Consumer Valuation of Food Attributes: A Comparison of Willingness to Pay Estimates from Choice Modelling and Contingency Valuation Methods

René Roy
Department of Agricultural Economics
McGill University, Montreal
May 2009

A thesis submitted to McGill University in partial fulfillment of the requirements of the degree of Master of Science

Abstract

This study compares the willingness to pay values from two different stated preference methods, choice modeling (CM) and contingent valuation (CV). The CV approach used was a multiple bounded discrete choice (MBDC) format. The WTP values were estimated for different food products that contained different environmental and health attributes. The two methods were found to generate statistically different WTP estimates for tomatoes and pork and were statistically similar for milk. The difference seems to reside in the model specification; when the attributes were analyzed as non-linear, the WTP estimate using the CM method was statistically similar to the one estimated with the CV method. Tests on sequencing and bid ordering effects were also conducted on the CV data. These biases did not affect the estimated WTP when using the MBDC format. While CM allows more flexibility than CV modeling, CM tends to generate higher estimates when the modeling includes continuous variables. Therefore, special attention is necessary when simulating WTP values from implicit prices derived from CM results.

Résumé

Cette étude compare les valeurs de volontés de payer issus de deux méthodes de préférence statutaire, c'est-à-dire le choix modulé et l'évaluation contingente. Dans le cas de l'évaluation contingente, le format de questionnaire utilisé est celui du choix multiple déterminé. Les valeurs de volontés de payer ont été estimées en utilisant un scénario où des produits alimentaires étaient évalués en fonction de bénéfices environnementaux et de santé. Ces produits sont étiquetés et présentés avec les mesures quantitatives des bénéfices mentionnées précédemment. Les deux méthodes ont générés des valeurs de volonté de payer différentes pour les produits tomate et porc alors que pour le produit lait, les valeurs estimées sont statistiquement identiques. La différence des résultats entre les deux méthodes semble résider dans le modèle statistique utilisé puisque les paramètres traités de façon non-linéaire se sont révélés statistiquement similaires. De plus, des tests sur la séquence d'apparition des questions et l'ordre des offres ont été effectués dans le questionnaire d'évaluation contingente pour déterminer leurs effets sur les valeurs exprimées par les répondants. Les résultats statistiques ont démontrés l'absence d'effet de ces deux facteurs sur les valeurs exprimées. En conclusion, alors que le choix modulé permet une plus grande flexibilité au niveau des scénarios et des applications des valeurs, cette méthode a généré des valeurs de volonté de payer élevées lorsque les attributs sont de natures quantitatives linéaires. Il apparaît donc judicieux d'utiliser les valeurs d'attributs de nature quantitative linéaire provenant de la méthode de choix modulé avec parcimonie lors de la simulation de scénarios.

Aknowledgement

"Whoever, either now or hereafter, may think of me and of the work I have done, must never forget that it is the product not of one intellect and conscience, but of three." (John Stuart Mill, 1806-1873, quoted in *The Worldly Philosophers, the Lives, Times, and Ideas of the Great Economic Thinkers,* New York, Simon and Schuster, 1999).

In the same spirit this study is not the fruit of my sole effort and work but is born from the contribution of several individuals who devoted energy and support for allowing this enterprise to be a successful one. The most important contributors are certainly, my thesis supervisor, Professor Paul J. Thomassin, and my research colleague, Sue May Yen, and my family, without whom, the following achievement would have never been possible.

I would like to highlight the help of my friends and classmates Howard Putra Gumilang, Yi Guo, Matthew Straub, and Polina Hristeva for their help and support during the different stages of this study through constructive discussions and various technical help. Also, I would like to recognize the assistance of the respondents who accepted to answer and return the questionnaire. Collectively, more than 250 hours were spent by the respondents to answer the questionnaires, which provided the necessary input data for this study.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Overview

The use of new technology in agricultural production, including the application of products developed by the petroleum industry and changes in plant structure through genetic modification, has revolutionized the techniques used to produce food. The drastic increase in agricultural production capability over the last several decades has altered the perceptions and needs of consumers in regards to food products. The main concern for consumers shifted from the availability of food to the safety of food where safety includes both the health and environment dimensions (Beus and Dunlap, 1990). As a result, consumers have modified their demand for food in ways that reflect a change in preferences.

This change in preference has resulted in the development of new types of agricultural products such as organic or locally grown products. These agricultural products were developed in order to capture the added value through a price premium. On the other hand, other agricultural products have caused safety concern. For instance, the foot and mouth disease outbreak in 2001, BSE in cattle in Canada, and, more recently, the avian flu problem have all raised concerns about the safety of agricultural products and the reliability of technology and methods of agricultural production. The debate concerning the safety of genetically modified products extended this feeling toward all food products. The negative perception of GM food was reinforced when mandatory labeling of products containing GM ingredients were required in several countries.

In response to the growing interest in food products with improved characteristics, society and governments have promoted agricultural production methods that have less environmental impact than conventional methods (Pronovost et al., 2008). For example, the development of farms using environmental management systems (EMS) is an attempt to apply a holistic approach to farming in order to mitigate the environmental impact of the farm organization (Straub, 2004). This new management system is similar to the International Standard Organization (ISO) system of environmental management. Both

systems are designed to continuously improve the environmental efficiency of the organization, but an EMS is publically managed while an ISO system is privately managed (Wall et al., 2001). Applying EMS to agricultural production could improve the environmental performance of firms, and the costs incurred by the firm to implement improvements could be recovered by a price premium that consumers would be willing to pay for products that fulfill specific environmental goals.

Since the implementation of such a system implies a cost to society, a proper evaluation of the benefits/cost is necessary. For this task, economists developed a group of methods to evaluate the non-market values of goods and services, often referred to as "stated preference" methods. This collection of methods is used when markets are non-existent. This approach involves the direct questioning of potential consumers of these goods and services (Adamowicz, 1995).

Several authors (Arrow K.R. et al., 1993, Kahneman and Knetsch, 1992) have raised concerns about the validity of using hypothetical questions, through verbal or written questionnaires, to estimate non-market values. Indeed, the earliest methods suffered from various forms of bias and refinement of the methods was necessary. Certain methods were considered to have problems that were too hard to solve and were discarded in favour of methods with higher performance. Today, the contingent valuation technique is the most widely used method to estimate non-market values. However, a method that is gaining popularity is the attribute-based method, which was introduced to undertake the same task. One technique that is available for evaluating the validity of value estimates is convergent validity, which is performed by comparing the results from different stated preference methods (Mogas et al., 2006).

1.2 Problem Statement

Several tools are available to measure the values of non-market goods. The question is: will different methods provide the same estimates? In recent years, contingent valuation using multiple bounded discrete choice questions has been widely used. However, the format of the method has inherent problems that have yet to be solved and this has motivated researchers to use other elicitation methods for the assessment of

non-market values. The attribute-based method, more precisely choice modeling (CM), is relatively popular in travel and marketing research and is considered to be an alternative method. Several studies have used this method for finding the values of non-market goods and services. This research will compare the willingness to pay (WTP) values estimated using the multiple bounded discrete choice (MBDC) method and the attribute-based method (CM).

1.3 Objectives

The contingent valuation and choice modeling methods, were used to estimate the WTP of selected food items, grown with specific production practices, from households in the same geographical area, namely the city of Montreal and its surrounding boroughs. The WTP estimates from each method were compared to determine if they were statistically different. An external test using a split sample design was also performed. Each elicitation method was randomly distributed to 500 households following a pattern pre-determined by the socio-demographic characteristics of the city and its boroughs.

The goal of this research was to determine if there were differences in the values estimated by the choice modeling and MBDC technique. The comparison was performed on the value of labeled food products containing different food attributes. This analysis is in some respects similar to the work of Dupont (2003), but it provides interesting and novel insights into the application of the methods. The research results identify the extent that these two methods are similar, in regards to their estimated willingness to pay values. The specific objectives of this study are:

- to determine the consumer willingness to pay for food attributes using MBDC and CM methods,
- to determine if there is a difference in the willingness to pay between MBDC and CM methods, and
- to evaluate the effect on WTP of the sequencing and bid ordering in the MBDC questionnaires.

1.4 Thesis Structure

The second chapter provides a review of previous studies that compare the two elicitation methods. A brief overview of both methods is presented. This includes the mathematical foundations of the methods and a review of their recognized weaknesses, both mathematically and conceptually. In the second part of the chapter, the validity test and comparison method is outlined.

The third chapter provides details of the questionnaire design, pre-testing, and survey distribution method. The model developed for determining the willingness to pay estimates is also explained and the hypotheses to be tested are outlined.

The fourth chapter presents and analyses the results. The first section provides a comparison of the sample characteristics with the population. The results of the modeling and the interpretation of the estimated values are presented in the second section. A comparison of the mean WTP from the choice modeling and MBDC techniques is also presented.

The final chapter presents the conclusions based on the analyses and provides the implications of the results. Finally, a discussion concerning the limitations of this research and future potential research is presented.

Chapter 2: Literature Review

2.1 Introduction

Determining the value of environmental goods and services has been the subject of many studies because it provides a means to estimate the preferences of individuals and, on a larger scale, to gauge the preferences of society. Since many methods are available for achieving this task, empirically comparing the two most commonly used methods is a worthwhile exercise. A review of the literature provides general information about the theoretical foundation of the methods, and this is followed by a detailed description of the validity test. In section 2.1, the different types of agricultural production systems of interest are described. Section 2.2 outlines the theory of valuation, focusing on the contingent valuation and choice model methods. In section 2.3, the different types of bias are indentified. Finally, section 2.4 summarizes the literature concerning validity testing and reports the findings germane to this research.

2.2 Agricultural Production Systems and their Characteristics

The food products used in this research can be produced from four different types of production systems. Each production system produces a good that has a vector of other attributes. These other attributes include: price, health effects, environmental effects and a fourth attribute depending on the good. Each of the production systems are described below.

2.2.1 Organic

Organic production relies on techniques of production that minimize the use of chemical inputs (Organic Agriculture Center of Canada, 2007). This type of production system aims to increase the quality and durability of the environment by avoiding the use of products such as synthetic pesticides and fertilizers, growth regulators, antibiotics, hormones, artificial additives and GMOs in the production process (Salha and Robitaille, 2005). In animal production, a special focus is placed on animal welfare.

Organic products have grown in popularity due to an increased interest in healthy food. Demand for organic food has been increasing since 1995. This is partly due to the uncertainty that has occurred with the outbreak of potentially dangerous diseases such as mad cow and foot-and-mouth disease (Salha and Robitaille, 2005). The stringent guidelines of this production method, in terms of the limits on chemical inputs used, explain the higher consumer confidence in food safety associated with organic production. These stricter requirements also results in higher prices for organic products in the market. Regarding the effect of organic production on the environment, recent research supports the argument that organic farms have a positive impact on the sustainability of soils (Liebig and Doran, 1999, Mader et al., 2002). Other aspects of agricultural production, such as animal welfare, are harder to quantify because there is no consensus in society on the ideal conditions under which animals should be raised (Lund et al., 2004). Animal welfare issues tend to focus on management practices, such as the availablility of free-range areas or living space per animal.

2.2.2 Conventional

Despite the fact that conventional agricultural systems are the most widely used production methods, compared to alternative systems such as organic and environmentally managed systems (EMS) (Beus and Dunlap, 1990), a definition is not easily found in the scientific literature. A practical definition is provided by Knorr and Watkins (1984) that states that "[conventional agriculture can be defined as] capital-intensive, large scale, highly mechanized agriculture with monocultures of crops and extensive use of artificial fertilizers, herbicides and pesticides, with intensive animal husbandry" (Knorr and Watkins, 1984, p.X). In order to make this definition more contemporary, including use of genetically modified organisms should be added. Where the definition above is mainly based on the technologies used in the system, the underlying goal of conventional agriculture is to constantly improving yield output while keeping the agricultural producer financially viable.

Since the system is based on productivity, it produces food at a lower cost than alternative systems. Consumers and public policy makers in Canada have long been in

favour of a low cost food supply and this has resulted in the adoption of conventional agriculture by the majority of producers. However, the long-term impacts of several of these technologies adopted were found to be negative. For instance, the negative environmental effect on soil (Reganold et al., 1987) and biodiversity (Bengtsson et al., 2005) are well documented today. Problems related to residual amounts of synthetic pesticides in conventional food products (Gambacorta et al., 2005) are also recognized as potential hazards to human health (Alavanja and Hoppin, 2004). This information has raised consumer concerns about for the environment and human health aspect of conventional production.

2.2.3 Environmental Management System

Since organic production systems impose significant constraints on the use of inputs, an alternative system was designed that was less restrictive. An Environmental Management System (EMS) seeks to reduce the environmental impact of production, while increasing the operating efficiency of the firm (EPA, 2005). This type of system is similar to a private management system implemented under the standards of ISO 14001. ISO 14001 is implemented on a voluntary basis and is monitored by an independent third party. The EMS is built on the concept of continual improvement with specific rules with respect to the process (Wall et al., 2001). The EMS program can be seen as following a publicly managed ISO standard.

This system is attractive because it helps firms to identify and to modify their production practices, which can result in significant environmental improvements. This allows firms to not only be accountable for their practices to the general public but provides them with the means to differentiate their products in the market place and thus gain a competitive advantage (Wall et al., 2001). For policy makers, this can be a tool to persuade agricultural producers to implement changes that result in environmental improvements and ultimately satisfy the needs and desires of the population with respect to the environment. To this aim, Agriculture and Agri-food Canada (AAFC) and the Ministère de l'Agriculture des pêcheries et de l'alimentation du Québec (MAPAQ) wanted to explore the possibility of implementing such a system.

However, this type of production method is not without financial implications. The cost of establishing, monitoring, and implementing changes can be substantial and prevent producers from adopting this new type of production. On the other hand, the advantages of an EMS are highly desirable both in terms of the environmental outcomes and the voluntary nature of the program. If consumers support the principles behind EMS and are willing to pay a premium for such commodities, this can be advantageous for society.

2.2.4 Genetically Modified Organism

A Genetically Modified Organism (GMO) is defined by the FAO Glossary of Biotechnology as: an organism "modified by the application of trangenesis or recombinant DNA technology, in which a transgene is incorporated into the host genome or a gene in the host is modified to change its level of expression" (FAO, 2004, p.8). This transference of genes may bring new properties to the host organism that can enhance or create new characteristics in food products. It is not a different agricultural production system but instead a way to create a new variety of products potentially distinguishable from conventional or alternative agricultural products.

Genetically modified (GM) food has been a topic of great debate and discussion during the last decade (Hoban, 2004). GM foods are generally accepted in the United States, while the European Union has recently banned their use in food products (Hoban, 2004). In Canada, the rate of approval has been steadily increasing. According to Pollara (2003), the Canadian population has increased their support of biotechnology from 63% in 2000 to 68% in 2003.

However, based on a review of the literature related to the safety of food using biotechnology, consumer opinions are not based on scientific knowledge. In fact, only a small number of studies have been conducted concerning the risk to human health related to the use of GMOs in food (Domingo, 2000, Pryme and Lembcke, 2003), and these results indicate that there is no scientific evidence that GMOs cause damage to human health (Feldmann et al., 2000). The situation is different regarding the impact of this technology on the environment. Research has demonstrated that there are negative

consequences of using GMOs in agricultural production, specifically regarding the potential of gene contamination (Altieri, 2000).

One argument in favour of the adoption of transgenic crops is their economic advantage. Research conducted to evaluate the economic advantages of agricultural biotechnology concluded that producers and consumer would benefit from their adoption (FAO, 2004). The primary advantage resides in lower input use, mainly pesticides, and decreased pest damage. Research conducted on cotton production in both developed and developing countries reached this conclusion (FAO, 2004). Therefore, it is reasonable to presume that the adoption of GMO crops would lead to a decrease in the price of GMO commodities.

2.3 Food Safety

Several studies (Yeung and Morris, 2001; Burton et al. 2001; Donaghy et al., 2003; Straub, 2004; Goldberg and Roosen, 2005;) have identified food safety or health as important attributes of food for the purchasing decisions of consumers. In the study undertaken by Yeung and Morris (2001), they found that food safety had the largest implicit price value of any attribute in their CM experiment. Goldberg and Roosen (2005) used both CV and CM approaches to estimate the WTP for food that had decreased levels of two different bacteria, Salmonellosis and Campylobacteriosis. They found that WTP increased when the levels of these bacteria decreased. These results were similar to those found by Burton et al. (2001). In their study food risk was a significant attribute that determined a consumer'sWTP. However, the relative importance of the food risk attribute decreased when the respondent frequently purchased the commodity.

Straub (2004) investigated the importance of a health attribute for food purchases using a choice modelling approach. The health attribute of food is more complex than simply food safety He found that changes in the health attribute had the largest implicit price of all the food attributes. Donaghy, Rolfe and Bennett (2003) also concluded that consumers were WTP a price premium for food that had a lower risk to human health than the status quo good. Their results also indicated that the price premium for food with lower risk to human health had regional heterogeneity.

Carlson, Frykblom and Lagerkvist (2007) used the CM approach to study the WTP of consumers for prohibiting the use of GMO products in animal feed. To undertake this experiment, meat was labelled either as possibly been raised on GMO feed or GMO feed was prohibited. They rejected the hypothesis that consumers' WTP was equal for these two types of labelled meat. Consumers have a higher WTP for meat that was labeled with GMO feed prohibited.

Darby et al. (2008) used CM to evaluate the food attribute "locally produced". They wanted to determine the geographical extent of "local". They also tested the independence of the "locally produced" attribute from "freshness" and "farm size", since they are often confused. They concluded that respondents valued a product labelled "nearby" and "in states" in a similar manner. They also concluded that consumers distinguished between the "locally produced" attribute from "freshness" and "farm size".

Cranfield, Deaton, and Shellikeri (2009) used CM to evaluate the most important attributes for determining organic food production standards in Canada. They found that regular testing of end products for pesticides and restricting the transportation distance were the two most important attributes for Canadian consumers.

In order to evaluate "non-GM" and "country-of-origin" attributes of canola oil, Volinskiy et al. (2009) used an incentive-compatible choice experiment. They measured a positive WTP of $0.45 to $0.65 for the "non-GM" attribute, while the attribute "country-of-origin" varied as choice context varied.

2.4 Valuation methods

Several valuation methods are available to estimate the price that consumers would be willing to pay for environmental benefits. Before discussing the techniques used in this research, an explanation of the underlying concepts is be presented.

2.4.1 The Concept of Value

As stated by Brown (2003), the concept of value in economics is directly linked to individual preferences. In addition, the value an individual places on something is a function of their ability to pay or their income. Important assumptions concerning consumer preferences are necessary in order to link preferences to monetary values. The assumptions used in neoclassical economic theory to link these are reviewed in section 2.3.3. It is essential for users of valuation methods to keep these assumptions in mind when interpreting their results.

2.4.2 Use and Non-use Values

Values can be categorized into two types: use and non-use values. Use value is associated with an economic activity, while non-use value does not have an explicit link with expenditure behavior (Adamowicz, 1995). For instance, a price premium for certain product attributes reveals consumer preferences directly in the market price, whereas the willingness to pay for preserving an endangered species is not related to any direct market transaction. Non-use values cannot be captured in conventional monetary transactions and make revealed preference (RP) methods inappropriate. This is also the case for marketable products that are not presently in the market or when attributes of products are not clearly defined for consumers. Stated preference methods can overcome the absence of a market and estimate non-use or future use value.

2.4.3 Welfare Measures

The main goal of using a stated preference method is to measure the welfare change, either positive or negative, associated with a change in a given level of hypothetical good. It is also possible to use the revealed preference method but it is less flexibility because it is bound to market data. Using information from a stated preference method, it is possible to extrapolate the effect on the whole population and to estimate the overall change to society. This method is not restricted to measuring natural resource

policy changes; it can be alsoapplied to other domains that have the potential to improve society.

The method used to measure welfare changes is derived from neoclassical economic theory and is based on the assumption that all members of the population have a preference ordering that is complete, continuous, transitive, non-satiated, monotonic, and convex. This set of preference characteristics is necessary in order to estimate a utility function U(X,Q) that is differentiable, increasing and quasi-concave, where X = $[x_1, x_2, \ldots, x_n]$ is a vector of all level of *n* goods possibly chosen by the consumer and Q= $[q_1, q_2, \ldots, q_k]$ the vector of *k* non-market goods for the same consumer. By solving the utility maximization problem subject to the consumer's budget constraint, it is possible to derive an optimal demand function X*=(X, Q, y) where y is the income of the consumer. Building a utility function based on these optimal demand functions generates an indirect utility function U(X*, Q) = v(P, Q, y).

Using the indirect utility function, it is possible to estimate the welfare change. Depending on the allocation of property rights, two different measurements are possible: compensating and equivalent variations. The compensating variation is defined as the amount of income that a consumer is willing to give up after some exogenous change in P or Q in order to return to their initial level of utility (Jehle and Reny, 2001). This measure is appropriate when the property rights favour the status quo. The compensating variation can be illustrated mathematically as $v(P^0, Q^0, y^0)= v(P^1, Q^1, y^1\text{-}C)$ where C is the amount of income given up by the consumer to compensate for the change, the superscript 0 represents the initial level and superscript 1 the level after the exogenous change.

The equivalent variation is used for situations when the property rights favour the change of state. It can be defined as the amount of additional income that a consumer is ready to accept in order to change their level of utility as a result of the change in P or Q. This is expressed mathematically as: $v(P^0, Q^0, y^0 + E)= v(P^1, Q^1, y^1)$ where E is the amount of income received by the consumer for accepting the change of state.

These welfare measurements are conceptually useful, but lack practical methods for empirical measurement. Such measurements are made from the expenditure function built by minimizing the expenditure function with the utility function as the constraint. By interchanging the constraint and the objective function, the optimized function X^h (P,

Q, U), called the Hicksian demand, allows the utility to fluctuate. A final step is needed to create a function that is similar to the indirect utility function. By multiplying the Hicksian demand by the price P, an expenditure function e(P, Q, U) is generated. This is the workable function used for establishing the empirical value of the measure.

The welfare measure can be applied to situations where there is a quantitative change in income, good, or price. As previously mentioned, the property right allocation will determine the choice between compensating and equivalent variation measures. To illustrate an application, assume good *j* with price P_i, and assume a decrease in price from P_i to price P_{-i}. Note here that P is a vector of price changes. The compensating variation is the difference between the expenditure functions in both situations, as shown in the following equation:

$$CV = e(p_i^0, P_{-i}^0, Q^0, U^0) - e(p_i^1, P_{-i}^0, Q^0, U^0) \quad (1)$$

Where P_i^0 and P_i^1 are respectively the price of good j before and after the price change, Q is a vector of the quantity of non-market goods, and U is a vector of the utility obtained by the consumption of Q.

2.4.4 Stated Preference Techniques

Stated preference methods were developed to estimate the value, typically in monetary terms, of non-market goods. The values are estimated using response data from individuals put in hypothetical situations and asked to make purchasing decisions. Stated preference methods include contingent valuation, attribute-based methods, and paired comparison (Brown, 2003).

The most popular method among the three stated preference methods is contingent valuation. It was designed primarily for valuing goods that are not traded in a market. Its application has been broadened to include market goods (Stevens, 2005). Attribute-based methods, on the other hand, have been primarily used for marketing research but are now becoming more widely used in the domain of natural resource valuation. The next section will provide an overview of each method.

2.4.5 Contingent Valuation Method

The concept of value is relatively simple when dealing with products that are traded in a market. However, the value of a product that is not traded is more abstract, and methods to estimate these values have been under a constant state of refinement for the past 40 years. Davis (1963) used contingent valuation for the first time. A decade later, this method started to gain in popularity (Randal, Ives and Eastman, 1974), which led to numerous CV valuation studies being conducted to value a wide range of environmental goods and services (Mitchell and Carson, 1989).

The debate over whether or not the method was an acceptable means of estimating non-use values reached a pinnacle when the CV method was used to estimate the compensation for the environmental damage caused by the Exxon Valdez oil spill in 1989. A panel of illustrious economists evaluated the credibility of the CV method. As a result of the hearings, the National Oceanic and Atmospheric Administration (NOAA) provided a number of recommendations for researchers to follow when conducting CV surveys (Arrow et al., 1993), which inherently validated the method as a reliable means of evaluating non-use values.

2.4.5.1 Response Format of Contingent Valuation

As the use of this valuation method expanded, the format of the questions also evolved to overcome problems related to the validity of the response data. Three types of formats are typically used: open ended, payment card, and dichotomous choice. The most popular is the dichotomous choice and its variants (Boyle, 2003). First introduced by Bishop and Heberlein (1979), this type of question proposes an amount of money and asks the respondent if they would be willing to pay this amount for the good. The respondent must choose to accept or reject the bid. The question format was later improved by increasing the number of bids. However, additional modification was necessary to reduce the length of the questionnaire, as the same question was being repeated several times. Instead, the question was asked a single time and the respondent answered either “Yes” or “No” to each of the proposed bids.

The dichotomous choice format was further refined to account for the level of certainty of the respondent. Derived from the dichotomous choice format, the multiple bounded discrete choice (MBDC) format incorporated uncertainty in the question format. The MBDC question is a matrix with a vertical vector of bids and a horizontal vector of certainty levels from which the respondent provides a response. An illustration of the response format is presented in Appendix 5.

Generally the CV method produces more conservative estimates than CM (Johnson and Desvourge 1997; Steven et al., 1992). Conservative estimates are preferred for nonmarket valuation because it diminishes the chance of overestimating the WTP values (Arrow et al., 1993).

