds the utility of choosing j, for individual n. That is, i is chosen over j if

$$U_{in} > U_{jn}. \qquad \textbf{(5)}$$

The utility to the consumer of i and j are postulated to be functions of the attributes of i and j, and the personal characteristics of individual n. Ignoring, for the moment, personal characteristics of individual n, the indirect utility function associated with choice of i by individual n can be represented as:

$$U_{in} = V(Z_{in}), \qquad \textbf{(6)}$$

where Z_{in} is a vector of the attributes of restaurant i as perceived by individual n. Since tastes differ across individuals, a vector of socioeconomic characteristics (age, income, gender, etc.) is incorporated into the indirect utility function in order to account for these differences in tastes. Thus, the indirect utility function for individual n becomes:

$$U_{in} = V(Z_{in}, S_n), \qquad (7)$$

where S_n is a vector of characteristics of the individual n.

Early choice experiments often gave results that violated the assumptions of consistency and transitivity Train, (1986). Probabilistic choice concepts were incorporated into discrete choice theory to explain apparent behavioural inconsistencies. Random utility theory is one such approach.

5. Random Utility Models

In random utility theory the expected utility of a good is viewed as a function of the attributes of the good and relevant personal characteristics of the decisionmaker, such as age, education and ethnic origin. The "random" component of random utility theory relates to those attributes and personal characteristics not observed by the researcher. That is, faced with a choice between restaurant i and restaurant j, if the expected utility of choosing i, U(i), is greater than the expected utility of choosing j, U(j), then i will be chosen. Empirical models of consumer choice calculate the probability that a particular alternative is chosen, based on data observed by the researcher. The probability of a choice is a function of observed and unobserved attributes of both the alternative and the decisionmaker. Different individuals are expected to place differing weights on the attributes of an alternative, thus two people faced with the same set of alternatives will not always make the same choice. That is, U(i) and U(j) will differ across individuals. Qualitative choice models specify the

probability of an alternative being chosen by individual n as a parametric function of the general form:

$$P_{in} = f(Z_{in}, Z_{jk} \text{ for all } j \text{ in } J_k \text{ and } j \neq i, S_n, \beta) \quad \textbf{(8)}$$

where: P_{in} = probability of choosing alternative i from set J_k
Z_{in} = the observed characteristics of i
Z_{jk} = the observed characteristics of all other alternatives
S_n = observed characteristics of the decisionmaker
β = a vector of parameters estimated by the researcher.

Estimates of P_{in} are based on observed choices and the attributes of alternatives and individuals. However, attributes that the researcher cannot, or does not, observe may also affect the choice. Thus, models of individual choice involve a deterministic component and a random component. Returning to utility theory, the utility of an alternative to individual n can be expressed as:

$$U_{in} = V(Z_{in}, S_n, \beta) + e_{in} \quad \textbf{(9)}$$

where e_{in} is the difference between "true" utility and the observed measures of utility.

Consider a researcher who observes a group of decisonmakers all facing the same set of alternatives and who possess similar observed personal characteristics. It is expected that unobserved personal traits will vary across the group and that everyone will not choose the same alternative. A certain portion of the group will choose alternative i. The estimated probability that person n will choose i, (P_{in}), is the proportion of times , as the number of times increases to infinity, that an individual facing the same alternatives as person n, and with the

same values of observed utility for each alternative, is expected to choose i. Given this definition, P_{in} can be expressed as follows:

$$P_{in} = \text{Prob}(U_{in} > U_{jk}, \text{ for all } J_k, J \neq i) \quad \textbf{(10)}$$

substituting from **(9)** for U_{in} and U_{jk} gives:

$$P_{in} = \text{Prob}(V_{in} + e_{in} > V_{jk} + e_{jk}, \text{ for all j in } J_k, J \neq i) \quad \textbf{(11)}$$

rearranging this yields:

$$P_{in} = \text{Prob}(e_{jk} - e_{in} < V_{in} - V_{jk}, \text{ for all j in } J_k, J \neq i) \quad \textbf{(12)}$$

The difference between V_{in} and V_{jk} can be calculated. The terms, e_{in} and e_{jk} are not observed. If e_{in} and e_{jk} are random variables, $e_{jk} - e_{in}$, will also be random.

Relating equation **(12)** and equation **(8)**: the right hand side of equation **(8)** is a probability density function which expresses the probability that $e_{jk} - e_{in}$ is below the known value $V_{in} - V_{jk}$, respectively, for all j in J_k, $J \neq i$. By making an assumption about the distribution of the error terms, the researcher can derive the distribution of each difference $(e_{jk} - e_{in})$, and using equation **(8)** the probability that an individual will choose i as a function of $V_{in} - V_{jk}$ can be calculated.

In summary, individual choice models are obtained by specifying a distribution for the error terms and then deriving functions for the choice probabilities. The functional form of the probability function arises from the error distribution chosen. If one assumes the error terms are IID Gumbel (or Extreme Value Type 1) distributed, the multinomial logit (MNL) model results (Train, 1986). The Gumbel distribution is often chosen because it makes the computation of the choice probabilities easy.

The logit model is commonly used in consumer choice analysis. The formula for the choice probabilities is relatively easy to interpret and the parameters are not too difficult to estimate. The logit model assumes that the errors are independently, identically distributed and that they are Weibull distributed. The logit choice probability function, for the choice of alternative i by person n, is:

$$P_{in} = \frac{e^{V_{in}}}{\Sigma_{j \in J_k} e^{V_{jk}}} \quad \text{for all i in } J_k. \qquad \textbf{(13)}$$

Because choice probabilities are functions of observed variables, partial derivatives of the choice probabilities can be taken to evaluate the effect of a change in an observed variable on the choice probability. The estimated probabilities range from 0 to 1. Intuitively, the effect of a change in an attribute will be greater when there is a high degree of uncertainty about the choice. As the choice becomes more certain (i.e. as P_{in} approaches 0 or 1), the effect of a change in an attribute is smaller.

The multinomial logit model is estimated using maximum likelihood techniques. Following Ben-Akiva and Lerman (1985), let N denote the size of the sample (n=1,...,N), then the likelihood function for a multinomial choice model is:

$$L = \prod_{n=1}^{N} \prod_{i \in Cn} P_{in}(i)^{Yin}. \qquad \textbf{(14)}$$

Taking the natural log of **(14)** results in the log likelihood function $\mathcal{L}$:

$$\mathcal{L} = \sum_{n=1}^{N} \sum_{i \in Cn} Y_{in}(\beta' X_{in} - \ln \sum_{j \in Cn} e^{\beta' x_{jn}}). \quad \textbf{(15)}$$

It has been shown that this likelihood function is globally concave so that a unique maximum will exist. The maximum likelihood estimator of β is consistent, asymptotically normal and asymptotically efficient (Ben-Akiva and Lerman, 1985).

In this study, each respondent was faced with five choices: to buy skim milk, to buy 1% milk, to buy 2% milk, to buy homogenized (Homo) milk, or to buy no milk at all. The choice set for person n can be represented as:

Choice =
1 if person n bought skim milk
2 if person n bought 1% milk
3 if person n bought 2% milk
4 if person n bought Homo milk
5 if person n bought no milk at all

The probability of person n choosing to buy skim milk, as opposed to buying no milk at all, can be written as:

$$\Pr(U(\text{skim}) > U(\text{buying no milk})) = \Pr(e_{1n} - e_{5n} \leq V_{5n} - V_{1n}). \quad \textbf{(16)}$$

A function for predicting the probability of each alternative being chosen is needed. A functional form for the random and deterministic components of the indirect utility function must be specified. The deterministic component of the indirect utility function is often specified as:

$$V_{in} = \beta' Z_{ik} + \gamma' S_n \quad \textbf{(17)}$$

where Z_{ik} is a vector of attributes of the alternative, S_n is a vector of socioeconomic characteristics of individuals, and β and γ are vectors of unknown

parameters. More specifically, this gives a linear utility function for the choice of skim milk of:

$$V_{1n} = \beta' Z_{1n} + \gamma' S_n \qquad \textbf{(18)}$$

where Z_{1n} is a vector composed of milk price, freshness and the "presence" of BST and S_n is a vector of socioeconomic characteristics of individual n.

B. Contingent Valuation and Contingent Behaviour

1. Contingent Valuation

Inferences about consumers' preferences can be made by using two different methodological approaches: revealed preferences and stated preferences. Revealed preferences are directly observable from a consumer's behaviour. For example, the buying of skim milk by a consumer reveals a preference for low-fat milk. There are some goods, however, that a consumer cannot directly purchase and so cannot reveal a preference for them. Such goods can be referred to as non-marketed goods. These goods may not yet exist or may not be traded in a market. A government program to restrict pesticide use in food production is an example of such a good. Such a program may not exist, although consumers may desire one. It is possible to ask consumers if they would be willing to pay a higher price for fruit that is free of all pesticide residues as a result of such a program. In this approach, consumers state their

preference for a good in a manner that reveals their preferences for a program to restrict pesticide use.

The Contingent Valuation (CV) method is an approach for directly valuing non-market goods and services. The valuation of a non-market good (e.g. fruit produced under a regime of reduced pesticide use) is contingent on the existence of a hypothetical market for the good. In CV the researcher creates a hypothetical situation in order to elicit an individual's willingness to pay (WTP) for a non-market good or their willingness to accept (WTA) compensation to give up the good. The researcher uses surveys to elicit this information

By its "what if" or hypothetical nature, CV can be subject to several sources of bias. Bishop and Heberlein (1979, 1986) identify two types of bias, hypothetical and strategic bias. Because the respondent perceives that the situation posed is hypothetical, he or she may not give an accurate response. That is, the respondent's actual behaviour may not be captured through the CV question. This type of bias is known as hypothetical bias. In the case of strategic bias, the respondent responds in a way that indicates what he or she would like to see done, rather than giving a response that accurately reflects his or her behaviour in an actual market. As an example, a respondent could overstate her WTP for a program to reduce pesticide use because she would like to see such a program implemented. Thus, the WTP she states is higher than the price she would actually pay if such a program did exist. Mitchell and Carson (1989) point out that a respondent may also give a response that differs from the true WTP in

an attempt to satisfy a perceived expectation of the researcher or to please a particular interviewer.

Poorly designed CV questions can also suffer from measurement bias. Mitchell and Carson (1989) identify two types of measurement bias: implied value cues and scenario misspecification.

Implied value cues are features of the CV question which give the respondent an indication of a range of values for their WTP. A starting bid or a range of bids given in a CV question may incorrectly suggest a range for the respondent's individual bid. The WTP or WTA estimates from such a study will change depending on the suggested starting bid or range of bids. The wording of a CV question can also result in measurement bias. If the description of the good includes information about its relationship to other goods this may influence the respondent's WTP or WTA. That is, the respondent may be valuing both goods rather than only the good for which the question is intended to elicit a value. The very act of being interviewed may suggest to the respondent that some level of the good in question has value.

