Canadian Consumers' Functional Food Choices: Labelling and Reference-Dependent Effects

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ABSTRACT

The growing interest among consumers in the link between diet and health makes functional food one of the fastest growing sectors in the global food industry, especially functional dairy products. Understanding consumer choices with respect to functional food is an important and relatively new research area. Given the credence nature of functional food attributes, labelling plays a key role in allowing consumers to make informed choices about foods with enhanced health attributes. In 2007, Canada launched a review of the regulatory system for health claims on functional foods, which included rules concerning the approval, labelling and verification of health claims. In 2010 two new health claims related to oat products and plant sterols were approved by Health Canada. An analysis of how consumers respond to health claim information is therefore timely.

This thesis focuses on examining the effects of different types of labelling and verification of health claims on consumers stated preferences for a specific functional food product, Omega-3 milk. The analysis incorporates reference-dependent effects. This study improves the knowledge of Canadian consumer understanding of health claims and the impact of health claims on consumer choice. This research is one of the first studies to simultaneously examine the effects of different types of health claims (e.g. function claims, risk reduction claims and disease prevention claims) and other ways of signalling or implying health benefits (e.g. symbols) on Canadian consumers' functional food choices. This study contributes to the knowledge in this domain by providing a comparative analysis of different types of labelling strategies. The extant knowledge of labelling effects in the formats of risk reduction claims, disease prevention claims and symbols or imagery on functional foods is limited. One of the primary contributions of this study is addressing this gap in the literature.

The theoretical framework of this thesis is based on random utility theory. A stated preference choice experiment is designed to examine consumers' response to Omega-3 milk under different labelling scenarios. Using data from an online survey of 740 Canadians conducted in summer 2009, discrete choice models, including Conditional Logit, Random Parameter Logit and Latent Class models, and Willingness-To-Pay (WTP) values are estimated. The results suggest that full labelling (function claims, risk reduction claims and disease prevention claims) is preferred over partial labelling (e.g. the use of a heart symbol to imply a health claim), but primarily for risk reduction claims. There is no significant difference between a function claim, such as “good for your heart” and partial labelling in the form of a red heart symbol. The results also suggest that consumers on average respond positively to verification of health claims by government and the third party agencies, however, the Latent Class models reveal considerable heterogeneity in consumer attitudes toward the source of verification. The influences of key-socio-demographic (e.g. income, education and health status) and attitudinal factors (e.g. attitude, trust and knowledge) provide further insights into consumer responses in the choice experiment to identify different consumer segments. Moreover, the results reveal reference-dependent effects where perceived losses of ingredient or price attributes have a greater influence on consumer choice than perceived gains.

In terms of industry and public policy implications, this study suggests that food manufacturers in Canada would benefit from the ability to make more precise health claims. The implications derived from the Latent Class Models could help the Canadian functional food industry to identify target consumer segments with different characteristics for the purpose of developing marketing strategies. Furthermore, the results of this study suggest that Canadian consumers are receptive to both full labelling and partial labelling. It indicates that public policy makers need to pay attention to effectively regulating health claims for functional foods so as to balance the need for credible health claims to facilitate the development of the functional food sector with the imperative of protecting consumers from misleading health claims. Public policy makers should also be aware that the verification of health claims plays an important role in reducing consumers’ uncertainty and making health claims more credible.

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1.1 Introduction and Background

Consumers are increasingly interested in the health benefits of foods beyond basic nutrition, and are giving more appreciation to the potential disease risk reduction and health improving properties of functional food products (Agriculture and Agri-Food Canada, 2009). There is increasing awareness of the link between health and diet (Anders and Moser, 2010; Malla, Hobbs and Perger, 2007; Cash, Goddard and Lerohl, 2006; West et al., 2002), while the economic and social costs of diet-related diseases, such as cancer, cardiovascular disease and diabetes, have been growing at a rapid pace (World Health Organization, 2002 and 2005). The American Dietetic Association (Bloch and Thomson, 1995) points out that accumulating scientific evidence supports the role of functional foods in the prevention and treatment of at least four types of leading diseases: cancer, diabetes, cardiovascular disease and hypertension. It has been claimed that functional foods provide an opportunity to improve the health of Canadians, reduce health care costs and support economic development in rural communities (Agriculture and Agri-Food Canada, 2009).

Given the broad range of functional food attributes, there is no simple, commonly accepted and exclusive definition for the term ‘functional food’. Different countries use different definitions in their regulatory systems. Researchers appear to have a variety of understandings of the concept, but they all recognize ‘health benefits’ as the main contribution of functional foods. For example, calcium enriched milk products are widely recognized as able to help maintain healthy bones and reduce the risk of osteoporosis (Canadian Food Inspection Agency, 2009). From the consumers’ point of view, the potential health benefits of functional foods could affect their consumption decisions: an individual consumer might over consume unhealthy foods or under consume healthy foods. In making a decision regarding the consumption of functional food, consumers face two types of uncertainty: uncertainty about the health attributes of a specific food and uncertainty over future health outcomes. Given the information asymmetry and credence nature inherent in functional foods, labelling (e.g. health claims) plays a key role in allowing consumers to make informed choices (Roe, Levy and Derby, 1999; Hailu, et al, 2009; Garretson and Burton, 2000; Wansink, 2003; Kozup, Creyer and Burton, 2003).

In 2007, Canada launched a review of the regulatory system for health claims on functional food products (Health Canada, 2007). Health Canada planned to update its' assessment framework to make the system clearer and the claims more credible. In a news article, Crowley (2008) comments that: “the current assessment process in Canada has been criticized as being slow, unpredictable, and restrictive as well as unclear concerning what types of health claims need to be submitted for consideration and the process to be used to evaluate them”. Regulation of functional foods includes rules concerning approval, labelling and verification of health claims (Health Canada, 1998a). Scientific support for health claims is also important to provide consumers with products that they can trust (Basu, Thomas and Acharya, 2007).

The challenges of changing the regulatory system for health claims are twofold. First, if the process for approving claims is relaxed, claims may not be credible and it is hard to protect consumers against harmful products and/or fraudulent claims. On the other hand, if the regulatory environment is too restrictive, it might restrict consumers’ access to functional foods with health benefits and limit the development of this sector of the food industry. The benefits associated with revising policies for health claims include potentially improving the diet of individual consumers by facilitating access to foods with proven health benefits; second, creating a more effective and credible food label system; and third, strengthening the country's competitiveness in the rapidly growing global functional food market.

1.2 Researchable Problem and Issues

There has been a dramatic expansion in the functional food sector of the global food market over the past decade. It has been claimed that access to functional foods, as well as adequate labelling of the health effects of functional foods are necessary keys to the growth of the Canadian functional food market (Basu, Thomas and Acharya, 2007). Regulation of health claims on food products needs to balance the twin goals of protecting consumers from misleading or unsubstantiated claims, while providing sufficient information to help consumers make informed decisions. Some commentators have argued that the Canadian health claim recognition system is more restrictive than that in other countries such as the United States, Japan and the European Union (L'Abbe et al., 2008 and Crowley, 2008). For example, currently, Health Canada allows seven science-based risk reduction claims (Health Canada, 2010a) to be used on food labels or in advertisements, compared with 17 health claims (FDA, 2009b and 2009c) in the United States. Among those seven acceptable science-based risk reduction claims in Canada, two of them were recently approved in 2010. The two newly approved claims suggest that oat products and plant sterols may reduce health risks by lowering blood cholesterol. It seems likely that additional health claims could be approved in Canada in the future, and therefore an analysis of how consumers respond to health claim information is timely. To update the policies for health claims on foods, both Canada and the United States have undertaken public consultations with consumers, the food industry and health professionals.

This study focuses on examining the effects of labelling on Canadian consumers' functional food choices by examining the effects on consumer choices of different types of health claim or ways of signalling health benefits. Using the data collected from a national survey, this study explores how changes in labelling formatting (referred to in this study as 'full labelling' and 'partial labelling') could alter individuals' preferences. In this study, formally stated health claims in an explicit way (e.g. function claims, risk reduction claims and disease prevention claims) are hereafter referred to as "Full Labelling"; and the use of an image or a visual cue to implicitly imply a health benefit is hereafter referred to as "Partial Labelling". Furthermore, this study also examines the existence of reference-dependent effects in Canadian consumers' functional food choices, a concept developed from psychology. Reference-dependent effects are used to measure the value of changes involving a gain or a loss compared with a reference point and changes to the reference point could lead to reversals of preference (Tversky and Kahneman, 1991).

In the literature, health claims are widely discussed for regulation issues (Smith, Marcotte and Harrison, 1996, Fitzpatrick, 2004 and L'Abbe et al., 2008). In the consumer analysis area, function claim and risk reduction claim are often examined in the study (Roe et al., 1999; Kleef, 2005; Hovde et al., 2007; and Bond, Thilmany and Bond, 2008). Very few studies have examined consumer acceptance of disease prevention claim, a more restrictive claim, and symbols, the major labelling format for functional food in Canada. This study aims to fill this gap. This research is one of the first studies to examine simultaneously the effects of different types of health claims (e.g. function claims, risk reduction claims and disease prevention claims) and other ways of signalling health benefits (e.g. symbols) on Canadian consumers' functional food choices. The extant knowledge of the labelling effects in the formats of risk reduction claims, disease prevention claims and symbols on functional foods is limited in the literature. This research aims to fill in this gap. This study improves the knowledge of Canadian consumer understanding of health claims and the impact of health claims on consumer choice. More specifically, the research questions explored in this thesis include: (1) how do Canadian consumers respond to full labelling and partial labelling as signals of a health benefit, (2) how do they respond to the verification of health claims by different organizations, (3) how do other attitudinal, behavioural and socio-demographic factors affect consumers' choice behaviours, and (4) whether reference-dependent effects exist when consumers make functional food consumption choices. Functional food (Omega-3 milk) and regular food (conventional milk) are used as examples to explore these research questions.

The next section begins by observing that the regulatory environment in Canada is different from the case in the United States in terms of the number of allowable health claims and the extent to which the use of health claims is subject to regulatory oversight. Section 1.2.2 explores the concepts of partial versus full labelling, while section 1.2.3 expands on the other researchable issues around the source of verification and the effect of behavioural and attitudinal factors. Section 1.3 briefly outlines the research methodology. The chapter concludes with an overview of the structure of the thesis.

1.2.1 A Comparison of Health Claims Regulation in the United States and Canada

The United States currently permits two types of claims on functional food products, function claims and risk reduction claims. First, a product may carry a function claim linking a substance to an effect on the functioning of the body, called a 'structure/function claim', for example, "calcium builds strong bones". This type of health claim must be truthful and not misleading and are not pre-reviewed or authorized by the Food and Drug Administration (FDA) (FDA, 2009a). Second, a health claim which links a nutrient to a particular disease risk reduction, called a 'risk reduction claim' is permitted. It must be reviewed and evaluated by FDA prior to use on food labels. Note that these types of health claims are limited to claims about disease risk reduction, and cannot be claims about the diagnosis, cure, mitigation, or treatment of disease (e.g. disease prevention claims) (FDA, 2009a). The FDA approach to regulating risk reduction claims are based on the strength of scientific evidence. There are two types of risk reduction claims in the United States, unqualified and qualified health claims (FDA, 2009a). The FDA of the United States has consulted the public on the effectiveness of their qualified and unqualified health claims since 2002.