The multiple bound matrix of bid prices and certainty levels was converted to a discrete choice matrix by choosing a certainty level that would define the discrete decision of accepting or rejecting the bid price. In this study, as with the study by Poe and Welch (1994), the certainty level "Absolutely Yes" was defined as accepting the bid price, while all other certainty levels were considered a rejection of the bid price. Respondents who opted to not purchase the food item where considered to have a zero bid price for the product.

2.4.5.2 Econometric Model for Analyzing MBDC Responses

MBDC questions allow respondents to express uncertainty for a particular bid response. During the empirical analysis, the expressed uncertainty must be transformed into a simple 'yes' or 'no' entry. The model used for the analysis of MBDC data is based on the same type of modeling approach as the maximum likelihood interval used with the payment card style questions. The following theory was developed by Poe and Welsh (1994) and Loomis and Ekstrand (1997).

The theory is based on the following assumptions: let X_{iC} be the price that a respondent would be certain to pay for a particular good. The statistical distribution function of the accepted bid value can be expressed as $F_C(X\ ;\ \beta_i)$ with parameter β_i standing for the explanatory variables. Since the response format is constructed as an interval, the bid is expressed in the interval $[X_{iL},X_{iU}]$, where X_{iL} is lower bound of the bid

interval and X_{iU} the upper bound of the bid interval. The statistical distribution function for the maximum stated price accepted can be expressed by $F_C(X_{iL} ; \beta)$ and $F_C(X_{iU} ; \beta)$ for the lowest stated price not accepted. The joint likelihood function generated is:

$$\ln(L) = \sum_{i=1}^{n} \ln[F_c(X_{iU};\beta) - F_c(X_{iL};\beta)] \quad (2)$$

The response category can be set at the desired level of certainty. For instance the "Absolutely Yes" can be defined as the only acceptable bid, where all other uncertainty levels are rejected. This becomes a discrete choice model because the whole range of levels is transformed into a Yes and No response. According to Poe and Welsh (1994) the threshold for certainty should limit the positive answers to only "Absolutely Yes".

The dependent variable, which is the probability that the respondent would be willing to pay the bid proposed for the product presented, is regressed using a maximum likelihood function. This model estimates the coefficients of the explanatory variables that will maximize the probability of the dependent variables.

2.4.5.3 Goodness of fit

For the purpose of testing the hypothesis of equality between estimated maximum likelihood response distributions (Poe and Welsh, 1996), the likelihood ratio (LR), which is the traditional approach for measuring goodness of fit, is inefficient (Kanninen and Khawaja, 1995). Instead, a Wald statistic can be used to estimate the goodness of fit (Harpman and Welsh, 1999). The statistic is estimated with:

$$W = [R\beta - r]'[R(V)R']^{-1} * [R\beta - r] \sim \chi^2_Q \quad (3)$$

where R is a matrix of linear restrictions of size K by Q. K is equal to the total number of estimated parameters, and Q the number of restrictions. The coefficient β is a

K x 1 vector of the estimated coefficients, and r is a Q x 1 matrix containing the vector of constants. Finally, V is the estimated variance covariance matrix of β.

The hypothesis is that all the coefficients β_{kx1} are simultaneously equal to zero. This Wald test statistic follows a Chi square distribution with degrees of freedom equal to the number of restrictions Q.

2.4.6 Attribute-Based Method

The attribute-based method (ABM) is another type of stated preference (SP) approach. The objective of the ABM is to determine the value of technically differentiable attributes or characteristics (Holmes and Adamowicz, 2003). The definition of an attribute is not only relegated to physical characteristics but may include price and ethical considerations, such as equitable prices to the producer. this method implicitly prices individual attributes of the good from the choice decisions of the respondent and estimate both the value of the attribute and the level of the attribute. For instance, the price, treated as an attribute, will provide a matrix of values that may be used in further benefit cost analysis. This study uses the ABM to assess environmental goods and services, but the method is also widely used by other disciplines, such as marketing, under the name of conjoint analysis.

This method provides some advantages over other SP and RP methods, as summarized below (Holmes and Adamowic, 2003):

- The variables under study are controlled by the surveyor, which is not the case when market data are used.
- A statistical design model avoids collinearity and statistical noise between explanatory variables.
- The multi-dimensional response format of the survey radically increases the richness of information. The application and flexibility of the information increases the potential uses of the results by decision makers.
- Attributes of interest in the valuation problem are well defined. Attributes can be quantitatively and qualitatively defined and therefore standardized over

the respondent sample. With a clear definition of the attributes, the reliability of statistical estimates is enhanced.

2.4.6.1 Historical Background

The conceptual foundation of the ABM was developed by Lancaster in 1966. His work provides a theory where the value of a good is a function of its attributes. He argued that instead of viewing goods as the object of utility, where utility is derived from the good itself; the good should be viewed as an aggregation of "properties or characteristic of the good" (Lancaster 1966, p.133). The utility is therefore derived from the aggregate attributes of the good where the representative utility V of the *i*th alternative of the *q*th individual is represented by the summation of a utility parameter (assuming a linear parameter) of the *k*th observed attribute with a specific socioeconomic background s:

$$V_{iq} = \sum_{k=1}^{K} \beta_{ik} s_{ikq} \tag{4}$$

Further advances in the application of the attributes of a good to nonmarket valuation was undertaken by McFadden (1974). He developed an econometric model linking the random utility model of Thurstone (1927) with hedonic price analysis. The multinomial logit (MNL) model is still used for the analysis of ABM survey data.

Different types of scales can be used for the evaluation of preferences. Three distinguishable types include: choice, rating, and ranking (Holmes and Adamowick, 2003). However various statistical problems occur with the use of the two latter types and the choice model has taken a prominent place in the evaluation of attributes.

2.4.6.2 Choice Model and Assumptions

Random Utility Theory (RUT) is the foundation of choice behavior, as shown in the model by Thurstone (1927):

$$U_{iq} = V_{iq} + \varepsilon_{iq} \tag{5}$$

where U is the utility of good i for individual q, V_{iq} is the expected, or systematic, value of U and ε is a random component. Recalling equation 1, it is important to note that the functional form of the utility function is assumed to be homogeneous among all individuals in the sample (Louviere et al., 2000). This homogeneity must be taken into consideration when designing the sampling method of the population. Other types of functional utility are captured by the error term ε. The term ε is derived from unobservable factors and momentary variability in the evaluation of the choice by individual q. The inclusion of this measurement error relies on the assumption that respondents are incapable of making an objective decision while abiding by their own preferences. The random component is generally assumed to be independently and identically distributed following an Extreme Value type I (EVI) distribution. From this utility model, it is possible to build the probabilistic model of choice. The basic assumption of the preference model is that competing alternatives i and j from alternative set A are chosen following the preference ordering:

$$i \succ j \text{ iff } U_{iq} > U_{jq}, \quad \forall j \neq i \in A \tag{6}$$

Alternative i is chosen over alternative j if and only if the utility of alternative i is greater than the utility of alternative j, for a given choice set A and for non-identical alternatives. From this preference ordering, the probabilistic statement of choosing alternative i over alternative j may be represented by:

$$P(x_{iq} \mid s_q, A) = P_{iq} = P[\{\varepsilon(s,x_j) - \varepsilon(s,x_i)\} < \{V(s,x_i) - V(s,x_j)\}] \quad , \qquad \forall j \neq i \tag{7}$$

Many choice measures may be consistent with this model. Stronger scales of measurement, such as rating and ranking, must be transformed to make them suitable for the RUT (Luce and Suppe, 1965). This is a strength of the theory in that it allows a stronger scale of measurement to be transformed into a weaker ordering and analyzed with this model. However, a numerical assignment is required so that the researcher is able to assess the different degrees of preference of the respondent. This class of measures is termed a "dominance measure" (Louviere et al., 2000). A simple nominal scale assignment of 1 as the chosen preference and 0 as the non-chosen one is sufficient for inferring a preference model.

The assumption of Independence from Irrelevant Alternatives (IIA axiom) is needed to evaluate the previously stated probabilistic statement. The axiom states that *the ratio of the probabilities of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the presence or absence of any additional alternatives in the choice set* (Louviere et al., 2000). This useful axiom allows the addition or elimination of alternatives in the choice set without re-estimation of the parameters. Nevertheless, additional assumptions are needed for completeness:

- Positivity: Given the respondent's socioeconomic characteristics and the alternatives of the choice set, the probability that a particular alternative is chosen must by greater than zero for all possible alternative sets A, vectors of measured attributes s of choice set A.
- Irrelevance of alternative set effect: It states that without replication on each individual it is not possible to identity an 'alternative choice set effect' (z). Thus, another restriction must be introduced to isolate the 'choice alternative effect'.

From the above assumptions, McFadden developed the multinomial logit model (MNL). The final output of the model may be summarized by the following equation (see McFadden (1974) for details):

$$P_i = \frac{1}{\sum_{j=1}^{J} \exp -(V_i - V_j)} \tag{8}$$

where P_i is the probability of choosing alternative *i*, and *V* is the systematic or observed utility component.

The maximum likelihood estimation of MNL, which is the most utilized measure, is summarized by:

$$V_{jq} = \sum_{k=1}^{K} \beta_{jk} X_{jkq} \tag{9}$$

where β is the constant of the alternative-specific constant of the alternative j and X is the attribute *j* of alternative *k*.

The experimental design of an ABM provides the means to manipulate the critical explanatory variables of attributes of interest (Holmes and Adamowick, 2003). However, a poorly designed experiment may result in statistical problems such as collinearity or biased parameters.

2.4.6.3 Response Format and Factorial Design

As opposed to the CV method, which values the good itself, the CM approach can evaluate multiple attributes of a single good. In addition, CM provides the ability to estimate the possible interaction between the different attributes. Therefore, the one-factor-at-a-time limitation of the CV method is not imposed on the CM method. In fact, it is the factorial design feature of CM that enables this method to take into account the special features of the MNL model. Using a factorial design, it is possible to observe several attributes, known as factors, and their possible interaction. Employing a factorial design is also recognized to be the most efficient technique because it minimizes the number of repetitions necessary while allowing all the interactions to be tested (Montgomery, 2005), as will be explained in greater detail in the following section.

A factorial design consists of the combination of n attributes with L levels of attributes. Individual combinations are referred to as "profile combinations" (Holmes and Adamowick, 2003). To illustrate this, assume the researcher wants to study three attributes (n=3) each with two different levels (L=2). Therefore the total number of profile combinations is eight (2^3). This design is named an "L^n design" referring to the total profile combinations generated. The individual effect of each attribute is called the main effect. It is also possible to expand the study to evaluate the interaction of two or all three attributes together. It is obvious that a small increase in L or n in the experiment expands the number of profile combinations required to conduct the experiment. However, it is possible to reduce the number of profile combinations without losing any information (Montgomery, 2005). The result is a fractional factorial design. The fractional factorial design consists of a reduced number of profile combinations, but retains the analytical capacity of the full design (Hensher et al., 2005). Most statistical software packages capable of building factorial designs have the ability to create fractional factorial designs as well.

2.4.6.4 Confidence intervals

The method for estimating confidence intervals is the one developed by Park et al. (1991). This is based on the Krinsky and Robb (1986) approach for calculating confidence intervals of elasticity. The method creates an empirical distribution of estimators. These estimators are allowed to be a nonlinear function of the estimated parameters (Park et al., 1991). The distribution is built using the variance covariance matrix and the coefficient β.

2.4.6.5 Convolution

In order to test the hypothesis that the WTP distributions estimated with the CV and CM methods are statistically similar, the convolution approach developed by Poe et al. (1994) has been used by other studies in the literature. This method is based on three principles. First, let X and Y be independent random variables with probability density

functions of $f_x(x)$ and $f_y(y)$. Second, the difference V=X-Y is a random variable. Third, the probability of the event V=v can be defined as the union of all possible combinations of x and y that creates a difference of v. The probability function is as follows:

$$f_v(v) = \int_{-\infty}^{\infty} f_y(x-v) f_x(x) dx = \int_{-\infty}^{\infty} f_x(v+y) f_y(y) dy \tag{10}$$

Or

$$F_v(v^0) = \int_{-\infty}^{v^0} fv(v) dv \tag{11}$$

The calculation becomes tractable by constraining the region of the X, Y, and the X-Y domain where no simulation appears and bounding the range of values observed:

$$\widehat{F}_{\bar{V}}(v^0) = \sum_{\min(\bar{X}-\bar{Y})}^{v^0} \sum_{\min(\bar{Y})}^{\max(\bar{X})} \widehat{f}_{\bar{X}}(\widehat{v}+\widehat{y}) \widehat{f}_{\bar{Y}}(\widehat{y}) \Delta y \Delta v \tag{12}$$

where min(.) and max(.) denote the maximum and minimum values and indicate the width of values X and Y, and "^" indicates that the distribution of values is a discrete approximation of a true underlying distribution. Equation 11 can be used for testing the null hypothesis: H_0: X-Y=0, since the distribution of the difference will generally not be known. The "percentile approach" by Efron (1982) for creating a lower and upper bound of a (1- a) confidence interval, as shown in the following equations:

$$\widehat{L}_{1-\alpha}(\widehat{v}) = \widehat{F}_{\bar{V}}^{-1}(\alpha/2) \tag{13}$$

$$\widehat{V}_{1-\alpha}(\widehat{v}) = \widehat{F}_{\bar{V}}^{-1}(1-\alpha/2) \tag{14}$$

where:

$$\widehat{L}_{1-\alpha}(\widehat{V}), \widehat{U}_{1-\alpha}(\widehat{V}) \tag{15}$$

is the approximate (1-a) central confidence interval for V.

The null hypothesis is accepted at the α level of significance if the approximate (1- α) confidence interval of the convolution equals 0 or otherwise rejected.

2.5 Potential Biases and Appropriate Design

Stated preference methods have certain weaknesses when used to value non-market goods (Hanemann, 1994). The main concern is whether the valuation exercise accurately estimates the real values of the individual or, in other words, if the distribution of the observed values are consistent with the true values (Morrison, and Bennett, 2004). Put in statistical terms, an unbiased estimator is necessary if the method is to be deemed useful. During the evolution of SP methods, certain techniques were used to eliminate bias. Despite improvements, SP methods, as well as all other methods, are still considered to not be completely free of bias. The following discussion identifies these areas for both CV (MBDC) and CM, and describes the methods employed to minimize their effects, when possible.

2.5.1 Information Bias

SP methods are designed to elicit information about a hypothetical scenario, and information is critical in order to evaluate the good in the situation desired. According to Boyle (1989), the key to the SP method is the exchange of information between the researcher and the respondent. This illustrates the importance of the information given by the researcher and emphasizes that the respondent is dependent on the information disclosed, either quantitatively or qualitatively. For instance, research performed by Samples, Dixon and Gowen (1986) established links between the disclosure of information about an animal (the endangered status, its physical and behavioral characteristics) on the willingness to pay of respondents to preserve it. This problem affects the mean estimates or the precision of both CV and CM methods (Boyle, 1989). Since SP methods are dependent on the information provided, it is possible to minimize the problem through the use of focus groups and pre-testing. This crucial step in the preparation of the questionnaire helps to refine the informational component and to

determine the appropriate vocabulary that results in the highest level of comprehension of the respondent (Dillman, 2000).

2.5.2 Starting Point Bias

Researchers discovered a relationship between the first price or bid suggested and the distribution of the estimates. Although the CV question format, specifically the iterative bidding format, was identified in the literature several years ago as suffering from this type of bias, the MBDC style of question was only demonstrated to have the same weakness in more recent work (Vossler et al., 2004).

The format of a MBDC question is a matrix where an explicit list of bids is presented against the levels of certainty. This format might invite the respondent to use a systematic method of choosing the certainty of a bid without reporting their true preference. This behaviour can be exacerbated by fatigue or impatience of the respondent (Carson and Mitchell, 1993). In all situations, the outcome of this behaviour affects the estimate. The problems in bid design can be classified into three main groups: the distribution of the bids around the median bid, the median bid itself, and the ascending or descending order of the bid.

The distribution of the bids has been considered to have an effect on the estimate by Roach et al. (2002) and Vossler et al. (2004) . It was in the aim of creating the most appropriate distribution that (Rowe et al., 1996) developed a mathematical method that used an exponential function of the form $(1+k)^{n-1}$ to generate a set of n bids, where $k>0$. This approach provides a bid design with intervals of values that increase at an increasing rate (Vossler et al., 2004).

The effect of the median bid on the estimate, also called the centering effect (Vossler et al., 2004) was related to the problem of "encouraging" the respondent to take the median value as their last acceptable bid and then switching from "yes" to "no" at this median point. This undesirable phenomenon would affect the mean and the distribution of the estimate. However, empirical work has concluded that the centering effect has not been found to be problematic when using the MBDC question format (Vossler et al., 2004).

Finally, the order of the bids, which can be either ascending or descending, has been documented over the years and recognized by the NOAA panel to have an effect. A descending order tends to induce higher estimates than an ascending order. It has been suggested that the ascending order should be encouraged in order to generate conservative estimates.

Starting point bias has not been documented in the literature of empirical CM studies. However, it is possible that the levels at which the price attributes are fixed creates biasness.

2.5.3 Embedding Effect

First described in 1992, the embedding effect is associated with the variation of willingness to pay values for a product described in CV when associated with a package of goods. The embedding effect has been controversial because several authors concluded that embedding was a problem that would discredit the use of CV (Kahneman and Knetsch, 1992). However, researchers have argued that the embedding effect occurs mainly when the questionnaire design is inappropriate and that the method CV is valid when used with well-prepared surveys (Carson and Mitchell, 1993, Randall, 1996). Also, according to Mitchell and Carson (1993), the embedding effect is "an ordinary phenomenon" (p.370) but inappropriate survey design or inappropriate application of CV can amplify the problem. Hanemann (1994) distinguishes between three types of embedding effects: sequencing, scope, and sub-additivity effects. The sequencing effect is related to the variation in the value of different goods when presented in a different order. The scope effect is related to the independence of the value given different quantities of one specific good. Finally, the sub-additivity effect is present when the sum of the values of the individual goods is greater than when this group is valued together.

Initially, the scope effect was the embedding effect that most researchers concentrated on because this was the one identified by Kahneman and Knetsch (1992). However, the sequencing effect, although it was recognized as being problematic (Carson and Mitchell, 1995, Smith, 1992), did not receive a lot of attention. It is recognized that if goods are valued in sequence, the later the good is ordered in the sequence, the lower the

value of that good (Randall and Hoehn, 1996). However some recent research has identified that there is a relationship between the good evaluated and the magnitude of this change. For example, Dupont (2003) used a split sample questionnaire design that divided respondents into three groups segregated by their use of the recreational activities: active, potentially active, and passive users. It concluded that passive users were more sensitive to scope effect than active users.

All of the previously cited research involved the valuation of an environmental good. The current research will explore the effect of sequencing on privately marketed goods. The three products will be positioned in six possible orders, and the WTP distributions will be tested for the presence of the sequencing effect and for their variability. Since the values of marketed goods are available, it is predicted that the effect of the sequencing should be small.

2.5.4 Hypothetical Bias

This is a generic problem that occurs with stated preference surveys when the respondent does not view the valuation exercise as possible or important. The two main effects possible are: an abnormal number of non-responses or, when the questions are answered, the responses do not reflect the real preference of the individual. In order to increase the interest of the respondent, different incentives can be used such as presenting the importance of the research, presenting the research as part of a recognized institution or providing some financial reward to the respondent (Dillman, 2000).

2.5.5 Strategic Bias

Strategic bias occurs when the respondent strategically modifies his/her responses in order to influence the conclusion in a desired direction. It can be done by exaggerating the acceptance of a bid in order to favour a certain policy. This behaviour would lead to false conclusions because the results would not reflect the true preferences of the individual. Therefore, the information presented in the survey becomes important because it can affect whether or not the respondent decides to act strategically. For example, the payment vehicle must be presented in such a way so that free riding is not possible.

Strategic bias can be exemplified in CV by strategically choosing an advantageous price. In the case of CM, strategic bias can take the form of systematically choosing a specific attribute or label without consideration of their real preferences.

2.6 Validity between Contingent Valuation and Choice Model

Comparisons have been made between the different methods in order to see whether the method affects the values estimated. The validation of these methods is usually made by comparing a pair of methods in order to assess the differences. There is no consensus on whether there are differences between the CV and CM methods. Following is a summary of the research for analyzing the differences between CM and CV.

Hanley et al. (1998) compared an open-ended CV with CM for the valuation of environmentally sensitive area and did not find any statistical differences. Lockwood and Carberry (1998) reached the same conclusion when comparing a dichotomous choice CV with CM for valuing remnant native vegetation conservation.

Chirstie and Azevedo (2009), using a referendum CV and CM, analyzed three programs to preserve and improve the quality of a lake's water and found evidences from their test of consistency between CV and CM data. Similarly, Foster and Mourato (2003), using a double bounded dichotomous choice CV and CM, valued the services provided by the charitable sector in the United Kingdom and found a difference between the values inferred by CM and those from CV.

A study by Cameron et al. (2002) compared seven elicitation methods, including CV (MBDC) and CM, using a split-sample design for the comparison. They concluded that there was no evidence of any differences in the elicited values between CV and CM methods.

Johnson and Desvousge (1997) designed a rated-pair stated preference model and used the Adaptive Conjoint Analysis (ACA) software. This program enables the experimental design to be modified as the respondent is answering questions. From the rating that respondents provided, the authors built a polychotomous choice model and dichotomous choice model. The former tended to have higher estimates than the latter

and the authors concluded that since the dichotomous choice model is similar to the CV method, CM gives a higher value than CV. However, the statistical difference between the CV and CM values was not tested.

A similar conclusion was reached by Steven et al. (1992). They compared three choice models where the third was a binary response model, similar to a referendum CV question and thus simulated a dichotomous choice model. They found that the two first models produced higher value estimates. Since the situation presented a market not directly accessible to most respondents (groundwater protection), the researchers concluded that CM tends to overestimate values compare with CV when it involves passive users.

2.7 Choice of Commodity

One interesting feature of this research is that a recent CM study using a similar questionnaire was undertaken in 2003 (Straub, 2004). The questionnaire was distributed to 500 respondents in the same geographical area, the island of Montreal. The products that were used in Straub's work were milk, tomatoes and chicken. In the present research, tomatoes, and milk remain but chicken was replaced by pork with the goal of observing whether or not transitivity of values is possible. In the choice modeling questionnaire, the changes in characteristics presented for chicken were kept for pork, in other words the label was changed but not the level of attributes of this label.

A fractional factorial design could not be used in the CV approach because the number of versions of the questionnaire would have been too large or the number of questions to be answered by any respondent would have been too many. As a result, the CV survey was designed to cover the same range of variation of some attributes of the food products as the CM survey. This was done by keeping some attributes constant while keeping a broad range of variation of other attributes. This design approach was used in order to allow comparison with the CM approach by providing the full range of some attribute values and keeping other attributes constant.

Chapter 3: Survey

Two questionnaires were designed for this experiment; each provided similar information to the respondent but differed in their respective elicitation format. This proved to be a challenge for the CV questionnaires because the products are not typically described by their attributes in CV studies. This extra information was presented in a way not to confuse the respondent. Following is a description of the two questionnaire designs.

The questionnaire format used for the CM experiment was similar to the one by Straub (2004) based on the initial design of Donaghy et al. (2003), a choice experiment conducted in Australia. The wording was modified to account for changes in information and product prices. The three products presented were milk, tomato, and pork. These products were chosen because they are products that most people consume and are generic foods. Although pork is not consumed by Jewish and Muslim communities, it was interesting to investigate consumers perception because hog production has been the subject of great debates in Quebec for the past decade. These debates were related to the effect of this production on the environment. The prices presented were those in the market at the time. The levels of prices and attributes are presented in Appendix 1. The CM questionnaire was separated into three sections; the first section contained questions related to the perceptions of food and purchasing habits, the second had the choice modeling questions and the third was related to the perception of government and their demographic background. The second section contained nine choice questions divided among the three products.

The CV questionnaire was composed of the same basic sections, the second section contained 12 questions in CV format. The format of these questions was inspired by previous CV questionnaires and was refined through pre-testing and focus group testing. Two pre-tests were performed in order to verify the clarity of the instructions and the scenarios proposed. The CM experiment provided a mix of product attributes that resulted in a total of 42 choice sets being described. Such a large number of commodities could not be used in the CM approach because it would have resulted in respondent

fatigue. Since it was impossible to implement all the possible combinations in the choice experiment, specific combinations of characteristics were selected for all the questionnaires using fractional factorial design. It resulted in 14 different choice sets used for a similar number of questionnaire version. Although the informational power of CV is lower when compared to CM, the products were described with the same attributes and having the same respective levels as the CM experiment. Since the product characteristics were similar, it was possible to simulate a product with the same characteristics using choice modeling and compare it with a similar product with CV survey. This process will be explained in greater detail in chapter 4.

For the CV questionnaire, the product was presented with its set of characteristics and compared to the status quo, which was the conventional product with a price that reflected the market price at the time (see Appendix 1). The bids increased at an increasing rate and decreased at an increasing rate. This was based on the methods used by Rowe et al. (1996), but the prices were rounded to the nearest cent.

The 12 CV questions were divided between the three products and were described according to their attribute levels. The conventional price was given while the bid prices offered provided a large enough range to minimize the number of uncertain responses at the maximum and the minimum bid levels. In addition, respondents were given the option of refusing the product proposed in the scenario. This option was included in the CV questions to be consistent with the choice modeling questionnaire, which allowed the respondent to effectively make the same decision by choosing the status quo product.