In scenario misspecification, a bias occurs when the respondent does not respond to the correct contingent scenario. The scenario suggested by the researcher may not be consistent with economic theory or with the respondent's environment. The good the respondent perceives may be different from the intended good. This can occur if the respondent values a symbolic entity instead of the researcher's intended good. A respondent choosing milk that has *not* been

produced using BST may be valuing the preservation of the family farm rather than an increase in food safety. The respondent may be valuing a larger or smaller entity than the researcher's intended good. The choice of payment vehicle may also result in bias. If the vehicle chosen to pay for the good involves increased taxes, a respondent who is averse to higher taxes or dislikes the government may under-report their WTP.

Problems in sampling may also bias CV results. Differences between people who answer surveys and people who do not may result in non-response bias. If the people who do answer a CV survey have a stake in the issue under study they may have a higher WTP than that of a more representative sample.

Some researchers are critical of the use of CV for valuing public goods or environmental amenities. Kahneman and Knetsch (1992) state that CV questionnaires are subject to an embedding effect. That is, the value of a subset of the goods in a CV survey may not give different results than values obtained using the entire set. They also identify a possible sequence effect. Valuation questions asked in different sequences may give different results. These authors suggest that the purchase of "moral satisfaction" or good feeling towards a good or service may be what is elicited in a CV survey rather than the true WTP.

The accuracy and validity of the CV method continues to be a subject of some debate. Many of the criticisms of CV arise from its application in valuing non-use goods, such as the existence of the Amazon rainforest, and from poorly designed CV questions. Studies, such as Bishop and Heberlein's (1979) use of

CV to value goose hunting permits, show that CV can give accurate results when it is used to value goods with which the respondents are familiar, such as a day of goose hunting. It is expected that this will also be true for the purchase of milk.

2. Contingent Behaviour

To this point the discussion of CV techniques has been drawn primarily from the literature on resource valuation. Such applications of CV are most familiar to economists. Contingent valuation methods are also used in business analysis and in the marketing literature. CV surveys are used to assess potential demand for a new product, consumer perceptions of a new product or to estimate the response to a change in an existing product. These types of surveys typically use an extension of the closed-ended CV method in which the respondent chooses between packages of payment amounts and quality changes. They use a statistical design that allows the impact of changes in attributes and willingness-to-pay to be examined (Adamowicz, 1992). This approach is referred to as conjoint analysis and is related to the method employed in this study.

Conjoint analysis presents an individual with a set of alternatives and asks the individual to rank the alternatives (e.g. best to worst). An example would be to present the respondent with a set of travel modes (e.g. airplane, car,

bus, train) with differing combinations of attribute levels, such as travel time and cost. The respondent could be asked to rank the travel alternatives from most to least preferred or to choose one alternative from the set (Louviere, 1988). The set of alternatives and attribute combinations is drawn from a fractional factorial, orthogonal "main effects" experimental design. If the set of all possible combinations of attributes is not too large, the individual can be presented with the entire set. If the set of all possible combinations is too large, the individual can be presented with a smaller set drawn from it (Louviere and Woodworth, 1983).

A potential difficulty with using ranking data (e.g. most preferred to least preferred) is that it is difficult to extrapolate from these rankings to choices. Constructing choices from rankings data can lead to unrealistic assumptions about the choice process implied by the ranking data drawn from a single choice set. A further difficulty with ranking data is that this requires the researcher to extrapolate aggregate level choices from individual level data (Louviere, 1988).

The use of data drawn from choice experiments allows the researcher to model choice directly and to analyze choices at the aggregate level. In a choice, experiment the researcher presents the respondent with a set of alternatives and asks him or her to allocate limited resources (e.g. time, money) among these. That is, the respondent must choose between the alternatives presented (Louviere, 1988). If a large enough group responds to the same set of choices, aggregate choice analysis can be performed.

In this study, consumers' perceptions of milk from cows treated with BST is examined. Each respondent is presented with a scenario in which the four "types" of milk (skim, 1%, 2% and Homogenized) are given as choice alternatives. Milk price, milk freshness and use of BST are varied across the alternatives. The respondent must choose how many litres of each "type" of milk to purchase, or whether not to purchase any milk at all. This satisfies Louviere's (1988) definition of a choice experiment in that it asks the individual to allocate a resource (money and litres to be purchased) across a set of alternatives (the four milk "types"). This approach can be characterized as contingent behaviour rather than contingent valuation because it asks the respondent "Would you choose to buy Milk X?" rather than "How much would you pay for Milk X?".

A particular strength of this method is the reduction of the possibility of hypothetical bias. In this study the respondent is presented with a familiar situation, the purchasing of milk. A new attribute, the use of BST, has been introduced. It is reasonable to assume that the respondent is capable of anticipating his or her response to milk from cows that have been treated with BST. Another advantage of this method is the decreased likelihood of payment vehicle bias. The payment vehicle is embodied in the prices of the milks in a scenario. This payment vehicle is familiar to the respondent and is a close approximation of an actual market situation.

The contingent choice scenarios in this study were designed to discover the trade-offs a consumer will make between the fat content, price and freshness

of milk, and the possibility that BST was used in the production of the milk presented in the scenario. The choice questions did not directly ask the respondent to place a value on milk from cows treated with BST. Rather, the respondent was allowed to choose whether to buy milk at all; if milk was purchased, the respondent was given the opportunity to avoid milk from cows treated with BST by choosing milks of a (possibly) higher fat content, higher price or reduced freshness. This allowed the respondent to indicate by his or her behaviour the value he or she placed on milk from cows that had been treated with BST.

C. Welfare Theory

The identification of milk as possibly being from cows that have been treated with BST could cause a change in welfare for consumers. The perceptions held by consumers about BST will affect their satisfaction with milk. Monetary values can be estimated for these potential changes in utility, in order to determine if consumers regard themselves as better off or worse off if BST is licensed for use in Canada,. The attributes specified for the choice scenarios used in this study included a price for each milk. The estimated coefficient for this price variable can be used as the basis of calculations to value the welfare change to consumers arising from the use of BST.

There are two ways of assigning a monetary value to a change in utility: compensating variation and equivalent variation. Both of these measures compare the welfare of a person in the current situation (no use of BST in Canada) to the person's welfare in the alternative situation (BST is used in Canada). Deaton and Muellbauer (1980) define compensating variation as "...the minimum amount by which a consumer would have to be compensated after a price change in order to be as well off as before". They define equivalent variation as '...the maximum amount the consumer would be willing to pay...to avoid the change..." (Deaton and Muellbauer, 1980 p. 186). Compensating variation represents the amount of money a consumer would have to be paid to be as well off as he or she was before the use of BST. Equivalent variation is the amount maximum of money the consumer would pay to avoid the use of BST. If there are no income effects due to price changes that might result from the licensing of BST, compensating variation and equivalent variation will be the same. The multinomial logit model described above can be used to estimate the value of a change in welfare resulting from the licensing of BST.

Hanemann (1982) described an approach which places a monetary value on the change in the expected utility of a good which arises from a change in the quality of that good. An estimate of the marginal utility of income, based on the estimated coefficient on the price variable, is used in this calculation. In this study, a possible new attribute of milk, the use of BST, is introduced. This new attribute may change the perceived quality of milk, and might therefore lead to a

change in the expected utility of milk to a consumer. Hanemann's (1982) method calculates C, the compensating variation for a change in the quality of a good as:

$$C = 1/\mu[ln\Sigma e^{X1\beta1} - ln\Sigma e^{X2\beta2}] \quad \textbf{(19)}$$

where: μ = the marginal utility of money
$ln\ X_1\beta_1$ = an estimate of expected utility in the current situation
$ln\ X_2\beta_2$ = an estimate of expected utility after a change in quality

The amount C is derived from the maximum likelihood estimates resulting from the MNL model of stated milk purchasing behaviour.

D. Previous Research

While much research into the potential production effects and farm-level economic effects of BST has been undertaken, few studies have assessed consumer response to, and perceptions of, the use of BST. Most of the research on consumers' response to BST has been performed in the United States. BST has been licensed for use in the United States and was introduced for use in February 1994.

Preston, McGuirk and Jones (1991) surveyed Virginia residents about their attitudes towards licensing BST and their milk purchases should BST be approved for use. Nearly 25 percent of the sample did not think that BST should be approved for use. One-third of the respondents were undecided about the

licensing of BST. Only a small proportion of the respondents (20 percent) had heard of BST prior to receiving the survey. The authors inferred that a large proportion of the sample could have been swayed for or against the use of BST. The study predicted that total household consumption of milk would decrease by 14 percent if BST was introduced and milk prices did not change. If the price of milk decreased substantially following the introduction of BST, total household milk consumption would decline by 9 percent. The negative consumption response was more pronounced among women than among men.

Kaiser, Scherer and Barbano (1992) surveyed households in New York state. Approximately 18 percent of respondents indicated that they would decrease their purchases of milk if BST was approved and the price of milk did not change. This response was extrapolated to a 15.6 percent decrease in milk consumption. Gender was not a significant factor in the consumption response. As was found in the survey of Virginia residents, a minority of respondents (26.7 percent) indicated that they had heard or read something about BST before receiving the survey. These authors concluded that "...most people simply do not know enough about BST to make a judgment about its safety" (Kaiser et al. 1992 p. 14). Both Kaiser et al. (1992) and Preston et al. (1991) concluded that the information available to consumers at the time of the introduction of BST would have a great effect on its acceptance.

A study by Grobe and Douthitt (1995) focused on Wisconsin consumers' perceptions of the long term health effects of BST. Gender played a significant

role in consumers' perceptions of BST. Women were more likely to perceive BST to be a risk than were men. This study also found that as the quantity of milk a person consumed increased, the more likely he or she was to express concern about the future health effects of BST. Grobe and Douthitt (1995) focused their study on consumers who were aware of the controversy surrounding BST. All respondents were told that the FDA had ruled that BST posed no human health threat. Although these consumers appeared to be knowledgeable about BST they still expressed a significant level of concern about BST. Grobe and Douthitt's (1995) results may suffer from bias due to strategic behaviour. Since the sample was composed of consumers who had previous knowledge of BST, it is possible that the sample over-represented consumers who are opposed to the use of BST. This may have resulted in responses that expressed a higher level of concern than was actually present amongst all Wisconsin milk consumers at that time.

The studies by Preston et al. (1991) and Kaiser et al. (1992) both used contingent valuation methods to assess consumers' response to BST. While both studies concluded that milk consumption might decline if BST was licensed in the United States, this does not appear to have occurred. Brinkman (1995), in a report to the Task Force appointed by the Government of Canada to review the impact of BST in Canada, stated that fluid milk consumption in the United States actually increased by 0.6 percent in the first full year of BST use. Both Preston et al. (1991) and Kaiser et al. (1992) indicated that there was a potential

market for milk labeled as "BST free". Brinkman (1995) however, states: "There are no precise figures for sales of milk identified as rbST (BST) free, but it appears from discussions of knowledgeable persons in a number of states and in the USDA that these sales likely represent less than two percent of total U.S. fluid milk sales" (Report of the rbST Task Force, 1995).