The FDA evaluated the scientific evidence supporting risk reduction claims in food and dietary supplement labelling. The FDA is currently adopting a four level system. FDA level A health claims are *unqualified*, reflecting "significant scientific agreement" ("SSA") about the validity of the disease-diet relationship, and levels B, C, D are *qualified* health claims where the evidence is progressively weaker (Federal Trade Commission, 2006). For example, "Diets rich in calcium may reduce the risk of osteoporosis." (Level A, unqualified health claims); and "Omega-3 fatty acids may reduce the risk of heart disease but the scientific evidence is promising but not conclusive." (Level B, qualified health claims). Currently through the FDA's health claims regulation system, 17 types of *unqualified* health claims (FDA, 2009b) are allowed for functional food products in the United States. Roe, Levy and Derby (1999) found that the presence of health claims on food labels could increase consumers' purchase intentions and made them consider the product healthier. Some foods and supplements are sold with FDA pre-approved health claims, and functional foods are often sold on the basis of structure/function claims in order to avoid

FDA pre-approval requirements that apply to health claims (Heller, Taniguchi and Lobstein, 1999).

The current Canadian regulations on functional food health claims are evolving. In 1995, two earlier studies commissioned by Agricultural and Agri-Food Canada (AAFC, 1995) and Foreign Affairs and International Trade Canada (FAIT, 1995) addressed Canada's regulatory issues related to health claims on functional food. In 1996, another research commissioned by Agricultural and Agri-Food Canada further conducted a comparative analysis of the regulatory framework affecting functional food development and commercialization in Canada, Japan, the European Union and the United States (Smith, Marcotte and Harrison, 1996). In recent years, the number of approved science-based risk reduction claims for use on functional food labels or in advertisements in Canada increased from five to seven in 2010. Unlike the United States, the Canadian government not only regulates the assessment and approval of disease risk reduction claims, but also sets conditions around the use of function claims. Minimum levels and content requirements need to be reviewed before a function claim is deemed acceptable and allowed to be used on a product label (Canadian Food Inspection Agency, 2009). Health Canada currently allows seven specific science-based disease risk reduction claims that reflect the following relationships (Health Canada, 2003; Canadian Food Inspection Agency, 2009; Health Canada, 2010a):

1. "a diet high in potassium and low in sodium, and the reduced risk of hypertension;
2. a diet adequate in calcium and vitamin D, and the reduced risk of osteoporosis;
3. a diet low in saturated fat and trans fat, and the reduced risk of heart disease;
4. a diet rich in vegetables and fruit, and the reduced risk of some types of cancer; and
5. maximal fermentable carbohydrates in gum, hard candy or breath-freshening products, and the reduced risk of dental caries." (Canadian Food Inspection Agency, 2009, p8-7)
6. plant sterols and the lowing of blood cholesterol (Health Canada, 2010c);
7. oat products and the lowing of blood cholesterol (Health Canada, 2010b).

The above seven statements are based on the existing *unqualified* health claims approved by the FDA in the United States (FDA, 2009b). Health Canada reviewed those claims and determined that seven of them would be allowed in Canada, while the others remain unapproved[1]. Note that the last two risk reduction claims were approved by Health Canada in 2010. These two claims are related to plant sterols and oat products.

Generally speaking, there are three steps for a disease-related health claim on functional food to be approved by Health Canada (Health Canada, 2010b). First, an application needs to be submitted to Health Canada to request an approval for the use of certain disease-related health claims. Taking the oat products for example, in 2007 Health Canada’s Food Directorate received a submission from industry requesting the approval for the use of a disease risk reduction claim on oat products. Second, Health Canada needs to satisfy itself that there is sufficient scientific evidence to support the claim. The petitioner for the oat products provided Health Canada the 1995 health claim petition which was submitted to the FDA of the United States on oats and coronary heart disease (which claim was subsequently approved by the FDA in 1997) and other scientific evidence. Third, after reviewing the evidence, Health Canada makes a final decision. In November 2010 Health Canada concluded that the following statements may be used on food labels or advertisements of oat products that meet the qualifying criteria: "[serving size from Nutrition Facts table in metric and common household measures] of (Brand name) [name of food] [with name of eligible fibre source] supplies/provides [X % of the daily amount] of the fibres shown to help reduce/lower cholesterol" (Health Canada, 2010b). Or a short statement in

[1] The unapproved unqualified health claims include: “dietary fat and cancer; folate and neural tube defects; fiber-containing grain products, fruits, and vegetables and cancer; fruits, vegetables, and grain products that contain fiber, particularly soluble fiber, and risk of coronary artery disease; dietary saturated fat and cholesterol, and risk of Coronary Heart Disease; soy protein and risk of Coronary Heart Disease; whole grain foods and risk of heart disease and certain cancers; potassium and the risk of high blood pressure and stroke; fluoridated water and reduced risk of dental caries” (FDA. 2009b).

addition to the primary statement can be used, such as: "Oat fibre helps reduce/lower cholesterol, (which is) a risk factor for heart disease".

Table 1.1 An Analytical Framework for Functional Foods Health Claims in Canada

	Structure/ Function Claims[a]	Risk Reduction Claims		Therapeutic Claims[a,b] (Disease Prevention Claims)
		Product Specific	Generic	
DEFINITION	Asserts the role of a nutrient or other dietary component intended to affect a specific structure or physiological function in humans.	Asserts a relationship between a specific food product and a reduced risk of a disease or condition.	Asserts a relationship between a nutrient or other dietary component in a diet, and a reduced risk of a disease or condition.	Asserts a relationship between a nutrient or other dietary component and the cure, treatment, mitigation or prevention of a disease, disorder or abnormal physical state.
TARGET GROUP	General population and sub-groups	General population and sub-groups	General population and sub-groups	Specific individuals with a disease (cure/treat/ mitigate) General populations and sub-groups (prevention)
Regulatory Mechanism	Exemption by Regulation for Food	Exemption by Regulation for Food	Exemption by Regulation for Food	*Food and Drug Regulations* - as at present
Standards of Evidence [c]	See Guide to Food Labelling and Advertising-Health Claims	See Guide to Food Labelling and Advertising-Health Claims	See Guide to Food Labelling and Advertising-Health Claims	As outlined in *Food and Drug Regulations*

[a] Generic and product-specific claims may be applicable here. [b] Includes prevention claims. [c] modified by Chapter 8-Health Claims, Guide to Food Labelling and Advertising, Canadian Food Inspection Agency

Source: Adapted from Health Canada (1998a) and Canadian Food Inspection Agency (2009)

Table 1.1 describes the regulatory framework governing health claims for functional foods in Canada (Health Canada, 1998a). Developed by Health Canada in 1998 and updated by the Canadian Food Inspection Agency in 2009, this framework describes the Canadian regulatory environment with respect to the definition, target group, regulatory mechanism and standards of evidence, for the three types of health claims which are functional claims, risk reduction claims and therapeutic claims[2] /disease prevention claims. Products claiming to treat, cure, mitigate or prevent a disease or illness are regulated as drugs. Disease prevention claims, linking consumption of a food to the prevention of a specific disease, are not permitted on food products either in Canada or the United States, although some scientific studies have shown supportive evidence (not conclusive) for the role of functional food in preventing certain chronic diseases (e.g. Bloch and Thomson, 1995).

In term of the regulatory mechanism, function claims and risk reduction claims are "exemption by regulation for food", which means these two types of health claims are exempted by Food and Drug Regulations and can be used on regular food products, while disease prevention claims are not exempted from drug claims and cannot be used directly on food in Canada. With respect to standards of evidence, if a product is claimed to have a health benefit, it must be supported by scientific evidence to demonstrate its efficacy. According to the risk-management framework of Health Canada (1998a), the standard of evidence must be proportionate to the degree of risk. For example, if a food product claims to prevent cancer (disease prevention claim), that claim should require the highest standards of evidence. However, if a food product is claimed to be good for the heart (structure/function claim), then a lower standard of evidence is sufficient. The Canadian Food Inspection Agency (2009) has updated the standards of evidence related to function claims and risk reduction claims for functional foods selling in the Canadian market. One aspect of this thesis examines Canadian consumers'

[2] "**Therapeutic claims** are claims about treatment or mitigation of a health-related disease or condition, or about restoring, correcting or modifying body functions. At present, no therapeutic claims have been approved for food in Canada." (Canadian Food Inspection Agency, 2009, p8-1)

response to the three types of health claims, which could inform future developments in the regulatory system with respect to the effect of different types of information on consumers' decisions.

The product examined in this research is Omega-3 milk (see details in chapter three). Of note is that the risk reduction claims for two types of Omega-3 fatty acids are already allowed by the FDA in the United States, but not by Health Canada. In 2004, the FDA announced qualified health claims for omega-3 fatty acids. The following health claims are allowed on food labels or in advertisements in the United States, "Supportive but not conclusive research shows that consumption of EPA and DHA Omega-3 fatty acids may reduce the risk of coronary heart disease" (FDA, 2004).

Due to the differences in government regulations, a number of products carrying health claims in other countries, such as in the US, cannot be labelled with the same health claims when sold in Canada. Canadian consumers may purchase such food products but they cannot be marketed in Canada as having the functional attribute. Clearly, the regulatory system needs to balance consumer protection and the avoidance of spurious or misleading health claims, with the ability for food manufacturers to communicate the genuine health benefits of functional foods to consumers. At the present time, the range of products identified as functional foods is therefore limited. This research aims to inform policy decisions governing health claims to better understand Canadian consumers' reactions to different types of health claims on functional food products and the effect of verification by different parties.

1.2.2 The Issue of Partial Labelling and Full Labelling

Understanding consumer choices with respect to functional foods is an important new area of research. With the growing scientific evidence regarding the effectiveness of functional ingredients in enhancing health, reducing the risk of diseases and perhaps preventing some chronic diseases, it is timely to consider the effects of different types of labelling for functional foods. The interesting research questions lie in understanding the labelling context: how do consumers make decisions in environments of uncertainty; which sources of information are credible; how do different information environments affect willingness to pay; and how do different perceived health effects affect consumer behaviour with respect to functional foods.

In the absence of labelling, the health benefits for functional foods are a credence attribute, since the differences between a functional food and a regular food cannot be detected by search or experience behaviours. Given the importance of labelling and information asymmetry in understanding the consumer decision-making process for functional foods, the effect of different labelling strategies should be examined; in particular, whether different labelling policies could offer sufficient information to affect consumers' consumption decisions.

'Full labelling' in this study means direct and explicit health claims on product labels (e.g. "calcium may reduce the risk of osteoporosis"), which includes function claims, risk reduction claims and disease prevention claims, as described in Table 1.1. For example, for Omega-3 functional foods products, none of the three types of full health claims is allowed on food labels in Canada. However, both function claims and risk reduction claims for Omega-3 fatty acids have been allowed on food labels in the United States since 2004. Although both partial labelling and full labelling can be used to carry health information for functional foods, it is possible that full labelling could communicate the information more directly and accurately than partial labelling. Therefore, this thesis seeks to examine consumer responses to the use of full labelling by three types of health claims on Omega-3 milk products.

The relatively restrictive regulatory environment for labelling in Canada has resulted in food companies using an image or visual cue to implicitly signal a health benefit, although some rules and concerns still apply to use symbols (e.g. heart symbol) on food labels or in advertisement in Canada (Canadian Food Inspection Agency, 2009). This thesis uses the term 'partial labelling' to describe this strategy. Partial label means the use of a symbol or a visual cue on the products to implicitly imply health information to consumers as compared with 'full labelling' which means the health claims are explicitly stated on food labels, such as function claims, risk reduction claims and disease prevention claims.

Kozup, Creyer and Burton (2003) found that when a heart-healthy symbol was present, consumers generally believed that the food would reduce the likelihood of heart disease or stroke. Currently, 'partial labelling' has become a significant labelling format in the Canadian functional food market. Figure 1.1 provides examples: (1) the use of a red heart symbol on a soybean milk package to imply that consumption of the product is good for heart health; (2) the picture of a stomach with an arrow featured on a probiotic yogurt by ACTIVA a Danone brand to imply that consumption of the yogurt can help digestive health. Informal consultation with a group of regular yogurt consumers suggested that this imagery was rather obtuse. If more explicit health claims for probiotic products were allowed in the Canadian food market, presumably food companies would use a direct health claim with a clear meaning rather than using an image that may be misinterpreted by consumers. On the other hand, if symbols (partial labelling) can convey health benefits effectively, such as the red heart symbol on the soybean milk in figure 1.1, those symbols may in fact help consumers to better understand the health benefits of the products. It is possible that partial labelling could convey the same amount of information, or even work better than full labelling to inform consumers about the health benefits of the products (perhaps because of the attractive design or if images are easier to understand than a written health claim which consumers may not take the time to read). Of course, it is also possible that 'partial labelling' is used to imply a health benefit for which there is scant scientific evidence. Therefore, this thesis seeks to explore consumer responses to the use of partial labelling vs. full labelling within the context of the Canadian regulation environment governing health claims on food products.