3.1 Fractional Factorial Design and Versions

The total number of profile combinations in the CM experiment was high ($4^3 * 3$ versions= 192 profile combinations). As a result, a fractional factorial design was used. Using the JMP software, 14 versions of the questionnaire were created, which was the smallest fractional factorial design possible. This number of versions formed a complete design for the analysis of main effects interaction. A matrix of the 14 versions and their levels is provided in Appendix 3.

For the CV method, in addition to the design of the questionnaire, two other factors were evaluated. The first was the effect of bid order. For the evaluation of this effect, half of the questionnaires had an ascending bid order and the other half had a descending bid order. The second effect tested was the sequencing effect of the questions. To test this effect, the products were combined in all possible sequences, thus generating 12 versions. The characteristic of each version is shown in Appendix 4. To summarize, a total of 14 versions of the CM questionnaire and 12 versions of the CV questionnaire were designed, in both French and English, for a total of 52 versions.

3.2 Pre-testing

According to Dillman (2000), the pre-testing phase of the questionnaire design is extremely important for a successful questionnaire. Corrections made to the CV questionnaire during this phase of the design results in clearer instructions and a better understanding of the surveyor's expectation from the respondents. This process was conducted by randomly choosing people from different demographic backgrounds and asking them to complete the questionnaire in a controlled environment.

3.3 Distribution of Questionnaires

3.3.1 Sampling

The experiment was conducted on the island of Montreal. A total of 1,000 questionnaires were distributed, 500 CV and 500 CM. In order to have a representative sample, the neighborhoods were divided into 10 different groups according to their socio-demographic characteristics. Table II in Appendix 5 provides a summary of the groupings and their weights. The two types of questionnaires were then randomly distributed among the population.

3.3.2 Survey Distribution Procedure

The distribution was made between March 1st and April 31st 2007 and was conducted using a drop-off pick-up method, which involved a personal elicitation at the door of household residences. The starting point of the distribution in the surveyed region was randomly determined, and the surveyor approached the individual at the door of the home. After a brief explanation of the purpose of the research, the surveyor gave a questionnaire to the respondent, assuming he/she agreed to participate, and informed the respondent of the pick up date. If a household accepted the questionnaire, the next house/unit approached was three doors away in order to avoid a concentrated sample from a small geographic area. If the individual refused to participate, the surveyor moved on to the next house. Residents in apartment buildings with five or more stories were not surveyed because surveyors did not have access to them. This can be seen as a limitation of the survey distribution procedure since it excluded a fraction of the population and will be discussed further in chapter 4. Despite any limitations in this type of distribution method, the response rate was higher compared to telephone or mail based surveys.

3.3.3 Collection Procedure

The collection of the surveys was generally made four days after the distribution. If the respondent did not complete the questionnaire, a grace period of three days was granted before a second collection was made. Two novel techniques were employed during the distribution method to increase the likelihood that the questionnaire would be completed and returned. First, a pre-determined date of the first pick-up was printed directly on the envelope to serve as a reminder to the individual. Second, if the respondent was not present on the first collection date, a note would be left informing him/her when the second pick-up would take place. This note also served to inform the respondent that he/she could leave the questionnaire in the mailbox if not available on the second pick up date. Although, no statistics were collected regarding the use of these techniques, they appeared to substantially improve the return rate of the questionnaires.

Chapter 4: Results and Analysis

In the first section of this chapter, a description of the sample is presented. An analysis of the results from the Likert scale questions are given in section 4.2. Sections 4.3 and 4.4 provide the statistical analysis of the CV and CM data, respectively. In order to compare results and perform validity tests, compensating variation values were calculated for the CM and CV data, as described in section 4.4. Finally, the results of the validity tests are presented in section 4.5.

4.1 Response Rate and Related Statistics

One thousand and fourteen surveys were distributed, of which 782 (77%) were returned. Of those returned, 407 (80%) were CM responses and 375 (74%) were CV responses. Table 1 provides a summary of the distribution and response rates. These rates were in the expected range and were consistent with those of a recent study by Straub (2004) using a similar distribution method. It is important to note that the response rates were based on the number of people who agreed to answer the questionnaire and not on the total number of people approached. This makes it difficult to compare the response rates from this survey with those of a mail or telephone survey, whose response rates typically include individuals who refuse to answer the questionnaire.

Table 1: Response rate

Survey Type	Total Distributed	Returned	Usable
CV	507	375 (74%)	257 (51%)
CM	507	407 (80%)	388 (77%)

Some of the returned questionnaires were could not be used in the analysis. Only 257 (51%) of the CV surveys had all of the necessary information and were able to be

used in the regression analysis. Many of them were discarded due to missing background information. Of the usable questionnaires, only two exhibited an irrational valuation scheme, where the respondent consistently chose the higher priced option over the lower priced one. Since it was very likely that these two respondents did not fully understand the questions and since their responses represented a negligible amount of the total responses, these questionnaires were discarded. The small number of irrational valuation responses suggests that the large majority of respondents who answered the questionnaire understood the instructions. Fewer CM responses were excluded due to incomplete responses. In total, 388 (77%) CM questionnaires were able to be used for the final analysis.

The lower response rate of the CV survey is not entirely understood, however three factors were identified as having a possible impact. First, CV surveys are considered to be cognitively more demanding than CM surveys due to the format of the questions (Louviere, 2000). CV questions ask respondents to place a value on a good; similar to bidding at an auction, and this is a more difficult task than those presented in CM questions, which simulate the kind of decision made at the supermarket, i.e. choosing a single good from among a selection of goods with different characteristics. Second, the CV questionnaire required approximately five more minutes to complete than the CM questionnaire. The time required to complete the CM questionnaire was estimated to be 20 minutes as opposed to 25 minutes for the CV questionnaire. According to Dillman et al. (1993), the length of the questionnaire can significantly impact the response rate. The casual observation of the CV questionnaires shows a general pattern where respondents return the questionnaire without answering the last section. The background information questions, essential for the analysis of the CV survey, were in the last section of the questionnaire and were left unanswered in 23% of the cases. Finally, the format of the CV question required a larger number of answers than the CM question. Using the MBDC approach, one CV question required twelve responses as opposed to one for the CM question. It is possible that the greater number of required responses induced survey fatigue earlier in the answering process and thus impacted the number of completed questionnaires.

4.2 Statistical Similarity between CV and CM Samples

It was expected that the two samples would be statistically similar because the distribution of questionnaires was completely randomized among the population sampled. Statistically similar samples for the two surveys are required for the validation tests to be meaningful. Table 2 presents a comparison of the socio-demographic characteristics of the two samples.

Table 2: Comparison of the socio-demographic characteristics of the samples

Socio-Demographic Characteristic	Variable name	Value	Code	CVM (%)	CM (%)	chi^2 value	P value
Language	lang	English	0	51	54		
		French	1	49	46		
				100	100	0,3623	0,547
Gender	gen	Female	0	66	63		
		Male	1	34	37		
				100	100	0,3861	0,534
Work Status	wkt	Employed	1	57	64		
		Unemployed	2	3	2		
		Retired	3	22	19		
		Student	4	10	8		
		Home duties	5	8	7		
				100	100	2,3822	0,666
Education Level	edu	Primary	1	1	0		
		High school	2	19	17		
		Certificate	3	30	29		
		Bachelor	4	30	33		
		Graduate	5	20	21		
				100	100	0,8842	0,829
Income Level	inc	Less than $10,000	1	1	2		
		$10,000-19,999	2	2	2		
		$20,000- 29,999	3	4	6		
		$30,000- 39,999	4	13	12		
		$40,000- 49,999	5	14	13		
		$50,000- 74,999	6	22	18		
		$75,000- 99,999	7	17	18		
		$100,000-124,999	8	13	11		
		$125,000 or more	9	14	18		
				100	100	3,5239	0,897
Grocery Spending	grsp	less than $90	1	9	11		
		$90-119	2	23	20		
		120- 149	3	23	20		

		$150- 189	4	18	20		
		$190- 210	5	12	14		
		$210 or more	6	15	15		
				100	100	1,7494	0,883
Age Level	age	18-24	1	7	8		
		25-34	2	12	11		
		35-44	3	23	22		
		45-54	4	23	27		
		55-64	5	19	20		
		65+	6	16	12		
				100	100	2,2373	0,815
Donation to environmental group	don	No	0	39	40		
		Yes	1	61	60		
				100	100	0,0417	0,838
Purchase Organic Habits	po	Never	1	24	26		
		Less than 1 product per week	2	39	42		
		Between 1 and 3 products per week	3	26	21		
		Between 4 and 10 products per week	4	9	10		
		As much as possible	5	2	1		
				100	100	2,6586	0,616
Househod Size	hsld	Number of people in the household	1	7	10		
			2	36	27		
			3	22	20		
			4	25	27		
			5	9	10		
			6	1	4		
			7	0	1		
			8	0	1		
				100	100	28,9886	0,08

However, due to the sampling method and the data collected, there is no statistical similarity between the samples and the population. Table 3 and the statistical analysis that follows describe how the samples differ from the population and attempt to provide an explanation as to why this is the case.

Table 3: Comparison of specific socio-demographic characteristics of the samples and the population

		2006 CENSUS (%)	Sample (%)	chi^2 value	P value
Language	0 (English)	31	48		
	1 (French)	69	52		
		100	100	11.5785	0.001
Gender	0 (female)	52	65		
	1 (male)	48	35		
		100	100	7.4286	0.006
Age	1 (18-24)	11	7		
	2 (25-34)	19	12		
	3 (35-44)	19	22		
	4 (45-54)	18	25		
	5 (55-64)	14	20		
	6 (65 +)	19	14		
		100	100	12.3239	0.03

Language

Each respondent who agreed to participate in the survey was given a questionnaire in his/her preferred language, either French or English. With more than half of the Montreal population being bilingual, 56% according to the 2006 Census (Statistics Canada, 2006), the language of the questionnaire is not considered to be a particularly useful indicator. The sample is statistically different (χ^2=11.579, p=0.001) from the population. Casual observation during the distribution of the questionnaires suggested that the choice of language was dependent on the language that the surveyor was most comfortable using to converse with the respondent. In addition, the questionnaire was available in only two languages, which limited the information that can be gleaned from this socio-demographic characteristic. Note that the language distributions of the CV and CM samples were statistically similar (χ^2=0.362, p=0.547).

Donation to environmental groups

This question was placed in the survey to identify the level of an individual's environmental awareness, and the collective responses estimated the proportion of the sample that voluntarily participates in environmental initiatives. When used as a model variable, this proxy for environmental awareness served to detect any relationship between the level of environmental commitment and the willingness to pay for specific product attributes. Approximately 40% of the respondents declared that they had donated to an environmental group in the past. For this characteristic, the two samples were statistically similar, according to a Chi square test (χ^2=0.0417, p=0.838).

Gender

A higher proportion of females (65%) answered the questionnaire as compared to males. This indicates that more women have the responsibility to purchase food for the household. However, the response to this question does not reveal the gender composition of the household and therefore it is not a good indicator of the gender distribution for the population in Montreal. As a result, the statistical difference in gender composition between the sample and the population was expected (χ^2=7.429, p=0.006). Nevertheless, the samples were statistically similar (χ^2=0.386, p=0.534). Upon reflection, it is clear that this question could have been better designed to identify the gender of the person who is the most responsible for food purchases in the household.

Average household size

The average household size provides information on the type of household surveyed. According to the information gathered, the average household size of the two samples is larger than that of the population. This may be explained by the types of households surveyed. The survey was not administered to apartment buildings with more than five stories because their access is usually restricted. This introduced bias into the sampling method because a certain part of the population was systematically avoided. Information from the Census (Statistics Canada, 2006), suggests that apartment buildings with more than five stories are occupied by households of smaller size. The average

household size of the two samples was statistically similar according to the Chi square test (χ^2=28.9886, p=0.08).

Income level

Income is a determining factor in the choice of food products because its level impacts the quantity and quality of goods that a consumer can purchase. It was expected that the sample would have a higher average household income than the population. This was because the sampling technique focused on surveying geographic regions that contained more single family homes, leaving apartment blocks underrepresented. According to the Chi Square test (χ^2=3.52, p=0.897) the two samples were statistically similar.

Age

Age is an important factor in food consumption. Different age groups have different nutrient requirements and attitudes toward food. This will impact food purchases. There was no statistical difference between the two survey samples (χ^2=2.23, p=0.815) in term of age distribution. However, as expected, the age of the surveyed samples was statistically different from the population (χ^2=12.324, p=0.03). Casual observation suggests that younger individuals were not as willing as older individuals to accept the survey.

Grocery expenditure

The share of income spent on groceries can indicate the relative importance of food quality. For instance, all things being equal, a household that buys organic food products will allocate more income to food than a household that buys conventionally produced food products. If a consumer feels that it is important to eat food that contains specific characteristics, then he/she should be willing to pay a higher price for that product. This would be reflected in their total grocery expenditure. Obviously, grocery expenditures are also a function of the size of the household. However, this principle applies to households of similar sizes. The weekly grocery expenditure values of the two samples were statistically similar (χ^2=1.74 p=0.883).

Organic purchases

The organic purchase variable is a proxy for information on the grocery purchasing habits of consumers. This information is similar to the donation to environmental groups variable, but it is related to food purchases. Based on a Chi-square test (χ^2=2.65, p=0.616), the values from the two samples were statistically similar. For the majority of the respondents, the consumption of organic products represents a small fraction of their food basket (89% of the respondents consume four organic products or less per week).

Working status

The working status question was included in order to approximate the level of income available. The two samples were not statistically different in this regard (χ^2=2.38, p=0.666)

4.3 Likert Scale - Analyzing opinions

Before answering questions related to the value of products, the respondents were asked to comment on the importance they assign to different food characteristics. A Likert scale was used for these questions. This is an ordinal scale that provides an indication of the importance that consumers give to each characteristic. It is possible to determine the importance of characteristics by aggregating the importance each individual places on the specific characteristic. The results from these questions were compared to the results of the valuation exercises undertaken with the CM and CV analysis in order to test for consistency (see section 4.2.3).

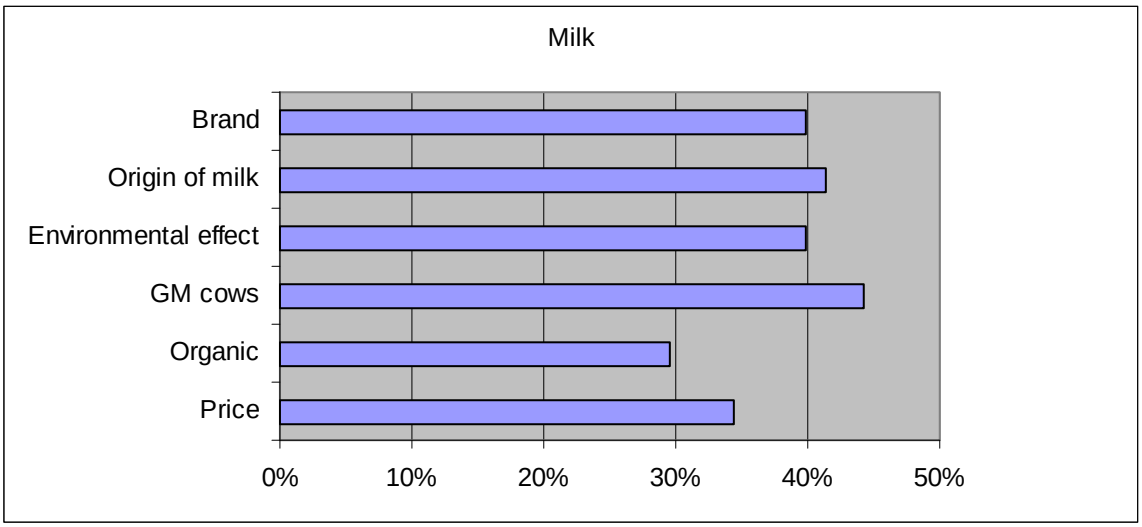
Not all of the characteristics proposed in the Likert scale question were realistic. For example, milk from genetically modified animals was given as an option in the questionnaire as if it were currently available to consumers. Even though this product does not exist in the market, consumer responses to it can help to forecast future response if such a product were to be made available.

To gauge the importance of a characteristic, the percentage of respondents who stated that the characteristic was considered 'important' or 'very important' was calculated. The most important characteristic varies for each product, although they seem to be mostly related to health. For example, pork from animals given antibiotics and milk from a GM source were ranked first, in terms of importance. The price and the brand of the products were less important. This reflects a trend that food safety is more important to consumers than other attributes of the products. The most important characteristics and their implications for each product is given below.

Milk

The most important characteristic for consumers was the presence of GM in the production of milk (44%). Although milk production in Canada does not allow for the use of GM cows, the results show a strong opposition to GM in milk. The second most important characteristic was the location of production (41%). According to Ipsos Reid (2008), locally grown products are considered to be a component of the 16 most popular trends in consumption for 2007 and 2008. Some factors that explain the importance given to locally grown produce include: fresness, socially favourable in terms of supporting local economies, and the increased awareness of the greenhouse gas emissions that result from the transportation of food.

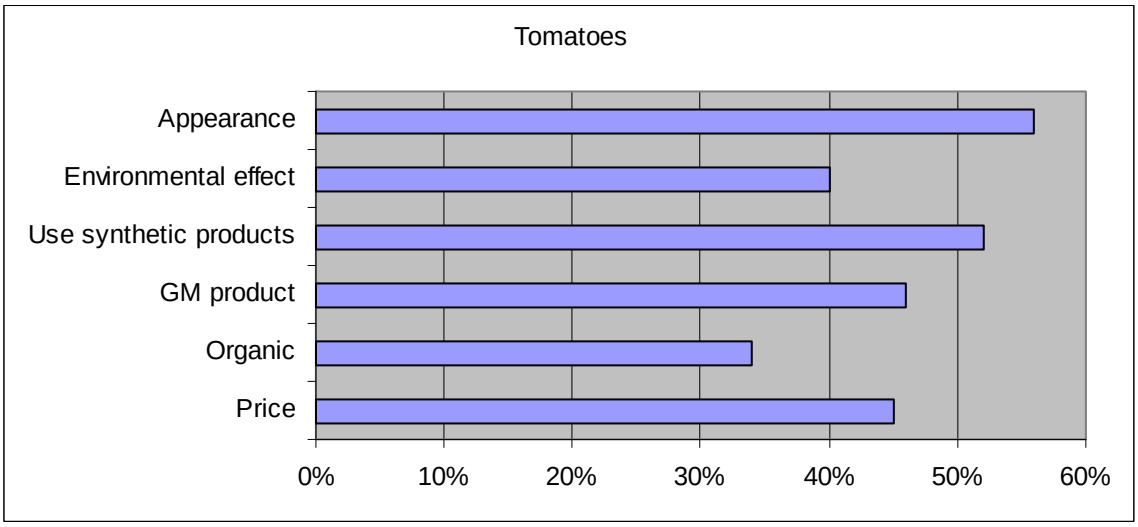
Figure 1: Importance of the different attributes for milk according to the Likert scale



Tomatoes

For tomatoes, the most important characteristic was the appearance of the product (56%). Since vegetables are usually sold without packaging, the best indicator for evaluating the freshness of the product is the appearance. The second most important characteristic was the use of synthetic products (52%) in tomato production. No definition of 'synthetic products' was provided in the questionnaire. According to several comments written in the questionnaire, the term was subject to personal interpretation and therefore may have caused confusion. Synthetic products are generally defined as inputs, mainly fertilizers and pesticides that are synthesized industrially. The only agricultural system of production that bans the use of synthetic products is organic (Salha and Robitaille, 2005). The high proportion (52%) of respondents that consider it important to avoid such products is not reflected in the proportion of people that buy organic products[1]. This demonstrates that consumers have a the negative perception of the word 'synthetic', as opposed to 'natural', without necessarily having a clear understanding of their differences.

Figure 2: Importance of the different attributes for tomatoes according to the Likert scale

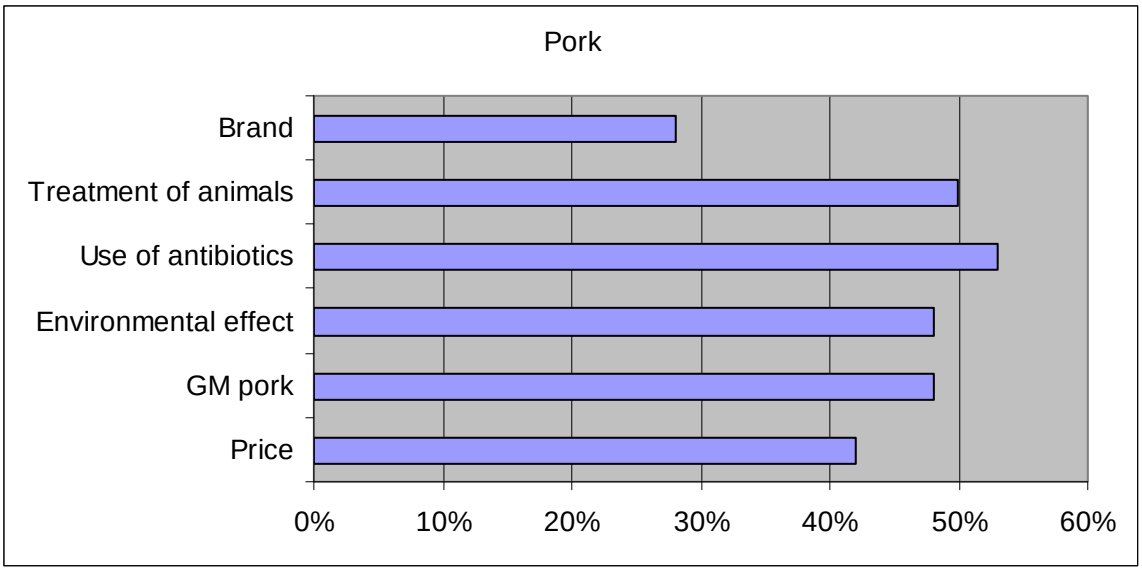


[1] Only 11% of the respondents declared that they buy more than 4 organic products per week.

Pork

The most important factor for consumers when making purchasing decisions for pork was the use of antibiotics (53%). However, this was not typically an identifiable characteristic on the average supermarket shelf because few pork producers offer this type of product. Furthermore, the large majority of supermarkets do not offer pork from animals raised without the use of antibiotics. A visit to the Jean-Talon Market, a public market in Montreal showcasing specialty food vendors, revealed that only two retailers stocked this type of pork. All of the methods of production presented in the survey, including organic, the most restrictive production system, allows for the use of antibiotics. The use of antibiotics is customary in animal husbandry operations because it helps to prevent loss in the quantity and the quality of production. For consumers, the word 'antibiotics' may have a negative connotation, and products from animals treated with antibiotics may be considered as not being 'natural', which is an important issue to consumers according to food marketing researchers. The second most important characteristic was the treatment of the animals (50%). This characteristic is also not easily identifiable in the market place because hog producers rarely promote their products with descriptions of the living conditions of the animals.

Figure 3: Importance of the different attributes for pork according to the Likert scale



4.4 Comparison between CV and CM

Due to their modeling differences, the willingness to pay values generated from the two methods could not be directly compared. Instead, a comparison was made between the WTP values from the CV data and the *simulated* WTP values extracted from the CM analysis. The values derived from each method will be explained and analyzed in the following section. In order to perform the most accurate comparison, the specifications of the CV and CM models used the same explanatory variables. In both cases, the independent variables were not always found to be significant, but refining the models to include only the statistically significant variables would have made the models inappropriately simplistic and lowered their explanatory power.

Missing information was treated similarly for both survey approaches. Observations were drop from the analysis if information related to the socio-demographic background, the choice of the food product in the CM survey, or the price information from the CV survey was missing. This decreased the number of observations; however, the sample size permitted this method to be used. Treating missing information from both surveys in a similar manner ensured that variation in the results was due to the treatment of missing data.

4.4.1 CV

The model was designed to estimate the value that a consumer would be willing to pay for the product presented with a set of specific characteristics. Unlike CM, CV models can only estimate the WTP value of the product presented; it is not possible to infer the implicit price of each individual attribute of the presented product. This can be seen as a weakness of the CV method. To account for this weakness, the CV scenarios focused on the variation of one or two attribute per product, so that a comparison could be made between the same products with different attributes levels.

The scenarios in the questionnaire were always presented with a status quo product, which was a conventional product with the current market price. A GM option

was only offered for tomatoes because pork and milk from GM sources are less likely to appear in the market in the foreseeable future. Also, Straub (2004) concludes that consumers in Montreal have a low acceptability rate for GM labeled products, and therefore this valuation exercise did not put a lot of emphasis on this label since the rejection rate was expected to be high.

The model was constructed with eight independent variables that were thought to have an effect on the dependant variable. In order to have consistent comparison, the same values were used for the CM models. The description of the variables and their values are presented in table 2. The model used for valuing the product had the following form:

WTP= f(age, don, hsld, wkt, inc, grsp, lang, po)

Where:
age = age of the individual
don = whether the individual has made donation to environmental groups
hsld = the number of occupant of the household
wkt = the work status of the respondent
inc = the income of the household
grsp = the average expenditure on grocery
lang = the language of response of the respondent
po = the level of consumption of organic products of the household

4.4.1.1 MILK

There were four questions related to milk products. Table 4 shows the differences between the scenarios presented to the respondents. The price of conventional milk was given as $2.75/2 L, which was the market price at the time of the survey. Only the EMS and Organic labels were presented for the milk scenarios. For scenarios 1 and 2, the attribute levels were varied for both the ‘environmental impact’ and the ‘location of

production' attributes. For scenarios 3 and 4, only the 'Environmental impact' attribute level was modified.