Another technique which has been used to examine consumer response to BST is that of an experimental auction. Fox, Hayes and Kliebenstein (1994) gave undergraduate students a glass of "BST milk" and $15. A glass of "non-BST milk" was then auctioned. Each student had the opportunity to replace his or her glass of "BST milk" with the glass of "non-BST milk" by bidding in the auction. Ten trials were performed without providing any information about BST. After these 10 trials, information about BST was provided. The mean bid for the glass of "non-BST milk" decreased after the information was provided. The authors concluded that approximately 60 percent of the subjects would purchase BST milk at the same price or at a slightly lower price than milk from cows that were not treated with BST.

The discrepancy between the consumption response indicated by Preston et al.(1991) and Kaiser et al. (1992) and actual consumption in the United States is problematic. This discrepancy may be due to the fact that the studies assumed that milk from cows treated with BST would be labeled as such. In most states, however, labeling of milk from cows treated with BST has not been required. If "BST milk" and "BST-free milk" were available to consumers at the dairy case, a

different consumer response may have been observed. It is also possible that the response found by these researchers may have been due to the fact that their surveys drew specific attention to the use of BST. A survey by Finn and Louviere (1992) of Alberta residents showed that food safety concerns rank relatively low compared to other social issues such as crime, quality medical care and poverty. When a food safety incident such as the "Alar on apples" controversy occurs, food safety becomes of more immediate concern for consumers. A survey which specifically mentions a food safety issue may raise a "red flag" in the respondent's mind and result in a response which is overstated relative to those that will occur in an actual market.

This study uses a contingent behaviour survey to examine the trade-offs consumers are willing to make between the possibility that milk is from cows treated with BST, relative to other selected attributes of fat content, price and freshness. Price, fat content and freshness were chosen, after discussions with dairy product consumers, because they are the attributes that consumers appear to be conscious of when choosing milk at the dairy case.

E. Summary

This study examines consumers' perceptions of BST through the use of a choice experiment. This chapter discussed the consumer choice process.

Consumer theory and discrete choice theory were described in the development of an economic model to analyze consumers' choices between skim, 1%, 2% and homogenized milk. A random utility, multinomial logit model for parametric analysis of consumer choices of milk was outlined.

The advantages of contingent valuation and potential sources of bias in CV studies were discussed. An extension of CV, known as contingent behaviour, was presented. This technique was applied to a choice scenario where a respondent is asked "Would you buy : skim milk, 1% milk, 2% milk, Homo milk, or no milk at all?" Hanemann's (1982) method for estimating welfare changes from discrete response data was presented. A review of previous research on consumer response to BST followed.

The data collection process and the data resulting from it will be discussed in Chapter III. The model and welfare estimation technique outlined in Chapter II are used to analyze consumers' perceptions of BST. The process of model estimation, its results and the welfare estimates based on these are given in Chapter IV.

CHAPTER III: THE DATA

A. Survey Design

The data for this study were collected through a mail survey of residents of Edmonton. The survey was designed to elicit information on consumers' attitudes towards milk, consumers' perceptions of attributes of milk, consumers' attitudes towards the use of BST and socio-economic and demographic characteristics of the survey respondents. Individuals in the Department of Rural Economy, University of Alberta, developed the survey with assistance from Dr. Adam Finn, Professor, Faculty of Business, University of Alberta, and Advantage Field Research, a private survey administration firm. A mailed pretest was not used in designing the survey. However, the survey was circulated among members of the Department of Rural Economy and members of the West End Christian Reformed Church. This initial testing indicated that the levels chosen for the attributes described in the contingent choice portion of the survey were acceptable. The final design for the contingent choice questions yielded 64 choice scenarios. These were split into four groups of 16 scenarios each. This resulted in four versions of the survey. A copy of Version 2 of the survey is included as Appendix A.

The first section of the survey asked respondents questions about their general attitudes towards the quality and nutritional value of milk. In the second portion of the survey, a series of milks (skim, 1%, 2%, and Homo) were

described in terms of the attributes of price, freshness, fat content and BST. The respondents were asked to rate these attributes of these milks as their "best" or "worst" feature.

The third part of the survey contained 16 contingent choice questions. Respondents were asked to indicate the number of litres of each of the described milk types that they would buy, or whether they would purchase milk at all. The responses to these contingent choice questions comprise the choice data used in this study. An example of a contingent choice question is given in Figure 3.1.

Figure 3.1: Example of A Choice Scenario
If the 4 milks listed below were available at all stores and were the only milks available

Feature	***skim***	***1 %***	***2 %***	***Homo***
Price ($/litre)	0.99	0.79	0.99	0.89
BST	no	no	Yes	no
Freshness	4 days before expiry date	8 days before expiry date	10 days before expiry date	8 days before expiry date
I would buy:	__litres of skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk
		___I would not buy any milk		

As can be seen from Figure 3.1, the respondent can choose to buy more than one milk. That is, the respondent can choose to buy skim milk, 1%, 2% and

homogenized milk in the same choice scenario. This is an extension of previous contingent choice techniques where the respondent could only choose one of the alternatives in a choice scenario. This type of choice scenario differs from the example of choosing one restaurant from a set of restaurants or the choice a farmer makes when choosing a pesticide in a scenario where a new pesticide has been introduced to the set of existing pesticides that are available (Louviere, 1988). The data generated by this technique are converted into proportions. That is, the choice probabilities are calculated based on the proportion of each milk type chosen in a given choice scenario. Consider a consumer who chooses to purchase 4 litres of skim milk and 4 litres of 2% milk in the scenario given in Figure 3.1. The proportions of the milk types chosen are: 0.5, 0, 0.5, and 0 for skim milk, 1% milk, 2% milk and Homo milk respectively.

The final portion of the survey collected socio-economic and demographic information from the respondents. The survey was relatively lengthy (16 pages) for a mail survey. The survey was designed using the Total Design Method to maximize the response rate (Dillman 1978). The survey was mailed in booklet form which helped to make it more "user friendly". A copy of one of the four "blocks" of the survey (i.e. the Version 2 component) is included as Appendix A.

B. The Data

The distribution of the survey was conducted by Advantage Field Research in the spring of 1996. Based on current Edmonton telephone listings, a random sample of four hundred Edmonton households was recruited for the survey by telephone. The survey was mailed to each of these households with a cover letter (see Appendix A) and a follow up reminder was mailed approximately 10 days later. Two hundred and ninety four households completed and returned the survey, for a return rate of 73.5%.

The survey was completed by 191 women and 88 men. Fifteen individuals did not indicate their gender. The higher number of female respondents was not unexpected. The cover letter included with the survey indicated that the survey should be completed by the person in the household who makes the majority of the food purchases. Household food purchases continue to be made primarily by women. Table 3.1 shows the age distribution of the sample and compares this to the age distribution found in the 1991 census data for Edmonton (Statistics Canada, 1991). As can be seen from Table 3.1, the survey sample is reasonably representative, in terms of age distribution, of residents of Edmonton. A more detailed description of the sample is given in Appendix B, Table B.1.

Table 3.1: Age Distribution Summary

	Age Distributions	
	Census 1991	**BST Survey 1996**
Age Groups	**% of Sample**	**% of Sample**
<30	27.0	22.8
30-60	54.5	58.8
60+	18.5	13.6
Did not answer		4.8
Total	100.0	100.0

Table 3.2 compares the percentage of each type of milk purchased by the respondents to the sales of each type of milk in Alberta during 1995.

Table 3.2: Distribution of Milk Types Purchased

	Alberta 1995[1]	**BST Survey 1996**
Milk Type	%	%
Skim	10.24	21.2
One Percent	19.63	29.1
Two Percent	44.94	37.4
Homogenized (Homo)	13.54	12.3
Chocolate	6.47	*these types of milk were*
Buttermilk	0.57	*not included in the*
Eggnog	0.59	*survey*
Total	100.0	100.0

[1]From the Annual Report of The Alberta Dairy Control Board, 1995.

The respondents to this survey appear to purchase the low-fat milks (skim and 1%) in higher proportions than the aggregate sales data for Alberta would indicate. The sales data for Alberta are not identified as being for household consumption only. It is understood that the aggregate data for Alberta also include sales of milk to hotels, restaurants and institutions. Anecdotal observation suggests that such sales tend to include a greater proportion of

higher fat milks. This may explain the discrepancy between the BST sample and the Alberta sales data. The sample can be considered to be representative in that it reflects the continuing popularity of one and two percent milk with consumers.

CHAPTER IV: MODEL DEVELOPMENT, ESTIMATION AND RESULTS

A. Model Development

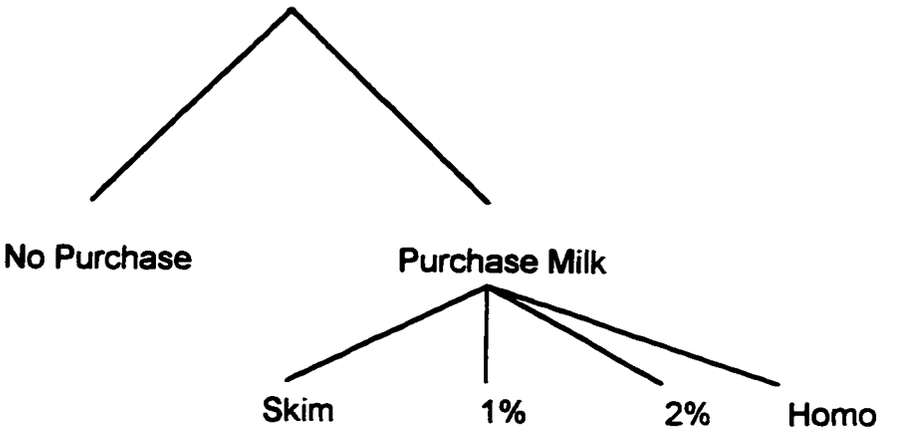
1. Introduction

The data used to estimate the economic model presented in this study were discussed in Chapter III. In this chapter the estimation of a multinomial logit random utility model of consumer choices of milk is described. The model presented in Chapter II and the data described in Chapter III are used to calculate the probability that a consumer would purchase one of the four milks (skim, 1%, 2%, Homo). The coefficients estimated by the model will be discussed and the estimation results will be used to determine the welfare changes resulting from the introduction of BST.

2. Specification of the Multinomial Logit Model of Consumer Milk Purchases

The foundations of consumer choice theories were discussed in Chapter II. The particular choice problem that this study is concerned with is a consumer's decision to purchase milk. This choice can be modeled as a two step process. First, the consumer decides whether he or she will purchase milk on a particular shopping trip. Second, the consumer decides which type of milk to purchase. This two-step decision process is represented by Figure 4.1 below.

Figure 4.1: The Milk Purchase Decision



As was noted in Chapter II, it is assumed that the consumer employs a decision rule to choose one or more milks. A decision rule based on utility maximization was developed for a consumer's choice to purchase milk. This decision rule is reflected in the indirect utility function described in equation 18. This function is linear in parameters. Its arguments include Z_{in}, a vector of attributes of milk; S_n, a vector of socioeconomic characteristics of individual n; and β and γ, vectors of unknown parameters. The utility functions for the four types of milk are:

$$V_{1n} = ASCS + \beta' Z_{1n} + \gamma' S_n \quad \textbf{(20)}$$
$$V_{2n} = ASC1 + \beta' Z_{2n} + \gamma' S_n \quad \textbf{(21)}$$
$$V_{3n} = ASC2 + \beta' Z_{3n} + \gamma' S_n \quad \textbf{(22)}$$
$$V_{4n} = ASCH + \beta' Z_{4n} + \gamma' S_n \quad \textbf{(23)}$$

where subscript 1 denotes skim milk, 2 denotes 1% milk, 3 denotes 2% milk and 4 denotes Homogenized milk. ASCS, ASC1, ASC2 and ASCH are alternative specific constants that are intended to capture the satisfaction associated with choosing skim, 1%, 2% and homogenized milk, respectively.