Figure 1.1: Partial labelling examples

1.2.3 Other Research Issues: Verification, Lifestyle, and Reference-Dependent Effects

Verification of health claims is another important issue, which could affect consumers' perceived qualify for credence attributes. Given the fact that the health benefits from functional foods are credence attributes, verification of health claims can help to reduce consumer uncertainty and make health claims more credible. Only a few studies have been done for this topic in the functional food sector in Canada, especially at national level (Caswell, Noelke and

Mojduszka, 2002; Hailu et al., 2009; and Innes and Hobbs, 2011). The effect of verification by different organizations is therefore examined in this study. A government organization (e.g. Health Canada) and a third party organization (e.g. the Heart and Stroke foundation) are selected as the verifying organizations examined in this study. For example, food products may contain symbols or images implying an endorsement or healthy diet recommendation by a third party, such as the Canadian Diabetic Association, or the 'Health Check' program of the Heart and Stroke Foundation. While government verification is likely to be backed by scientific evidence, this may not be the case for a third party such as the Heart and Stroke Foundation (H.S.F.). Nevertheless, these organizations may be still credible. Understanding how consumers react to public sector (government) vs. third party (H.S.F.) verification is a topic explored in this thesis.

This study also evaluates the effects of consumers' attitudes and lifestyle behaviours on their functional food choices. Consumers' characteristics, attitudes towards functional foods and diet and exercise behaviours have been recognized in the literature as factors which could affect their healthy food choices (West et al., 2002, Lusk and Parker, 2009; Hailu et al., 2009; Verbeke, 2005; Cox, Koster and Russell, 2004; DeJong et al., 2003, and Gilbert, 2000). This study explores how demographic characteristics (e.g. income, education, gender and heart disease) and attitudinal and behavioural factors (e.g. attitudes towards functional foods, trust in health claims and nutrition labels, and health knowledge) help account for the heterogeneity of Canadian consumers' preferences for Omega-3 milk.

In addition, the area of reference-dependent effect might be also helpful to further explain consumer's choice behaviour (Tversky and Kahneman, 1991; Hardie, Johnson and Fader, 1993 and Hu, Adamowicz and Veeman, 2006), while, the application of this topic in the domain of functional food is very limited. The Reference-Dependent model was originally developed from psychology (Prospect Theory) as an approach to explain consumers' preferences. The central assumption of the theory is that losses and disadvantages have greater impact on preferences than gains and advantages (Tversky and Kahneman, 1991). In Prospect Theory, outcomes are expressed as changes (gains or losses) from a neutral reference point. There are two important properties of this theory: reference dependence and loss aversion. Reference dependence means individuals' preferences depend on a reference point; a change in a reference point might leads to reversals of preference. Loss aversion means losses dominate gains, and people will work harder to avoid losses than to obtain gains.

The reference-dependent approach informs our understanding of how consumers make choices about food products with health claims. Reference-dependent effects reflect the fact that individuals with different reference points could make heterogeneous choice decisions. Thus, a utility function need to be constructed relative to the reference condition. Chapter 6 takes random utility theory as the underlying theoretical framework and uses stated preference survey data to examine the reference-dependent and loss aversion effects in Canadian consumers' functional food choices. It focuses on testing the reference-dependent effects of the functional ingredient (e.g. Omega-3) and price attributes. The sources of heterogeneity for reference-dependent effects are also examined through several demographic and attitudinal variables.

1.3 Research Methodology and Organization of the Thesis

The theoretical framework of this thesis is based on random utility theory. A stated preference choice experiment is used to examine consumers' response to Omega-3 milk under different labelling scenarios. Chapter 2 provides an overview of the functional food market and reviews the literature examining consumers' functional food choices. Chapter 3 describes the design of this consumer survey and choice experiment. Chapter 4 presents the econometric models and descriptive analysis of the survey data. The analysis uses Discrete Choice models, incorporating Factor Analysis. Chapter 5 presents empirical estimation results of the effects of labelling on Canadian consumers' functional food choices. Chapter 6 presents the Reference Dependent model and Prospect Theory and examines reference-dependent effects in consumers' functional food choices. Chapter 7 presents conclusions, discusses the limitations of the study and provides suggestions for future research.

Chapter 2: Background: the Functional Food Sector and Consumer Research Methodologies

This chapter focuses on introducing different definitions of functional foods, describing the development of functional food markets, and reviewing consumer research literature with respect to information asymmetry, consumer preference methodologies and the application of those methodologies to functional food products.

2.1 Definitions of Functional Foods

When Canadian consumers are asked, "have you ever heard about functional foods?" we can expect a range of responses from puzzlement, to vague familiarity, to knowledgeable interest. While relatively few consumers are likely to have a clear idea about the term 'functional foods', a substantial number of them have probably consumed functional foods at some point in the recent past, whether knowingly or not. Increasingly, a wide range of functional food products are available in Canada, such as orange juice fortified with calcium, probiotic enriched yogurt, omega-3 fatty acid enriched milk, vitamin C-enhanced soft drinks, and breakfast cereals enriched with minerals, etc. Functional foods have become recognized as a separate food category only in recent years in Canada and the United States, while they have been popular in Europe and Japan since the 1990s. The central characteristic of functional foods is the pro-active 'health benefits' that the food imparts; placing the food category between normal food and medicine.

What are functional foods? The central idea is that they are foods with health benefits. There are numerous definitions of functional foods in the literature. Health Canada (1998b) defines functional foods as a food product that is consumed as part of a usual diet, and has demonstrated physiological benefits and/or reduces the risk of a chronic disease beyond a basic nutritional function. Functional food includes both traditional food products and food innovations derived through conventional breeding methods or through genetic engineering. Poulsen (1999) categorizes four 'enrichment' methods by which functional foods can be produced: upgrading, by adding more of a substance that the food already contains; substitution, by replacing a substance with a similar but healthier component; enrichment, by adding an ingredient not normally found in the food product; and elimination, by removal of an unhealthy ingredient from a food.

Doyon and Labrecque (2008) summarized 26 different definitions in the literature and identified a broadly accepted definition of functional foods. The authors found that four general concepts should be included in a definition: health benefits, the nature of the food, function and regular consumption. First, the concept of health benefits is the central component as illustrated by the 26 selected definitions. There were three specified health benefits in the definitions, which are physiological benefits (4/26), reducing the risk of diseases (7/26) and preventing health problems (3). Second, the nature of food means a functional food should be or should look like a traditional food. More than half the definitions (15/26) mentioned the nature of the food concept. Third, according to half of the selected definitions (13/26), the concept of function refers to benefits beyond its basic nutritional functions that make it a functional food. The last identified concept was regular consumption, which means a functional food must be part of a normal diet or fit a normal consumption pattern in a specific geographic and/or cultural context, mentioned in 9 out of 26 of the selected definitions. Therefore, a food which is defined as a functional food in one country may not necessarily be also considered as a functional food in another country. With an extensive literature review and elicitation of experts' opinions, Doyon and Labrecque (2008) generated a working definition: "a functional food is, or appears similar to, a conventional food. It is part of a standard diet and is consumed on a regular basis, in normal quantities. It has proven health benefits that reduce the risk of specific chronic diseases or beneficially affect target functions beyond its basic nutritional functions" (p1144).

Several of the 26 different definitions summarized by Doyon and Labrecque (2008) refer to the disease prevention or treatment functions of functional foods. For example, DeFelice (2007) defined functional foods as any substance that is a food or part of a food that provides medical and/or health benefits, including the prevention and treatment of disease. An article from CSIRO Human Nutrition (2004) defined functional foods as: "Foods that may be eaten regularly as part of a normal diet, that have been designed specifically to provide a physiological or medical benefit by regulating body functions to protect against or retard the progression of diseases such as coronary heart disease, cancer, hypertension, diabetes and osteoporosis". These definitions are closely related to the disease prevention claims examined in this study, although as has been noted, there is supportive but not conclusive scientific evidence for the role of functional foods in the prevention or treatment of chronic diseases. In the current North American functional foods market, only function claims and disease risk reduction claims are permissible. Disease prevention claims are regulated as drug claims and not allowed on food products in either Canada or the United States.

2.2 Developments in Functional Food Markets

Functional food is reportedly one of the fastest-growing sectors in the food industry. Fitzpatrick (2003) estimated that the Canadian functional food market was expanding by 7% to 10% each year. Estimates of the size of the global functional foods market vary widely, from

US$11 billion to $155 billion annually, depending on the source of the information and on the definitions of a functional food (Weststrate, Poppel and Verschuren, 2002). The global market for functional foods was estimated to be worth about US$33 billion in 2000 (Hilliam, 2000), and had grown to an estimated of US$85 billion by 2006 (Nutrition Business Journal, 2007).

The Canadian retail market for the functional food and nutraceutical industry was estimated to be about US$2.5 billion in 2005 (AAFC News Release, 2007)[3]. Currently, the largest and most rapidly expanding functional food and nutraceutical market in the world is in the United States (World Nutraceuticals, 2006). In 2003, Canadian international trade in functional food and nutraceuticals represented an estimated 3% of the global market compared to the United States (35%) and EU (32%) (D'Innocenzo, 2006). The United States, Japan and the European Union are the three largest importers of Canadian functional food and nutraceutical products (Statistics Canada, 2003).

Functional dairy products, such as Omega-3 milk, probiotic and prebiotic[4] yogurts, are one of the earliest and most widely adopted forms of functional foods. The European market for functional food is dominated by digestive health products, with dairy products originally being the key sales category at an estimated US$1.35 billion as early as 1999 (Hilliam, 2000). Some observers have noted a 30-50% price premium in high volume functional food segments, such

[3] Nutraceutical, a product isolated or purified from food that is generally sold in medicinal forms not usually associated with food, and has been demonstrated to have a physiological benefit or provide protection against chronic disease (Health Canada). http://www.hc-sc.gc.ca/sr-sr/biotech/about-apropos/gloss-eng.php#n (Accessed Dec.1, 2010) In the Canadian regulatory context, nutraceuticual is classed as a "Natural Health Product". Note that nutraceuticals and functional foods are substitute products from a health benefits point of view, and they are often mentioned simultaneously in the existing literature.

[4] **Probiotics** are defined as "live microorganisms which, when administered in adequate amounts confer a health benefit on the host."(FAO/WHO, 2001) **Prebiotics** are "non-digestible substances that provide a beneficial physiological effect on the host by selectively stimulating the favorable growth or activity of a limited number of indigenous bacteria." (Reid et al., 2003)

as functional dairy products in Europe (while raising questions about the sustainability of those premia in the long-run without proven efficacy and credible health claims) (Menrad, 2003).