Table 4: CV milk scenarios and their respective attributes levels

Scenario	Product	Risk to human health	Environmental impact	Location of production
1	EMS	No change	10% decrease	Outside of Canada
2	EMS	No change	25% decrease	In Canada
3	Organic	No change	15% decrease	In Quebec
4	Organic	No change	25% decrease	In Quebec

Table 5 presents the WTP values generated by a convolution routine using the GAUSS program. Comparing scenarios 1 and 2, milk produced outside of Quebec is less attractive to consumers, as shown by the mean WTP values of $2.41 for milk produced 'outside of Canada' and $3.20 for milk produced 'in Canada' (yet outside of Quebec). The values calculated in scenarios 3 and 4 show that the 10% difference in 'environmental impact' did not have a significant impact on the WTP values. Also, the mean WTP value for milk produced outside of Canada is $0.29 below the price of the conventional product. This demonstrates the importance that consumers give to products produced in Canada.

The change in 'environmental impact' between scenarios 3 and 4 did not have an impact on the willingness to pay, and this could be considered a scope effect because the unique variation between the two scenarios is the decrease from 15% to 25% in environmental impact. Lack of sensitivity to scale has already been identified as a potential issue with the CV method (Foster and Mourato, 2003). It is also possible that an improvement above 10% did not provide marginal benefits for the consumers thus leaving the WTP value static.

Table 5: Mean WTP values for the milk scenarios

Scenario	Hanemann WTP estimate	Standard deviation	Log likelihood	Wald statistics
1	2.4078	0.0764	966.0272	202.8461
2	3.1958	0.0550	1056.0679	278.9138
3	3.5074	0.0599	1044.9908	291.0423
4	3.5088	0.0597	1043.6344	291.2783

Table 6 reports the values of the coefficients in the CV model for the four milk scenarios. The explanatory variables do not exhibit a constant pattern across the four scenarios. In scenario 1, answering the questionnaire in French (lang), having previously donated to an environmental group (don), and spending a greater amount of money on food purchases has a negative impact on the chance that the respondent is willing to pay a higher price for a product containing the attributes of scenario 1. This suggests that consumers that attach importance to the environment demonstrate an aversion for commodities produced outside of Canada. In other words, the motivation for consuming locally produced food products may be related to environmental concerns. The role of the variables in the model used for Scenario 2 is more ambiguous, as not one is statistically significant. However, for scenarios 3 and 4, the same variables are significant. Having a higher income (inc) and a greater frequency of purchasing organic products increases the chances that the WTP value is higher. On the other hand, having a larger household (hsld) and being older (ag) negatively impacts the likelihood that the respondent is willing to pay a higher price. The former result is somewhat expected because a larger household size increases the pressure on the household budget and lowers the amount of income available for food commodities. Older respondents show less interest than younger respondents in the 'environmental impact' attribute, which could be attributed to the increased environmental awareness among the younger generation.

Table 6: Estimated CV coefficients for milk scenarios[a]

	Scenarios			
variable	1	2	3	4
const	4.4823**	6.0019	5.6782**	5.6547**
lang	-0.6688**	0.2844	0.2638	0.2191
don	-0.4764*	-0.3426	0.0986	0.1362
inc	0.0594	0.0109	0.1745**	0.1540**
grsp	-0.1805**	0.0552	0.0735	0.0772
ag	-0.1291	-0.0725	-0.1892**	-0.1801**
po	0.1283	0.1304	0.2523**	0.2420*
wkt	-0.0527	0.2691	0.2518	0.2797
hsld	-0.0532	-0.0693	-0.2427*	-0.2485**
bid	-1.5188**	-1.9414**	-1.7962**	-1.8013**

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

4.4.1.2 TOMATOES

Four scenarios were presented concerning the consumption of tomatoes. Table 7 outlines the details for each scenario. The only two labels presented were GM and EMS.. Scenario 1 introduced a small change in both the 'risk to human health' and 'environmental impact' attributes, while scenario 2 presented a significant change in 'risk to human health' without any modification to the 'environmental impact' attribute. Scenarios 3 and 4, labeled EMS, differed only in the 'appearance' attribute level in order to detect the impact of a decrease in appearance. The price of conventional tomatoes was $4.00/kg.

Table 7: CV tomato scenarios and their respective attributes levels

Scenario	Product	Risk to human health	Environmental impact	Appearance
1	GM	5% increase	5% increase	15% increase
2	GM	15% increase	No change	15% increase
3	EMS	15% decrease	No change	15% decrease
4	EMS	15% decrease	No change	No change

As shown in Table 8, many respondents choose not to buy the products that increased risk to human health. This suggests that an increased risk in health was unacceptable. Several comments from the respondents confirm this perception. For scenarios 1 and 2, the respondents who opted not to buy the product were significant; 78% and 81% respectively. There were also some respondents who choose not to buy the tomatoes presented in scenarios 1 and 2 because they were labeled 'genetically modified'. One can conclude that the GM option was rejected due to the negative perception of the label itself. Scenario 1 has a higher mean WTP than scenario 2. The attribute 'risk to human health' is still significantly lower than that in scenarios 3 and 4. The 5% increase in health risk had a smaller rejection rate than scenario 2. In scenarios 3 and 4, the difference is in the 'appearance' attribute. The difference in the mean WTP for an EMS tomato that had a 15% decrease in appearance was $0.12. Scenario 4 describes a tomato that is similar to the status quo tomato except for a 15% percent decrease in health risk. The mean WTP for this attribute is $0.37 as compared to the status quo good. In conclusion, the GM labeled tomato was rejected not only because of the hypothesized increase in health risk but also because of the negative perception that consumers have of GM foods.

Table 8 : Mean WTP of tomato scenarios

Scenario	Hanemann WTP estimate	Standard deviation	Log likelihood	Wald statistics
1	2.8713	0.1172	512.9343	70.0417
2	2.6966	0.1500	466.1615	58.5492
3	4.2512	0.0379	1095.7271	279.7539
4	4.3723	0.0446	1125.4445	278.0489

For the tomato scenarios, the GM label appears to exhibit no explanatory impact on the model. This may be explained by the high rejection rate of the GM label. The rejection of the GM label is not associated with any specific demographic characteristic. For scenarios 3 and 4, the individuals who decided to respond in French (lang), had larger

income (inc) and, who purchase more organic products (po) tend to be willing to pay a higher price for EMS products. The variable age (ag) was significant only for the fourth scenario. The variable that had a significant negative impact was the size of the household. Therefore, the availability of income seems to be an important factor affecting food purchasing decisions. Individuals that are interested in organic products seem to consider the EMS label as a good alternative. Also, those who responded in French were more sensitive to the risk to human health attribute.

Table 9: Estimated CV coefficients for tomato scenarios [a]

	Scenarios			
variable	1	2	3	4
const	7.3238**	6.1586**	9.9950**	9.3873**
lang	-0.2184	-0.0489	0.3753*	0.4003*
don	-0.2474	-0.3815	0.1081	0.0424
inc	0.0350	0.0042	0.2039**	0.1983**
grsp	-0.1081	0.0161	0.1336	0.0913
ag	-0.1623	-0.0261	-0.0514	-0.1675**
po	-0.1549	-0.1124	0.3923**	0.2742**
wkt	-0.4612	-0.3482	0.3361	0.1340
hsld	-0.0187	-0.1968	-0.2005*	-0.2126*
bid	-2.0090**	-1.8102**	-2.8606**	-2.4148**

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

4.4.1.3 PORK

The respondents were presented with four scenarios for pork (Table 10). The two labels presented were EMS and Organic. Scenarios 1 and 2 differ in 'risk to human health' and 'environmental impact', while scenarios 3 and 4 differed in three attributes. The status quo product was conventional pork at $8.00 per kilogram.

Table 10: CV pork scenarios and their respective attributes levels

Question number	Product	Risk to human health	Environmental impact	Animal Welfare
1	EMS	No change	No change	15% improvement
2	EMS	15% decrease	15% decrease	15% improvement
3	Organic	No change	No change	15% improvement
4	Organic	15% decrease	15% decrease	No change

Table 11 presents the mean willingness to pay for the four scenarios. Scenarios 2, 3, and 4 have a significant price premium. In contrast, scenario 1 exhibits a lower willingness to pay than the status quo product. This could have occurred because the EMS label was not considered by the respondents to have an impact on animal welfare, as compared to the organic label. The organic label (scenario 3) had the same product attribute levels but had a willingness to pay of $8.26, which is $0.26 greater than the status quo product. The difference between scenarios 2 and 4, is the animal welfare attribute. The EMS option has a 15% improvement in animal welfare which explains why it has a higher WTP value than the organic option that has animal welfare at the status quo level. This indicates that consumers are willing to pay for animal welfare improvements when the attribute is carried by the organic label.

Table 11: Mean WTP of pork scenarios

Scenario	Hanemann WTP estimate	Standard deviation	Log likelihood	Wald statistics
1	7.9831	0.1194	1179.8113	249.0124
2	8.7193	0.1586	1081.9093	255.3601
3	8.2550	0.1264	1139.5694	256.9908
4	8.5482	0.1381	1118.2415	259.1068

The models for the different scenarios are given in Table 12. Income (inc) has a positive impact on the chance of choosing a higher bid. This is the only significant explanatory variable that has a positive impact on the price across the four scenarios. This

would suggest that higher income is a positive factor increasing the willingness to pay for pork attributes perceived to provide benefits. Older consumers (ag) are less likely to choose a higher bid and are therefore less sensitive to improvements in the attributes presented.

Table 12: Estimated CV coefficients for pork scenarios [a]

	Scenarios			
variable	1	2	3	4
const	7.2793**	5.1515**	6.7673**	5.5951**
lang	0.2090	0.2639	0.3024	0.4613**
don	0.0871	0.1074	0.1961	-0.0480
inc	0.1185*	0.2322**	0.1691**	0.2489**
grsp	0.1760*	0.0843	0.1051	0.0912
ag	-0.2327**	-0.1882**	-0.2030**	-0.1050
po	-0.0365	-0.0628	-0.0140	-0.0588
wkt	0.1608	0.0788	0.2139	0.0970
hsld	-0.1575	-0.0759	-0.1792	-0.1413
bid	-0.9186**	-0.6904**	-0.8680**	-0.7884**

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

Income (inc), age (ag), household size (hsld) and frequency of organic purchases (po) were the explanatory variable that were statistically significant across the various models. Higher income increases the WTP for products with improved attributes, while an increase in household size decreases the WTP for the same products. This was expected since food expenditures account for a significant portion of a household budget in large families. Also, respondents that buy more organic products are more sensitive to the improved attribute levels presented and this interest is reflected in their WTP values.

When a label is controversial (i.e. GM) or the product contains attributes that are generally unpopular (i.e. produced in other countries), there are no explanatory variables that are significant. This can be explained by an overall rejection by a large percentage of the sample, no matter the demographic background of the respondents. The results indicate that respondents prefer food that is locally produced. If GM products were labeled in the market, the results indicate that a large portion of the sample would want to avoid them even if they offer improvements in other attributes.

4.4.2 CM

The results of the CM analysis are different from those derived from the CV analysis. The values derived from the models are implicit prices and not WTP values. To allow the comparison with CV results, the implicit prices are transformed to WTP values. The informational power of the CM method is higher and therefore allows for the inference of implicit prices. The following section provides information about CM. For each product, two models were specified; the first is a basic model, Model 1, without any explanatory variables other than the product attributes. The second model; Model 2, includes the product attributes and the same explanatory variables used in the CV analysis[2]. The base model is used as a point of comparison and its goodness of fit is measured using the log likelihood ratio (Hensher et al., 2005).

4.4.2.1 MILK

Model 1 for milk has the following form:

$$V_{Conv} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside}$$
$$V_{GM} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{GMHealth} + \beta_6 Z_{GMEnvironment}$$
$$V_{EMS} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{EMSHealth} + \beta_6 Z_{EMSEnvironment}$$
$$V_{ORG} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{ORGHealth} + \beta_6 Z_{ORGEnvironment}$$

In this model the regional coefficient was treated as a generic attribute. Although four locations of production were distinguished in the questionnaire, the attribute 'In Quebec' was not included in the model. Since generic attributes are represented as dummy variables, for the purposes of estimating the coefficients, one of the four attributes must be excluded from the model to ensure orthogonality. The excluded coefficient, 'in Quebec', is also associated with the status quo product. Assigning 'In

[2] A third model was built for each product with only the significant explanatory variables. Since the goodness of fit of this model was never better than that of model 2, it is not included in this discussion and instead these results are presented in Appendix 6.

Quebec' as the status quo attribute is a reasonable assumption because importation of raw milk from other provinces is limited (FPLQ, 2008). The attributes *risk to human health* and *impact on the environment* were analyzed with the help of labels that evaluated the perception the respondents have for the label itself.

Model 2 for milk takes the following form:

$$V_{Conv} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside}$$

$$V_{GM} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{GMHealth} + \beta_6 Z_{GMEnvironment}$$
$$+ \beta_7 Z_{GMAge} + \beta_8 Z_{GMDonation} + \beta_9 Z_{GMHouseholdsize} + \beta_{10} Z_{GMEmployed}$$
$$+ \beta_{11} Z_{GMIncome} + \beta_{12} Z_{GMFoodExpenditure} + \beta_{13} Z_{GMFrench} + \beta_{14} Z_{GMOrganicPurchase}$$

$$V_{EMS} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{EMSHealth} + \beta_6 Z_{EMSEnvironment}$$
$$+ \beta_7 Z_{EMSAge} + \beta_8 Z_{EMSDonation} + \beta_9 Z_{EMSHouseholdsize} + \beta_{10} Z_{EMSEmployed}$$
$$+ \beta_{10} Z_{EMSIncome} + \beta_{11} Z_{EMSFoodExpenditure} + \beta_{12} Z_{EMSFrench} + \beta_{13} Z_{EMSOrganicPurchase}$$

$$V_{ORG} = \beta_1 Z_{Price} + \beta_2 Z_{Mtlregion} + \beta_3 Z_{Canada} + \beta_4 Z_{Outside} + \beta_5 Z_{ORGHealth} + \beta_6 Z_{ORGEnvironment}$$
$$+ \beta_7 Z_{ORGAge} + \beta_8 Z_{ORGDonation} + \beta_9 Z_{ORGHouseholdsize} + \beta_{10} Z_{ORGEmployed}$$
$$+ \beta_{11} Z_{ORGIncome} + \beta_{12} Z_{ORGFoodExpenditure} + \beta_{13} Z_{ORGFrench} + \beta_{14} Z_{ORGOrganicPurchase}$$

Table 13 presents the two different models with their coefficients. Model 2 (pseudo-R^2 of 0.33) has a better goodness of fit than Model 1 (pseudo-R^2 of 0.26). This is also demonstrated by the Log likelihood ratio test (Hensher et al., 2005), as shown below, which results in the rejection of the null hypothesis that model 2 is not an improvement over the basic model.

$-2(LL_{Largest} - LL_{Smalest}) \sim \chi^2$ (difference in the number of parameters estimated between the two models)
$= -2(-1193.84-(-889.84) = 607.82 > \chi^2\ (24) = 42.98$

In model 2, all of the attributes that were presented to the respondents were statistically significant. The location of production variable suggests that the further away the location of production is, the less likely the consumer will choose the product. Table 14 presents the implicit prices of the attributes and these suggest that a milk produced outside of Canada would result in a $0.85 price reduction. This is the most important

attribute in terms of the effect on the price of milk. The positive sign on the coefficient means that as the attribute increases, the probability of choosing the product is also increased. The importance of the 'environment' attribute is relatively small when compared with the two other attributes. In addition, the three labels are statistically significant (Table 13).

In contrast to the attribute variables, the statistical significance of the explanatory variables in model 2 are not consistent across the three labels. The significant variables for the GM label are: the *age* of the respondent, the *household size,* and *food expenditures*. Older respondents tend to avoid GM milk more than younger respondents. With respect to the *food expenditure* variable, households that spend more on food tend to avoid GM products. This is because people who spend more on food purchases tend to buy characteristics that people want. On the other hand, the positive sign of the household size coefficient suggests that as the household increases in size, the respondents are more inclined to buy GM products, which are assumed to be less expensive. The EMS and Organic labels share *donation* and *purchase organic* as common explanatory variables. Respondents who were already inclined to buy organic food will choose the labels that are more expensive but provide improvements in the attributes.

Table 13: Milk CM values [a]

	MODEL 1		MODEL 2	
VARIABLES	Coeff.	Std.Err.	Coeff.	Std.Err.
Price	-0.6173***	0.086	-0.7311***	0.1014
Production Montreal Region	0.3972***	0.0864	0.4357***	0.1008
Production in Canada	-0.6088**	0.0908	-0.2844***	0.1066
Production Outside of Canada	-2.2470***	0.0982	-0.6215***	0.1107
ASC GM	0.3971***	0.2397	-0.8887	0.8706
GM Health	0.1175***	0.0325	0.1235***	0.0363
GM Environment	0.0430**	0.0219	0.0396	0.0247
GM Age			-0.2990*	0.1559
GM Donation			-0.1067	0.4849
GM Household Size			0.3246*	0.1773
GM Employed			-0.0447	0.1367

GM Income			-0.1359	0.1053
GM Food Expenditure			-0.4309**	0.1916
GM French			-0.2294	0.4313
GM Organic Purchase			0.1268	0.2504
ASC EMS	-0.2071	0.1856	-1.1444***	0.4277
EMS Health	0.0924***	0.0121	0.1059***	0.014
EMS Environment	0.0187**	0.0092	0.0194*	0.0103
EMS Age			0.0155	0.0652
EMS Donation			0.6294***	0.1819
EMS Household Size			0.1672**	0.0762
EMS Employed			-0.0795	0.056
EMS Income			0.0780*	0.0471
EMS Food Expenditure			-0.2683***	0.0725
EMS French			0.074	0.1701
EMS Organic Purchase			0.4474***	0.0993
ASC ORG	-0.4041*	0.2097	-1.0405**	0.5083
ORG Health	0.0779***	0.0146	0.0750***	0.0173
ORG Environment	0.0307***	0.011	0.0344***	0.013
ORG Age			-0.0677	0.0787
ORG Donation			0.6365***	0.2157
ORG Size			0.1449	0.0923
ORG Employed			-0.1408**	0.0651
ORG Income			-0.082	0.0556
ORG Food Expenditure			-0.1397	0.0857
ORG French			-0.4164**	0.2044
ORG Organic Purchase			1.0716***	0.1177
Log L	-1193.84		-889.84	
Pseudo-R Square	0.26		0.33	

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

The implicit prices derived from the coefficients indicate that the most important attribute was the location of production followed by the impact on health and finally the

impact on the environment. The most important non-attribute variables were those related to the budget constraints: income and household size. Respondents who have less available income tend to choose lower priced products.

Table 14: Milk implicit prices

Attributes	Implicit prices
Production Montreal Region	0.60
Production in Canada	-0.39
Production Outside of Canada	-0.85
GM Health	0.17
GM Environment	Not significant
EMS Health	0.17
EMS Environment	0.05
ORG Health	0.14
ORG Environment	0.03

4.4.2.2 TOMATOES

As in the milk experiment, two models were estimated for the tomato analysis. Model 1 for tomatoes is constructed as follows:

$$V_{Conv} = \beta_1 Z_{\Pr ice}$$
$$V_{GM} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{GMHealth} + \beta_3 Z_{GMEnvironment} + \beta_4 Z_{GMAppearance}$$
$$V_{EMS} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{EMSHealth} + \beta_3 Z_{EMSEnvironment} + \beta_4 Z_{EMSAppearance}$$
$$V_{ORG} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{ORGHealth} + \beta_3 Z_{ORGEnvironment} + \beta_4 Z_{ORGAppearance}$$

and Model 2 takes the form:

$$V_{Conv} = \beta_1 Z_{Price}$$

$$V_{GM} = \beta_1 Z_{Price} + \beta_2 Z_{GMHealth} + \beta_3 Z_{GMEnvironment} + \beta_4 Z_{GMAppearance} + \beta_5 Z_{GMAge} + \beta_6 Z_{GMDonation} + \beta_7 Z_{GMHouseholdsize} + \beta_8 Z_{GMEmployed} + \beta_9 Z_{GMIncome} + \beta_{10} Z_{GMFoodExpenditure} + \beta_{11} Z_{GMFrench} + \beta_{12} Z_{GMOrganicPurchase}$$

$$V_{EMS} = \beta_1 Z_{Price} + \beta_2 Z_{EMSHealth} + \beta_3 Z_{EMSEnvironment} + \beta_4 Z_{EMSAppearance} + \beta_5 Z_{EMSAge} + \beta_6 Z_{EMSDonation} + \beta_7 Z_{EMSHouseholdsize} + \beta_8 Z_{EMSEmployed} + \beta_9 Z_{EMSIncome} + \beta_{10} Z_{EMSFoodExpenditure} + \beta_{11} Z_{EMSFrench} + \beta_{12} Z_{EMSOrganicPurchase}$$

$$V_{ORG} = \beta_1 Z_{Price} + \beta_2 Z_{ORGHealth} + \beta_3 Z_{ORGEnvironment} + \beta_4 Z_{ORGAppearance} + \beta_5 Z_{ORGAge} + \beta_6 Z_{ORGDonation} + \beta_7 Z_{ORGHouseholdsize} + \beta_8 Z_{ORGEmployed} + \beta_9 Z_{ORGIncome} + \beta_{10} Z_{ORGFoodExpenditure} + \beta_{11} Z_{ORGFrench} + \beta_{12} Z_{ORGOrganicPurchase}$$

Model 2 was the best fitting model with a pseudo-R^2 value of 0.25. This model is an improvement over the basic model: $-2(-1338.40-(-1006.73) = 663.34 > \chi^2 (24) = 42.98$. For this model, the GM label did not appear to be an attractive option in terms of health risk and environmental impact when compared to the EMS and Organic labels. According to the implicit prices provided in Table 16, the *health* attribute is the most important attribute for EMS and organic tomatoes followed by the *impact on the environment* and the *appearance* attribute.

Many of the explanatory variables in this model did not have the expected sign. For instance, the food expenditure variable has a negative impact on the probability of choosing the Organic label. This is counter intuitive, but the low significance level (between 5% and 10%) means that only a weak relationship exists. For the other explanatory variables that were statistically significant, the likelihood of choosing the GM label has a negative relationship with the *income* and the *French* language variables. This result means that French speaking individuals have more of a negative perception of GM foods when compared to English/other speaking individuals. Respondents with higher levels of income have fewer purchases of GM foods. As in the milk model, the budget constraint represents an important factor that encourages choosing products with lower prices. The language is also significant in the CV model. This is an interesting relationship, indicating that respondents whose first language is French have a negative perception of GM tomatoes and would purchase fewer GM tomatoes. The same

relationship exists with the organic option; French speaking respondents are less inclined to purchase organic food. This could be explained by the different information provided by French and English media. For the EMS and Organic labels, the variables *donation* and *organic purchase* have a positive impact on the likelihood of choosing either option. This demonstrates that respondents who already participate monetarily in environmentally friendly initiatives tend to favour EMS and Organic labels.

Table 15: Tomato CM values [a]

	MODEL 1		MODEL 2	
VARIABLES	Coefficient	Std.Err.	Coefficient	Std.Err.
Price	-0.7935***	0.0868	-0.8927***	0.1043
ASC GM	-1.8173***	0.255	-0.1251	0.7387
GM Health	0.1460***	0.0243	0.1608***	0.0280
GM Environment	0.0298*	0.0171	0.0359*	0.0194
GM Appearance	0.0391*	0.0218	0.0434*	0.025
GM Age			0.0796	0.1096
GM Donation			-0.4317	0.3653
GM Household Size			-0.0221	0.1397
GM Employed			0.2634	0.3212
GM Income			-0.2282***	0.0786
GM Food Expenditure			-0.1577	0.1326
GM French			-0.5558*	0.2979
GM Organic Purchase			-0.0129	0.1866
ASC EMS	-0.2791	0.1947	-1.1640**	0.4546
EMS Health	0.0926***	0.0115	0.1039***	0.0132
EMS Environment	0.0360***	0.0091	0.0406***	0.0104
EMS Appearance	0.0218*	0.0117	0.0238*	0.0133
EMS Age			0.0162	0.0674
EMS Donation			0.8157***	0.1872
EMS Size			-0.0876	0.077
EMS Employed			0.2128	0.1854
EMS Income			0.0525	0.0479
EMS Food Expenditure			-0.0563	0.0726

EMS French			0.2093	0.1753
EMS Organic Purchase			0.4302***	0.1013
ASC ORG	-0.1088	0.1769	-0.8890*	0.4986
ORG Health	0.05747***	0.0129	0.0523***	0.0156
ORG Environment	0.0506***	0.0105	0.0503***	0.0124
ORG Appearance	0.0262*	0.0126	0.0377**	0.0148
ORG Age			0.042	0.0752
ORG Donation			0.3607*	0.211
ORG Size			0.0318	0.0861
ORG Employed			0.0685	0.205
ORG Income			-0.0011	0.0534
ORG Food Expenditure			-0.1348*	0.0806
ORG French			-0.3370*	0.1951
ORG Organic Purchase			0.9604***	0.113
Log L	-1338.40		-1006.73	
Pseudo-R Square	0.18		0.25	

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

The implicit prices in table 16 show that the most important attribute for tomatoes is *health*. In the case of the GM label, the *health* implicit price is higher than the others implying that a decrease in this attribute has an important negative effect on choosing this label. The attributes environment and appearance have almost the same implicit prices for the three labels; about $0.05.