The final step in specifying the model was choosing the variables to include in the indirect utility function. The variables chosen for the vector Z were based on those attributes of milk that are directly observable by the consumer at the dairy case. The variables included in this vector are: price, freshness and the "presence" of BST. The fat contents of the milks are expressed through the four milk types.

An examination of previous studies on BST and literature related to consumers' perceptions of food safety, combined with *a priori* beliefs, led to the inclusion of the following socioeconomic variables in the model: age, gender, number of young children in the household, household income, years of education and prior knowledge of BST. Studies on food safety, such as Lin (1995), have indicated that age and gender may have a significant effect on attitudes towards food safety. Older consumers are generally expected to be more concerned about food safety. Women generally appear to be more concerned about food safety than are men. Lin (1995) also suggests that households with young children will be more concerned about food safety and that consumers with higher levels of education will be more aware of food safety issues. Households with higher incomes may feel they have greater financial resources to devote to reducing external risks. Consumers with prior knowledge of BST may be more concerned about its use. The inclusion of these variables is supported by the studies of consumers' perceptions of BST conducted by McQuirk, Preston and Jones (1990); Kaiser, Scherer and Barbano (1992); Grobe

and Douthitt (1995); and Fox, Hayes and Kliebenstein (1994). The variables used in estimating the final models are defined below.

3. Variable Definitions

ASCS This variable is an alternative specific constant representing the utility associated with choosing to purchase skim milk.

ASC1 This variable is an alternative specific constant representing the utility associated with choosing to purchase 1% milk.

ASC2 This variable is an alternative specific constant representing the utility associated with choosing to purchase 2% milk.

ASCH This variable is an alternative specific constant representing the utility associated with choosing to purchase Homo milk.

PRICE This variable represents the price per litre for the milks presented in the choice scenarios. The price ranges from $0.69/litre to $0.99/litre.

BST This is a dummy variable indicating whether the milk presented in a choice scenario is from cows that have been treated with BST. Numeral 1 indicates that the milk may be from cows treated with BST, while 0 indicates that the milk is from cows that have not been treated with BST.

FRESH	This variable represents the freshness of a milk presented in a choice scenario. These values range from "4 days before expiry date" to "10 days before expiry date".
AGE	This variable represents the age of the respondent.
GENDER	This is a dummy variable representing the respondent's gender, whereby 1 is equated with female, 0 with male.
YCHILD	This variable represents the number of children in the household who are under the age of six.
HINC	This variable represents the total household income before taxes.
EDUC	This variable represents the number of years of education completed by the respondent.
PRIOR	This is a dummy variable which represents whether the respondent had knowledge of BST prior to receiving the survey. Numeral 1 is equated with having previous knowledge, 0 with having no knowledge before receiving the survey.

B. Estimation and Results

1. Model Estimation and Results

The multinomial logit model was estimated using LIMDEP, Version 7.0 (Greene, 1995). A number of model versions were estimated using the variables discussed above.

In multinomial logit models it is necessary to express the socioeconomic variables as alternative specific variables. That is, the variables denoting age, gender, etc. are each expressed as constants that are specific to each alternative. Thus, there are four age coefficients in the model: AGES, AGE1, AGE2 and AGEH. The coefficient AGES expresses the effect of age on the probability of choosing to purchase skim milk relative to the base case (choosing not to purchase any milk). AGE1, AGE2 and AGEH express the effect of age on the probability of choosing 1%, 2% and Homo milk, respectively. PRICE, BST and FRESH are already expressed as alternative specific variables. Table 4.1 gives the name of each variable in each alternative.

Table 4.1: Alternatives and Variables

Coefficient	**Alternative**			
	Skim	**1%**	**2%**	**Homo**
CONSTANT	ASCS	ASC1	ASC2	ASCH
PRICE	PRICE	PRICE	PRICE	PRICE
BST	BST	BST	BST	BST
FRESH	FRESH	FRESH	FRESH	FRESH
AGE	AGES	AGE1	AGE2	AGEH
GENDER	GENDERS	GENDER1	GENDER2	GENDERH
YCHILD	YCHILDS	YCHILD1	YCHILD2	YCHILDH
HINC	HINCS	HINC1	HINC2	HINCH
EDUC	EDUCS	EDUC1	EDUC2	EDUCH
PRIOR	PRIORS	PRIOR1	PRIOR2	PRIORH

Three non-nested logit models were estimated to define the relationships between the variables and the choice of milks as illustrated in the decision tree given in Figure 4.1. The three non-nested models assume that a consumer will regard the four milk types as related goods and will be prepared to make choices between them.

The estimation of the coefficients in all three non-nested models are based on equations 20 through 23. All three non-nested models (Model 1, Model 2 and Model 3) include the variables PRICE, BST and FRESH in the vector Z. In Model 1, the vector of socio-economic variables, vector S, includes the variables AGE, GENDER, YCHILD, HINC and EDUC. In Model 2, the included socio-economic variables are: AGE, GENDER, YCHILD and EDUC. The variable denoting household income was excluded from Model 2 to assess the possibility of a correlation between education and household income. In Model 3, the vector of socio-economic variables includes: AGE, GENDER, YCHILD, HINC, EDUC and PRIOR. The variable PRIOR was added in Model 3 to examine the possible effect of previous knowledge of BST on consumers' milk purchases should BST be licensed for use in Canada. The results of the model estimations are given in Tables 4.2 through 4.4. The chi-squared statistics and the significance levels show that all three models are highly significant. The value of the adjusted McFadden's pseudo R^2 ranges from 0.1788 to 0.1839[1].

[1] Following Ben-Akiva and Lerman (1985), the calculation for McFadden's adjusted R^2 is: $R^2 = 1 - [(\text{Log-L of the unrestricted model} - \text{the number of coefficients in the unrestricted model})/\text{Log-L of the restricted (slopes=0) model})]$.

The estimated coefficients display the expected signs in all three non-nested models. PRICE is negative and significant, indicating that increasing price decreases the probability of a consumer purchasing milk. The coefficient on BST is also negative and significant. This indicates that the probability of a consumer purchasing milk decreases if the milk is from cows that are treated with BST. In contrast, the coefficient on FRESH is positive and significant. An increase in the freshness of milk increases the probability of a consumer purchasing milk. The size of these estimated coefficients and their T- ratios do not change appreciably across the three models. That is, the effect of the three milk attributes on the decision to purchase milk does not appear to change with model specification.

The effect of the variable AGE is positive for all types of milk in all three models. That is, the coefficients AGES, AGE1, AGE2 and AGEH are positive in Model 1, Model 2 and Model 3. AGE is significant for skim and 1% milk in Models 1, 2 and 3. This indicates that the probability of a consumer purchasing skim and 1% percent milk increases as the age of the consumer increases. The coefficients on GENDERS and GENDER1 are significant and positive across the three models. Female consumers are more likely to purchase skim and 1% milk than are male consumers. Coefficients on YCHILD2 and YCHILDH are positive and significant in the three non-nested models. Households with young children have a higher probability of purchasing 2% and Homo milk than choosing the base case of not purchasing any milk. The coefficient on EDUCS is positive and

significant in all three models. Consumers with higher education levels are more likely to purchase skim milk. EDUC1, EDUC2 and EDUCH are negative in Models 1, 2 and 3. This indicates that more educated consumers are less likely to purchase 1%, 2% or Homo milk than to purchase no milk at all. However, educated consumers are more likely to purchase skim milk. The exclusion of HINC does not appear to affect significantly the coefficients on EDUCS, EDUC1, EDUC2 and EDUCH, resulting from the estimation of Model 2. If a correlation between household income and education exists in the data, it does not appear to have a significant effect on the coefficients resulting from the non-nested models. The coefficient on HINCH is negative and significant in Models 1 and 3. Households with higher incomes are less likely to purchase Homo milk. HINC1 is positive and significant in Model 3. HINC2 is negative and significant in Model 3. Households with higher incomes are more likely to purchase skim and 1% milk. The variable PRIOR was included in Model 3 only. The coefficient on PRIOR is significant and positive for all milk types. That is, consumers who had heard or read about BST prior to receiving the survey were more likely to purchase at least one type of milk than to purchase no milk at all. It may be that people who are more likely to purchase milk also tend to purchase larger amounts of milk and are more informed on issues relating to milk.

In all three models the alternative specific constants behave similarly. ASCS is negative in all three models. This could be taken to indicate that there is some disutility associated with purchasing skim milk, all other things held

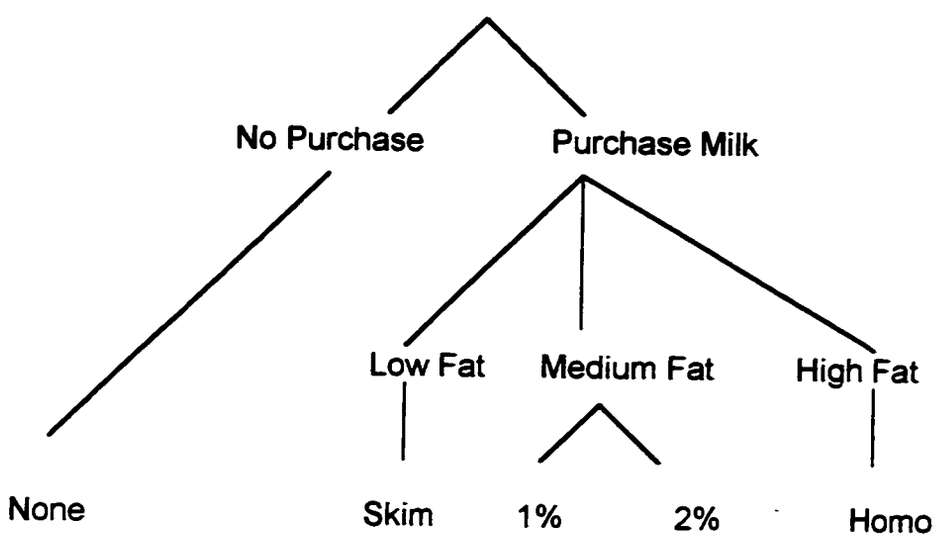
constant. The alternative specific constants, however, cannot be interpreted separately from the other coefficients calculated in the model.

A nested logit model was also estimated on the data. The nesting structure for Model 4 is shown in Figure 4.2. The nested model contains three milk sub-groups: Low Fat, Medium Fat and High Fat. This model, Model 4, allows for the possibility that a consumer may regard these milk types as related goods, but may not distinguish appreciably between 1% and 2% milk. In Model 4, it is hypothesized that consumers view 1% and 2% milk as one category of milk, separate from skim and homogenized milk. That is, 1% and 2% milk are assumed to be more similar to each other than they are to skim milk and Homo milk.