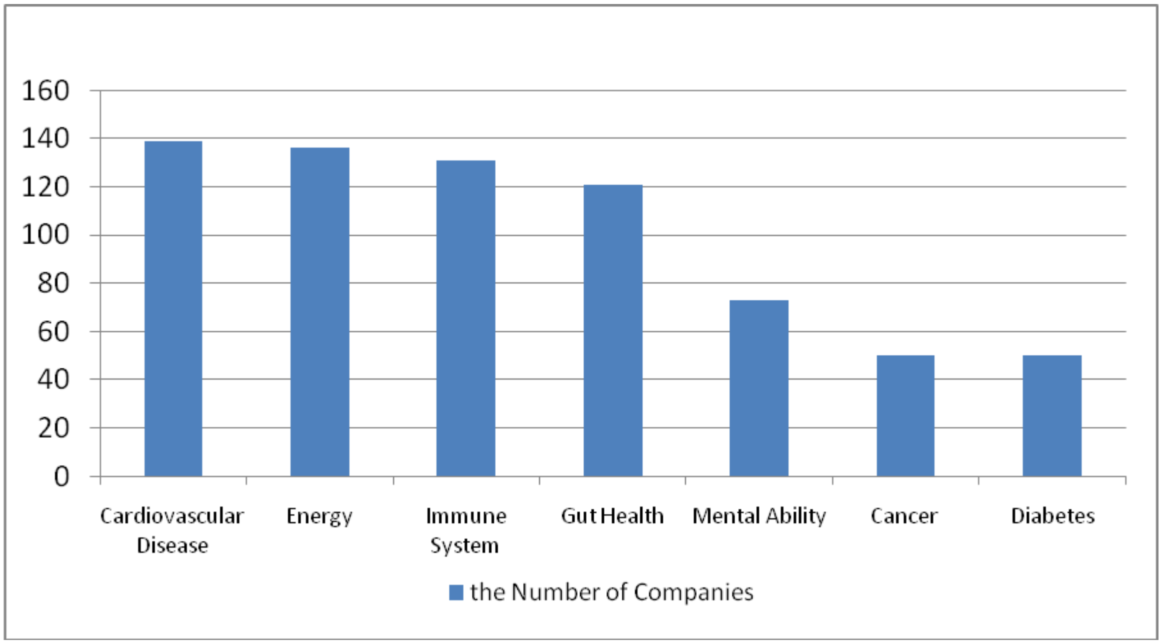
Canadian functional foods companies produce a wide range of functional food products. The highest profile products are from agricultural and fisheries companies which produce high quality fatty acids and oil products that contain Omega-3-fatty acids (Basu, Thomas and Acharya, 2007). It has been observed that Canada has the potential to expand its production of functional foods:

> "the country boasts more than 300 companies - from small start-ups to multinational enterprises - many that are internationally recognized for their bioactive ingredients, such as soluble fibre from oats, barley and pulses; omega-3 fatty acids from fish and flax oil; unsaturated fatty acids from canola oil; plant sterols and stanols from vegetable oils; and protein from soy. Industry is also interested in incorporating into food products functional ingredients, such as probiotic bacterial cultures; prebiotics (e.g. fructo-oligosaccharides) from corn; bioactives concentrated from berries and flax; and novel fibres from pulses" (Agriculture and Agri-Food Canada, 2009).

More than half of the above bioactive ingredients cannot form the basis of a health claim in food labels or in advertisements under current Canadian regulations. It seems that Canadian functional food companies might have incentives to lobby the government to approve more health claims for functional foods in the Canadian food market. In a survey, Statistics Canada (2007) asked Canadian functional food and nutraceutical companies about the Canadian regulatory environment for health claims: 60% of the respondents believed that government verification of health claims would lead to higher sales within the industry (Tebbens, 2005). Thus, the regulatory agency is likely to face ongoing pressure to expand allowable health claims in the Canadian market, which needs to be balanced with the imperative of consumer protection.

Figure 2.1 is derived from a survey of food companies by Statistics Canada in 2007, it shows the number of Canadian companies with functional and health products in the market by targeted disease and/or condition. It suggests that the Canadian functional food industry is an emerging industry and focuses on products targeting cardiovascular disease, energy, immune system, gut health, mental ability, cancer and diabetes. The disease-related distribution is relatively narrow focusing on a few major health concerns.

Figure 2.1 Number of Canadian Companies with Functional and Health Products in the Market



Sources: Functional Foods and Nutraceuticals Survey, Statistics Canada (2007).

In the next section, the notion of information asymmetry in the context of functional foods is explored. Information asymmetry underpins consumer research on functional food choices given the credence nature of the health benefits.

2.3 Functional Foods and Information Asymmetry

According to information theory, in general goods are categorized as having search, experience and credence quality attributes (Nelson, 1970 and Darby and Karni, 1973). The quality of a search attribute is determined before purchase (e.g. the appearance of the food); an experience attribute is one whose quality is determined after purchase (e.g. taste); while the quality of a credence attribute cannot be determined either before or after purchase (e.g. the nutritional component of the food). Functional foods are usually considered to be foods with credence attributes, since (in the absence of labelling) the functional properties cannot be inferred by the consumer before or even after purchase (Zou and Hobbs, 2006).

The market for functional foods is characterized by information asymmetry for consumers with respect to the presence, level and efficacy of the functional attributes. This point has been recognised in the literature: Menrad et al. (2000) argue that information and communication activities are needed to deal with the problem that consumers have limited information and knowledge about the health effect of some functional ingredients; Malla, Hobbs and Perger (2005) discussed labelling as a solution to information asymmetry regarding health attributes in food products.

Akerlof's (1970) well-known paper on the market for lemons underpins most subsequent work on information asymmetry as a cause of market failure. Briefly, he argued that good quality products could be eventually driven out of the market by poor quality products because of information asymmetry between buyers and sellers. Sellers have more knowledge about product quality; if the quality cannot be credibly signalled, goods of both qualities will sell at the same price. The absence of a price premium for higher quality results in only low quality products being offered for sale.

Two information problems are apparent in the functional foods market. One is whether the functional component is present, such as the presence of elevated levels of Omega-3 fatty acids. Of course, this is related to different quality levels of functional foods: higher quality (functional foods) and lower quality (no specific health benefit: 'normal' foods). The other information problem is whether the functional health claim is credible, which depends on whether consumers believe that consumption of functional foods will lead to specific health outcomes.

If consumers cannot identify functional foods, they will not be willing to pay a higher price for foods with those qualities, and the economic incentive to produce a functional food is not present. Eventually there would be no functional food in the market. Clearly, producers of functional food have a strong incentive to label their products. Labelling can be viewed as a means of providing information for consumers to make choices, and there is considerable debate about the merits of different labelling policies. Unfettered, unregulated labelling can lead to misleading health claims, confusion and distrust among consumers, while the absence of labelling information or very restrictive, limited labelling information does little to alleviate the uncertainty and information asymmetry facing consumers. The two types of information asymmetry problem in the functional foods market are related to the credibility of labelling.

Food labelling is generally classified as mandatory or voluntary labelling. Mandatory labelling requires that products with certain kinds of ingredients be labelled clearly (CFIA, 2001); for example, food containing allergens in Canada, or food containing genetically modified (GM) ingredients in the European Union. Mandatory labelling is usually imposed where it is perceived that the private market would fail to provide sufficient information to consumers. Voluntary labelling allows firms the choice of labelling an attribute, but if the products are labelled, the information must be true and credible (Caswell, 2000); this approach is used for voluntary labelling of GM-free foods in Canada and the US. For functional foods with a 'health benefit' attribute, voluntary labelling is appropriate as firms have an incentive to label the presence of a positive attribute, albeit labelling claims may be regulated to ensure credibility and prevent misleading health claims.

Relative to the labelling of functional foods, the labelling of GM foods has been studied much more widely. The GM food labelling literature provides some useful insights for potential research directions with respect to functional foods. Hu, Veeman and Adamowicz (2005) suggest that there are two research areas in terms of the impact of (GM) labelling. One area is to study existing (GM) food labelling and how this labelling affects consumer behaviour; the other area is related to the labelling context and how different types of labelling information affect consumers' choices. A considerable literature exists on the effect of food labelling information on consumer choices; researchers have used stated choice methods (e.g. Blend and Ravenswaay, 1999), contingent valuation (e.g. Roosen, Lusk and Fox, 2003), and experimental auctions (e.g. Rousu et al., 2004). Since functional food is a relatively new food category in Canada, and the regulatory environment for functional food labelling claims remains opaque, the second area of the labelling context is an appropriate focus for current research, particularly with respect to health claim attributes and understanding how consumers make choices in an uncertain information environment.

Definitions of functional foods vary, as do estimates of the size of the market for functional foods. Nevertheless, the inherent information asymmetry given the credence nature of functional food is indisputable. It is also not difficult to conclude that labelling (in whatever form) is a central means of providing consumers with information about functional foods. The next section reviews previous studies on Canadian consumer attitudes towards functional foods.

2.4 Canadian Consumer Attitudes towards Functional Foods: Previous Studies

A growing literature has examined consumers' attitudes towards functional foods consumption in recent years (for example, Hailu et al., 2009; Lusk and Parker, 2009; Verbeke, 2005; Sorenson and Bogue, 2005; Cox, Koster and Russell, 2004 and DeJong et al., 2003). Consumers' attitudes and beliefs about the relationship between food and health play an important role in their acceptance of functional food products (Gilbert, 2000; West et al., 2002 and Labreque et al., 2006). Health and nutrition information could change consumers' attitudes towards functional foods, specifically, reading health claims on food labels can enhance consumer perceptions of functional foods (Bech-Larsen and Grunert, 2003).

Chase et al. (2007) examine Canadian consumer purchasing behaviour and attitudes towards Omega-3 products using ACNielsen Homescan^{TM} data combined with ACNielsen Panel Track^{TM} survey data from 2003 to 2005 with a sample of 9,825 respondents in Canada. The study examined consumers' purchases of four types of Omega-3 products: eggs, yogurt, milk and margarine. This study is interesting because it uses data on actual purchases of Omega-3 products. Using a Probit model, the author found that the most frequent purchaser of Omega-3 products in Canada is baby boomers (born 1946-1955); while, the presence of children in the household could increase the purchasing frequency of Omega-3 yogurt and Omega-3 margarine; and the important factors that could affect the purchase of Omega-3 products were reading the Nutrition Facts panel and health benefits. This study also found that the growth in sales of Omega-3 products (eggs, milk, yogurt and margarine) exceeded the growth in sales of conventional food products during the study period from 2003 to 2005 in the Canadian food market. Interestingly, the researchers suggested that the approved health claims for certain specific Omega-3 fatty acids by the FDA in the United States was a step in the right direction, while such a claim has not yet been approved in Canada.

Peng, West and Wang (2006) conducted research on consumer attitudes towards and acceptance of Conjugated Linoleic Acid (CLA) enriched dairy products in Western Canada. Unlike the above analysis of Omega-3 products, consumers' demand for CLA-enriched products is not observable since they are not yet available in the market. A telephone survey was conducted in 2004 with a sample of 803 respondents (401 in Alberta and 402 in British Columbia). Seven CLA-enriched dairy products were examined in this study, which were 1%, 2%, whole and flavoured CLA milk, CLA yogurt, CLA butter and CLA cheese. Using a contingent valuation method, consumers were asked to provide ordinal ranking preferences for those seven products. A Probit model was applied for the final data analysis, with the calculation of marginal effects. The results showed that consumers believed that food choices played a role in preventing chronic diseases and this perception had an impact on their CLA yogurt and CLA cheese choices. The study also asked consumers to rate the extent to which they believed the five out of seven types of risk reduction claims permitted by Health Canada as described in Chapter 1. The results indicated that consumers who were more likely to believe health claims of food labels and the potential health benefits of CLA were more interested in purchasing CLA products. The authors also concluded that baby boomers should be targeted as CLA dairy product consumers, while the presence of children also had strong impacts on consumers' purchase intentions for some CLA dairy products. However, previous purchase experience of Omega-3 products and soy products was not related to interest in CLA milk products. The authors indicated that perhaps there were few "spill-over" effects between different categories of functional food products and suggested that future research should address consumer willingness to pay premiums for CLA dairy products.