Table 16: Tomato implicit prices

Attributes	Implicit prices
GM Health	0.18
GM Environment	0.04
GM Appearance	0.05
EMS Health	0.12
EMS Environment	0.05
EMS Appearance	0.03

ORG Health	0.06
ORG Environment	0.06
ORG Appearance	0.04

4.4.2.3 PORK

As in the milk and tomatoes experiments, two models were estimated for pork. Model 1 for pork contained the following variables:

$$V_{Conv} = \beta_1 Z_{\Pr ice}$$
$$V_{GM} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{GMHealth} + \beta_3 Z_{GMEnvironment} + \beta_4 Z_{GMAnimalWelfare}$$
$$V_{EMS} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{EMSHealth} + \beta_3 Z_{EMSEnvironment} + \beta_4 Z_{EMSAnimalWelfare}$$
$$V_{ORG} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{ORGHealth} + \beta_3 Z_{ORGEnvironment} + \beta_4 Z_{ORGAnimalWelfare}$$

For this product, the best model was model 2 given the following -2(-1206.12-(-933.95) = 272.17 > χ^2 (24) = 42.98. Model 2 had the following structure:

$$V_{Conv} = \beta_1 Z_{\Pr ice}$$
$$V_{GM} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{GMHealth} + \beta_3 Z_{GMEnvironment} + \beta_4 Z_{GMAnimalWelfare} + \beta_5 Z_{GMAge}$$
$$+ \beta_6 Z_{GMDonation} + \beta_7 Z_{GMHouseholdsize} + \beta_8 Z_{GMEmployed} + \beta_9 Z_{GMIncome} + \beta_{10} Z_{GMFoodExpenditure}$$
$$+ \beta_{11} Z_{GMFrench} + \beta_{12} Z_{GMOrganicPurchase}$$
$$V_{EMS} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{EMSHealth} + \beta_3 Z_{EMSEnvironment} + \beta_4 Z_{EMSAnimalWelfare} + \beta_5 Z_{EMSAge}$$
$$+ \beta_6 Z_{EMSDonation} + \beta_7 Z_{EMSHouseholdsize} + \beta_8 Z_{EMSEmployed} + \beta_9 Z_{EMSIncome} + \beta_{10} Z_{EMSFoodExpenditure}$$
$$+ \beta_{11} Z_{EMSFrench} + \beta_{12} Z_{EMSOrganicPurchase}$$
$$V_{ORG} = \beta_1 Z_{\Pr ice} + \beta_2 Z_{ORGHealth} + \beta_3 Z_{ORGEnvironment} + \beta_4 Z_{ORGAnimalWelfare} + \beta_5 Z_{ORGAge}$$
$$+ \beta_6 Z_{ORGDonation} + \beta_7 Z_{ORGHouseholdsize} + \beta_8 Z_{ORGEmployed} + \beta_9 Z_{ORGIncome} + \beta_{10} Z_{ORGFoodExpenditure}$$
$$+ \beta_{11} Z_{ORGFrench} + \beta_{12} Z_{ORGOrganicPurchase}$$

Model 2 for pork does not provide as many significant coefficients as with the two other products. In fact, the *animal welfare* attribute was statistically significant only for the GM label and it is negative, which reflects the negative perception that this label

carries. According to the Likert scale questions, animal welfare was an important attribute for consumers, but this sentiment was not expressed in the valuation exercise. Based on the latter result, the animal welfare attribute was the least important for consumers, which contradicts the results from the subjective evaluation. The *health* attribute result was expected; an increase in the level of the *health* attribute leads to a higher level of acceptance of the product for all three labels.

For EMS, the *health* coefficient had the expected sign. This is however the only attribute that was statistically significant. As compared with the two other products, the EMS label does not seem to convey to the respondents that it carries improved attributes.

For the Organic label, the significant attributes were the *environment* and *health.* Both had the expected sign and were statistically significant at the 1% level.

Table 17: CM pork values [a]

	MODEL 1		MODEL 2	
VARIABLES	Coeff.	Std.Err.	Coeff.	Std.Err.
Price	-0.189144***	0.0352	-0.175458***	-0.1754
ASC GM	-1.76072***	0.2608	0.271222	0.2712
GM Health	0.042367*	0.0247	0.0569235**	0.0569
GM Environment	0.009866	0.0193	0.009045	0.009
GM Animal Welfare	-0.03954	0.0247	-0.0459827*	-0.0459
GM Age			0.011394	0.0113
GM Donation			-0.06726	-0.0672
GM Household Size			0.002472	0.0024
GM Employed			-0.431865***	-0.4318
GM Income			-0.297641***	-0.2976
GM Food Expenditure			0.041818	0.0418
GM French			-0.1522	-0.1521
GM Organic Purchase			-0.01586	-0.0158
ASC EMS	0.216839	0.1655	-1.67177***	-1.6717

EMS Health	0.104347***	0.0111	0.119807***	0.1198
EMS Environment	0.003416	0.0086	0.013214	0.0132
EMS Animal Welfare	-0.01311	0.0111	-0.01777	-0.0177
EMS Age			0.022088	0.022
EMS Donation			0.552314***	0.5523
EMS Size			0.035646	0.0356
EMS Employed			0.029854	0.0298
EMS Income			0.158603***	0.1586
EMS Food Expenditure			-0.137527*	-0.1375
EMS French			0.46178***	0.4617
EMS Organic Purchase			0.432863***	0.4328
ASC ORG	-0.665328***	0.2532	-2.67337***	-2.6733
ORG Health	0.0596747***	0.0146	0.0650198***	0.065
ORG Environment	0.0616445***	0.0115	0.071338***	0.0713
ORG Animal welfare	-0.01892	0.0144	-0.01498	-0.0149
ORG Age			0.094634	0.0946
ORG Donation			0.135026	0.135
ORG Size			0.179123*	0.1791
ORG Employed			-0.02243	-0.0224
ORG Income			-0.00164	-0.0016
ORG Food Expenditure			-0.04352	-0.0435
ORG French			-0.04063	-0.0406
ORG Organic Purchase			0.941411***	0.9414
Log L	-1206.12		-933.95	
Pseudo-R Square	0.21		0.26	

[a] * Denotes a 10% significance level,**denotes a 5% significance level, ***denotes a 1% significance level.

The estimates of the implicit prices for pork attributes are given in Table 18. When compared to the milk and tomato attribute implicit prices, there are fewer significant values for the pork attributes. The only attribute that has a negative sign is the

GM animal welfare attribute, and this result is counter intuitive. Even though only a little more than half of the implicit prices are significant, they all carry the expected sign, except the animal welfare attribute. The unexpected sign for animal welfare can probably be attributed to the relative weight of other attributes as compared with the *animal welfare* attribute.

Table 18: Pork implicit prices

Attributes	Implicit prices
GM Health	0.32
GM Environment	not significant
GM Animal Welfare	-0.26
EMS Health	0.68
EMS Environment	not significant
EMS Animal Welfare	not significant
ORG Health	0.37
ORG Environment	0.41
ORG Animal welfare	not significant

In conclusion, the attribute that seems to hold the highest importance was risk to human health. Overall, the attributes were significant and of the expected sign, except the *animal welfare* attribute that is neither significant nor of the expected sign. This latter result was different from those found by Straub (2004). Straub found statistically insignificant *animal welfare* for GM chicken while *animal welfare* was statistically significant for organic and EMS chicken. The reason for this difference can be attributed to a decrease in importance of animal welfare attribute over the other attributes presented or change in animal product being analyzed; i.e. chicken versus pork. Compounding the problem of these estimates were the higher number of non-responses for the pork. The explanatory variables that are statistically significant include: *income, French, organic purchase,* and *donation*.

4.4.3 Comparison of Modeling Results with Likert Scale Responses

When comparing the most important characteristics stated by the respondents in the Likert scale questions with the results from the CM and CV analysis, the health attribute was the one found in both methods to be most important factor affecting food choices. Environmental effects were also considered important and were reflected in the implicit prices of both milk and tomatoes. In the Likert Scale questions, the health attribute took the form of specific characteristics such as the use of antibiotics for pork and the use of synthetic products for the tomatoes. From the Likert scale responses it is possible to evaluate the importance of the GM label on the respondents, although it is not possible to evaluate if the impact was positive or negative. The values from the modeling results reveal the negative perception of the label. The high importance the consumer gives to the origin of production for milk in the Likert Scale responses is consistent with the estimates generated with the CM and CV model results. The only attribute that is inconsistent is animal welfare for pork. In the Likert scale, the relative importance of this attribute ranked second while the attribute did not significantly impacted the values for the CV and CM models. Generally, the results from Likert scale are consistent with those estimated from the CM and CV methods.

The consistency between the Likert scale, the CV, and CM models can provide interesting tools for questionnaire design in the stated preference method. Through the ranking of the attributes, a more precise questionnaire could be developed and thus provide more accurate estimates from the quantitative methods.

4.4.4 WTP Simulation Using Compensating Variation

Since the implicit prices calculated by the CM process are not comparable with WTP values generated by the CV method, additional data manipulation was required. To this effect, the compensating variations of the CM data were calculated using the following equation:

$$CV = -\frac{1}{\beta_m}(V_1 - V_0) \tag{16}$$

Where β_m is the price coefficient, V_0 represents the utility function at the status quo level (i.e., the conventional product), and V_1 is the utility function of product evaluated. For instance, if the product evaluated is EMS milk and is assumed to possess the following attributes: produced in the province of Quebec, no change in risk for health and a 15% decrease in environmental impact; the following equation would be used to calculate the compensating variation:

$$WTP = -\frac{1}{\beta_m}(V_{EMS} - V_{CONV}) = \\ -\frac{1}{\beta_m}\left[(\beta_1 Z_{\text{Price}} + \beta_2 Z_{EMSHealth} + \beta_3 Z_{EMSEnvironment} + \beta_4 Z_{Quebec}) - 0\right] \quad (17)$$

Since the estimation of the coefficient was based on the conventional product, the utility function V_{CONV} was equal to 0. The last step was to divide the numerator by β_m, which was the price coefficient of milk (-0.73). The compensating variation ($2.51) was the value above the conventional price that an average consumer would be willing to pay for a product with the described characteristics. The only variables used for the calculation were the statistically significant attribute coefficients. The milk product with the attributes describe above had the following WTP value:

$$WTP_{\text{EMS Milk}} = 0.08(0) + 0.03(15) + 0 = 0.45$$

4.4.5 CM Simulated WTP and Comparison with CV WTP

The CM WTP values were estimated using the compensation variation measurement simulating the attributes found in the CV scenario descriptions. This produces a direct comparison of the WTP values from the two valuation techniques. The hypothesis tested was:

H_0: $WTP_{\text{Simulated CM}} = WTP_{CV}$

H_1: $WTP_{\text{Simulated CM}} \neq WTP_{CV}$

Table 19 summarizes the mean WTP for both the CV scenarios and their respective CM simulated prices. The 95% confidence intervals for each mean were estimated using Krinsky-Robb (1986) simulation procedure and are given in the Table 19. To determine if the WTP values between CV and CM are statistically similar, the confidence intervals of CM and CV must overlap. Therefore, the milk scenarios 2, 3, 4 and tomato scenario 1 and 2 were statistically similar while the scenarios for milk 1, tomatoes 2 and 3, and all pork scenarios were not. Recall that the location of production is the most important attribute tested in the milk scenarios and that the various locations were treated as dummy variables in the modeling process. The implication of this is that this attribute, as oppose to the other attributes, was not as affected by the level and thus resulting in WTP values that were more stable. Furthermore, the NLOGIT modeling software assumes a linear relationship between the variables and the probability of choosing one of the product options. This assumption may not be reasonable when using rates of improvement because it may overstate the value of the simulated product.

For tomatoes, the CM simulated values were higher than the CV values. Two factors could have contributed to this result. First, the attribute levels that were presented in the scenarios were relatively high, which results in considerably higher WTP values. Second, the implicit prices were assumed to bear a linear relationship, which may result in significant changes in the WTP values. For example, the milk scenarios 3 and 4 simulate a change in only one attribute level; scenario 3 has a 15 percent decrease in environmental impact and scenario 4 has a 25 percent decrease in environmental impact. The WTP values that resulted from the analysis were identical ($3.51 for scenario 3 and 3.51 for scenario 4). However, the CM simulation exercise calculates a WTP that results in a difference of $0.56 between the two scenarios.

For the pork scenarios, the CM values were higher, when significant. Since the animal welfare coefficients were not statistically significant, it was not possible to simulate WTP for scenarios 1 and 3. For scenarios 2 and 4, the linearity assumption previously discussed may explain these high values.

Table 19: A comparison of WTP values from CV and CM

	CV		CM	
Scenario	Mean WTP	Confidence interval	Mean WTP	Confidence interval
Milk 1	2.41	(2.24, 2.54)	2.11	(2.00, 2.22)
Milk 2	3.20	(3.08, 3.30)	3.06	(1.95, 4.13)
Milk 3	3.51	(3.39, 3.63)	3.50	(2.92, 4.12)
Milk 4	3.51	(3.38, 3.62)	4.06	(3.04, 5.04)
Tomato 1	2.87	(2.63, 3.11)	4.06	(2.23, 3.85)
Tomato 2	2.70	(2.39, 3.00)	2.54	(2.23, 3.85)
Tomato 3	4.25	(4.17, 4.32)	6.22	(5.16, 7.38)
Tomato 4	4.37	(4.28, 4.46)	5.85	(5.21, 6.48)
Pork 1	7.98	(7.74, 8.22)	Not significant	Not significant
Pork 2	8.71	(8.40 ,9.04)	20.92	(14.44, 27.40)
Pork 3	8.25	(8.00, 8.51)	Not significant	Not significant
Pork 4	8.54	(8.27, 8.82)	22.79	(13.82, 31.82)

The general trend was that the simulated prices from the CM technique were higher than the prices from the CV analysis. This is consistent with findings in similar studies performed on other types of goods (Johnson and Desvourge, 1997, Stevens et al., 1992).

4.5 Sequencing Effect

Due to the relatively large size of the sample, it was possible to test for the presence of a sequencing effect. The statistical test performed was:

H_0: $WTP_{product\ 1} = WTP_{product\ 2} = WTP_{product\ 3}$

H_1: $WTP_{product\ 1} \neq WTP_{product\ 2} \neq WTP_{product\ 3}$

The test for evaluating the sequencing effect was performed using the convolution approach developed by Poe et al. (1994). The program used for this analysis was developed by the same authors and is supported by the Gauss software. The main intent of this experiment was to evaluate if the distribution of the willingness to pay values was

dependent on the sequence in which the valuation questions were presented. The implication of such dependence would be that respondents were sensitive to questionnaire design and thus it would reduce the validity of the estimates from the CV data. Table 20 provides a summary of the calculated values.

Table 20: Confidence intervals from sequencing tests

Models	95% Confidence Interval
milk first - milk second	(-0.04, 0.25)
milk first - milk third	(-0.13, 0.21)
milk second - milk third	(-0.25, 0.10)
tomato first - tomato second	(-0.05, 0.38)
tomato first - tomato third	(0.21, 0.59)
tomato second - tomato third	(0.07, 0.39)
pork first - pork second	(-0.18, 0.57)
pork first - pork third	(-0.46, 0.23)
pork second - pork third	(-0.22, 0.39)

In order to analyze the difference between the distributions of willingness to pay, the values for each product were segregated into one of three groups, based on the order of the questions in the questionnaire. These values were then used to generate a distribution using their respective characteristics, using the Krinsky and Robb (1986) routine built by Park et al. (1991) for the Gauss software. In order to detect any similarity between the distributions, the groups consisting of the same product were tested against each other. For instance, the first row of Table 20 tests the values of the milk questions that were placed first in the questionnaire against those that were placed second in the questionnaire. The null hypothesis of this test is that the mean willingness to pay values of the two distributions is similar. This happens when both the lower bound and the upper bound of the distribution include zero. As shown in Table 20, the distribution of WTP sequences was similar in all cases except when the tomato questions were ranked third. Additional tests were performed on the tomato cases to determine the full effect on the results when the tomato questions were in the third position. Table 21 details the results of this investigation.

Table 21: Comparison of WTP values when tomato questions were ranked first or third in the questionnaire

Mean Willingness to Pay		
	Tomato first	Tomato third
scenario 1	2.75	3.15
scenario 2	2.54	2.93
scenario 3	4.22	4.26
scenario 4	4.37	4.40

Comparing scenarios 1 and 2, the mean willingness to pay value is much higher when the tomato questions were placed third in the questionnaire. The only time that the GM label appears in the questionnaire was in the tomato scenarios 1 and 2. The presentation of the GM label at the end of the questionnaire decreased the proportion of consumers who rejected the label. The most plausible explanation to this phenomenon is the fatigue of the respondent who, at the end of the questionnaire, did not pay close attention to the details of the final questions, thus missing the change of label.

Overall the sequencing effect did not have a systematic effect on the estimates. However, when new information was added at the end of the questionnaire, the consumers responded differently than if this information was presented at the beginning of the questionnaire. This stresses the importance of questionnaire design for avoiding biasness. A relative stability in the information provided in the scenario played a role for avoiding distortions in the estimates.

4.6 Bid Ordering Effect

A second test was performed to determine if the bid ordering effect (i.e., if the presentation of the bids in an ascending or descending order in the question) impacted the estimated WTP. The statistical hypothesis for this test is:

H_0: $WTP_{ascending} = WTP_{descending}$

H_1: $WTP_{ascending} \neq WTP_{descending}$

The bid ordering effect has been observed in other studies (Dupont, 2003) and challenges the validity of the CV method because, if this bias is present, the WTP values inferred would be sensitive to the order of the bids presented. While this topic has been the focus of much research, most studies in the literature investigate the bid ordering effect on passive users of environmental services, not active users. Active users have more extensive knowledge about the products of interest (e.g. milk) and, therefore, it is interesting to observe if the order influences the WTP values.

Table 22: Confidence intervals from the bid ordering tests (calculated with a confidence interval of 0.95)

Models	Lower bound	Upper bound	Alpha
milk scenario 1 ascending - milk scenario 1 descending	-0.21	0.37	0.6008
milk scenario 2 ascending – milk scenario 2 descending	-0.18	0.25	0.7608
milk scenario 3 ascending – milk scenario 3 descending	-0.08	0.36	0.2033
milk scenario 4 ascending – milk scenario 4 descending	-0.19	0.29	0.6866
tomato scenario 1 ascending – tomato scenario 1 descending	-0.21	0.86	0.2733
tomato scenario 2 ascending – tomato scenario 2 descending	-0.65	0.61	0.9617
tomato scenario 3 ascending – tomato scenario 3 descending	-0.15	0.17	0.9500
tomato scenario 4 ascending – tomato scenario 4 descending	-0.16	0.20	0.8447
pork scenario 1 ascending – pork scenario 1 descending	-0.41	0.55	0.7640
pork scenario 2 ascending – pork scenario 2 descending	-0.56	0.70	0.8122
pork scenario 3 ascending – pork scenario 3 descending	-0.52	0.48	0.9410
pork scenario 4 ascending – pork scenario 4 descending	-0.37	0.72	0.5200

Table 22 indicates that the null hypothesis (i.e., that the mean WTP are similar) cannot be rejected. This conclusion supports the findings in the literature that there is a low sequencing effect in CV questionnaires, specifically those using the MBDC question format. The fact that the WTP values from active users do not seem to be dependent on the order of the bid values in the questions is an important result because it indicates that any ordering effect detected in the CV method may be due to a lack of information on the part of the respondent and not due to a systematic flaw in the valuation method itself. If this is the case, it is therefore possible to alleviate the lack of information problem with an appropriate survey design and the results generated can be considered an appropriate measure of consumer's taste and preferences.

Chapter 5: Conclusion and Discussion

The main purpose of this research was to compare the welfare values from two different valuation methods, the Choice Modeling (CM) method and the Contingent Valuation (CV) method, more specifically; the multiple bounded discrete choice method (MBDC). In addition, the CV data was tested for the presence of a sequencing effect and a bid ordering effect. The questionnaire developed for conducting this research defined four labels based on four different agricultural production systems, each with different levels of desirable attributes. The questionnaires were distributed to 1000 Montreal households using a split sample design, resulting in 500 CV and 500 CM questionnaires being distributed.

The comparison between the CV and CM methods was intended to evaluate the differences between the willingness to pay (WTP) estimates derived from the two methods. Although some research has concluded that CM tends to generate higher WTP estimates, the values in those studies were mainly related to passive users of environmental services. This study used food products with known attributes for the valuation exercises.

The application involved the valuation of three different food commodities: pork, tomatoes, and milk, each composed of different levels of attributes. These hypothetical scenarios evaluated the acceptance of and price premium for existing product options as well as ones not yet available on the market, eg. the Environmental Management System (EMS) label. This system was compared to the conventional and organic labels, two commodities that exist and are distinguishable in the marketplace. Genetically modified (GM) food was also added as a distinct label given the possibility of a mandatory labeling system in Canada for products containing GM ingredients. This exercise allowed for the evaluation of the general acceptance of food labeled as “GM” in the marketplace.

The welfare measures were estimated using a multinomial logit model for both CV and CM methods. The implicit prices inferred from the CM analysis were transformed into simulated WTP values for products similar to those presented in the CV

questionnaire. The Krinsky-Robb (1986) simulation procedure was used to generate confidence intervals to evaluate the statistical similarity of the estimates generated.

The explanatory variables used in the CV model, when significant, generally had the *a priori* expected sign. Surprisingly, many coefficients were not statistically significant. In regards to the WTP values generated, the CV analysis resulted in values that fell into a reasonable range. In the case of the CM analysis, the same explanatory variables were included in the models but more were significant than in the CV models. The milk scenario resulted in WTP values that were statistically similar to the CV values. However, the WTP values generated from the tomato and pork CM analysis were not statistically similar, and in the case of pork, the values were more than two times higher than the WTP values in equivalent CV scenarios.

There are several advantages to using the CM approach over the CV method. First, more information in terms of implicit prices of attributes, is generated with the CM method when compared to the CV method. Using the same number of surveys distributed, the CM experimental design allows for the analysis of a greater number of attributes and attribute levels. In the case of CV, one question provides only one measurement, which is the WTP change from the status quo to the new policy setting. Second, the simulation capacity of CM is higher because it is possible to vary the different combinations of attributes and attribute levels. In comparison, the CV method provides only one measurement that applies to a specific scenario. Therefore, if any modification to the projected scenario occurs after the distribution of the questionnaire, the usefulness of the estimates decreases greatly. However, the CM estimates tend to be greater than those estimated from the CV method. This difference can have an important impact if the estimates are used for benefit cost analysis. In other words, if CM estimates are greater than the real WTP values of the society, policy benefits can be overestimated resulting in a less than optimal social outcome.

Two other hypotheses were tested specifically concerning the MBDC format of the CV questionnaire. They were related to the order of the questions (sequencing) and the effect of the ordering of the bids. The study by Dupont (2003) found that when respondents value environmental services and were active users of environmental services, any bias from the sequencing and bid ordering effects tends to disappear,

however, both effects were present when respondents were passive users. This emphasizes the importance of designing an appropriate questionnaire (Mitchell and Carson, 1989) and performing pre-tests before survey distribution (Dillman, 2003) to minimize any bias that might be introduced by the questionnaire itself. As previously discussed, the presence of this type of bias has a negative impact on the validity of the CV method because the estimates are largely dependent on the design of the questionnaire.

Testing for the presence of a sequencing effect was performed using a split sample, where the sequence of the different products varied in order to capture the possible effect on the WTP values. In order to evaluate their statistical similarity, the WTP value of each product was grouped by the order the product's questions appeared in the questionnaire. The convolution method was used to evaluate the similarity of each WTP distribution. The statistical tests concluded that no significant sequencing effect was present, except in one particular case. The WTP value of tomatoes when its questions were in the third position of the questionnaire was different from the value when the tomato questions were placed first and second in the questionnaire. Further analysis revealed that respondents who answered the GM tomato related questions at the end of the questionnaire valued this label higher than when these questions were in first or second position. A possible explication for this is that respondent fatigue caused them not to pay as close attention to the product's characteristics (e.g., label) upon reaching the end of the questionnaire. Therefore, the design of the questionnaire is crucial to avoid misinterpretation of the questions by the respondent.

The amount of time that a typical respondent can devote to answering a questionnaire is limited and could have an important impact on the answers provided and on the response rate. This study provided questionnaires that were estimated to take 20 minutes for the CM format and 25 minutes for the CV questions. According to the difference in response rates between CV and CM and comments from respondents, the maximum time required to answer the questionnaire for the majority of respondents was 20 minutes. Therefore, the design of the questionnaire in terms of the time expected to complete the questionnaire should be taken into careful consideration.

Regarding the bid order effect, the test followed the same procedure as the sequencing effect testing; the values were extracted from a split sample design and the WTP values were tested using the convolution approach. The statistical comparison did not reject the null hypothesis that the WTP distributions of the ascending and descending bid orders were the same. This result demonstrates that active users are not influenced by the order of the bids. The knowledge of the respondents, not only of the product information but also of their own budget constraint, allows for a valuation independent from the presentation of the bids. One can conclude that when environmental services are evaluated by active users, the welfare measures are not affected by an ascending or descending bid order. In addition, the bid ordering effect seems to be minimum with the MBDC questionnaire design.

5.1 Limitations, Extensions and Future Considerations

This study focused on the comparison of welfare estimates between two stated preference methods and tested for the presence of bias introduced by the MBDC format of the CV method. However, the results of this research raise other questions and reveal possible ways to refine the methods used. These can be grouped into three categories: the survey distribution, the survey design, and the model specification.