The nested model (Model 4) includes the variables: PRICE, BST, FRESH, AGE, GENDER, YCHILD, HINC, EDUC and PRIOR. The socioeconomic variables are included in the Low Fat, Medium Fat and High Fat branches of the nesting structure. Thus, the effect of the socioeconomic variables is calculated for each of the milk categories. For example, there are three AGE coefficients in this model: AGE(LFAT), AGE(MEDFAT) and AGE(HFAT). The model also includes two inclusive value parameters. The inclusive value parameter, MEDFAT, provides an indication of the validity of the hypothesized sub-groupings of milk types (LFAT, MEDFAT and HFAT). If the coefficient on MEDFAT is significant, it can be concluded that consumers regard 1% and 2% milk to be more similar to each other than to skim milk and homogenized milk.

The other inclusive value parameter, PURCH, tests the modeling of milk purchase decisions as a two-step process. If the coefficient on PURCH is significant, this supports the hypothesis that milk purchasing is a two-step process. The estimated coefficients for Model 4 are given in Table 4.5.

Figure 4.2: Nesting Structure of Model 4.



Models 3 and 4 essentially contain the same variables and the sign and significance of their estimated coefficients can be compared to each other. The coefficient on AGE is insignificant in Model 4 but is significant and positive for the choice of skim and 1% milk in Model 3. GENDER behaves similarly in both models. Women are more likely to choose low and medium fat milks in Model 4, and to choose skim and 1% milk in Model 3. The variable YCHILD has similar effects in both models. Households with young children are more likely to purchase high fat (Homo) milk. In both models the coefficients for HINC indicate

that higher income households have a greater probability of purchasing skim milk. The coefficients for EDUC in Models 3 and 4 indicate that consumers with more education are more likely to choose to purchase skim milk in both models. In Models 3 and 4, consumers who had previously read or heard about BST had a higher probability of purchasing milk.

In Model 4, PRICE and BST were negative and significant, indicating that increasing price decreases the probability of purchasing milk and that the "presence" of BST decreases the probability of purchasing milk. This result concurs with those found for the three non-nested models. The coefficient on FRESH was positive and significant in Model 4. As the freshness of milk increases, the probability of a consumer choosing to purchase milk increases. This result also agrees with Models 1, 2 and 3.

Due to modeling constraints imposed by the econometric software used in this analysis, all the alternative specific constants can not be included in Model 4. To do so results in a singular matrix and the choice probabilities cannot be estimated. Therefore, the alternative specific constant for Homo milk (ASCH) is excluded and the remaining alternative specific constants are interpreted with the choice of Homo milk as the base case. ASCS is negative and significant. This appears to indicate that there is less utility associated with choosing skim milk than with Homo milk. However, it must be stated again that this alternative specific constant cannot be interpreted apart from the other coefficients associated with choosing skim milk. In contrast, ASC1 and ASC2 are positive

and significant. This appears to indicate that there is a positive utility associated with purchasing 1% and 2% milk as opposed to purchasing Homogenized milk.

The inclusive value parameter, MEDFAT is significant. This indicates that the four types of milk cannot be considered close substitutes for each other. Thus, skim milk cannot be considered to be a close substitute for Homo milk and vice versa. The inclusive value parameter, PURCH, is also significant, indicating that the modeling of the milk purchase decision as a two-step process is valid. The inclusive value parameters, MEDFAT and PURCH, are both larger than one. Inclusive value parameters that are larger than one are not generally considered to be consistent with utility maximization (Kling and Thomson, 1996). However, research by Kling and Thomson(1996) and Borsch-Supan (1990) demonstrates that there are local sufficiency conditions that permit inclusive value parameters that are larger than 1. These local conditions appear to apply to nested logit models where the alternatives are grouped into subsets, as is the case in Model 4.

Model 4 has appreciably higher Chi-Squared and Adjusted Pseudo R^2 values than do Models 1, 2 and 3. It appears that the nesting structure of Model 4 tends to increase the explanatory power of the model.

Table 4.2: Multinomial Logit Estimates, Model 1 (Non-Nested)

Log-Likelihood	-5276.319
Restricted (slopes=0) Log-L	-6449.018
Chi-Squared (X)	2345.398
Significance Level	0.000
Adjusted Pseudo R^2	.1804

Variable	Coefficient	Standard Error	T Ratio
PRICE	-0.92413*	0.19524	-4.733
BST	-1.6989*	0.04532	-37.489
FRESH	0.07285*	0.00866	8.412
ASCS	-0.54106*	0.32434	-1.688
AGES	0.00576*	0.00314	1.833
GENDERS	0.50438*	0.12516	4.030
YCHILDS	-0.08625	0.09821	-0.878
HINCS	0.00314	0.00210	1.493
EDUCS	0.04090*	0.01578	2.532
ASC1	1.2067*	0.26684	4.522
AGE1	0.00568*	0.00285	1.997
GENDER1	0.24998*	0.10867	2.300
YCHILD1	-0.04791	0.08843	-0.542
HINC1	0.00305	0.00186	1.641
EDUC1	-0.01846	0.01213	-1.522
ASC2	1.6225*	0.27224	5.960
AGE2	0.00249	0.00288	0.863
GENDER2	0.01909	0.10942	0.175
YCHILD2	0.35338*	0.08468	4.173
HINC2	-0.00346	0.00192	-1.805
EDUC2	-0.01942	0.01228	-1.581
ASCH	0.58425*	0.30102	1.941
AGEH	0.00423	0.00401	0.309
GENDERH	-0.11307	0.13246	-0.854
YCHILD	0.72489*	0.09604	7.548
HINCH	-0.00417*	0.00233	-1.791
EDUCH	-0.02922*	0.01587	-1.841

* denotes significance at the $\alpha = 0.05$ level.

Table 4.3: Multinomial Logit Estimates, Model 2 (Non-Nested)

Log-Likelihood	-5288.124
Restricted (slopes=0) Log- L	-6449.018
Chi-Squared (X)	2321.788
Significance Level	0.000
Adjusted Pseudo R^2	0.1788

Variable	Coefficient	Standard Error	T Ratio
PRICE	-0.92249*	0.19505	-4.730
BST	-1.6950*	0.04519	-37.510
FRESH	0.07289*	0.00865	8.425
ASCS	-0.49427	0.32415	-1.525
AGES	0.00606*	0.00311	1.948
GENDERS	0.49798*	0.12505	3.982
YCHILDS	-0.08379	0.09813	-0.854
EDUCS	0.04592*	0.01534	2.993
ASC1	1.2567*	0.26416	4.757
AGE1	0.00597*	0.00283	2.109
GENDER1	0.24528*	0.10827	2.266
YCHILD1	-0.04749	0.08850	-0.537
EDUC1	-0.01394	0.01181	-1.181
ASC2	1.5677*	0.27081	5.789
AGE2	0.00204	0.00286	0.714
GENDER2	0.02758	0.10934	0.252
YCHILD2	0.35152*	0.08449	4.161
EDUC2	-0.02447*	0.01207	-2.027
ASCH	0.52612*	0.29986	1.755
AGEH	0.00051	0.00379	0.135
GENDERH	-0.10383	0.13250	-0.784
YCHILD	0.72170*	0.09596	7.521
EDUCH	-0.03522*	0.01491	-2.363

* denotes significance at the $\alpha = 0.05$ level.

Table 4.4 Multinomial Logit Estimates, Model 3 (Non-Nested)

Log-Likelihood	-5256.830
Restricted (slopes=0) Log- L	-6449.018
Chi-Squared (X)	2358.376
Significance Level	0.000
Adjusted Pseudo R^2	0.183

Variable	Coefficient	Standard Error	T Ratio
PRICE	-0.91997*	0.19518	-4.713
BST	-1.7021*	0.04550	-37.412
FRESH	0.07311*	0.00867	8.436
ASCS	-0.54708	0.32422	-1.687
AGES	0.00561*	0.00315	1.778
GENDERS	0.54097*	0.12611	4.290
YCHILDS	-0.07441	0.09878	-0.753
HINCS	0.00349	0.00212	1.642
EDUCS	0.03547*	0.01591	2.229
PRIORS	0.80332*	0.26403	3.043
ASC1	1.1907*	0.26689	4.461
AGE1	0.00534*	0.00286	1.868
GENDER1	0.31910*	0.11108	2.873
YCHILD1	-0.02744	0.08882	-0.309
HINC1	0.00372*	0.00187	1.985
EDUC1	-0.02768*	0.01210	-2.270
PRIOR1	1.2020*	0.22982	5.230
ASC2	1.6235*	0.27232	5.962
AGE2	0.00234	0.00289	0.809
GENDER2	0.04011	0.11072	0.362
YCHILD2	0.35783*	0.08501	4.209
HINC2	-0.00331*	0.00193	-1.716
EDUC2	-0.02242*	0.01235	-1.815
PRIOR2	0.48521*	0.24558	1.976
ASCH	0.57049*	0.30089	1.896
AGEH	0.00099	0.00385	0.259
GENDERH	-0.05888	0.13487	-0.437
YCHILD	0.74931*	0.09652	7.763
HINCH	-0.00358	0.00235	-1.526
EDUCH	-0.03812*	0.01607	-2.372
PRIORH	1.1709*	0.27686	4.229

* denotes significance at the $\alpha = 0.05$ level.

Table 4.5 Multinomial Logit Estimates, Model 4 (Nested Model)

Log-Likelihood	-5245.965
Restricted (slopes=0) Log-L	-7971.859
Chi-Squared (X)	5451.789
Significance Level	0.000
Adjusted Pseudo R^2	0.3409

Variable	Coefficient	Standard Error	T Ratio
ASCS	-1.0041*	0.25056	-4.008
ASC1	0.63538*	0.14390	4.415
ASC2	0.69471*	0.14481	4.797
PRICE	-0.82479*	0.13709	-6.016
BST	-1.5101*	0.05077	-29.745
FRESH	0.05945*	0.00686	8.664
AGE(HFAT)	-0.00039	0.00299	-0.131
GENDER (HFAT)	-0.13833	0.10637	-1.301
YCHILD(HFAT)	0.62299*	0.07175	8.683
HINC (HFAT)	-0.00332*	0.00190	-1.746
EDUC (HFAT)	-0.03240*	0.01117	-2.900
PRIOR (HFAT)	0.82791*	0.20853	3.970
AGE (MEDFAT)	0.00249	0.00153	1.627
GENDER (MEDFAT)	0.08293	0.06044	1.372
YCHILD (MEDFAT)	0.09395*	0.04804	1.956
HINC (MEDFAT)	-0.00008	0.00104	-0.079
EDUC (MEDFAT)	-0.01805*	0.00655	-2.756
PRIOR (MEDFAT)	0.48908*	0.13054	3.747
AGE (LFAT)	0.00324	0.00239	1.356
GENDER (LFAT)	0.44151*	0.09733	4.536
YCHILD (LFAT)	-0.17299*	0.07587	-2.280
HINC (LFAT)	0.00314*	0.00159	1.974
EDUC (LFAT)	0.03739*	0.01301	2.875
PRIOR (LFAT)	0.42831*	0.19360	2.212
LFAT	1.0000	Fixed Parameter	
MEDFAT	1.2452*	0.09317	13.365
HFAT	1.0000	Fixed Parameter	
PURCH	1.8151*	0.11448	15.856
NOPURCH	1.000	Fixed Parameter	

* denotes significance at the $\alpha = 0.05$ level.