Hailu et al. (2009) used conjoint analysis to examine consumer evaluation of functional foods and nutraceuticals in Canada. The paper applied a choice experiment to examine three products enriched with probiotics: yogurt, ice cream (functional food) and a pill (nutraceutical). Four attributes were selected and tested in this study. They were mode of delivery (three examined products), health claims (general well-being claim and risk reduction claim for cancer), source of claim (government, manufacturer and other organization) and price. Data was collected through a mall intercept survey with a sample of 322 respondents in 2005 in Guelph, Ontario. A Multinomial Logit model and cluster analysis was applied to the data. The results showed that consumers place a high value on claims verified by government, but little value on 'non-verified' claims made by product manufacturers. Health claims were the key to an effective marketing strategy for functional foods and nutraceuticals. The authors also found that there were clear sub-groups of consumers, some of which prefer delivery of probiotics as a nutraceutical and others who prefer to consume it in the form of a food.

To further understand what types of research methodologies are suitable for the study consumers' functional food choices, the following section provides an overview of consumer research methodologies.

2.5 Review of Consumer Research Methodologies

2.5.1 Stated Preference Methods versus Revealed Preference Methods

The research methodology adopted in this study is one of the Stated Preference Methods: a choice experiment. Broadly speaking, there are two basic economic valuation methods to examine individual's preferences for market and non-market goods: Revealed and Stated Preference Methods. Revealed Preference Methods, one of the earliest consumer demand theories, pioneered by Paul Samuelson (1938), states that consumers' preferences can be revealed by their purchasing habits. This method is usually applied to the demand for existing products where data is available on consumers' actual choice behaviour in the real market.

Stated Preference Methods are usefully empirical research techniques to understand and predict the decision maker's choice behaviour among discrete products, and were originally developed in marketing research in the 1970s. The methods focus on assessing consumer responses to potential product characteristics (Quagrainie, Unterschultz and Veeman, 1998). Kroes and Sheldon (1988) state that the term 'stated preference methods' refers to a family of techniques which use individual respondent's statements about their preferences in a set of options to estimate a utility function.

An extensive literature discusses and compares Stated and Revealed Preference Methods (see for example, Kroes and Sheldon, 1988; Adamowicz, Louviere and Williams, 1994 and Morikawa, Ben-Akiva and McFadden, 2002). There are two major advantages of Stated Preference Methods over Revealed Preference Methods. First, Stated Preference Methods allow researchers to estimate and predict the demand for new products with non-existing attributes in a situation where the revealed preference data is not yet available. Second, the data collected by Revealed Preference Methods, the attributes and attribute levels of non-market goods (for example a lake for recreational fishing) usually do not have variability over time in a single cross-section, and it is difficult to estimate the value changes provided by the non-market good without panel data (Louviere, Hensher and Swait, 2000). For example, the observation of choosing a location for lake fishing is fixed in a single time period, while the change effects of respondents' choices can be observed over multiple periods of time. It is also common to have collinearity among multiple attributes (e.g. the relationship of sales and price) in revealed preference data, which makes it difficult to isolate the effect of one variable from another. A well designed Stated Preference study should avoid these problems.

The challenge of the Stated Preference Method is its hypothetical nature. Consumers may provide unrealistic statements if there is no cost to over (or under-) stating their willingness to pay (WTP). Also, if consumers are unfamiliar with the product (which could be the case for a new functional food attribute), their stated WTP may be inaccurate, because this method asks respondents to state their WTP values but does not record an actual choice action as is the case with revealed preference studies. The fact that Stated Preference Methods are based on what people say rather than what people do, is the source of its greatest strengths and its greatest weaknesses compared with Revealed Preference.

2.5.2 Contingent Valuation and Conjoint Analysis

Generally speaking, Contingent Valuation and Conjoint Analysis are two major Stated Preference Methods. The Contingent Valuation Method (CVM) is a survey based economic technique and has often been applied to non-market goods, such as environmental resources and wildlife (Hanemann, 1994). CVM uses a survey instrument to ask respondents questions directly about their WTP or willingness-to-accept (WTA) as a compensation for the non-market goods in a hypothetical scenario. Conjoint Analysis (CA) estimates the structure of a consumer's preference given his/her overall evaluation of a set of alternatives that are pre-specified in terms of levels of different attributes (Green and Srinivasan, 1978). Both CVM and CA are survey-based stated preference approaches for data collection. The major difference between CVM and CA is that CVM focuses on a single scenario to collect the precise information from each respondent's choice, while CA tends to examine a respondent's preference by providing a richer description of the attributes trade-offs in the overall scenarios and results in a smaller variance for welfare values than CVM (Adamowicz et al., 1998). The data collection approaches that can be used to conduct conjoint analysis include judgment data (e.g. rating and ranking conjoint) and choice data (e.g. choice experiment) (Louviere, 1988).

A choice experiment is a type of choice based conjoint analysis, a sub-family of conjoint analysis techniques, also called a Discrete Choice Conjoint Experiment (Louviere, 1988). It is consistent with Random Utility Theory and Lancaster's (1966) Consumer Demand Theory. The choice experiment was developed from Conjoint Analysis and Discrete Choice Theory by Louviere and Woodworth in 1983, allowing the researcher to study the choice process and attribute trade-offs process simultaneously. The choice experiment method evaluates the values of attributes of a product by asking people to choose the most preferred product out of a few available products. In each scenario of a stated choice experiment, the alternative options are described as combinations of different levels of the attributes, and the descriptions of the alternatives vary among scenarios. The respondents make their choices in a series of hypothetical choice sets. The preference effects of attributes can be derived by observing the changes of respondents' choices due to the variation in the choice alternatives.

2.5.3 Application of Choice Experiments in the Food Sector

A number of previous studies have used choice experiments to examine consumers' attitudes towards functional foods or foods with credence attributes (West et al., 2002, Cranfield, Deaton and Shellikeri, 2009; Steiner, Gao and Unterschultz, 2010; Quagrainie, Unterschultz and

Veeman, 1998; Larue et al., 2004; Lusk and Parker 2009; Hu, Woods and Bastin, 2009; Hovde et al., 2007).

West et al. (2002) used a choice experiment to analyze consumers' responses to different types of functional foods, produced by conventional, organic, and GM technology. This is one of the earliest studies on the functional food sector. A representative sample of 1,008 Canadian household food shoppers responded to the stated preference experiment administered through a telephone survey in 2001. Each choice set in the questionnaire asked consumers to choose between the same foods produced by three different food production processes. As it was a phone survey, the number of other characteristics describing the foods had to be small, and the three alternatives differed in terms of price and the presence or absence of a functional health property. A Mixed Logit model was used to analyse the responses. The authors found that the majority of respondents were willing to pay a price premium for functional foods, particularly if the functional ingredients were derived from plants. Consumers were less receptive to a functional property if the functional food was a meat product. The results also indicated that many Canadian consumers would avoid GM foods regardless of the presence of functional health properties, and they are likely to accept conventional and organic functional foods if the prices are reasonable.

Another example of the application of this method is the paper by Quagrainie, Unterschultz and Veeman (1998). A stated preference experiment was administered in major cities in western Canada in 1996 via a mail survey; there were 530 respondents. The research question dealt with how product origin, packaging, and selected demographics affect consumers' choice of red meats. Several attributes were selected for each different fresh meat product, including price, product origin and packaging. A Nested Logit model was used to analyse the Stated Preference data. The estimation results indicated that the consumers generally preferred Alberta fresh beef rather than a more general Canadian origin, but the consumers were indifferent between fresh pork from Alberta and elsewhere in Canada. Consumers' age, household income and family size were found to have an effect on meat choice.

A recent article by Lusk and Parker (2009) applied a choice-based conjoint experiment to examine consumer preferences for the amount and type of fat in ground beef. This paper linked consumers' beef choices to their health concerns and fat content. Several attributes and levels were selected, including the levels of Omega-3 fatty acid, conjugated linoleic acid (CLA) and saturated fat. The examined product, ground beef enriched with Omega-3 and lower fat content, is also a type of functional food. The goal was to examine preferences for a 'heart healthy' beef product. A survey was mailed to 2,000 randomly selected households throughout the United States in April 2007 with 241 surveys returned, a 12.7% response rate. This paper aimed to determine consumers' willingness to pay for beef with a healthier fat content, and to determine the importance of fat content in beef relative to other beef attributes. WTP estimates showed that consumers placed significant value on beef enhanced with Omega-3 fatty acids, ranging from $1.30 to $2.21 per-pound of ground beef depending on total fat content. The authors suggested that it might be profitable for the beef industry to market and sell products that are healthier for the consumer (e.g. heart healthy beef). This paper confirmed the importance of Omega-3 functional products. The method used to calculate the total WTP is also helpful to develop the WTP estimates in this study.

Hu, Woods and Bastin (2009) used the choice experiment method to study consumers' acceptance and willingness to pay for blueberry products with nonconventional attributes: organic, Kentucky-grown and sugar-free. An in-store intercept survey was conducted in

Kentucky with a sample of 557 respondents in 2007. The results found strong evidence that demographic variables had a significant impact on consumers' preferences. For example, consumers with different age, household income and years of education have different preferences. Depending on their personal characteristics, consumers' preferences and willingness to pay differ for various attributes. For example, younger and mid-aged consumers with low to moderate income valued the attribute Kentucky-grown much higher than the organic feature for a pure blueberry jam product. The analysis in this study used the WTP method to obtain the marginal values when the selected attributes also contained demographic interaction variables in a Mixed Logit model. The calculation of marginal WTP when there is significant demographic interaction effects involved in the estimation model provides insights that are valuable for the estimation methods used in this study.

Hovde et al. (2007) use a choice experiment to identify market preferences for high selenium beef in the United States. The survey design included three attributes: price premium, health claims and origin. Health claims levels included the FDA level A and FDA level C claims. Data was obtained from a nationwide internet survey with a sample of 1,304 respondents in 2006. A Multinominal Logit Model was estimated. Unexpected results showed that respondents did not prefer the high-selenium beef products with the FDA level A and C health claims. The authors explained that because the words "cancer" and "selenium" were included in the claims; both words might have elicited negative perceptions about the product. Also, consumers were unfamiliar with the function of the new functional ingredient, selenium, which might reduce the risk of certain cancers. One interesting finding was that those with less health-oriented lifestyles, including those who did not exercise and who use tobacco, preferred high-selenium beef with health claims. Those findings provide some insights for this study, such as the importance of careful wording in the examined health claims.

The choice experiment studies summarized here represent only a fraction of the literature in the area of consumers' attitudes towards and beliefs about functional foods or healthy food choices. The next chapter (Chapter 3) focuses on how a choice experiment was applied in this study to examine the effects of labelling on Canadian consumers' choices of Omega-3 milk products. Chapter 3 discusses the selection of product attributes and levels, the choice experiment design and the survey and data collection.

Chapter 3: Research Methodology: the Choice Experiment

The choice experiment approach is a widely adopted empirical methodology in the economics literature (Louviere, Hensher and Swait, 2000; Hensher, Rose and Green, 2005; Adamowicz et al., 1998 and Hu, Veeman and Adamowicz, 2005). For an individual consumer's choice problem, the classic random utility approach of consumer theory is appropriate (Manski, 1977). The choice experiment method is consistent with Random Utility Theory. It is a data generation approach which depends on the design of choice tasks to reveal factors influencing choices and to understand how respondents make choice decisions (Louviere, Hensher and Swait, 2000). A choice experiment is used to observe the effects upon one variable, a response variable, given the manipulation of the levels of one or more other variables in the choice sets (Hensher, Rose and Green, 2005). The choice set is a subset of all alternatives in a universal set that are available at the time of the choice and have a non-zero probability of being chosen (Adamowicz et al., 1998).

The first step in conducting a choice experiment is to refine the understanding of the problem being studied and ask the question: "what does the research hope to achieve?" After understanding the problem, the researchers identify a list of alternatives, attributes and attribute levels which are appropriate for the choice experiment. This step is called stimulus refinement, which means brainstorming and then narrowing the range of alternatives to consider in the experiment (Hensher, Rose and Green, 2005). The key issues in designing a choice experiment method include selecting the attributes and levels, the experimental design and the treatment of the no-choice option. These aspects of choice experiment design are discussed in sections 3.1, 3.2, and 3.3, respectively. The chapter concludes with a description of the survey design and data collection.