The door-to-door survey distribution method used in this study resulted in an excellent response rate when compared to mail or phone administered surveys. However, the implementation of this distribution method introduced bias by omitting specific household types from the sample. This bias is hard to overcome because it is a result of physical barriers, specifically the surveyors did not have access to all types of residential buildings. The buildings most inaccessible were large apartment complexes on residential blocks that were occupied by lower income households and smaller sized households. According to the modeling results generated in this study, a smaller household is more inclined to pay premiums for products with enhanced environmental attributes, while lower income consumers did not exhibit a statistically significant effect on WTP. Therefore, employing more than one method of survey distribution can help to collect

samples that are statistically similar to the populations and therefore would increase the representativeness of the WTP estimates.

As mentioned previously, survey design plays a key role in collecting data free from bias and contributes to the overall responsiveness of the respondents. Although this questionnaire was well designed and did not suffer from any major problems, improvements could be made. Specifically, the background information questions could be refined to make the data derived from these questions more useful and to allow for more in-depth analysis of the possible determining factors that influence choice. In addition, the sequencing test performed on the CV data would have been possible with CM questionnaire if there were fewer questionnaire versions.

The comparison of the two methods reveals differences in the welfare estimates calculated, but it is not possible to conclude which method generates the most realistic estimates. A more definitive conclusion could be drawn by comparing these two methods with a revealed preference method.

Improvements in the survey design could be achieved through the modification or the refinement of the attribute definition. For example, asking respondents to put a monetary value on a percentage change in the health attribute was challenging for some respondents. Using percentage changes in attribute levels is also subject to interpretation by the respondent. Their interpretation is relative to the knowledge and background of the respondent and therefore more subject to bias. Providing a more defined change in attribute level, that is freer from subjective interpretation, would be beneficial[3].

Another area of research that could be pursued would address the design of the choices in the CV approach. In this study four attributes were provided to respondents to make their decision. It would be of interest to investigate how attribute number impacted WTP estimates and implicit values of the attributes themselves. For example, if only two attributes are given to describe the food product, how would this impact WTP or the implicit prices when compared to having four or five attributes.

Finally, the model specification impacted the results of this study, and although additional analysis was possible using the CM data, these were outside the scope of this study. For example, Mogas et al. (2006) demonstrated that second order interaction can

[3] Based on comments of thesis external examiner, Professor Jeff Bennett.

improve the efficiency of welfare estimates. The results from the CV modeling suggest that this type of relationship has an effect on the values generated. However, no tests were performed to evaluate the importance of such interactions. In terms of the treatment of the CV data, excluding the 'I would not buy the product' responses from the dataset could generate different mean WTP estimates and would thus lead to a different interpretation of the estimates.

5.2 Summary

The main objective of the study was to compare the WTP estimates derived from two stated preference methods: CV and CM. For the contingent valuation approach, the multiple bounded discrete choice model was used. Two possible forms of bias associated with the MBDC format were tested: the sequencing effect and the bid ordering effect. The WTP values estimated involved food products; i.e. milk, pork, and tomatoes. The product attributes of interest were: the location of production, environmental impact, health impact, appearance, and animal welfare, and these characteristics were analyzed in various combinations and at different attribute levels. The questionnaires were distributed on the island of Montreal using a drop-off pick-up method. A split sample design was also used for the sequencing and bid ordering effect.

The values were generated using a Multinomial Logit (MNL) model. While CV provides direct WTP values from the MNL modeling process, CM provides implicit prices that were used for simulating the CV scenarios. For testing the statistical similarity, the confidence intervals were constructed using Krinsky-Robb (1986) simulation.

A comparison of the values generated by the two methods reveals that, in most cases, the CV estimates were smaller than those generated by the CM approach. In terms of their statistical similarity, the WTP values in only three milk scenarios and one tomato scenario were statistically similar. In two cases out of four, the simulated WTP values in the pork scenarios were not statistically similar. For the two other scenarios, the CM WTP values were more than 200% higher than CV WTP values.

The results indicate that when attributes are non-linear, the CM and CV WTP values generated are more likely to be statistically similar. Also, when implicit prices are not statistically similar, the WTP values cannot be generated and therefore limits the efficiency of the model.

The convolution approach was used for testing the sequencing and bid order effects. Based on the results, it can be concluded that sequencing effect was, in most cases, absent and that the bid ordering effect did not influence the WTP estimates. These results provide strong evidence that responses were not influenced by these two biases. Nevertheless, during the survey design phase it is important to consider the length of the questionnaire and at what point in the questionnaire new information and/or instructions are presented in order to avoid introducing bias caused by respondent fatigue.

The comparison of the two stated preference methods clearly exposes their strengths and weaknesses. The flexibility in terms of modeling capacity, the informational capacity, and the simplicity of the choice questions are the strengths of the CM method. For the CV method, because the WTP value is directly provided by the respondent, the estimated values are always available, as compared with the CM method where WTP values are dependent on the statistical significance of the coefficients. Also, in the present study, the WTP values generated fall into realistic ranges. The valuation exercise of CV is harder for the respondent to understand and the static nature of the scenario presented diminishes the flexibility of the technique. The limitations of the CM method stem from the fact that the WTP values can only be calculated with statistically significant coefficients and that the WTP values generated in the simulations generally diverge from realistic market prices. This divergence tends to be more important when the coefficient is assumed to have a linear relationship with the dependent variable and when the attribute levels simulated are significantly large.

References

Adamowicz, V. "Alternative Valuation Technique: a Comparison and Movement to Synthesis." *Environmental Valuation : New Perspectives*. K. G. Willis, and J. T. Corkindale, eds.,pp.144-159.Wallingford: CAB International, 1995.

Alavanja, M.C.R., and J.A. Hoppin. "Health Effect of Chronic Pesticides Exposure: Cancer and Neurotoxicity." *Annual Review of Public Health* 25, no. 1(2004): 155-197.

Altieri, M.A. "The Ecological Impacts of Transgenic Crops on Agroecosystem Health." *Ecosystem Health* 6, no. 1(2000): 13-23.

Arrow K.R. et al..*Report of the NOAA Panel on Contingent Valuation*, Federal Registry, vol. 58, No. 10, pp. 4601 - 4614, 1993.

Bengtsson, J., J. Ahnstrom, and A.C. Weibull. "The Effects of Organic Agriculture on Biodiversity and Abundance: A Meta-Analysis." *Journal of Applied Ecology* 42, no. 2(2005): 261-269.

Beus, C.E., and R.E. Dunlap. "Conventional Versus Alternative Agriculture: the Paradigmatic Roots of the Debate." *Rural Sociology* 55, no. 4(1990): 590-616.

Bishop, R.C., and T.A. Heberlein. "Measuring Values of Extra-market Goods - Are Indirect Measures Biased?" *American Journal of Agricultural Economics* 61, no. 5(1979): 926-930.

Boyle, K.J. "Commodity Specification and the Framing of Contingent Valuation Questions." *Land Economics* 65, no. 1(1989): 57-63.

Boyle, K.J. "Contingent Valuation in Practice." Champ P. A., K. J. Boyle, and T. C. Brown. eds., pp.111-167. Dordrecht Boston : Kluwer Academic Publishers, 2003.

Brown, T.C. "Introduction to Stated Preference methods." Champ P. A., K. J. Boyle, and T. C. Brown. eds., pp.99-110. Dordrecht Boston : Kluwer Academic Publishers 2003.

Burton, M., D. Rigby, T. Young, and S. James. "Consumer Attitude to Genetically modified organisms in food in the UK" *European Review of Agricultural Economics* 28, no. 4(2001): 479-498.

Cameron, T.A., G.L. Poe, R.G. Ethier, and W.D. Schulze. "Alternative Non-market Value-Elicitation Methods: Are the Underlying Preferences the Same?" *Journal of Environmental Economics and Management* 44, no. 3(2002): 391-425.

Carlsson, F., P. Frykblom, C.J.Lagerkvist. "Consumer Benefits of Labels and Bans on GM Foods – Choice Experiments with Swedish Consumers" *American Journal of Agricultural Economics* 89, no.1(2007): 152-161.

Carson, R.T., and R.C. Mitchell. "Sequencing and Nesting in Contingent Valuation Surveys." *Journal of Environmental Economics and Management* 28, no. 2(1995): 155-173.

Carson, R.T., and R.C. Mitchell. "The Issue of Scope in Contingent Valuation Studies." *American Journal of Agricultural Economics* 75(1993): 1263-1267.

Christie M., and C.D. Azevedo. "Testing the Consistency between Standard Contingent Valuation, Repeated Contingent Valuation and Choice Experiments." *Journal of Agricultural Economics* 60(2009): 154-170.

Cranfield, J., B.J. Deaton, and S. Shellikeri. "Evaluating Consumer Preferences for Organic Food Production Standards" *Canadian Journal of Agricultural Economics* 57, no.1(2009): 99-117.

Darby, K., M.T. Batte, S. Ernst, and B. Roe. "Decomposing Local: A Conjoint Analysis of Locally Produced Foods" *American Journal of Agricultural Economics* 90, no.2(2008): 476-486.

Davis, R.K. "Recreation Planning as an Economic Problem." *Natural Resources Journal* 3, no. 2(1963): 239-249.

Dillman, D.A. *Mail and Internet Surveys: The Tailored Design Method*. New York ; John Wiley and Sons, 2000.

Dillman, D.A., M.D. Sinclair, and J.R. Clark. "Effect of Questionnaire Length Respondent Friendly Design and Difficult Question on Response Rate for Occupant Addressed Census Mail Survey." *Public Opinion* Quarterly 57, no. 3(1993): 289-304.

Domingo, J.L. "Health Risks of GM Foods: Many Opinions but Few Data." *Science* 288, no. 5472(2000): 1748-1749.

Donaghy, P., J. Rolfe, and J. Bennett. "Consumer Demands for Organic and Genetically Modified Foods." Department of Primary Industries. Freemantle, Western Australia, 2003.

Dupont, D.P. "CVM Embedding Effects when there are Active, Potentially Active and Passive Users of Environmental Goods." *Environmental and Resource Economics* 25, no. 3(2003): 319-341.

Fédération des producteurs de lait du Québec site, " Statistiques et Profil Général de l'industrie," http://www.lait.org/zone3/.

Feldmann, M.P., M.L. Morris, and D. Hoisington. "Genetically Modified Organisms: Why all the Controversy?" *Choice Magazine*, First Quarter 2000, pp. 8-12.

Foster, V., and S. Mourato. "Elicitation Format and Sensitivity to Scope - Do Contingent Valuation and Choice Experiments Give the Same Results?" *Environmental and Resource Economics* 24, no. 2(2003): 141-160.

Gambacorta, G., M. Faccia, C. Lamacchia, A. Di Luccia, and E. La Notte. "Pesticide Residues in Tomato Grown in Open Field." *Food Control* 16, no. 7(2005): 629-632.

Goldberg, I., and J. Roosen. "Measuring Consumer Willingness to Pay for Health Risk Reduction of Salmonellosis and Campylobacteriosis." Paper presented at EAAE annual meeting, Copenhagen, Denmark, 24 - 27 August 2005.

Government of Canada, Statistics Canada. "2006 Census of Population" April 18, 2008. http://www12.statcan.ca/english/census/index.cfm.

Hanemann, W.M. "Valuing the Environment Through Contingent Valuation." *Journal of Economic Perspectives* 8, no. 4(1994): 19-43.

Hanley, N., D. MacMillan, R.E. Wright, C. Bullock, I. Simpson, D. Parsisson, and B. Crabtree. "Contingent Valuation Versus Choice Experiments: Estimating the Benefits of Environmentally Sensitive areas in Scotland." *Journal of Agricultural Economics* 49, no. 1(1998): 1-15.

Harpman, D.A., and M.P. Welsh. "Measuring Goodness of Fit for the Double-bounded Logit Model: Comment." *American Journal of Agricultural Economics* 81, no. 1(1999): 235-237.

Heilbroner, R.L. *The Worldly Philosophers, the Lives, Times, and Ideas of the Great Economic Thinkers*. New York; Simon and Schuster, 1999.

Hensher, D.A., J.M. Rose, and W. H. Greene. *Applied Choice Analysis : a Primer*. Ed. Cambridge: Cambridge University Press, 2005.

Hoban, T.J. (2004) United Nations, Food and Agriculture Organization. *Public Attitude Towards Agricultural Biotechnology*. Rome, 2005.

Holmes, T.P., and W.L. Adamowick. "Attribute Based Method." *A Primer on Nonmarket Valuation.* P. A. Champ, K. J. Boyle, and T. C. Brown, ed. pp. Dordrecht MA: Kluwer Academic Publishers, 2003.

Hu, W., W.L. Adamowicz, and M.M. Veeman. "Consumers' Preferences for GM Food and Voluntary Information Access: A Simultaneous Choice Analysis" *Canadian Journal of Agricultural Economics* 57, no.2(2009): 241-267.

Ipsos Reid, "Ipsos Reid Public Affairs; The 16 Hot Trends and Consumer Purchase Behaviour," http://www.ipsos.ca/pdf/Ipsos_16HotTrends.pdf.

Jehle, G.A., and P.J. Reny, *Advanced Microeconomic Theory*, 2nd ed. Addison Wesley, 2003.

Dillman, D.A. *Mail and Internet Surveys: The Tailored Design Method*. New York ; John Wiley and Sons, 2000.

Johnson, F.R., and W.H. Desvousges. "Estimating Stated Preferences with Rated-Pair Data: Environmental, Health, and Employment Effects of Energy Programs." *Journal of Environmental Economics and Management* 34, no. 1(1997): 79-99.

Kahneman, D., and J.L. Knetsch. "Valuing Public-Goods -The Purchase of Moral Satisfaction." *Journal of Environmental Economics and Management* 22, no. 1(1992): 57-70.

Kanninen, B.J., and M.S. Khawaja. "Measuring Goodness of Fit for the Double-Bounded Logit Model." *American Journal of Agricultural Economics* 77, no. 4(1995): 885-890.

Knorr, D.W., and T.R. Watkins. *Alterations in Food Production*. New York : Van Nostrand Reinhold, 1983.

Krinsky, I., and A.L. Robb. "On Approximating the Statistical Properties of Elasticities." *Review of Economics and Statistics* 68, no. 4(1986): 715-719.

Lancaster, K.J. "New Approach to Consumer Theory." *Journal of Political Economy* 74, no. 2(1966): 132-157.

Liebig, M.A., and J.W. Doran. "Impact of Organic Production Practices on Soil Quality Indicators." *Journal of Environmental Quality* 28, no. 5(1999): 1601-1609.

Lockwood, M., and D. Carberry. "Stated Preference Survey of Remnant Native Vegetation Conservation." Report No. 104, Johnstone Centre, Charles Sturt University, 1998.

Loomis, J., and E. Ekstrand. "Economic Benefits of Critical Habitat for the Mexican Spotted Owl: A Scope Test Using a Multiple-Bounded Contingent Valuation Survey." *Journal of Agricultural and Resource Economics* 22, no. 2(1997): 356-366.

Louviere, J.J., D.A. Hensher, and J.D. Swait. *Stated Choice Method: Analysis and Applications*. Cambridge, UK: Cambridge University Press, 2000.

Lowenthal, D. "Awareness of Human Impact: Changing Attitudes and Emphases." *The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere Over the Last 300 Years.*" B. L. Turner, R. Kates eds. pp. 121-135. Cambridge: Cambridge University Press with Clark University, 1990.

Luce, R.D., and P. Suppe. "Preference, Utility and Subjective Probability." *Handbook of Mathematical Psychology.* Luce R.D., R.R. Bush, and E. Galanter eds., vol. 3, pp.249-410. New York: John Wileys and Sons, 1965.

Lund, V., R. Anthony, and H. Rocklinsberg. "The Ethical Contract as a Tool in Organic Animal Husbandry." *Journal of Agricultural and Environmental Ethics* 17, no. 1(2004): 23-49.

Mader, P., A. Flie bach, D. Dubois, L. Gunst, P. Fried, and U. Niggli. "Soil Fertility and Biodiversity in Organic Farming." *Science* 296, no. 5573(2002): 1694-1697.

McFadden, D. *Conditional Logit Analysis of Qualitative Choice Behavior*. New-York, Academic Press, 1974.

Mitchell, R. C., and R. T. Carson. *Using Surveys to Value Public Goods : the Contingent Valuation Method*. Washington, D.C.: Johns Hopkins University Press, 1989.

Mogas, J., P. Riera, and J. Bennett. "A Comparison of Contingent Valuation and Choice Modelling with Second-Order Interactions." *Journal of Forest Economics* 12, no. 1(2006): 5-30.

Montgomery, D.C. *Design and Analysis of Experiments*. Hoboken, NJ : John Wiley and Sons, 2005.

Morrison, M. and J. Bennett. "Valuing New South Wales Rivers for Use in Benefit Transfer" *Australian Journal of Agricultural and Resource Economics*, 48 no. 1 (2004): 591-616.

Organic Agriculture Center of Canada. *Standards-Canadian Organic Production System*, Organic Agriculture Center of Canada, 2007.

Park, T., J.B. Loomis, and M. Creel. "Confidence Interval for Evaluating Benefits Estimates from Dichotomous Choice Contingent Valuation Studies" *Land Economics* 67, no. 1(1991): 64-73.

Poe, G.L., E.K. Severancelossin, and M.P. Welsh. "Measuring the Difference (X-Y) of Simulated Distributions: A Convolutions Approach." *American Journal of Agricultural Economics* 76, no. 4(1994): 904-915.

Poe, G.L., and M.P. Welsh. "WTP Certainty Intervals and the Disparity between Contingent Valuation Elicitation Formats: Application of a Multiple-Bounded Discrete Choice Approach." *American Journal of Agricultural Economics* 78, no. 5(1996): 1393.

Pollara, R. "Public Opinion Research into Biotechnology Issues in Canada." Government of Canada, 2003

Pronovost, J., M. Dumais, and P. Tremblay. *Agriculture et Agroalimentaire Québécois: assurer et bâtir l'avenir: rapport.* Commission sur l'avenir de l'agriculture et de l'agroalimentaire Québécois, Québec, 2008.

Pryme, F.I., and R. Lembcke. "In Vivo Studies on Possible Health Consequences of Genetically Modified Food and Feed with Particular Regard to Ingredients Consisting of Genetically Modified Plant Material." *Nutrition and Health* 17(2003): 1-8.

Randall, A., and J.P. Hoehn. "Embedding in Market Demand Systems." *Journal of Environmental Economics and Management* 30, no. 3(1996): 369-380.

Randall, A., B. Ives, and C. Eastman. "Bidding Games for Valuation of Aesthetic Environmental Improvement." *Journal of Environmental Economics and Management* 1, no. 2(1974): 132-149.

Reganold, J.P., L.F. Elliott, and Y. L. Unger. "Long-term Effects of Organic and Conventional Farming on Soil Erosion." *Nature* 330, no. 6146(1987): 370-372.

Roach, B., K.J. Boyle, and M. Welsh. "Testing Bid Design Effects in Multiple-bounded, Contingent Valuation Questions." *Land Economics* 78, no. 1(2002): 121-131.

Rowe, R.D., W.E. Schulze, and W. S. Breffle. "A Test for Payment Card Biases." *Journal of Environmental Economics and Management* 31, no. 2(1996): 178-185.

Salha, S.B., and J. Robitaille. "Les produits biologiques: quel est leur avenir sur le marché canadien?" *BioClip+*, Décembre 2005, p. 11.

Samples, K.C., J.A. Dixon, and M.M. Gowen. "Information Disclosure and Endangered Species Valuation." *Land Economics* 62, no. 3(1986): 306-312.

Smith, V.K. "Arbitrary Values, Good Causes, and Premature Verdicts " *Journal of Environmental Economics and Management* 22, no. 1(1992): 71-89.

Stevens, T.H. "Can Stated Preference Valuation Help Improve Environmental Decision Making?" *Choices*, Third Quarter of 2005, pp. 189-193.

Stevens, T.H., C. Barrett, and C.E. Willis. "Conjoint Analysis of Groundwater Protection Programs." *Agricultural Resource Economics Review* 26(1992): 229-236.

Straub, M.O.R. "Product Attributes and Consumer Willingness to Pay for Environmental Management System in Agriculture: Using the Choice Modelling Technique." Msc Thesis, McGill University, 2004.

Thurstone, L.L. "A Law of Comparative Judgment (Reprinted from Psychological Review, Vol 34, pp. 273, 1927)." *Psychological Review* 101, no. 2(1994): 266-270.

United Nations, Food and Agriculture Organization. *The State of Food and Agriculture*. Rome, 2004.

Volinskiy, D., W.L. Adamowicz, M. Veeman, and L. Srivastava. "Does Choice Context Affect the Results from Incentive-Compatible Experiment? The Case of Non-GM and Contry-of-origin Premia in Canola Oil" *Canadian Journal of Agricultural Economics* 57, no.2(2009): 205-221.

Vossler, C.A., G.L. Poe, M.P. Welsh, and R.G. Ethier. "Bid Design Effects in Multiple Bounded Discrete Choice Contingent Valuation." *Environmental and Resource Economics* 29, no. 4(2004): 401-418.

Wall, E., A. Weersink, and C. Swanton. "Agriculture and ISO 14000." *Food Policy* 26, no. 1(2001): 35-48.

Yeung, R.M.W., and J. Morris. "Food Safety Risk Consumer Perception and Purchase Behaviour." *British Food Journal* 103, no. 3(2001): 170-186.

Appendix 1. CM Attribute and their respective levels

Experiment	Attributes	Conventional Levels (Status quo)	GM Levels	EMS Levels	Organic Levels
Milk	Price ($/2 litres)	2.50	1.00, 1.50, 2.00, 2.50	2.75, 3.00, 3.50, 4.00	3.50, 4.00, 4.50, 5.00
	Risk to human health (% change)	No change	-15, -10, -5, 0	-5, 0, 5, 10	0, 5, 10, 15
	Impact on the environment (% change)	No change	-15, -10, -5, 0, 5	5, 10, 15, 20, 25	-5, 0, 5, 10, 15
	Location of production	In Quebec	Montreal region, another Canadian province, outside Canada	Montreal region, another Canadian province, outside Canada	Montreal region, another Canadian province, outside Canada
Tomatoes	Price ($/kg)	4.00	2.50, 3.00, 3.50, 4.00	4.25, 4.50, 5.00, 5.50	4.50, 5.00, 5.50, 6.00
	Risk to human health (% change)	No change	-15, -10, -5, 0	-5, 0, 5, 10	0, 5, 10, 15
	Impact on the environment (% change)	No change	-15, -10, -5, 0, 5	5, 10, 15, 20, 25	-5, 0 5, 10, 15
	Appearance (% change)	No change	0, 5, 10, 15	-15, -10, -5, 0	-15, -10, -5, 0
Pork	Price ($/kg)	8.00	4.00, 5.00, 6.00, 7.00	8.00, 9.00, 10.00, 11.00	11.00, 12.00, 13.00, 14.00
	Risk to human health (% change)	No change	-15, -10, -5, 0	-5, 0, 5, 10	0, 5, 10, 15
	Impact on the environment (% change)	No change	-15, -10, -5, 0, 5	5, 10, 15, 20, 25	-5, 0, 5, 10, 15
	Animal welfare (% change)	No change	-15, -10, -5, 0	0, 5, 10, 15	0, 5, 10, 15

Appendix 2. CV questionnaire versions with their characteristics

Version #	Sequence	Bid order
1	Milk-Tomato-Pork	Ascending
2	Milk-Pork-Tomato	Ascending
3	Tomato-Milk-Pork	Ascending
4	Tomato-Pork-Milk	Ascending
5	Pork-Milk-Tomato	Ascending
6	Milk-Tomato-Pork	Ascending
7	Milk-Tomato-Pork	Descending
8	Milk-Pork-Tomato	Descending
9	Tomato-Milk-Pork	Descending
10	Tomato-Pork-Milk	Descending
11	Pork-Milk-Tomato	Descending
12	Milk-Tomato-Pork	Descending

Appendix 3. Survey distribution pattern in the different neighborhoods

Neighborhoods	Population	Group	Proportion	Number of surveys distributed	Total for group
Mont-Royal	20361	1	5.62	51	
Westmount	19727	1	5.44	49	100
Pointe-Claire	29286	2	8.08	23	
Dollard-Des-Ormeaux -- Roxboro	53848	2	14.85	43	
Kirkland	20434	2	5.64	16	
Beaconsfield -- Baie d'Urfe	23123	2	6.38	18	100
Villeray -- Saint-Michel -- Parc-Extension	145485	3	40.13	30	
Montreal-Nord	83600	3	23.06	17	
Rosemont -- La Petite-Patrie	131138	3	36.18	27	
Mercier- Hochelaga-Maisonneuve	128440	3	35.43	26	100
Cote-Saint-Luc -- Hampstead -- Montreal-Ouest	41580	4	11.47	64	
Outremont	22933	4	6.33	36	100
Pierrefonds -- Senneville	55933	5	15.43	72	
L'Ile-Bizard -- Sainte-Genevieve -- Sainte-Anne-de-Bellevue	22201	5	6.12	28	100
Saint-Laurent	77391	6	21.35	81	
Dorval -- L'ile-Dorval	17706	6	4.88	19	100
Anjou	38015	7	10.49	26	
Riviere-des-Prairies -- Pointe-aux-Trembles -- Montreal-Est	106004	7	29.24	74	100
Plateau -- Mont-Royal	101364	8	27.96	30	
Cote-des Neiges -- Notre-Dame-de-Grace	163110	8	45.00	48	
Ville-Marie	74832	8	20.64	22	100
Saint-Leonard	69604	9	19.20	36	
Ahunstic-Cartierville	125145	9	34.52	64	100
Sud-Ouest	66474	10	18.34	28	
Lachine	40222	10	11.10	17	
LaSalle	73983	10	20.41	31	
Verdun	60564	10	16.71	25	100
	1812503		500	1000	1000

McGill

Survey on Consumer Food Purchases

Instructions

Your participation in this survey is completely voluntary and anonymous. The survey should take approximately 20 minutes to complete.