2. Predictive Ability

The four models are similar in predictive ability. All of them correctly predict the choice of 2% milk more frequently, closely followed by 1%. In all four models the ability to predict the choices of skim milk, Homo milk and No Purchase is somewhat less. The nested model (Model 4) does yield some improvement in predicting the No Purchase alternative.

Table 4.6: Frequencies of Correct Predictions in Nested and Non-Nested Models

	Model 1	**Model 2**	**Model 3**	**Model 4**
% Correct Skim predictions	25.7	25.5	25.7	25.4
% Correct 1% Predictions	39.6	39.4	39.7	38.1
% Correct 2% Predictions	42.4	42.2	42.5	42.2
% Correct Homo Predictions	18.5	18.8	19.0	18.3
% Correct No Purchase Predictions	22.4	22.4	22.9	27.0

3. Sensitivity To Model Specification

The three non-nested models have similar Pseudo R^2 and Chi-Squared values. The addition or removal of variables does not appear to significantly affect Models 1, 2 and 3. A Likelihood Ratio test[2] comparing Models 1 and 2

[2] The Likelihood Ratio Test is calculated as: Likelihood Ratio = 2(Log-L of unrestricted model - Log-L of restricted model), Train (1986) page 52.

results in a chi-squared value of 23.61 which is significant and indicates that the variable HINC adds to the explanatory power of the model. A Likelihood Ratio test of Models 1 and 3 gives a chi-squared value of 38.98. This is also significant and shows that the variable PRIOR adds to the model's explanatory power. These tests led to the inclusion of the variables used in Model 3 in the nested model (Model 4).

C. Welfare Implications

1. Choice Proportions

In this section the coefficients estimated in the previous section are used to examine the effect of possible BST use on consumers' choices among milk types. For this purpose the percentage of each type of milk chosen by the respondents is estimated under differing scenarios. As an example, the percentage of each type of milk chosen when all the milk types are from cows that have been treated with BST is estimated. The trade-offs between BST use, milk price, milk freshness and milk type can therefore be examined.

The coefficients estimated by Model 4 are not easily amenable to this type of calculation. For this reason and since Model 3 provided the best "fit" to the data, the coefficients from Model 3 are used in this section. The proportions were calculated based on a "representative" consumer. This representative consumer is a woman, aged 40, with 1 young child, a household income of $40, 000.00 and 12 years of education, who has not previously read or heard about

BST. This consumer was chosen to be broadly representative of the consumers in this sample. An example of the formula used to estimate the choice proportion for skim milk is given below:

$$\text{Proportion (skim)} = \frac{e^{X\beta_S}}{e^{X\beta_S} + e^{X\beta_1} + e^{X\beta_2} + e^{X\beta_H} + e^{X\beta_N}} \qquad (24)$$

where: X = the values of the variables (e.g. AGE, GENDER, PRICE, etc.)

β_S = the coefficients estimated for the choice of skim milk

β_1 = the coefficients estimated for the choice of 1% milk

β_2 = the coefficients estimated for the choice of 2% milk

β_H = the coefficients estimated for the choice of Homo milk

β_N = the coefficients estimated for the choice not to purchase milk

Four possible scenarios are examined: Scenario A, when it is assumed that all of the milk types are from cows that have not been treated with BST; Scenario B1, in which all of the milk types are from cows that have been treated with BST; Scenario B2, in which all of the milk types are from cows that have been treated with BST but the option to not purchase milk is not available, and Scenario C, in which one of the milk types is identified as "BST-free" and the others are identified as "BST milk". In Scenarios A, B and C all the milks cost $0.79/litre and have 8 days remaining before their expiry date. The estimated proportions of each type of milk chosen under these three scenarios are given in Tables 4.7 and 4.8. Scenario A describes the current situation. If the situation

changes to Scenario B1 (where all milk is identified as being from cows that may have been treated with BST), the percentage of purchases of each type of milk decreases significantly and the number of times that no milk is purchased increases significantly. This representative consumer clearly wishes to avoid "BST milk" when possible. This conclusion is reinforced in Scenario C. When one of the milks is "BST-free" and the others are not, the number of times the "BST-free" milk is purchased increases significantly. This occurs even if the fat content of the "BST-free" milk is higher. The consumer is willing to make a trade-off between fat content and avoiding BST. However, when the option to not purchase milk is excluded from the calculation (Scenario B2), the proportion of each milk type purchased does not change appreciably from Scenario A. Forcing the representative consumer to purchase "BST milk" did not appear to alter milk purchasing behaviour. The consumers in this study may have had negative perceptions of BST use and it might be that these perceptions are primarily reflected through the "no purchase" option. Allowing consumers a "no purchase" option in the survey may have resulted in an overstatement of consumers' aversion to the use of BST.

In Table 4.8, Scenario C is repeated but the price of the "BST-free" milk is increased. The price of "BST-free" milk is $0.99/litre while the price of the other milks is $0.79/litre. Again the proportion of purchases of the "BST-free" milk increases. The representative consumer is evidently willing to pay a price premium for milk that is not from cows that have been treated with BST. The

number of times that no milk is purchased is slightly higher than in Table 4.7. The increased price for "BST-free" milk has a tempering effect on the consumer's desire to avoid BST.

Table 4.7: Choice Proportions, Scenarios A and B

Milk Type	**Proportions (%)**		
	Scenario A (all milks are "BST-free)	**Scenario B1** (all milks are "BST milks")	**Scenario B2** (all "BST milks", no purchase option is excluded)
Skim	13.3	9.9	14.4
1%	29.7	22.2	32.1
2%	36.3	27.1	39.3
Homo	13.2	9.8	14.2
None	7.5	30.9	
Total	100	100	100

Table 4.8: Choice Proportions, Scenario C

Milk Type	**Proportions (%)**			
	Only Skim is "BST-Free"	Only 1% is "BST-Free"	Only 2% is "BST-Free"	Only Homo is "BST-Free"
Skim	37.70	4.98	4.48	6.89
1%	15.35	61.00	10.01	15.39
2%	18.76	13.60	67.13	18.82
Homo	6.81	4.93	4.44	37.46
None	21.38	15.49	13.94	21.44
Total	100	100	100	100

Table 4.9: Choice Proportions, Scenario C, Price Premium for BST-free Milk

Milk Type	Proportions (%)			
	Only Skim is "BST-Free"	Only 1% is "BST-Free"	Only 2% is "BST-Free"	Only Homo is "BST-Free"
Skim	33.47	5.55	5.06	7.36
1%	16.40	56.54	11.29	16.44
2%	20.05	15.15	62.94	20.09
Homo	7.27	5.50	5.00	33.24
None	22.81	17.26	15.71	22.87
Total	100	100	100	100

2. Welfare Calculations

Changes in economic welfare of consumers arising from the possible use of BST were calculated for the representative consumer described in Section 1, according to Hanemann's (1982) method. Recall from Chapter II that this method calculates economic welfare as the compensating variation associated with a change in the quality of a good. Adapting equation 19 from Chapter II, the change in welfare, C, was calculated as:

$$C = 1/\mu[/n\Sigma e^{X1\beta1} - /n\Sigma e^{X2\beta2}] \qquad \textbf{(25)}$$

where:
- μ = the marginal utility of money (the coefficient on PRICE is used to represent the marginal utility of money)
- X_1 = the values of the variables in the current situation (i.e. BST = 0, AGE = 40, etc)
- X_2 = the values of the variables when the milks may be from cows treated with BST (i.e. BST = 1, AGE = 40, etc)
- β_1 = the coefficients for the current situation (i.e. where all milk is "BST-free")
- β_2 = the coefficients that apply when all the milks may be from cows treated with BST.

This equation describes the change in the representative consumer's welfare when BST is introduced. It is assumed that milk that is from cows that have not been treated with BST is clearly identified as such at the retail shelf. Because the coefficient on BST was negative in all the models, the introduction of BST can be expected to decrease the consumer's welfare. Because the coefficients resulting from nested logit models are not easily incorporated into equation 25, the coefficients estimated in Model 3 were used for the welfare estimates.

Table 4.9 shows the estimated welfare changes for the representative consumer of Section 1 in six different situations. Recall, from the previous section, that the base case is specified as milk that is known to be "BST-free", costs $0.79/litre and has 8 days remaining before the expiry date. In Situation 1 there is a change from the current situation (all milk is "BST-free") to all the milk being "BST milk". In Situation 2 the same change occurs but the "BST milk" is fresher (12 days to expiry date). In Situation 3 the "BST milk" is 16 days from its expiry date. In Situation 4 both "BST-free milk" and "BST milk" have the same freshness level but "BST milk" is less expensive ($0.49/litre). In Situation 5 the "BST milks" are priced even lower, at $0.29/litre. In Situation 6 all the milks available are "BST milks" but the no purchase option is not available to the consumer. That is, the consumer must purchase at least one type of milk.

In all six situations, the consumer experiences a loss in welfare. The loss decreases with increasing freshness for the "BST" milk but this effect levels off

when freshness is at 12 days before the expiry date. The consumer does not appear to be willing to trade-off freshness for BST after a gain in freshness of 4 days. This is likely due to the fact that milk is usually consumed quickly rather than being stored for future use. The consumer likely gains little from increased freshness levels greater than 12 days before expiry. The results indicate that the representative consumer is willing to make a trade-off between BST and price. A decreasing price does reduce the welfare loss to the consumer. There still is a welfare loss when "BST milk" is $0.50/litre cheaper than "BST-free" milk (Situation 5). A significantly reduced price for "BST milk" does not appear to completely offset the consumer's concern about the use of BST. When the consumer is denied the option of not purchasing any milk (Situation 6), the welfare loss is the greatest. The representative consumer has a negative perception of the use of BST and clearly wishes to avoid "BST milk".

Table 4.10 presents five more situations. In Situation 7, skim milk is "BST-free" while the other milk types are not. In Situations 8, 9 and 10 respectively, 1%, 2% and Homo milk are "BST-free". In Situation 11 the representative consumer is presented with a full variety of BST and non-BST milks. That is, the dairy case is assumed to contain skim, 1%, 2% and Homo milks that are "BST-free" and skim, 1%, 2% and Homo milks are "BST milks".

When skim, 2% and Homo milk are "BST-free", respectively, the welfare loss is $0.67. When 1% milk is "BST-free" the welfare loss is $0.26. Skim milk purchasers may be more health conscious than other consumers. Homogenized

and 2% milk are often purchased for children. This might explain the higher welfare losses in Situations 7, 9 and 10.

When the consumer is presented with a full variety of milks, (Situation 11), there is a welfare gain of $0.24 per shopping trip. This result contrasts with the welfare changes estimated when all the milks are "BST milks" or when only one of the milk types is "BST-free" (Situations 1 through 10). Situation 11 allows consumers who are concerned about the use of BST to avoid it altogether without changing their milk purchasing habits, and this may be reflected in the welfare estimate. Consumers who are not concerned about BST use can be expected to be unaffected by Situation 11.