3.1 The Selection of Attributes and Levels in the Choice Experiment

The choice experiment explores how consumers value and make trade-offs among the selected attributes. The selected attributes need to properly reflect the competitive environment of the available alternatives and/or be closely relevant to consumers' decision making (Blamey, Louviere, and Bennett, 2001). For example, as mentioned in Chapter 1, the research questions of this study focus on examining consumers' response to full labelling, partial labelling and the verification of health claims, when making functional food choices. Therefore, full labelling (function claims, risk reduction claims and disease prevention claims), partial labelling (symbol) and verification organizations (government and third party verification) were selected as the main attributes for inclusion in the choice experiment.

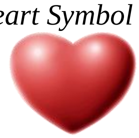
When selecting attributes, the following aspects need to be considered by analysts. First, although many products might have the potential to become examined product(s), only the most representative product or service should be selected. The selected product or service will be used as the alternatives in the choice sets. For example, this study focuses on the effects of labelling on consumers' functional food choices, so the examined product should be a representative functional food which can credibly carry the labelling attributes. Second, not all attributes and levels that are relevant to consumers' choice decisions for the examined product are included in the choice experiment design. For example, taste might be a significant attribute in consumers' food choices. However, if taste itself is not relevant to the research question it should not be included as an attribute in the experiment.

In some studies, the utility brought by the levels of a single attribute is referred to as part-worth utility or marginal utility. The more levels are brought in by analysts, the more complexity of choice tasks or tradeoffs that are added. It is important to thoroughly understand the research topic and simplify the selected attributes and levels. The information on the relevant attributes and levels could be obtained through the use of focus groups (Lindlof and Taylor, 2002), discussion with relevant industry stakeholders, and review of relevant literature. For this study, the process of selecting attributes included interviewing individual consumers and scientific experts, informal market research on dairy products and a review of relevant literature.

Omega-3 milk has been selected as the product examined in this study. Why is Omega-3 milk chosen? First, the dairy sector is the earliest and a dominant functional food sector, and milk is widely consumed among Canadians. Second, Omega-3 fatty acid is one of the most popular functional ingredients as it is found in several functional food products. According to the World Health Report of the World Health Organization (2002), the potential health benefits of Omega-3 include cardiovascular disease prevention and control, cancer prevention, improved immune function and brain health. Cancer and cardiovascular/heart disease are also two out of the four leading causes of death in Canada. Third, health claims are not currently permitted on food products enriched with Omega-3 in Canada. Fourth, as Health Canada continues to review health claims in recent years, there may be changes in the near future regarding the regulation of health claims. For example, explicit health claims for products enhanced with Omega-3 ingredients may be allowed in the future.

Table 3.1 summarizes the selected attributes and levels in this choice experiment. Health claims, verification organization, heart symbol, Omega-3 functional ingredient and price are the selected attributes. The labelling effects include partial labelling and full labelling, which are included as two separate attributes in this design. Three types of full labelling health claims are defined as function claims, risk reduction claims and disease prevention claims. Function claims and risk reduction claims have already been applied on functional foods in the U.S. and Canadian markets. Function claims, such as “calcium could build strong bones”, usually do not need to be pre-approved in the United States, but certain conditions need to be met to be applied on food labels in Canada. Risk reduction claims (which link a nutrient to a particular disease) need to be supported by scientific evidence and need to be pre-approved in both Canada and the United States. Disease prevention claims are regulated as drug claims and are not yet permitted on any food products in either Canada or the United States.

Table 3.1: Attributes and Levels in Choice Experiment

ATTRIBUTES	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1. Omega-3	Contains Omega-3 (included as a alternative specific constant)	None	-	-
2. Health Claims (full labelling)	*Function Claim:* “Good for your heart.”	*Risk Reduction Claim:* “Reduces the risks of heart disease and cancer”	*Disease Prevention Claim:* “Helps to prevent Coronary Heart Disease and Cancer“	None
3. Symbol (partial labelling)	*Heart Symbol* 	None	-	-
4. Verification Organization	*Government:* Health Canada	*Third Party:* Heart and Stroke Foundation of Canada	None	-
5. Price (per two-litre)	$1.99 (conventional)	$2.69 (conventional or Omega-3)	$3.59 (conventional or Omega-3)	$4.49 (Omega-3)

In this study, the full labelling health claims attribute has four levels: Function Claim (FC), Risk Reduction Claim (RRC), Disease Prevention Claim (DPC) and no claim. The partial labelling attribute is represented by the ‘heart symbol’ defined as two levels: with a heart symbol and without. The research design also explored the role of verification organizations in lending credibility to a health claim, with ‘Verification Organization’ also included as an attribute. Three levels are specified for the verification organization attribute: Government (Health Canada), Thirty Party (Heart and Stroke Foundation) and none.

The Omega-3 attribute enters the choice experiment as an alternative specific constant variable, which has two levels: containing Omega-3 and none. In other words, each choice set contains two Omega-3 milk options as the first two alternatives and one conventional milk option as the third alternative. Although Omega-3 could have been used as a separate attribute in the experiment, initial tests of experimental designs showed that its inclusion required too many restrictions with respect to the relationship with other attributes and significantly reduced the efficiency of the design. For example, in the case of the absence of any Omega-3 in the choice set, all the other attributes (except price) would have to be restricted to the “none” levels (e.g. no health claim, no symbol and no verification).

The price attribute is directly related to the measurement of consumers’ WTP for other attributes in the experiment. The selected price levels should reflect but not be limited to the retail price in the market, with the price range covering the likely lowest price and the highest price for milk products as much as possible. According to observations for milk prices from food markets in Saskatoon, Edmonton, Calgary, Toronto, Vancouver and from information gathered from the internet, the four selected levels of the price attribute are: $1.99, $2.69, $3.59 and $4.49 for a two-litre carton of milk. Note that the highest price ($4.49) is applied only to Omega-3 milk and the lowest price ($1.99) is only applied to conventional milk to maintain the realism of the choice task.

There are four alternatives in each choice set: the first two are Omega-3 milk, the third is conventional milk and the fourth is the no-purchase alternative (discussed in section 3.3). There are some restrictions for the attribute combination appearing in choice alternatives. Health claims and the heart symbol can only appear in the functional milk alternatives since conventional milk cannot contain a health claim or heart symbol. Verification organizations can only appear with health claims, otherwise there is nothing to be verified by those organizations. The Omega-3 attribute cannot appear in the conventional milk and the no-purchase alternatives, but it must appear in the first two alternatives in each choice set to indicate that they are the functional food alternatives.

Although Omega-3 milk products already exist in the Canadian functional food market, health claims for Omega-3 are not currently permitted, therefore a choice experiment allowed the potential health claims, and verification of those claims by different organizations, to be examined. The design of the choice experiment is discussed in the next section.

3.2 Choice Experiment Design

An efficient experimental design is used to maximize the information collected from the stated preference choice experiment. The objective is to create efficient choice sets, including how to combine attribute levels into product profiles and how to put profiles into choice sets (Batsell and Louviere, 1991).

Two more concepts need to be clarified before outlining the formal design used in this study. One issue concerns main effects and interaction effects, and the other deals with labelled experiments and unlabelled experiments. The main effect is the independent effect of a particular treatment upon the dependent variable, the choice. The measurement of the main effect is by the estimated parameter of that treatment variable. An interaction effect is the combined effect of two or more treatments upon the dependent variable. The interaction effect could be measured by the estimated parameter of the combined variables. The main effects and interaction effects determine the degrees of freedom of the experiment, which is directly related to the design of the minimum number of profiles. The number of the profiles needs to be sufficient to estimate both the main effects and interaction effects.

A labelled experiment refers to an experiment using a label or a brand title for each alternative of the choice task. For example, brand names for milk products, such as Dairyland or Beatrice could be used as a label for an alternative. An unlabelled experiment refers to an experiment using a generic title for each alternative and the generic title does not convey any information to the decision maker. A label or a brand title in a labelled experiment has a brand effect in the design. The design processes are different for labelled experiments and unlabelled experiments. Generally speaking, to make an efficient design, the unlabelled experiment requires a smaller number of profiles than the labelled experiment. The design of this study uses an unlabelled experiment since a brand effect is not directly relevant to the research questions being examined.

A full factorial design is a design in which each level of each attribute is combined with every level of all other attributes (Louviere, Hensher and Swait, 2000). It allows all possible combinations of the attribute levels and alternatives to be used, and allows all the main effects and interaction effects to be estimated. The number of possible profiles in a full factorial design is equal to L^A for an unlabelled experiment and L^{MA} for a labelled experiment, where L is the number of levels, A is the number of attributes and M is the number of alternatives (Hensher, Rose and Greene, 2005). Usually it is too costly and tedious to expose respondents to all possible choice sets. There are some strategies available to reduce the number of choice sets given to respondents, including reducing the number of levels, using a fractional factorial design, blocking the design or using a fractional factorial design combined with a blocking strategy (Hensher, Rose and Greene, 2005).

A fractional factorial design is a design in which only a fraction of all treatment combinations is used in the choice sets. How are the combinations chosen? Two principles should be considered which are orthogonality and balance (Hensher, Rose and Greene, 2005). An orthogonal design requires all attributes to be statistically independent of each other, which means zero correlations between attributes. A balanced design requires the probability of each attribute level occurring equally often for each attribute of each alternative in all choice sets. One way to express a fractional factorial design could be L^{A-P}, where L and A have the same meaning as above, and P represents the size of the reduced fraction of the full factorial design determined by researchers (Holmes and Adamowicz, 2003). There is a minimum design requirement that the number of the profiles in a fractional factorial design must satisfy the estimation of the main effects and the two-way interaction effects. The limitation of the fractional factorial design is that it cannot guarantee to impart the maximum amount of information about the parameters of the attributes relevant to each specific choice task (Hensher, Rose and Greene, 2005).

Related to the orthogonal fractional factorial design, the optimal or statistically efficient design is another design method in the choice experiment literature and was the method adopted in this study. The development or application of the optimal efficient design method is discussed in Kuhfeld, Tobias and Garratt (1994); Huber and Zwerina (1996); and Kanninen (2002). The optimal efficient design needs to have balance, orthogonality and minimal level overlap (Huber and Zwerina, 1996). The goal of the optimal efficient design is to minimize the variance and covariance of parameter estimates and maintain those optimal design properties as much as possible (Kuhfeld, Tobias and Garratt, 1994). The criterion of the optimal efficient design is to have the design be as efficient as possible, which means to search for a minimum-variance design. Such a design is known as a D-optimal design, which aims to maximize the determinant of the variance-covariance matrix of the model to be estimated. There are some differences between the orthogonal fractional factorial design and the optimal efficient design. The orthogonal fractional factorial design aims to make the attributes of the design statistically independent and uncorrelated. In contrast, the optimal efficient design optimizes the amount of information in the design and aims to be statistically efficient but is likely to have correlation among attributes (Hensher, Rose and Greene, 2005).

The design of the choice experiment in this study is based on Warren F. Kuhfeld's (2005) Marketing Research Methods in SAS and Johnson et al. (2007). This is an unlabelled generic design because there are no 'brands' in the alternatives for the examined products. There are four alternatives in each choice set. The first two alternatives are Omega-3 functional milk; the third alternative is conventional milk; and the fourth alternative is the 'no purchase' option.

In this study, the choice set design is somewhat different from other choice experimental studies. In most studies, only one representative product needs to be selected, and the difference among alternatives in each choice set is the changes of the treatment combinations, which is a relatively straightforward choice design. For this partial constant design, two products are included in each choice set to mirror reality: conventional milk taken as the base/reference product, and Omega-3 milk examining additional functional attributes. In the real milk market, conventional milk still dominates the market and functional milk, such as Omega-3 milk, only takes a relatively small market share. In this experimental design, it is therefore reasonable to have conventional milk as the base/reference product, so respondents could make trade-offs not only between different treatment combinations, but also between conventional milk and functional milk.