There are no right or wrong answers to the questions on this survey. We are simply interested in your opinions.

Please follow these instructions while completing the survey:

1) Use either pencil or pen, and please mark your answers clearly.

2) If you are not sure of your exact answer, please answer as best you can.

3) If there are any questions that you do not wish to answer or that you feel uncomfortable answering, please leave them blank.

4) Please do not include any personal identification information on the survey.

5) Completed surveys will be collected in 4 to 7 days from the time of distribution.

We appreciate your participation in this study.

SECTION I
General questions

To begin, we would like to ask you a few general questions.

1) When you return this survey, one dollar will be given to a charity of your choice. Which charity would you like to receive the $1 donation in appreciation of your completed survey?
Please check only one box.

- ☐ Moisson Québec (Quebec food bank association)
- ☐ Centraide (Quebec United Way)
- ☐ Équiterre (Quebec organization promoting environmental/social responsibility)
- ☐ Canadian Cancer Society

2) How often do you purchase organic food products?
Please check the box that best describes your purchasing patterns.

- ☐ Never
- ☐ Rarely (less than 1 product per week)
- ☐ Sometimes (between 1 and 3 products per week)
- ☐ Often (between 4 and 10 products per week)
- ☐ Always (organic products as much as possible)

3) Please give your opinion on the following statements about environmental practices on farms.
Please rate how much you agree with each statement by circling one answer on each row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a. Environmental regulations for farms are necessary to help protect the environment.	1	2	3	4	5
b. The government does a good job of explaining why new environmental regulations for farms are needed.	1	2	3	4	5
c. The farmers do a good job of complying with new environmental regulations.	1	2	3	4	5
d. Environmentally friendly farming practices help improve consumers' perception of farmers.	1	2	3	4	5
e. Environmentally friendly farming practices reflect principles that are important to me.	1	2	3	4	5

We would now like to know how various product characteristics might influence your purchasing decisions for the following three products: milk, tomatoes, and pork.

Please circle one answer on each row.

4) Please rate how much each of the following factors affects your decision to buy MILK.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the milk	1	2	3	4	5
b. Whether the milk is certified organic	1	2	3	4	5
c. Whether the milk is from genetically modified cows	1	2	3	4	5
d. Impact on the environment from milk production	1	2	3	4	5
e. Where the milk is produced	1	2	3	4	5
f. The brand of the milk	1	2	3	4	5

5) Please rate how much each of the following factors affects your decision to buy TOMATOES.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the tomatoes	1	2	3	4	5
b. Whether the tomatoes are certified organic	1	2	3	4	5
c. Whether the tomatoes are genetically modified	1	2	3	4	5
d. Whether the tomatoes are produced using synthetic fertilizers and pesticides.	1	2	3	4	5
e. Impact on the environment from tomato production	1	2	3	4	5
f. The appearance of the tomatoes	1	2	3	4	5

6) Please rate how much each of the following factors affects your decision to buy PORK.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the pork	1	2	3	4	5
b. Whether the pork is from genetically modified animals	1	2	3	4	5
c. Impact on the environment from pork production	1	2	3	4	5
d. Whether the pig feed contains antibiotics	1	2	3	4	5
e. How the pigs were treated while they were raised	1	2	3	4	5
f. The brand of the pork	1	2	3	4	5

SECTION II
Aspects to consider when purchasing food

In the following pages, we will present you with several hypothetical food buying situations involving milk, tomatoes, and pork. You will be asked to make a purchasing decision among the choices available.

Each question will ask you to choose among four different products. You will be choosing among products grown 1) in a conventional farming system, 2) with the aid of genetic modification, 3) in an environmental management system, or 4) in an organic farming system.

Here is some basic information about the different types of farming practices.

Conventional Farming
Conventional farming is the type of production method used on most North American farms and it typically uses synthetic fertilizers and pesticides, and other technologies. This production method seeks to produce low-cost, abundant food using modern agricultural technologies but has recently raised public concerns with regard to animal welfare and the long term sustainability of agriculture.

Genetically Modified Foods (GM-foods)
Genetically modified foods have been genetically altered in order to change some physical property or capability of the food or the organism that produces the food. The genetic makeup is often altered to make the organism hardier or more productive. For example, a gene may be implanted into a seed to produce a fruit that is more resistant to drought or insects, or to improve a crop's appearance or size. These properties may help to decrease food costs, but some people question their long term safety.

Environmental Management System (EMS)
Environmental Management Systems are relatively new to agriculture. Farmers who establish an EMS must consider the environmental impacts of each resource, process, product, and service that they use. This system minimizes the dependence on synthetic fertilizers and pesticides but does not ban their use. An EMS requires testing and monitoring of standards in food quality and can potentially produce as much food per acre as conventional agriculture systems. However, the cost of setting up an EMS may result in higher food prices for consumers.

Organic Farming
The principal goal of organic production systems is to produce food using methods that promote and enhance the health of agricultural ecosystems, including biodiversity and soil fertility. Organic farms are also characterized by their use of certain animal husbandry methods that take animal welfare into consideration. Organic farming bans the use of synthetic fertilizers and pesticides, genetically-modified organisms, and antibiotics and growth hormones in animal husbandry. Nevertheless, compared with conventional farms, organic farms tend to produce less food per acre and require more labour, often resulting in higher prices for organic foods.

Products grown under each of the farming systems described previously have different characteristics including price, potential impacts on human health, impacts on the environment, location of production, and appearance.

Here is some information on the characteristics of food products that may influence your buying decisions.

Price

Many factors might affect the price that you are willing or able to pay for food products. When you make your choice among the options presented in this survey, please consider how much you can realistically afford to pay for an item, in addition to the following issues:

- That improvements in food safety and sustainable farming practices cost money;
- That the use of genetic modification may allow some foods to be produced cheaper than the current foods;
- That buying genetically-modified foods may lower your weekly grocery bills while buying organic foods may increase them.

Potential impact on human health

While recent food scares have increased concerns regarding food safety, food shopping choices may affect human health in many ways. Some of the issues people could be concerned with include:

- Whether chemical residues from pesticides might be present on foods;
- Whether foods may be contaminated with health threatening bacteria, such as E. coli or salmonella;
- Whether there are health risks associated with the unknown consequences of consuming genetically modified foods;
- Whether the nutritional content of the food satisfies one's dietary requirements (e.g., amounts of fat, carbohydrates, cholesterol, or levels of vitamins).

Impact on the environment from production

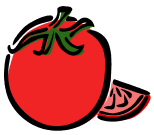
Agriculture has undeniable impacts on the environment. However, different farming methods may impact the environment to a greater or lesser extent. Some of the issues people could be concerned with include:

- Sediment, nutrient and chemical contamination of groundwater and waterways;
- Soil erosion;
- Loss of biodiversity;
- Ecological risks associated with the use of genetically modified organisms.

Location of production

Where foods are produced and where food dollars go can affect the local economy and the availability of jobs. Some people may be concerned about whether food they purchase is produced:

- In the region of Montreal;
- Elsewhere in Quebec;
- In another Canadian province;
- Outside of Canada.



Appearance

While shopping, it is difficult to judge the quality of fruits and vegetables without being able to taste them. Consumers often rely on appearance, which may vary according to:

- The age of the product;
- Whether the product was grown using chemical pesticides and synthetic fertilizers;
- How the product was transported, handled, and stored;
- Whether genetic engineering was used to enhance the appearance of the product.

Animal welfare

Animal welfare relates to the humane treatment of animals. Some people might be concerned about how the animals used for human consumption are treated, including:

- Under what conditions the animal are raised and transported;
- What the animal eats.

We will now present you with nine questions: three related to milk purchases, three related to tomatoes purchases, and three related to pork purchases. For each you must choose among the four choices given.

In each question the first choice available is the product grown under a conventional farming system; this is considered the standard product, and its characteristics are always the same. The remaining choices relate to the same product but grown under different farming systems. Note that the characteristics of these choices differ between milk, tomatoes, and pork. Thus, even though the questions look similar, in each case there are different options available to you.

Treat these choices as though the products given were readily available at your grocery store, always keeping your food budget in mind. If you are not sure which product to choose, please pick the one that looks best overall and move on.

7) Purchasing MILK

If you were purchasing a 2-litre carton of milk, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing milk				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Location of production** 	***I would choose***
Conventional	$2.50 for 2 litres	No change	No change	In Quebec	☐
Genetically Modified	$1.00 for 2 litres	15% **increase** in the risk to your health	5% **increase** in environmental impacts	Outside of Canada	☐
Environmental Management System	$3.50 for 2 litres	10% **decrease** in the risk to your health	20% **decrease** in environmental impacts	Outside of Canada	☐
Organic	$4.50 for 2 litres	10% **decrease** in the risk to your health	**No change** in environmental impacts	In the region of Montreal	☐

8) Purchasing MILK

If you were purchasing a 2-litre carton of milk, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing milk				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Location of production** 	***I would choose***
Conventional	$2.50 for 2 litres	No change	No change	In Quebec	☐
Genetically Modified	$1.00 for 2 litres	5% **increase** in the risk to your health	10% **increase** in environmental impacts	Outside of Canada	☐
Environmental Management System	$4.00 for 2 litres	10% **decrease** in the risk to your health	5% **decrease** in environmental impacts	In Quebec	☐
Organic	$4.00 for 2 litres	15% **decrease** in the risk to your health	10% **decrease** in environmental impacts	Outside of Canada	☐

9) Purchasing MILK

If you were purchasing a 2-litre carton of milk, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing milk				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Location of production** 	***I would choose***
Conventional	$2.50 for 2 litres	No change	No change	In Quebec	☐
Genetically Modified	$2.50 for 2 litres	15% **increase** in the risk to your health	5% **increase** in environmental impacts	In the region of Montreal	☐
Environmental Management System	$3.00 for 2 litres	**No change** in the risk to your health	5% **decrease** in environmental impacts	Another Canadian province	☐
Organic	$3.50 for 2 litres	15% **decrease** in the risk to your health	5% **increase** in environmental impacts	In Quebec	☐

10) Purchasing TOMATOES

If you were purchasing 1 kilogram (kg) of tomatoes, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing tomatoes				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Appearance** 	***I would choose***
Conventional	$4.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$2.50 for 1 kg	15% **increase** in the risk to your health	5% **increase** in environmental impacts	15% **improve-ment** in appearance	☐
Environmental Management System	$5.00 for 1 kg	10% **decrease** in the risk to your health	20% **decrease** in environmental impacts	No change in appearance	☐
Organic	$5.50 for 1 kg	10% **decrease** in the risk to your health	No change in environmental impacts	15% **decrease** in appearance	☐

11) Purchasing TOMATOES

If you were purchasing 1 kilogram (kg) of tomatoes, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing tomatoes				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Appearance** 	***I would choose***
Conventional	$4.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$2.50 for 1 kg	**No change** in the risk to your health	**No change** in environmental impacts	10% **improve-ment** in appearance	☐
Environmental Management System	$5.00 for 1 kg	**No change** in the risk to your health	5% **decrease** in environmental impacts	**No change** in appearance	☐
Organic	$4.50 for 1 kg	15% **decrease** in the risk to your health	15% **decrease** in environmental impacts	5% **decrease** in appearance	☐

12) Purchasing TOMATOES

If you were purchasing 1 kilogram (kg) of tomatoes, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing tomatoes				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Appearance** 	***I would choose***
Conventional	$4.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$2.50 for 1 kg	5% **increase** in the risk to your health	5% **decrease** in environmental impacts	No change in appearance	☐
Environmental Management System	$4.25 for 1 kg	5% **decrease** in the risk to your health	25% **decrease** in environmental impacts	15% **decrease** in appearance	☐
Organic	$5.50 for 1 kg	15% **decrease** in the risk to your health	5% **decrease** in environmental impacts	10% **decrease** in appearance	☐

13) Purchasing PORK

If you were purchasing 1 kilogram (kg) of pork, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing pork				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Animal welfare** 	***I would choose***
Conventional	$8.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$4.00 for 1 kg	10% **increase** in the risk to your health	**No change** in environmental impacts	10% **decrease** in animal welfare	☐
Environmental Management System	$8.00 for 1 kg	**No change** in the risk to your health	15% **decrease** in environmental impacts	5% **improvement** in animal welfare	☐
Organic	$12.00 for 1 kg	10% **decrease** in the risk to your health	10% **decrease** in environmental impacts	5% **improvement** in animal welfare	☐

14) Purchasing PORK

If you were purchasing 1 kilogram (kg) of pork, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing pork				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Animal welfare** 	***I would choose***
Conventional	$8.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$6.00 for 1 kg	15% **increase** in the risk to your health	5% **increase** in environmental impacts	10% **decrease** in animal welfare	☐
Environmental Management System	$8.00 for 1 kg	5% **increase** in the risk to your health	25% **decrease** in environmental impacts	5% **improve-ment** in animal welfare	☐
Organic	$11.00 for 1 kg	10% **decrease** in the risk to your health	5% **increase** in environmental impacts	15% **improve-ment** in animal welfare	☐

15) Purchasing PORK

If you were purchasing 1 kilogram (kg) of pork, which of the following four options would you choose?

Please check only ONE box.

	Important issues to consider when purchasing pork				
	Price 	**Risk to human health** 	**Impact on the environment from production** 	**Animal welfare** 	***I would choose***
Conventional	$8.00 for 1 kg	No change	No change	No change	☐
Genetically Modified	$7.00 for 1 kg	10% **increase** in the risk to your health	**No change** in environmental impacts	15% **decrease** in animal welfare	☐
Environmental Management System	$11.00 for 1 kg	10% **decrease** in the risk to your health	25% **decrease** in environmental impacts	15% **improve-ment** in animal welfare	☐
Organic	$14.00 for 1 kg	10% **decrease** in the risk to your health	10% **decrease** in environmental impacts	10% **improve-ment** in animal welfare	☐

16) In the previous questions, did you always choose the conventional product?

☐ Yes

☐ No (Skip to question 18)

17) If you answered "Yes" to question 16, which statement(s) most closely describe(s) your reason for doing so?

Please check at least one box.

☐ I am not concerned with environmental, food safety, or animal welfare issues.

☐ I support environmental protection, food safety, and animal welfare initiatives, but cannot afford any of the prices mentioned.

☐ I am opposed to the idea of organic food.

☐ I am opposed to the idea of genetically modified food.

☐ I did not know which option was best so I selected the conventional option.

☐ Other reason(s) (please specify): _____

_____

_____

18) We would like to know your feelings toward the nine previous shopping scenarios presented. Beside each statement below, please check the box that most closely describes your point of view.

Please check a response to every statement.

	Yes	No	Don't know
a. I needed more information than what was provided.	☐	☐	☐
b. The information was biased in favour of the environment.	☐	☐	☐
c. The options were confusing.	☐	☐	☐
d. The options were unrealistic.	☐	☐	☐

Other comments: _____

_____

_____

19) The following statements relate to the regulation of food products.

Please rate how much you agree with each statement by circling one answer on each row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a. The government can be trusted to ensure farmers maintain adequate food safety standards.	1	2	3	4	5
b. The government can be trusted to ensure food retailers maintain adequate food safety standards.	1	2	3	4	5
c. Scientists can be trusted to set acceptable food safety standards.	1	2	3	4	5
d. Scientists can be trusted to develop genetically modified foods safely.	1	2	3	4	5
e. An environmental management system (EMS) would be beneficial to both farmers and consumers.	1	2	3	4	5
f. Labels are important in my food purchase decisions.	1	2	3	4	5
g. There should be labels on all genetically modified foods for sale in supermarkets.	1	2	3	4	5
h. I would choose non-genetically modified foods over genetically modified foods.	1	2	3	4	5
i. The use of chemical fertilizers and pesticides in agricultural production should be strictly limited.	1	2	3	4	5

SECTION III
Background information

In this section of the questionnaire, we ask you a few questions to make sure that individuals we survey come from a wide range of backgrounds.

Please check only one box for each question.

20) What is your age group?

☐ 18 - 24 ☐ 25 - 34 ☐ 35 - 44
☐ 45 - 54 ☐ 55 - 64 ☐ 65+

21) What is your sex?

☐ Male ☐ Female

22) Have you ever donated to any environmental organizations?

☐ Yes ☐ No

23) How many people live in your household?

_____

24) What is your current work status?

☐ Employed full-time or part-time
☐ Unemployed / looking for work
☐ Retired / pensioner
☐ Student
☐ Home duties / stay at home
☐ Other: _____

25) What is the highest level of education you have obtained or are in the process of obtaining?

☐ Completed primary school
☐ Completed high school
☐ Diploma or certificate (trade)
☐ Bachelor's degree
☐ Graduate school

26) Please check the box below that most closely indicates your household income before tax.

- ☐ Less than $10,000
- ☐ $10,000 - $19,999
- ☐ $20,000 - $29,999
- ☐ $30,000 - $39,999
- ☐ $40,000 - $49,999
- ☐ $50,000 - 74,999
- ☐ $75,000 - $99,999
- ☐ $100,000 - $124,999
- ☐ $125,000 or more

27) Approximately how much would you say your household spends on groceries per week?

- ☐ Less than $90
- ☐ $90 - $119
- ☐ $120 - $149
- ☐ $150 - $189
- ☐ $190 - $210
- ☐ $220 or more

28) In your own words, what is the most important environmental issue that you would like to see better managed?

_____

_____

_____

29) If you have any other comments about any of the topics covered on this survey, please write them on the lines provided below.

_____

_____

_____

Thank you for taking the time to complete this survey.
Your help with this research is greatly appreciated.

McGill

Survey on Consumer Food Purchases

Instructions

Your participation in this survey is completely voluntary and anonymous. The survey should take approximately 30 minutes to complete.

There are no right or wrong answers to the questions on this survey. We are simply interested in your opinions.

Please follow these instructions while completing the survey:

1. Use either pencil or pen, and please mark your answers clearly.
2. If you are not sure of your exact answer, please answer as best you can.
3. If there are any questions that you do not wish to answer or that you feel uncomfortable answering, please leave them blank.
4. Please do not include any personal identification information on the survey.
5. Completed surveys will be collected in 4 to 7 days from the time of distribution.

We appreciate your participation in this study.

SECTION I
General questions

To begin, we would like to ask you a few general questions.

1) When you return this survey, one dollar will be given to a charity of your choice. Which charity would you like to receive the $1 donation in appreciation of your completed survey?
Please check one box.

- ☐ Moisson Québec (Quebec food bank association)
- ☐ Centraide (Quebec United Way)
- ☐ Équiterre (Quebec organization promoting environmental/social responsibility)
- ☐ Canadian Cancer Society

2) How often do you purchase organic food products?
Please check the box that best describes your purchasing patterns.

- ☐ Never
- ☐ Rarely (less than 1 product per week)
- ☐ Sometimes (between 1 and 3 products per week)
- ☐ Often (between 4 and 10 products per week)
- ☐ Always (organic products as much as possible)

3) Please give your opinion on the following statements about environmental practices on farms.
Please rate how much you agree with each statement by circling one answer on each row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a. Environmental regulations for farms are necessary to help protect the environment.	1	2	3	4	5
b. The government does a good job of explaining why new environmental regulations for farms are needed.	1	2	3	4	5
c. The farmers do a good job of complying with new environmental regulations.	1	2	3	4	5
d. Environmentally friendly farming practices help improve consumers' perception of farmers.	1	2	3	4	5
e. Environmentally friendly farming practices reflect principles that are important to me.	1	2	3	4	5

We would now like to know how various product characteristics might influence your purchasing decisions for the following three products: milk, tomatoes, and pork.

Please circle one answer on each row.

4) Please rate how much each of the following factors affects your decision to buy MILK.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the milk	1	2	3	4	5
b. Whether the milk is certified organic	1	2	3	4	5
c. Whether the milk is from genetically modified cows	1	2	3	4	5
d. Impact on the environment from milk production	1	2	3	4	5
e. Where the milk is produced	1	2	3	4	5
f. The brand of the milk	1	2	3	4	5

5) Please rate how much each of the following factors affects your decision to buy TOMATOES.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the tomatoes	1	2	3	4	5
b. Whether the tomatoes are certified organic	1	2	3	4	5
c. Whether the tomatoes are genetically modified	1	2	3	4	5
d. Whether the tomatoes are produced using chemical pesticides and synthetic fertilizers	1	2	3	4	5
e. Impact on the environment from tomato production	1	2	3	4	5
f. The appearance of the tomatoes	1	2	3	4	5

6) Please rate how much each of the following factors affects your decision to buy PORK.

	Not important	Somewhat important	Neutral	Important	Very important
a. The price of the pork	1	2	3	4	5
b. Whether the pork is from genetically modified pigs	1	2	3	4	5
c. Impact on the environment from pork production	1	2	3	4	5
d. Whether the pig feed contains antibiotics	1	2	3	4	5
e. How the pigs were treated while they were raised	1	2	3	4	5
f. The brand of the pork	1	2	3	4	5

SECTION II
Aspects to consider when purchasing food

In the following pages, we will present you with several hypothetical food buying situations involving milk, tomatoes, and pork. You will be asked to make a purchasing decision among the choices available.

The following question will ask you to value four different products. You will value products grown 1) in a conventional system, 2) with the aid of genetic modification, 3) in an environmental management system, or 4) in an organic farming system.

Here is some basic information about the different types of farming practices.

Conventional Farming
Conventional farming is the type of production method used on most North American farms and it typically uses synthetic fertilizers, chemical pesticides, and other technologies. This production method seeks to produce low-cost, abundant food using modern agricultural technologies but has recently raised public concerns with regard to animal welfare and the long term sustainability of agriculture.

Genetically Modified Foods (GM-foods)
Genetically modified foods have been genetically altered in order to change some physical characteristics of the food or the organism that produces the food. The genetic makeup is often altered to make the organism hardier or more productive. For example, a gene may be implanted into a seed to produce a fruit that is more resistant to drought or insects, or to improve a crop's appearance or size. These properties may help to decrease food costs, but some people question their long term safety.

Environmental Management System (EMS)
Environmental Management Systems are relatively new to agriculture. Farmers who establish an EMS must consider the environmental impacts of each resource, process, product, and service that they use. This system minimizes the dependence on synthetic fertilizers and pesticides but does not ban their use. An EMS requires testing and monitoring of standards in food quality and can potentially produce as much food per acre as conventional agriculture systems. However, the cost of setting up an EMS may result in higher food prices for consumers.

Organic Farming
The principal goal of organic production systems is to produce food using methods that promote and enhance the health of agricultural ecosystems, including biodiversity and soil fertility. Organic farms are also characterized by their use of certain animal husbandry methods that take animal welfare into consideration. Organic farming bans the use of synthetic fertilizers and pesticides, genetically-modified organisms, antibiotics and growth hormones in animal husbandry. Nevertheless, compared with conventional farms, organic farms tend to produce less food per acre and require more labour, often resulting in higher prices for organic foods.

Products grown under each of the farming systems described above have different characteristics including price, potential impacts on human health, impacts on the environment, location of production, and appearance.

Here is some information on the characteristics that may influence your buying decisions.

Price

Many factors might affect the price that you are willing or able to pay for food products. When you make your choice among the options presented in this survey, please consider how much you can realistically afford to pay for an item, in addition to the following issues:

- That improvements in food safety and sustainable farming practices cost money;
- That the use of genetic modification may allow some foods to be produced cheaper than the current foods;
- That buying genetically-modified foods may lower your weekly grocery bills while buying organic foods may increase them.

Potential impact on human health

While recent food scares have increased concerns regarding food safety, food shopping choices may affect human health in many ways. Some of the issues people could be concerned with include:

- Whether chemical residues from pesticides might be present on foods;
- Whether foods may be contaminated with health threatening bacteria, such as E. coli or salmonella;
- Whether there are health risks associated with the unknown consequences of consuming genetically modified foods;
- Whether the nutritional content of the food satisfies one's dietary requirements (e.g., amounts of fat, carbohydrates, cholesterol, or levels of vitamins).

Impact on the environment from production

Agriculture has undeniable impacts on the environment. However, different farming methods may impact the environment to a greater or lesser extent. Some of the issues people could be concerned with include:

- Sediment, nutrient and chemical contamination of groundwater and waterways;
- Soil erosion;
- Loss of biodiversity;
- Ecological risks associated with the use of genetically modified organisms.

Location of production
Where foods are produced and where food dollars go can affect the local economy and the availability of jobs. Some people may be concerned about whether food they purchase is produced:

- In the region of Montreal;
- Elsewhere in Quebec;
- In another Canadian province;
- Outside of Canada.

Appearance
While shopping, it is difficult to judge the quality of fruits and vegetables without being able to taste them. Consumers often rely on appearance, which may vary according to:

- The age of the product;
- Whether the product was grown using chemicals and fertilizers;
- How the product was transported, handled, and stored;
- Whether genetic engineering was used to enhance the appearance of the product.

Animal welfare
Animal welfare relates to the humane treatment of animals. Some people might be concerned about how the animals used for human consumption are treated, including:

- Under what conditions the animal are raised and transported;
- What the animal eats;
- How the animal is transported.