When the gender of the representative consumer is changed to male, the welfare losses decrease slightly. Increasing the age, education level and household income of the consumer also decreases the welfare losses but the behaviour pattern reflected in the welfare estimates does not change. The identified use of BST, under the assumptions of this study, results in welfare losses that are not entirely offset by increases in the freshness of milk or by decreasing the price of milk. If consumers are offered a full selection of BST and non-BST milks, a small welfare gain results.

Welfare changes for a representative consumer who is identical to the consumer described in Section 1, except for having previous knowledge of BST, were also estimated. A representative consumer who has previous knowledge of BST appears to experience larger welfare losses than the representative

consumer of Tables 4.10 and 4.11. This appears to conflict with the estimated results of Models 1 to 4 described earlier in this chapter. The model coefficients for PRIOR, shown in Tables 4.4 and 4.5, are positive and significant. Having previous knowledge of BST increases the probability that a consumer will choose to purchase milk. The welfare estimates indicate that a person with previous knowledge of BST experiences a greater welfare loss than a person who has no previous knowledge of BST. It appears that consumers with previous knowledge of BST wish to avoid "BST milk" but do not wish to leave the grocery store without milk. It may be that these higher welfare losses reflect a greater concern over the use of BST while the positive coefficient for PRIOR might suggest a greater willingness to purchase to "BST-free" milks even though they have a higher fat content, are less fresh, or are more expensive than the milk the informed consumer would normally purchase. It is evident that, should the use of BST be approved, the information that consumers receive about BST can be expected to have a significant effect on their perceptions of BST and on their behaviour.

Table 4.10: Welfare Changes, Situations 1 - 6

Situation	**Welfare Change ($/shopping trip)**
1 (all milks are "BST milk")	-1.53
2 ("BST milks are 2 days fresher)	-1.42
3 ("BST milks" are 4 days fresher)	-1.30
4 ("BST milks" are $0.49/litre)	-1.32
5 ("BST milks" are $0.29/litre)	-1.16
6 (all milks are "BST milks" but the no purchase option is not available)	-1.85

Table 4.11: Welfare Changes, Situations 7 - 11

Situation	**Welfare Change ($/shopping trip)**
7 (skim milk is "BST-free")	-0.67
8 (1% milk is "BST-free")	-0.26
9 (2% milk is "BST-free)	-0.67
10 (Homo milk is "BST-free")	-0.67
11 (full variety)	0.24

CHAPTER V: SUMMARY AND CONCLUSIONS

A. Summary

This study examined Edmonton consumers' choices of milk in a hypothetical market situation. This hypothetical market included milk that was identified as possibly being from cows that have been treated with BST. The hypothetical market was created through the use of a contingent behaviour survey. There were four versions of the survey; each version contained 16 contingent behaviour questions. The design proved to be effective in that it generated a high response rate.

The study was designed to examine the trade-offs that consumers appear to be willing to make between four milk attributes: fat content, price, freshness and BST. The effects of selected socioeconomic variables on these trade-offs were also examined. A multinomial logit model of consumer choice was developed to examine the choice between milks that varied in price, freshness and the use of BST. The four fat contents of milk available (skim, 1%, 2% and Homo) were used as the choice alternatives or "brands" in the study.

Three non-nested logit models and one nested logit model were tested on the data from the survey. The results show that the four models developed were not highly sensitive to specification. All the models displayed similar predictive abilities.

One of the non-nested models was chosen for calculating welfare changes. A number of different situations were postulated and economic welfare impacts, for a representative consumer, were calculated. In all but one of these situations, the representative consumer experienced welfare losses with the introduction of BST. A reduced price or increased freshness level for "BST milk" was not sufficient to offset the welfare losses. These welfare losses are slightly less for a male consumer than for a female consumer. Increased levels of education and income also reduced the welfare losses slightly. These welfare losses were greatest when the representative consumer was denied the option of choosing not to purchase any milk at all. Although previous knowledge of BST increased the probability of a consumer choosing to purchase milk in the choice models, a consumer who had knowledge of BST prior to receiving the survey experienced larger welfare losses. Should BST be licensed for use in Canada, the information consumers receive about BST can be expected to have a significant effect on their acceptance of its use.

When the representative consumer was offered a full range of "BST milks" and "non-BST milks" a small welfare gain was observed. That is, when skim, 1%, 2% and Homo milks were offered as both "BST-free" and as "BST milk" there was a small welfare gain. It appears that making appropriately labeled "BST-free" milk available to consumers would decrease negative reactions to the introduction of BST. In Minnesota and New York "BST-free" milk is reported to be sold at a 10 to 15 cent per gallon (producer level) premium.

However, this milk accounts for a relatively small portion of milk sales, approximately 4 percent to 5 percent, in 1994. In Wisconsin and Vermont, "BST-free" milk was initially reported to account for a significant portion of milk sales. The initial popularity of "BST-free" milk in Wisconsin and Vermont is thought to be more related to farmer opposition to BST and rural lifestyle issues than to consumers' concern over the safety of BST (Brinkman, 1995). The popularity of "BST-free" milk is now thought to be declining in these states (Brinkman, 1996). Moreover, the cost of establishing a system to separately collect, process and distribute "BST-free" and "BST milk" was viewed as prohibitive by a Government of Canada Task Force (Report of the rbST Task Force, 1995).

The approach used in this study offers advantages over the methods used in previous studies of consumer response to BST use. In this study consumers were asked to choose from a hypothetical set of milks (including a non-purchase option) rather than simply asking "Would you buy more, less or the same amount of milk if BST was licensed for use?" The approach of this study relates more directly to consumer behaviour and allows consumers to make trade-offs between BST, fat content, price and freshness. The studies conducted by Preston et al. (1991), Kaiser et al.(1992) and Fox et al. (1994) only allowed for trade-offs between BST and price.

B. Study Limitations

This study used information generated through consumers' stated choices in a hypothetical market. Thus the results must be assessed in light of concerns regarding the reliability of the contingent valuation, or contingent behaviour, method. Several possible sources of bias that might apply were discussed in Chapter II. The contingent behaviour questions in the survey were designed to avoid payment vehicle bias and to simulate the "real world" conditions at the dairy case of the grocery store as closely as possible. Previous studies of consumer response to BST in the United States also indicated welfare losses and possible decreases in milk consumption following the introduction of BST. Since BST was licensed for use in the United States the predicted decrease in milk consumption has not occurred. This may be due to the fact that milk from BST treated cows has not been identified by labeling. Further, "BST-free" labeled milk carries a disclaimer that BST use has no discernible effects on the composition of milk. Finally, clearly labeled "BST-free" milk has not been offered for sale in most markets in the United States (Brinkman, 1996).

The survey did not include beverages other than milk. The inclusion of other beverages may give a more accurate indication of consumer response to BST. That is, consumers might substitute other beverages for milk, which they were not able to do in the survey. Such a survey would be more complex and more difficult to design and interpret.

The survey was conducted during a period of media coverage of "mad cow disease" in Britain. This disease is caused by the organism *bovine spongioform encephalitus*, sometimes referred to as BSE. The respondents did not appear to confuse the acronyms BST and BSE. This media coverage, however, may have increased consumers' awareness of food safety issues and possibly generated a more pronounced negative response to BST use than might have otherwise been elicited.

C. Future Research Needs

In this study consumers were able to choose more than one milk alternative. Thus a consumer could choose to buy, say, skim and 2% milk in the same choice scenario. It appears that consumers "switched" milks if the milk type they would normally purchase was not "BST-free". Further research could usefully examine the extent of this "switching" behaviour. This may give a clearer picture of the trade-offs between fat content, price, freshness and BST. Eliminating the choice not to purchase any milk in such a survey may also give a clearer picture of the trade-offs embodied in the choice scenarios. When a representative consumer was presented with a situation in which all the milks available were "BST milks" and was not given the option not to purchase milk, the proportions of each milk type purchased did not change appreciably from when all the milks were "BST-free". When the "no purchase" option was

excluded from the welfare calculations the welfare loss for a situation in which all the milks available were "BST milks" was $1.85 per shopping trip.

Evidence on milk consumption patterns in the United States since the licensing of BST indicates that little impact on actual milk purchases has occurred. An examination of how consumers screen, use, accept or reject information on food safety is evidently required. Further study of the factors that influence consumers' perceptions of food safety is also needed.

The survey also contained Best-Worst scaling questions, which allow a researcher to calculate utilities for individual attributes. Due to time constraints, this portion of the data set was not examined in this study. Future research could examine this data set in order to evaluate and compare the results of the two techniques, contingent behaviour and Best-Worst scaling.

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APPENDIX A : THE DATA COLLECTION SURVEY
Version 2 of Four Versions In The Total Design

A SURVEY ON POTENTIAL NEW TECHNOLOGIES

FOR PRODUCING MILK

Dear Consumer,

The following survey is being sent to a select group of households to gather consumers' opinions regarding consumer preferences for certain aspects of milk. **The questionnaire should be completed by the person in the household who does the majority of the milk purchasing.** This survey is a University of Alberta research project. Your participation is entirely voluntary. This research will provide input into policy issues regarding milk production. The information you give will not be used for any other purpose.

Would you please take a few minutes now to complete this questionnaire? Your name is not required for this survey, only your answers to the questions. If there is a question you would rather not answer you may leave it blank.

Please return this survey in the self addressed stamped envelope provided.

Thank you for your help!

For further information, contact:

Peter Kuperis or Michele Veeman
Department of Rural Economy
University of Alberta
Edmonton T6G 2H1

Telephone: 492-4225
Fax: 492-0268

Version 2

1. Please check (√) only one box in each row to indicate whether you Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, or Strongly Disagree with each of the following statements.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
a. Milk is an important part of the daily diet.	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5
b. The presence of drug and other residues and other substances in milk is of concern to me.	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5
c. The freshness of milk is important to me.	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5
d. The milk available to me at grocery stores is of high quality.	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5
e. For dietary or health reasons I drink milk with a lower fat content than I did 5 years ago.	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5

2. During a typical shopping trip I buy:

____ **litres of Skim milk**

____ **litres of 1% milk**

____ **litres of 2% milk**

____ **litres of Homogenized (Homo) milk.**

3. Typically, I visit a store to buy milk:

____ **more than once a week**

____ **about once a week**

____ **less than once a week**

PART B: RATING ATTRIBUTES OF MILK

A series of milks will be described to you. The milk is described in the centre column of each table. Please indicate which is the **Best** feature of the milk described (circle only one), and which is the **Worst** feature of the milk described (circle only one).

The glossary below provides descriptions of the "Features" given in the questions beginning on the next page.

Feature	Explanation
Milk Type	This is the type of milk according to its fat content. The milk types are: Skim (no fat), 1% (one percent fat), 2% (two percent fat) and Homo (3.2% fat).
Price	This is the price for the milk, in dollars per litre ($/litre).
BST	BST (Bovine Somatotrophin) is a naturally occurring hormone that can be made synthetically. When BST is injected into dairy cows they give more milk. Some groups oppose the use of BST because they believe it may have harmful long-term effects to human health. Others support the use of BST because research has not found any harmful effects and using BST does not change the composition of milk. **BST is not currently used in Canada.** A "Yes" for the BST feature means that the milk may be from cows that have been treated with BST. A "No" means that the milk is from cows that have not been treated with BST.
Freshness	This is the number of days remaining before the expiry date (best before date) on the milk container. For example, "10 days before expiry date" means that there are 10 days left before the expiry date on the milk container.