Technically, there are two methods whereby conventional milk can be incorporated into the experimental design. One straightforward method is to take conventional milk as a possible treatment combination/profile, and in this type of design conventional milk could occur in any alternative in each choice set. This study applies the other method, by taking conventional milk as a fixed alternative in a partial-constant design. The design treats conventional milk as a partial constant alternative with only the price level changing. Thus, all other attributes remain constant and stay at the 'none' level (i.e. just conventional milk without health claims or verification). This is very similar to the creation of the 'no-purchase' option. The 'no-purchase' option is explained in detail in the next section. A pilot study was used to investigate both design alternatives. Feedback from respondents and the experiment results favoured the second method which treats conventional milk as a partial constant alternative. This structure provides respondents with a more realistic choice task, making comparisons among profiles and products easier. The remainder of this section explains the creation of this design.

Applying the SAS Macro program (Kuhfeld, 2005), the %Mktruns and %Mktex macros were used to create initial candidate choice sets, and then the %choiceff macro was used to select the optimal design with the highest D-efficiency score[5] out of 100 designs. This study contains four attributes (with 4/3/2/4 levels), and there would be 96 choice sets for a full factorial design. Therefore, the optimal design needs to include an appropriate amount of choice tasks to satisfy a complex model which can handle the possible main effects and interaction effects, the

[5] D-efficiency score is defined as: $100*(1/N|X'X^{-1}|^{1/K})$ (Kuhfeld, 1997).

possible alternative specific effects and demographic effects. The design also needs to be practical since it will be tedious and might be hard for respondents to efficiently complete too many choice tasks within one survey.

The number of minimum profiles for this study can be calculated by the number of main effects and two-way interaction effects. Evaluating the number of degrees of freedom is important to estimate the entire set of main effects and interaction effects (Louviere, Hensher, and Swait, 2000). This study includes four attributes with 4/3/2/4 levels. Each main effect is associated with L-1 degrees of freedom (L is the number of levels for each attribute). Therefore, there are 9 degrees of freedom for the main effects. This design also considers partial interaction effects between partial labelling and full labelling, and between full labelling and verification organizations. For interaction effects, the degrees of freedom are calculated by $(L_1-1)*(L_2-1)$, where L_1 and L_2 are the levels of the two-way interacted attributes. For this study, there are 9 degrees of freedom for the interaction effects. Therefore, there are 18 degrees of freedom for both main effects and interaction effects for one alternative in the choice sets. Since there are two alternatives in each choice set that involves both main effects and interaction effects (Omega-3 milk options), in total there are 36 degrees of freedom in this study. The number of profiles in the choice design must exceed the number of degrees of freedom. Thus, the minimum number of profiles for this study is 36. This design includes 48 profiles which exceeds this requirement.

Finally, it was necessary to impose some restrictions when generating the profiles. Based on retail prices for existing Omega-3 milk products, prices in the first two Omega-3 alternatives cannot realistically be the lowest price $1.99, and conventional milk in the third alternative should not realistically be at the highest price $4.49. If there is no health claim in a product, there should not be a verification organization in that product. It is impossible to expect each respondent to complete the full 48 choice sets used in this design. Accordingly, the %Mktblock macro in SAS was used to block the design into six blocks, so that each respondent faced eight choice sets. Eight was considered a reasonable choice set number for each respondent, given that there were other questions that needed to be answered in the survey. An example of a choice set is shown in Table 3.2.

Table 3.2 An Example of a Choice Set from the Survey

Attributes	Option A	Option B	Option C	Option D
Symbol on Package	 Milk	 Milk	 Milk	I would not purchase any of these milk products.
Additional Ingredient	Omega 3	Omega 3		
Health Claims	Reduces the Risks of Heart Disease and Cancer	Helps to Prevent Coronary Heart Disease and Cancer		
Verifying Organization of Health Claims	Heart & Stroke Foundation	Health Canada		
Price	$3.59	$4.49	$2.69	
Choices	□	☑	□	□

Option A is a 2-litre carton milk **enriched with Omega-3**. It has a health claim **"Reduces the Risks of Heart Disease and Cancer"**, verified by the **Heart & Stroke Foundation**. This carton of milk costs $3.59.

Option B is a 2-litre carton milk **enriched with Omega-3**. It has a health claim **"Helps to Prevent Coronary Heart Disease and Cancer"**, verified by **Health Canada**. This carton of milk costs $4.49.

Option C is a **carton of 2-litre conventional milk** and costs $2.69.

Option D can be selected if you would not buy options A, B, or C.

In this example, option B was chosen.

3.3. The treatment of the 'No-purchase' Option

The 'No-purchase' option is a constant alternative in each choice set and does not vary among choice sets. The purpose of the no-purchase option is to simulate the real purchase environment where consumers always have the option to choose not to buy a product. The inclusion of the no-purchase option in the choice set avoids forced choices. If the no-purchase option is not provided in the choice experiment consumers are forced to make choices among the hypothetical alternatives which might change the values of attributes relative to a real market situation. Forced choices could also bias the product demand estimation and WTP results (Carson et al., 1994).

There are several formats through which to present a no-choice option in the choice experiment: 'no-purchase' and 'the current purchased product', etc. A no-purchase option is often applied when the research objective is to simulate realism or measure market demand. Another alternative is to allow consumers to choose their current purchased product. This enables a researcher to examine which attribute or level of the new product is attractive to induce consumers to switch from their current purchased product (Batsell and Louviere, 1991). There is no clear guideline on which format should be applied, and is primarily a matter of choice for the researcher. For this study, the no-purchase option has been applied as a constant alternative in each choice set to simulate the real shopping environment.

One popular approach in the literature to deal with the inclusion of the no-purchase option in the choice set is by the measurement of an alternative specific constant (ASC) variable to normalize the alternative utilities (Train, 2003). The ASC approach is used in this study. This method treats the no-purchase option similarly to other alternatives and assumes the marginal utilities of the attributes in the no-purchase option to be zero since there are no attributes associated with this option. The ASC approach measures the relative value of the utility associated with one alternative compared with another alternative. The difference in the utility associated with the no-purchase option and other purchase options is captured by the ASC variable. The coefficient of the ASC variable for the no-purchase option is a relative utility associated with that option relative to the other purchase options.

This section has explained some key steps in the design of the choice experiment, including the selection of attributes and levels, the experimental design and the treatment of the no-purchase option. The following section provides details on the remainder of the survey and the data collection process used in this study.

3.4 Survey and Data Collection

The choice experiment was administrated through a consumer survey[6]. The survey contained six sections. The first section asked about respondents' general milk consumption habits and previous experience consuming conventional milk and Omega-3 milk. This section was used to collect data on reference points for different attributes, which is discussed in Chapter 6. The second section asked respondents to complete a series of choice tasks, which was the primary source of choice data for the estimation models in this thesis. The third section gathered data on consumers' trust in food labels, symbols and health claims, and the source of health information for food products. The fourth section asked about consumers' attitudes, beliefs and consumption of functional foods and regular foods. The fifth section gathered information on consumers' health problems and histories, their health status and exercise habits. The final

[6] This survey was approved by the Behavioural Research Ethics Board at the University of Saskatchewan in January 2009.

section of the survey contained some socio-demographic information. A copy of the entire survey is provided in Appendix 4.

Before conducting the formal survey a pilot study was completed in March 2009 in Saskatoon. This pilot survey was carried out in different locations in Saskatoon - at the Midtown Plaza Mall, the Lawson Heights Mall, the student centre at the University of Saskatchewan and various Tim Hortons Café locations. Forty two respondents completed a pilot survey. This pilot study provided very useful feedback in finalizing the survey instrument. For example, in the pilot survey, fat percentage was initially used as a milk product attribute in the choice experiment. However, it was found that fat percentage is a dominant factor in determining milk choices for many respondents but the fat percentage has little relationship with the research questions and it clouded the analysis and created bias. After careful consideration this attribute was removed from the choice experiment design and taken instead as a constant attribute (i.e. in introducing each choice set, respondents were told to assume that all fat percentages of milk products are available). The pilot study also assisted in refining the wording of questions and removing unnecessary questions.

The formal survey was conducted in July 2009 as an online survey in English with respondents recruited from across Canada, with the exception of Quebec due to resource limitations. A professional marketing research company administered the online survey and recruited participants using survey sample recruitment firms. As an incentive to participate in the survey, participants had a chance to win a monthly sweepstakes which could be redeemed for cash or they could choose to donate any winnings to assigned charities. The survey was kept open until the target sample size had been reached. A total of 924 completed surveys were received, with 740 of these responses usable. The procedures used to identify qualified responses are explained below.

Several quality control procedures were implemented to control for the quality of survey data. For example, first, two screener questions were used to screen out unqualified participants, which were 'do you consume cow's milk at least once per month?' and 'are you one of the primary food grocery shopper in your household?'. Participants answering 'No' to either question did not proceed with the survey. Second, the data from respondents who completed the survey in 10 minutes or less were not used in the analysis. From the pilot study it was clear that it should usually take 15-20 minutes to complete the survey and individuals who finished it within ten minutes might not take the survey seriously (See appendix 3 for details). There were 47 (or 5.1%) respondents who took less than 10 minutes to complete the survey in the initial 924 respondents.

Furthermore, for the choice experiment section initially 8 choice sets had been randomly assigned to each respondent. To ensure the quality of the collected data, two more choice sets were included. These were 'trap' choice sets, designed to weed out respondents who were answering the choice sets inconsistently. "Trap question" was originally developed from Sociology literature (e.g. Barry and Bateman, 1996). In this study, one trap choice set was to include a strictly dominated alternative (e.g. one alternative included superior attributes and the lowest price, so this option was a logical answer if a respondent was answering rationally). This was positioned to be the ninth choice set for each respondent for simplicity. Only data from those respondents answering this choice set logically were used in the analysis. An additional trap choice set (the tenth choice set) was an identical repeat of an earlier choice set to check whether a respondent's answers are consistent. If a respondent's answer was different in the repeated choice set from his/her earlier choice, his/her choice data were considered invalid and were removed from the data used for analysis. For ease of programming and data analysis, the repeated choice set was the same within each block (e.g. the second choice task was always repeated as the tenth choice task for each respondent). These two additional 'trap' choice sets were used as flag questions to enhance the quality of the final choice data. In total, there were 95 (or 10.3%) respondents out of the initial 924 respondents who failed to pass the two flag questions. Finally, to avoid an ordering effect in the choice tasks, the order of the choice sets was randomized for each respondent in this survey with the exception of the additional ninth and tenth trap choice sets.

As mentioned above, some unqualified data were not used in the formal analysis in this study. Those unqualified data include those respondents who completed the survey too quickly and who did not pass the "trap" questions. In Appendix 3, some post hoc estimation are examined by using the unqualified data. The results in the appendix show that the unused/unqualified data set is problematic and may provide inconsistent and not robust estimation results. Therefore, it is reasonable for this study to remove those "noise" data from the total data set and use the qualified data sample in the formal analysis. To the researcher's knowledge, this type of work has been rarely done in the literature. The findings in Appendix 3 should have some useful implications to improve data quality and produce valid measurements in terms of web survey methodology (see Appendix 3 for details).

This chapter has described the design of the choice experiment and administration of the survey in this study. The next three chapters present the analyses of the survey data. Chapter 4 presents the econometric models and the descriptive analysis of the survey data. Chapter 5 presents estimation results for the effects of labelling using seven different discrete choice models. Chapter 6 examines the existence of reference-dependent effects in Canadian consumers' functional food choices.