We will now present you with 12 questions: four related to milk purchases, four related to tomatoes purchases, and four related to pork purchases.

In each question, you are asked to compare products produced under a conventional farming system against products produced under another type of farming system. Note that the characteristics of the products differ in every question thus you are presented with different options. After considering the options provided, please state your certainty by checking ONE box for each price.

If you would not want to buy the product at any price because of its characteristics, please check the box under the choices stating: "I would not buy this product".

7) Environmental Management System (EMS) MILK

Currently, a 2-litre carton of milk produced using a conventional farming method costs $2.75. Assume that you have the opportunity to purchase a 2-litre carton of EMS milk that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional milk*
- Impact on the environment: ***10% decrease*** *in environmental impact, compared with conventional milk*
- Location of production: ***outside of Canada****, compared with conventional milk produced in Canada*

How much would you be willing to pay for a 2-litre carton of EMS milk?

Please check ONE box for each price.

Price for 2 litres	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 2.00	☐	☐	☐	☐	☐
$ 2.50	☐	☐	☐	☐	☐
$ 2.65	☐	☐	☐	☐	☐
$ 2.75	☐	☐	☐	☐	☐
$ 3.00	☐	☐	☐	☐	☐
$ 3.50	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

8) Environmental Management System (EMS) MILK

Currently, a 2-litre carton of milk produced using a conventional farming method costs $2.75. Assume that you have the opportunity to purchase a 2-litre carton of EMS milk that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional milk*
- Impact on the environment: ***25% decrease*** *in environmental impact, compared with conventional milk*
- Location of production: ***in Canada, same as*** *conventional milk produced in Canada*

How much would you be willing to pay for a 2-litre carton of EMS milk?

Please check ONE box for each price.

Price for 2 litres	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 2.00	☐	☐	☐	☐	☐
$ 2.50	☐	☐	☐	☐	☐
$ 2.65	☐	☐	☐	☐	☐
$ 2.75	☐	☐	☐	☐	☐
$ 3.00	☐	☐	☐	☐	☐
$ 3.50	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

9) Organic MILK

Currently, a 2-litre carton of milk produced using a conventional farming method costs $2.75. Assume that you have the opportunity to purchase a 2-litre carton of ORGANIC milk that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional milk*
- Impact on the environment: ***15% decrease*** *in environmental impact, compared with conventional milk*
- Location of production: ***in Quebec, compared with*** *conventional milk produced in Canada*

How much would you be willing to pay for a 2-litre carton of ORGANIC milk?

Please check ONE box for each price.

Price for 2 litres	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 2.00	☐	☐	☐	☐	☐
$ 2.50	☐	☐	☐	☐	☐
$ 2.65	☐	☐	☐	☐	☐
$ 2.75	☐	☐	☐	☐	☐
$ 3.00	☐	☐	☐	☐	☐
$ 3.50	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

10) Organic MILK

Currently, a 2-litre carton of milk produced using a conventional farming method costs $2.75. Assume that you have the opportunity to purchase a 2-litre carton of ORGANIC milk that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional milk*
- Impact on the environment: ***25% decrease*** *in environmental impact, compared with conventional milk*
- Location of production: ***in Quebec,*** *compared with conventional milk produced in Canada*

How much would you be willing to pay for a 2-litre carton of ORGANIC milk?

Please check ONE box for each price.

Price for 2 litres	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 2.00	☐	☐	☐	☐	☐
$ 2.50	☐	☐	☐	☐	☐
$ 2.65	☐	☐	☐	☐	☐
$ 2.75	☐	☐	☐	☐	☐
$ 3.00	☐	☐	☐	☐	☐
$ 3.50	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

11) Genetically Modified (GM) TOMATOES

Currently, a kilogram (kg) of tomatoes produced using a conventional farming method costs $4.00. Assume that you have the opportunity to purchase 1 kilogram of GENETICALLY MODIFIED tomatoes that is known to contain the following attributes:

- Risk to human health: ***5% increase*** *in the risk to your health, compared with conventional tomatoes*
- Impact on the environment: ***5% increase*** *in environmental impact**,** compared with conventional tomatoes*
- Appearance: ***15% improvement*** *in appearance, compared with conventional tomatoes*

How much would you be willing to pay for 1 kilogram of GENETICALLY MODIFIED tomatoes?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 3.50	☐	☐	☐	☐	☐
$ 3.75	☐	☐	☐	☐	☐
$ 3.90	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 4.10	☐	☐	☐	☐	☐
$ 4.25	☐	☐	☐	☐	☐
$ 4.50	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 6.00	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason: _____**

12) Genetically Modified (GM) TOMATOES

Currently, a kilogram (kg) of tomatoes produced using a conventional farming method costs $4.00. Assume that you have the opportunity to purchase 1 kilogram of GENETICALLY MODIFIED tomatoes that is known to contain the following attributes:

- Risk to human health: ***15% increase*** *in the risk to your health, compared with conventional tomatoes*
- Impact on the environment: ***same as*** *conventional tomatoes*
- Appearance: ***15% improvement*** *in appearance, compared with conventional tomatoes*

How much would you be willing to pay for 1 kilogram of GENETICALLY MODIFIED tomatoes?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 3.50	☐	☐	☐	☐	☐
$ 3.75	☐	☐	☐	☐	☐
$ 3.90	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 4.10	☐	☐	☐	☐	☐
$ 4.25	☐	☐	☐	☐	☐
$ 4.50	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 6.00	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

13) Environmental Management System (EMS) TOMATOES

Currently, a kilogram (kg) of tomatoes produced using a conventional farming method costs $4.00. Assume that you have the opportunity to purchase 1 kilogram of EMS tomatoes that is known to contain the following attributes:

- Risk to human health: ***15% decrease*** *in the risk to your health, compared with conventional tomatoes*
- Impact on the environment: ***same as*** *conventional tomatoes*
- Appearance: ***15% decrease*** in appearance, compared with *conventional tomatoes*

How much would you be willing to pay for 1 kilogram of EMS tomatoes?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 3.50	☐	☐	☐	☐	☐
$ 3.75	☐	☐	☐	☐	☐
$ 3.90	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 4.10	☐	☐	☐	☐	☐
$ 4.25	☐	☐	☐	☐	☐
$ 4.50	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 6.00	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

14) Environmental Management System (EMS) TOMATOES

Currently, a kilogram of tomatoes (kg) produced using a conventional farming method costs $4.00. Assume that you have the opportunity to purchase 1 kilogram of EMS tomatoes that is known to contain the following attributes:

- Risk to human health: ***15% decrease*** *in the risk to your health, compared with conventional tomatoes*
- Impact on the environment: ***same as*** *conventional tomatoes*
- Appearance: ***same as*** *conventional tomatoes*

How much would you be willing to pay for 1 kilogram of EMS tomatoes?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 3.50	☐	☐	☐	☐	☐
$ 3.75	☐	☐	☐	☐	☐
$ 3.90	☐	☐	☐	☐	☐
$ 4.00	☐	☐	☐	☐	☐
$ 4.10	☐	☐	☐	☐	☐
$ 4.25	☐	☐	☐	☐	☐
$ 4.50	☐	☐	☐	☐	☐
$ 5.00	☐	☐	☐	☐	☐
$ 6.00	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

15) Environmental Management System (EMS) PORK

Currently, a kilogram (kg) of pork produced using a conventional farming method costs $8.00. Assume that you have the opportunity to purchase 1 kilogram of EMS pork that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional pork*
- Impact on the environment: ***same as*** *conventional pork*
- Animal welfare: ***15% improvement****, compared with conventional pork*

How much would you be willing to pay for 1 kilogram of EMS pork?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 6.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 7.50	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐
$ 8.25	☐	☐	☐	☐	☐
$ 8.50	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐
$ 11.00	☐	☐	☐	☐	☐
$ 13.00	☐	☐	☐	☐	☐
$ 18.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

16) Environmental Management System (EMS) PORK

Currently, a kilogram (kg) of pork produced using a conventional farming method costs $8.00. Assume that you have the opportunity to purchase 1 kilogram of EMS pork that is known to contain the following attributes:

- Risk to human health: ***15% decrease*** *in the risk to your health, compared with conventional pork*
- Impact on the environment: ***15% decrease*** *in environmental impact, compared with conventional pork*
- Animal welfare: ***15% improvement****, compared with conventional pork*

How much would you be willing to pay for 1 kilogram of EMS pork?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 6.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 7.50	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐
$ 8.25	☐	☐	☐	☐	☐
$ 8.50	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐
$ 11.00	☐	☐	☐	☐	☐
$ 13.00	☐	☐	☐	☐	☐
$ 18.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

17) Organic PORK

Currently, a kilogram (kg) of pork produced using a conventional farming method costs $8.00. Assume that you have the opportunity to purchase 1 kilogram of ORGANIC pork that is known to contain the following attributes:

- Risk to human health: ***same as*** *conventional pork*
- Impact on the environment: ***same as*** *conventional pork*
- Animal welfare: ***15% improvement****, compared with conventional pork*

How much would you be willing to pay for 1 kilogram of ORGANIC pork?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 6.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 7.50	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐
$ 8.25	☐	☐	☐	☐	☐
$ 8.50	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐
$ 11.00	☐	☐	☐	☐	☐
$ 13.00	☐	☐	☐	☐	☐
$ 18.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

18) Organic PORK

Currently, a kilogram (kg) of pork produced using a conventional farming method costs $8.00. Assume that you have the opportunity to purchase 1 kilogram of ORGANIC pork that is known to contain the following attributes:

- Risk to human health: ***15% decrease*** *in the risk to your health compared with conventional pork*
- Impact on the environment: ***15% decrease*** *in environmental impact, compared with conventional pork*
- Animal welfare: ***same as*** *conventional pork*

How much would you be willing to pay for 1 kilogram of ORGANIC pork?

Please check ONE box for each price.

Price for 1 kg	Definitely Yes	Maybe Yes	Neutral	Maybe No	Definitely No
$ 6.00	☐	☐	☐	☐	☐
$ 7.00	☐	☐	☐	☐	☐
$ 7.50	☐	☐	☐	☐	☐
$ 8.00	☐	☐	☐	☐	☐
$ 8.25	☐	☐	☐	☐	☐
$ 8.50	☐	☐	☐	☐	☐
$ 9.00	☐	☐	☐	☐	☐
$ 11.00	☐	☐	☐	☐	☐
$ 13.00	☐	☐	☐	☐	☐
$ 18.00	☐	☐	☐	☐	☐

☐ **I would not buy this product. Please specify reason:** _____

19) We would like to know your feelings toward the nine previous shopping scenarios presented. Beside each statement below please check the box that most closely describes your point of view.

Please check a response to every statement.

	Yes	No	Don't Know
a. I needed more information than what was provided.	☐	☐	☐
b. The information was biased in favour of the environment.	☐	☐	☐
c. The options were confusing.	☐	☐	☐
d. The options were unrealistic.	☐	☐	☐

Other comments: _____

_____

_____

_____

Please turn the page to continue.

20) The following statements relate to the regulation of food products.

Please rate how much you agree with each statement by circling one answer on each row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
a. The government can be trusted to ensure farmers maintain adequate food safety standards.	1	2	3	4	5
b. The government can be trusted to ensure food retailers maintain adequate food safety standards.	1	2	3	4	5
c. Scientists can be trusted to set acceptable food safety standards.	1	2	3	4	5
d. Scientists can be trusted to develop genetically modified foods safely.	1	2	3	4	5
e. An environmental management system would be beneficial to both farmers and consumers.	1	2	3	4	5
f. Labels are important in my food purchase decisions.	1	2	3	4	5
g. There should be labels on all genetically modified foods for sale in supermarkets.	1	2	3	4	5
h. I would choose non-genetically modified foods over genetically modified foods.	1	2	3	4	5
i. The use of chemical fertilizers and pesticides in agricultural production should be strictly limited.	1	2	3	4	5

SECTION III
Background information

In this section of the questionnaire, we ask you a few questions to make sure that individuals we survey come from a wide range of backgrounds.

Please check only one box for each question.

21) What is your age group?

☐ 18-24 ☐ 25-34 ☐ 35-44
☐ 45-54 ☐ 55-64 ☐ 65 or more

22) What is your sex?

☐ Male ☐ Female

23) Have you ever donated to any environmental organizations?

☐ Yes ☐ No

24) How many people live in your household?

_____

25) What is your current work status?

☐ Employed full-time or part-time
☐ Unemployed / looking for work
☐ Retired / pensioner
☐ Student
☐ Home duties / Stay at home
☐ Other: _____

26) What is the highest level of education you have obtained or are in the process of obtaining?

☐ Completed primary school
☐ Completed high school
☐ Diploma or certificate (trade)
☐ Bachelor's degree
☐ Graduate school

27) Please check the box below that most closely indicates your household income before tax.

- ☐ Less than $10,000
- ☐ $10,000 - $19,999
- ☐ $20,000 - $29,999
- ☐ $30,000 - $39,999
- ☐ $40,000 - $49,999
- ☐ $50,000 - $74,999
- ☐ $75,000 - $99,999
- ☐ $100,000 - $124,999
- ☐ $125,000 or more

28) Approximately how much would you say your household spends on groceries per week?

- ☐ Less than $90
- ☐ $90 - $119
- ☐ $120 - $149
- ☐ $150 - $189
- ☐ $190 - $210
- ☐ $220 or more

29) In your own words, what is the most important environmental issue that you would like to see better managed?

_____

_____

_____

_____

30) If you have any other comments about any of the topics covered on this survey, please write them on the lines provided below.

_____

_____

_____

_____

Thank you for taking the time to complete this survey.
Your help with this research is greatly appreciated.

Appendix 6. General protocol for the delivery of questionnaires

General protocol for the delivery of the questionnaires.

DELIVERY

Step 1. (At the door). Good evening, my name is _____ and I am a graduate student at McGill University. I am working with a research group to gather information from consumers about their perceptions of particular food attributes. We are interviewing a few select households on the island of Montreal, and your voluntary cooperation would be greatly appreciated. If you agree to help us we will leave you with a questionnaire which should take about 20 minutes to complete. We will pick up the completed questionnaire in a few days. Would you like to participate?

Step 2. (**NO**) Thank you, have a good evening.

(**YES**) (*Provide the questionnaire*) A student will return to collect this questionnaire at the time written on the envelope. If you are unavailable, please leave the questionnaire in your mailbox.

Step 3. Do you have questions concerning the project?

Step 4. Thank you very much for your help. We greatly appreciate it!

Step 5. When outside, *validate the address information.*

RECEPTION 1 (after 2-3 days)

Step 1. Good evening, I am a graduate student at McGill University working with a research group to survey consumers on their perceptions of various food attributes. I am here to collect the survey that was delivered 2 days ago.

If the respondent is NOT PRESENT, leave a small message informing them when the second reception happens.

Step 2. (If the respondent PROVIDES the completed survey). Do you have any further questions concerning the questionnaire or the research? Thank you very much for your help. We greatly appreciate it!

(If the respondent DOES NOT PROVIDE the filled survey). If you would still like to participate, would it be possible to return in two days to pick up the questionnaire? At what time will you be available?

Write down the convenient time. Thank you very much for your help. We greatly appreciate it!

RECEPTION 2 (After the additional two days)

Step 1. Good evening, I am a graduate student at McGill University working with a research group to survey consumers on their perceptions of various food attributes. I am here to collect the survey that was delivered 2 days ago.

Step 2. (If the respondent PROVIDES the completed survey). Do you have any further questions concerning the questionnaire or the research? Thank you very much for your help. We greatly appreciate it!

(If the respondent DOES NOT PROVIDE the filled survey). Unfortunately, we will not be able to return again. Thank you very much for your time. Have a good evening.

Appendix 7. CM values with Model 3

Milk CM values

	MODEL 1		MODEL 2		MODEL 3	
VARIABLES	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
Price	-0.6173***	0.086	-0.7311***	0.1014	-0.6641***	0.1007
Production Montreal Region	0.3972***	0.0864	0.4357***	0.1008	0.4290***	0.0955
Production in Canada	-0.6088**	0.0908	-0.2844***	0.1066	-0.2732***	0.1038
Production Outside of Canada	-2.2470***	0.0982	-0.6215***	0.1107	-0.5689***	0.107
ASC GM	0.3971***	0.2397	-0.8887	0.8706	-1.5055**	0.6339
GM Health	0.1175***	0.0325	0.1235***	0.0363	0.1367***	0.0377
GM Environment	0.0430**	0.0219	0.0396	0.0247		
GM Age			-0.2990*	0.1559	-0.3361**	0.1481
GM Donation			-0.1067	0.4849		
GM Household Size			0.3246*	0.1773	0.3177*	0.1682
GM Employed			-0.0447	0.1367		
GM Income			-0.1359	0.1053		
GM Food Expenditure			-0.4309**	0.1916	-0.476***	0.1683
GM French			-0.2294	0.4313		
GM Organic Purchase			0.1268	0.2504		
ASC EMS	-0.2071	0.1856	-1.1444***	0.4277	-0.6696**	0.3182
EMS Health	0.0924***	0.0121	0.1059***	0.014		
EMS Environment	0.0187**	0.0092	0.0194*	0.0103	0.0114	0.0098
EMS Age			0.0155	0.0652		
EMS Donation			0.6294***	0.1819	0.6446***	0.1723
EMS Household Size			0.1672**	0.0762	0.0918	0.0655
EMS Employed			-0.0795	0.056		
EMS Income			0.0780*	0.0471	0.0904**	0.0415
EMS Food Expenditure			-0.2683***	0.0725	-0.1969***	0.0638
EMS French			0.074	0.1701		
EMS Organic Purchase			0.4474***	0.0993	0.3567***	0.0929

ASC ORG	-0.4041*	0.2097	-1.0405**	0.5083	-1.5582***	0.3179
ORG Health	0.0779***	0.0146	0.0750***	0.0173	0.0637***	0.0168
ORG Environment	0.0307***	0.011	0.0344***	0.013	0.0357***	0.0129
ORG Age			-0.0677	0.0787		
ORG Donation			0.6365***	0.2157	0.5428***	0.2066
ORG Size			0.1449	0.0923		
ORG Employed			-0.1408**	0.0651	-0.0666	0.0587
ORG Income			-0.082	0.0556		
ORG Food Expenditure			-0.1397	0.0857		
ORG French			-0.4164**	0.2044	-0.3386**	0.1828
ORG Organic Purchase			1.0716***	0.1177	0.9845***	0.1108
Log L	-1193.84		-889.84		-929.51	
Pseudo-R Square	0.26		0.33		0.30	

Tomato CM values

	MODEL 1		MODEL 2		MODEL 3	
VARIABLES	Coefficient	Std.Err.	Coefficient	Std.Err.	Coeff.	Std.Err.
Price	-0.7935***	0.0868	-0.8927***	0.1043	-0.8644***	0.1025
ASC GM	-1.8173***	0.255	-0.1251	0.7387	-1.1453***	0.4033
GM Health	0.1460***	0.0243	0.1608***	0.0280		
GM Environment	0.0298*	0.0171	0.0359*	0.0194	0.0419**	0.0186
GM Appearance	0.0391*	0.0218	0.0434*	0.025	0.0478**	0.023
GM Age			0.0796	0.1096		
GM Donation			-0.4317	0.3653		
GM Household Size			-0.0221	0.1397		
GM Employed			0.2634	0.3212		
GM Income			-0.2282***	0.0786	-0.2448***	0.0586
GM Food Expenditure			-0.1577	0.1326		
GM French			-0.5558*	0.2979	-0.5201**	0.2654
GM Organic Purchase			-0.0129	0.1866		
ASC EMS	-0.2791	0.1947	-1.1640**	0.4546	-1.0179**	0.2469
EMS Health	0.0926***	0.0115	0.1039***	0.0132	0.1035***	0.0129
EMS Environment	0.0360***	0.0091	0.0406***	0.0104	0.0378***	0.0101
EMS Appearance	0.0218*	0.0117	0.0238*	0.0133	0.0197	0.0131
EMS Age			0.0162	0.0674		
EMS Donation			0.8157***	0.1872	0.8722***	0.1742
EMS Size			-0.0876	0.077		
EMS Employed			0.2128	0.1854		
EMS Income			0.0525	0.0479		
EMS Food Expenditure			-0.0563	0.0726		
EMS French			0.2093	0.1753		
EMS Organic Purchase			0.4302***	0.1013	0.4275***	0.0942
ASC ORG	-0.1088	0.1769	-0.8890*	0.4986	-0.7814***	0.2984
ORG Health	0.05747***	0.0129	0.0523***	0.0156	0.0541***	0.0154
ORG Environment	0.0506***	0.0105	0.0503***	0.0124	0.0495***	0.0123

ORG Appearance	0.0262*	0.0126	0.0377**	0.0148	0.039***	0.0147
ORG Age			0.042	0.0752		
ORG Donation			0.3607*	0.211	0.3924**	0.2003
ORG Size			0.0318	0.0861		
ORG Employed			0.0685	0.205		
ORG Income			-0.0011	0.0534		
ORG Food Expenditure			-0.1348*	0.0806	-0.0954*	0.0544
ORG French			-0.3370*	0.1951	-0.4211**	0.1699
ORG Organic Purchase			0.9604***	0.113	0.9778***	0.1081
Log L	-1338.40		-1006.73		-1055.98	
Pseudo-R Square	0.18		0.25		0.23	

CM pork values

	MODEL 1		MODEL 2		MODEL 3	
VARIABLES	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
Price	-0.189144***	0.0352	-0.175458***	-0.1754	-0.1721***	0.0392
ASC GM	-1.76072***	0.2608	0.271222	0.2712	0.2416	0.4674
GM Health	0.042367*	0.0247	0.0569235**	0.0569	0.0568*	0.0272
GM Environment	0.009866	0.0193	0.009045	0.009		
GM Animal Welfare	-0.03954	0.0247	-0.0459827*	-0.0459	-0.0495**	0.0252
GM Age			0.011394	0.0113		
GM Donation			-0.06726	-0.0672		
GM Household Size			0.002472	0.0024		
GM Employed			-0.431865***	-0.4318	-0.4449***	0.1563
GM Income			-0.297641***	-0.2976	-0.286***	0.0735
GM Food Expenditure			0.041818	0.0418		
GM French			-0.1522	-0.1521		
GM Organic Purchase			-0.01586	-0.0158		
ASC EMS	0.216839	0.1655	-1.67177***	-1.6717	-1.1793***	0.2704
EMS Health	0.104347***	0.0111	0.119807***	0.1198	0.1182***	0.0128
EMS Environment	0.003416	0.0086	0.013214	0.0132		
EMS Animal Welfare	-0.01311	0.0111	-0.01777	-0.0177		
EMS Age			0.022088	0.022		
EMS Donation			0.552314***	0.5523	0.4850***	0.1596
EMS Size			0.035646	0.0356		
EMS Employed			0.029854	0.0298		
EMS Income			0.158603***	0.1586	0.1491***	0.0418
EMS Food Expenditure			-0.137527*	-0.1375	-0.1104**	0.0545
EMS French			0.46178***	0.4617	0.5041***	0.1483
EMS Organic Purchase			0.432863***	0.4328	0.4459***	0.0959
ASC ORG	-0.665328***	0.2532	-2.67337***	-2.6733	-2.2431***	0.384

ORG Health	0.0596747***	0.0146	0.0650198***	0.065	0.0645***	0.0165
ORG Environment	0.0616445***	0.0115	0.071338***	0.0713	0.0716***	0.0129
ORG Animal welfare	-0.01892	0.0144	-0.01498	-0.0149		
ORG Age			0.094634	0.0946		
ORG Donation			0.135026	0.135		
ORG Size			0.179123*	0.1791	0.1237*	0.0696
ORG Employed			-0.02243	-0.0224		
ORG Income			-0.00164	-0.0016		
ORG Food Expenditure			-0.04352	-0.0435		
ORG French			-0.04063	-0.0406		
ORG Organic Purchase			0.941411***	0.9414	0.9401***	0.109701
Log L	-1206.12		-933.95		-938.95	
Pseudo-R Square	0.21		0.26		0.26	

McGill

Research Ethics Board Office
Faculty of Agricultural and Environmental Sciences

McGill University
Macdonald Campus
21 111 Lakeshore
Saint-Anne-de-Bellevue, QC
H3A 2T5

Tel: (514) 398-8716
Fax: (514) 398-8732
Ethics website:
www.mcgill.ca/macdonald/research/compliance/human/

Research Ethics Board
Faculty of Agricultural and Environmental Sciences
Certificate of Ethical Acceptability of Research Involving Humans

REB File #: 881-0207

Project Title: Valuing environmental benefits through an attribute based method: a comparison of the implied price of food attributes between urban and rural consumers

Principal Investigator: Rene Roy **Department:** Natural Resource Sciences

Status: Graduate Student **Supervisor:** Paul Thomassin

Funding Agency and Title: n/a

This project was reviewed and approved by

Expedited Review X
Full Review ____

M. E. Rau

Manfred E. Rau, Chair
REB, Faculty of Agricultural and Environmental Sciences

Approval Period: February 26, 2007 **to** February 25, 2008

This project was reviewed and approved in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Subjects and with the Tri-Council Policy Statement: Ethical Conduct For Research Involving Humans

*All research involving human subjects requires review on an annual basis. A Request for Renewal form should be submitted at least one month before the above expiry date.
*If a project has been completed or terminated and ethics approval is no longer required, a Final Report form must be submitted.
*Should any modification or other unanticipated development occur before the next required review, the REB must be informed and any modification can't be initiated until approval is received.