Example:

Best Feature		***Worst Feature***
7	**Milk Type:** 2%	7
(2)	**Price ($/litre):** $0.79	2
9	**BST:** Yes	9
11	**Freshness:** 4 days before expiry date	(11)

Explanation:
The person chose **"Price"** as the *best feature* and **"Freshness"** as the *worst feature*.

QUESTIONS ON ATTRIBUTES OF MILK

Milk A

Best Feature		*Worst Feature*
6	**Milk Type:** 1%	6
2	**Price ($/litre):** $0.79	2
9	**BST:** Yes	9
11	**Freshness:** 4 days before expiry date	11

Milk B

Best Feature		*Worst Feature*
7	**Milk Type:** 2%	7
1	**Price ($/litre):** $0.69	1
10	**BST:** No	10
13	**Freshness:** 8 days before expiry date	13

Milk C

Best Feature		*Worst Feature*
5	**Milk Type:** Skim	5
4	**Price ($/litre):** $0.99	4
10	**BST:** No	10
14	**Freshness:** 10 days before expiry date	14

Milk D

Best Feature		*Worst Feature*
8	**Milk Type:** Homo	8
3	**Price ($/litre):** $0.89	3
9	**BST:** Yes	9
12	**Freshness:** 6 days before expiry date	12

PART C: CHOOSING MILKS

The glossary below provides descriptions of the "Features" given in the questions beginning on the next page.

Feature	Explanation
Price	This is the price for the milk, in dollars per litre ($/litre).
BST	BST (Bovine Somatotrophin) is a naturally occurring hormone that can be made synthetically. When BST is injected into dairy cows they give more milk. Some people oppose the use of BST because they believe it may have harmful long-term effects to human health. Others support the use of BST because research has not found any harmful effects and using BST does not change the composition of milk. **BST is not currently used in Canada.** A "Yes" for the BST feature means that the milk may be from cows that have been treated with BST. A "No" means that the milk is from cows that have not been treated with BST.
Freshness	This is the number of days remaining before the expiry date (best before date) on the milk container. For example, "10 days before expiry date" means that there are 10 days left before the expiry date on the milk container.

Example:

If the 4 milks listed below were available at all stores and were the only milks available:

Feature	Skim	1%	2%	Homo
Price ($/litre)	$0.99	$0.69	$0.69	$0.69
BST	Yes	No	No	No
Freshness	10 days before expiry date	6 days before expiry date	6 days before expiry date	6 days before expiry date
I would buy:	4 litres of Skim milk	2 litres of 1% milk	__litres of 2% milk	__litres of Homo milk

___ I would not buy any milk

If you would not buy any milk please check (√) the blank for "I would not buy any milk."

Explanation:
The person chose 4 litres of Skim milk and 2 litres of 1% milk.

QUESTIONS ON CONSUMER CHOICES OF MILK

Suppose that on your next grocery shopping trip you are at the dairy case to purchase milk. Considering the various features of milk (price, BST and freshness) how many litres of the milks (Skim, 1%, 2% and Homo), presented in the following scenarios, would you buy?

Scenario 1

If the 4 milks listed below were available at all stores and were the only milks available

Feature	*Skim*	*1 %*	*2 %*	*Homo*
Price ($/litre)	$0.69	$0.69	$0.79	$0.79
BST	No	No	No	No
Freshness	6 days before expiry date	4 days before expiry date	10 days before expiry date	10 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 2

If the 4 milks listed below were available at all stores and were the only milks available

Feature	*Skim*	*1 %*	*2 %*	*Homo*
Price ($/litre)	$0.69	$0.99	$0.89	$0.79
BST	Yes	Yes	Yes	No
Freshness	8 days before expiry date	8 days before expiry date	6 days before expiry date	8 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 3

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.99	$0.89	$0.69	$0.89
BST	Yes	Yes	No	No
Freshness	10 days before expiry date	4 days before expiry date	6 days before expiry date	10 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 4

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.99	$0.79	$0.99	$0.89
BST	No	No	Yes	No
Freshness	4 days before expiry date	8 days before expiry date	10 days before expiry date	8 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 5

If the 4 milks listed below were available at all stores and were the only milks available

Feature	*Skim*	*1 %*	*2 %*	*Homo*
Price ($/litre)	$0.79	$0.69	$0.69	$0.69
BST	Yes	Yes	Yes	Yes
Freshness	6 days before expiry date	8 days before expiry date	8 days before expiry date	8 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 6

If the 4 milks listed below were available at all stores and were the only milks available

Feature	*Skim*	*1 %*	*2 %*	*Homo*
Price ($/litre)	$0.79	$0.99	$0.99	$0.69
BST	No	No	No	Yes
Freshness	8 days before expiry date	4 days before expiry date	4 days before expiry date	10 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 7

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.89	$0.89	$0.79	$0.99
BST	No	No	Yes	Yes
Freshness	10 days before expiry date	8 days before expiry date	4 days before expiry date	8 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 8

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.89	$0.79	$0.89	$0.99
BST	Yes	Yes	No	Yes
Freshness	4 days before expiry date	4 days before expiry date	8 days before expiry date	10 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 9

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.89	$0.99	$0.69	$0.99
BST	Yes	No	Yes	No
Freshness	8 days before expiry date	6 days before expiry date	10 days before expiry date	4 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 10

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.89	$0.69	$0.99	$0.99
BST	No	Yes	No	No
Freshness	6 days before expiry date	10 days before expiry date	6 days before expiry date	6 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 11

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.79	$0.79	$0.79	$0.69
BST	No	Yes	Yes	No
Freshness	4 days before expiry date	6 days before expiry date	6 days before expiry date	4 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 12

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.79	$0.89	$0.89	$0.69
BST	Yes	No	No	No
Freshness	10 days before expiry date	10 days before expiry date	10 days before expiry date	6 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 13

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.99	$0.99	$0.79	$0.89
BST	No	Yes	No	Yes
Freshness	8 days before expiry date	10 days before expiry date	8 days before expiry date	6 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 14

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.99	$0.69	$0.89	$0.89
BST	Yes	No	Yes	Yes
Freshness	6 days before expiry date	6 days before expiry date	4 days before expiry date	4 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____I would not buy any milk

Scenario 15

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.69	$0.79	$0.69	$0.79
BST	Yes	No	No	Yes
Freshness	4 days before expiry date	10 days before expiry date	4 days before expiry date	6 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

Scenario 16

If the 4 milks listed below were available at all stores and were the only milks available

Feature	Skim	1 %	2 %	Homo
Price ($/litre)	$0.69	$0.89	$0.99	$0.79
BST	No	Yes	Yes	Yes
Freshness	10 days before expiry date	6 days before expiry date	8 days before expiry date	4 days before expiry date
I would buy:	__litres of Skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk

____ I would not buy any milk

PART D: SUPPLEMENTARY QUESTIONS

Your answers to these questions will help in analyzing the choices you made in Parts B and C. Please circle the appropriate category.

1. How many people live in your household?

1 .....**3 or less**
2 .....**4 to 6**
3 .....**7 or more**

2. What is your age?

1 .....**Under 30 years**
2 .....**31 - 40 years**
3 .....**41 - 60 years**
4 .....**Over 60 years**

3. What is your gender?

1 .....**Female**
2 .....**Male**

4. How many children under the age of 6 are in your household?

1 .....**One**
2 .....**Two**
3 .....**Three**
4 .....**More than three**

5. What is your approximate total household income, before taxes?

1 .....**Less than $10,000**
2 .....**$10,001 - $30,000**
3 .....**$30,001 - $40,000**
4 .....**$40,001 - $50,000**
5 .....**$50,001 - $60,000**
6 .....**$60,001 - $70,000**
7 .....**$70,001 - $80,000**
8 .....**$80,001 - $90,001**
9 .....**$90,001 - $100,000**
10 .....**More than $100,000**

6. How many years of education have you completed?

1 .....**Less than 6 years**
2 .....**7 - 9 years**
3 .....**10 - 12 years**
4 .....**13 - 16 years**
5 .....**More than 16 years**

7. BST is not licensed for use in Canada. What is your opinion on BST use? Should the Federal Government allow the use of BST?

1 .....**Yes**
2 .....**No**
3 .....**I have no opinion on BST use.**

8. Before receiving this survey had you heard or read about BST?

1 .....**Yes**
2 .....**No**

9. Do you have anything about the issues in this survey that you would like to tell us? If so, please use the space below for that purpose, or include your comments on a separate sheet of paper.

_____

_____

_____

_____

_____

Thank you. Your assistance in this research project is greatly appreciated.

APPENDIX B: SAMPLE CHARACTERISTICS AND CONTINGENT BEHAVIOUR QUESTION SUMMARY

Table B.1 Sample Characteristics

Socio- Economic Variable	Categories	Number of Respondents
Household Size	3 persons or less	183
	4 to 6 persons	100
	7 or more persons	2
	did not answer	9
Gender	Female	191
	Male	88
	Did not answer	15
Number of Children <6 Years old	Zero	87
	One	49
	Two	23
	Three	4
	More than three	0
	Did not answer	131
Household Income (before taxes)	<$10,000	22
	$10,001-$30,000	60
	$30,001-$40,000	44
	$40,001-$50,000	38
	$50,001-$60,000	20
	$60,001-$70,000	25
	$70,001-$80,000	16
	$80,001-$90,000	7
	$90,001-$100,000	11
	>$100,000	10
	did not answer	39
Years of Education	less than 6 years	6
	7 to 9 years	12
	10 to 12 years	98
	13 to 16 years	122
	more than 16 years	44
	did not answer	12
Should BST be licensed for use in Canada?	Yes	14
	No	212
	No opinion	54
	did not answer	14
Previous Knowledge of BST	Yes	125
	No	163
	did not answer	6

Table B.2 Responses To The Contingent Behaviour Scenarios

Scenario	*Alternative*					
	Skim	**1% Milk**	**2% Milk**	**Homo**	**None[1]**	**did not answer[2]**
	# of times chosen	# of times chosen	# of times chosen	# of times chosen	# of times chosen	# of times chosen
1	62	108	75	62	52	76
2	64	60	90	73	57	73
3	68	55	73	80	63	44
4	53	117	119	46	18	56
5	68	93	89	43	50	48
6	58	95	80	54	45	58
7	59	112	114	21	26	77
8	77	76	70	17	62	66
9	54	114	112	36	29	60
10	72	79	56	60	55	69
11	62	40	110	59	56	55
12	63	120	73	66	27	62
13	53	102	76	27	67	72
14	55	99	126	22	35	62
15	68	107	99	21	32	79
16	60	67	119	26	42	84

[1] That is, the respondent chose the alternative "I would not buy any milk".

[2] This category also includes choice scenarios which were filled out incorrectly.