Chapter 4: Econometric Models and Descriptive Analysis

This chapter focuses on developing the econometric models and estimation methods to examine the effects of labelling on Canadian consumers' functional food choices. As described in Chapter 1, this study examines Canadian consumers' responses to different types of health claims, symbols, credibility of verification organizations, and the effects of other attitudinal and behavioural factors when making functional food choices. Furthermore, the analysis examines how different types of labelling information affect consumers' preferences for functional foods.

This chapter also presents the descriptive analysis from the online consumer survey which includes a sample of 740 respondents (see Chapter 3 for details). This chapter contains two sub-sections: a discussion of the econometric models and estimation methods, and a descriptive data analysis and details of the factor analysis used to examine the behavioural and attitudinal variables.

4.1. Econometric Models and Estimation Methods

According to McFadden (1974) and Train (2003), an individual i receives utility U when choosing an alternative j with a group of attributes X_{ij} from a choice set. The utility has been modelled with two components: an observed deterministic component V_{ij} and an unobserved stochastic component ε_{ij} of the utility function. The utility received from alternative j is represented by:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad (4.1)$$

Where $V_{ij} = f(X_{ij})$, the deterministic component, is a function of the attributes of the alternatives. In the choice model, individual i faces a choice of one alternative from a finite choice set C. The probability P_{ij} that alternative *j* will be chosen equals the probability that the utility gained from this choice is no less than the utility of choosing another alternative in the finite choice set. The probability of individual *i* choosing alternative *j* is expressed as:

$$P_{ij} = \mathrm{Pr}ob\{\mathrm{V_{ij}} + \varepsilon_{ij} \geq \mathrm{V_{ik}} + \varepsilon_{ik};\ for j \neq k, \& k \in C\} \qquad (4.2)$$

In this study, consumer *i* faces the choice of one alternative among Omega-3 milk, conventional milk and the no-purchase option, given various attribute level combinations in each choice set. The probability of consumer *i* choosing alternative *j* equals the probability that the utility received from alternative *j* is greater or equal to the utility when choosing any other milk alternative or the no-purchase option.

McFadden (1974) developed the Conditional Logit model to estimate these probabilities assuming the stochastic error term is independent and follows a Type-I extreme value distribution. Assume the observed deterministic component V_{ij} is a linear function of perceived product attributes X_j, so $V_{ij} = \beta' X_j$. The choice probability of consumer *i* choosing alternative *j* in the Conditional Logit Model is formed as:

$$P_{ij} = \frac{\exp(\mu\beta' X_j)}{\sum_{k=1}^{K} \exp(\mu\beta' X_k)} \qquad (4.3)$$

where μ is a scale parameter which is usually assumed to be 1, β is a vector of parameters, and *k* is an index representing the chosen product by consumers from the choice set (*k* =1,…,K, where K = 4 in this study). Parameters in this model can be estimated by the maximum likelihood estimation method.

This study uses Random Utility Theory as the underlying theoretical framework. The indirect utility of consumer *i* choosing alternative *j* can be expressed as the following function:

$$\mathbf{U_{ij} = X_{ij}\beta + e_j} \qquad \mathbf{(4.4)}$$

where *ß* is a vector of estimated parameters and X_{ij} represents a vector of the selected attribute levels in the choice set, and e_j is the error term associated with the utility brought by alternative *j*, which cannot captured by the attributes. Given the specified attributes and levels of milk products in this study, a linear additive indirect utility function of consumer *i* choosing alternative *j* in one choice set is specified as:

$$\mathbf{U_{ij} = \beta_1 NoPurchase + e_j} \qquad (j = \text{no purchase}) \qquad \mathbf{(4.5)}$$

$$\mathbf{U_{ij} = (1\text{-}NoPurchase)*(\beta_2 FunctionClaim_j + \beta_3 RiskReductionClaim_j + \beta_4 DiseasePreventionClaim_j + \beta_5 HeartSymbol_j + \beta_6 Goverment_j + \beta_7 ThirdParty_j + \beta_8 Omega\text{-}3_j + \beta_9 Price_j) + e_j} \qquad (j \neq \text{no purchase}) \qquad \mathbf{(4.6)}$$

This is a base model which specifies the utility function with the main effects variables in the choice experiment. As specified in Table 3.1 in Chapter 3, four attributes are included in this choice experiment, which are health claims, verification organizations, heart symbol and price. Those attributes include different levels which are all dummy-coded, and they become the main variables to test the effects of labelling in the random utility function. The health claim attribute (full labelling) is separated as four dummy variables: Function Claim (FC), Risk Reduction Claim (RRC), Disease Prevention Claim (DPC) and No Health Claim (the base level). ‘$HeartSymbol_j$’ is a dummy variable representing partial labelling equal to 1 if the milk product has a red heart symbol, otherwise equal to 0. The verification organization attribute is represented by three dummy variables: Government Verification (Government), Third Party

Verification (Heart and Stroke Fundation) and No Verification (the base level). ‘Omega-3_j’ is an alternative specific constant attribute equal to 1 if the milk product includes Omega-3 ingredient and equal to 0, otherwise. ‘NoPurchase’ is a dummy variable equal to 1 if an alternative represents the option of not purchasing any of the milk products, and equal to 0 otherwise. ‘$Price_j$’ is the retail price of the milk product in alternative *j*. Note that for each selected attribute, the base level has been removed from the utility function (4.6) to avoid the singularity problem with dummy variables.

When designing the choice experiment as presented in Chapter 3, the possible interaction effects between the main variables was also considered. The indirect utility function of consumer *i* choosing alternative *j* with both the main effects and the interaction effects could be expressed as follows:

$$\mathbf{U_{ij} = (1\text{-}NoPurchase)*(ß_2FC_j + ß_3RRC_j + ß_4DPC_j + ß_5HeartSymbol_j + ß_6GOV_j + ß_7TP_j + ß_8Omega\text{-}3_j + ß_9Price_j + ß_{10}FC_j*Heart_j + ß_{11}RRC_j*Heart_j + ß_{12}DPC_j*Heart_j + ß_{13}RRC_j*GOV_j + ß_{14}RRC_j*TP_j + ß_{15}DPC_j*GOV_j + ß_{16}DPC_j*TP_j) + e_j} \qquad \mathbf{(4.7)}$$

Where $FC_j*Heart_j$, $RRC_j*Heart_j$, and $DPC_j*Heart_j$ are the interaction variables between the variable Heart Symbol (partial labelling) and the variables Function Claim (FC), Risk Reduction Claim (RRC) and Disease Prevention Claim (DPC) (full labelling). RRC_j*GOV_j is the interaction effect between the variables Risk Reduction Claim and Government Verification (GOV). RRC_j*TP_j is the interaction effect between the variables Risk Reduction Claim and Third Party Verification (TP). Similarly, DPC_j*GOV_j and DPC_j*TP_j are the interaction effects between the variables Disease Prevention Claim and Government Verification and between Disease Prevention Claim and Third Party Verification.

Equation (4.7) includes both the main effects and the interaction effects. A main effect represents the effect of one level of the selected attribute on the dependent variable measured independently from other variables. A two-way interaction effect is the first order interaction between two main variables. An interaction effect between two variables exists if consumers' preferences for the levels of one attribute depend on the levels of the other (Louviere, Hensher and Swait, 2000). In this study, the potentially relevant interaction effects are between partial labelling and full labelling, and also between health claims and verification organizations. Consumers' preferences for three types of health claims (full labelling) might depend on whether a heart symbol (partial labelling) is present on food labels. For example, consumers might be less sensitive to the presence of a heart symbol when the risk reduction claim is also present on food labels, compared with the presence of a heart symbol combined with the function claim. The risk reduction claim itself might convey enough health information to consumers no matter whether or not a heart symbol is present, while this might not be the case for the function claim. Similarly, consumers' preferences for each type of health claim might depend on which organization verifies the health claim. For example, consumers might prefer the government to verify a risk reduction claim relative to a third party verified risk reduction claim.

In addition to the choice experiment section, the other parts of the survey also collected extensive information on consumers' attitudes towards and beliefs about functional food consumption, as well as socio-demographic information. One method to incorporate the attitudinal information into the utility model is through the interaction between the main variables and exogenous covariate variables. The indirect utility function in equation (4.8) incorporates the socio-demographic and attitudinal information into the random utility model:

$$\mathbf{U_{ij} = (1\text{-}NoPurchase)*(ß_2FC_j + ß_3RRC_j + ß_4DPC_j + ß_5HeartSymbol_j + ß_6GOV_j + ß_7TP_j + ß_8Omega\text{-}3_j + ß_9Price_j + \gamma_n Z_n * X_j) + e_j} \qquad \textbf{(4.8)}$$

Where Z_n represents the selected exogenous covariate variables (e.g. income, education, gender and heart disease); X_j represents the product attributes that can be interacted with Z_n; γ_n represents the coefficients of those interaction variables. For example, Z_n*X_j can be specified as the interaction variables $HeartDisease_i*RRC_j$, $Income_i*Omega\text{-}3_j$, Edu_i*RRC_j or $Gender_i*Omega\text{-}3_j$, etc. $HeartDisease_i*RRC_j$ is an interaction effect between the variables Risk Reduction Claim and Heart Disease, and it captures the possibility that consumers who have heart disease might be more sensitive to the presence of a risk reduction claim on food labels than those who do not have heart disease. A similar interpretation pertains to the variable $HeartDisease_i*DPC_j$. $Income_i*Omega\text{-}3_j$ is an interaction effect between the variables Omega-3 and Income, capturing the effect that the presence of Omega-3 on food labels might receive a different response from higher income consumers relative to lower income consumers. Edu_i*RRC_j is an interaction effect between the variables Risk Reduction Claim and Education, which allows a test of whether consumers' responses to the presence of a risk reduction claim are different between better educated consumers and less educated consumers. $Gender_i*Omega\text{-}3_j$ captures the interaction between Omega-3 and Gender, to estimate female consumers responses' to the presence of Omega-3 on food labels relative to male consumers. Interaction effects between the main attributes and other exogenous covariates are also possible.

As mentioned previously, the survey collected a great deal of information about consumers' trust in food labels, purchase habits, healthy lifestyle habits, health status, etc. This information could help to explain consumers' responses to choice tasks. However, it is impossible to directly incorporate all the individual attitudinal variables into the estimation model. Statistically speaking, because some questions in the survey address related issues taking those questions directly as the covariate variables and interacting them with the main variables might create serious colinearity problems among these covariate variables and cause endogeneity between error terms and the explainable variables, which might become a source of bias in the estimation results. Besides, a large number of covariate variables are not good for model estimation. Factor Analysis is a popular method for data reduction. The purpose of Factor Analysis is to examine relationships between variables and find a way to condense or summarize the information contained in an original set of variables into a smaller set of factors for subsequent regression, correlation or discriminant data analysis (Hair et al., 1992). Thus, interactions between key factors and the main variables can be introduced into the utility model. The key factors derived from Factor Analysis are orthogonal to each other, so there is no correlation among factors. Factor Analysis was used to capture additional information about individual preferences and attitudes, and is discussed in more detail below. The indirect utility function of consumer *i* choosing alternative *j* that incorporates three key factors is expressed as:

$$\mathbf{U_{ij} = (1\text{-}NoPurchase)*(ß_2FC_j + ß_3RRC_j + ß_4DPC_j + ß_5HeartSymbol_j +}$$

$$\mathbf{ß_6GOV_j + ß_7TP_j + ß_8Omega\text{-}3_j + ß_9Price_j + \gamma_n Z_n * X_j +}$$

$$\mathbf{ß_{10}RRC_j*Factor1_i + ß_{11}RRC_j*Factor2_i + ß_{12}RRC_j*Factor3_i + \ldots) + e_j \qquad (4.9)}$$

Where $RRC_j*Factor1_i$ is an interaction effect between Risk Reduction Claim and Factor 1 (the definition of the factors is discussed below); $RRC_j*Factor2_i$ captures the interaction between Risk Reduction Claim and Factor 2; and $RRC_j*Factor3_i$ is an interaction effect between Risk Reduction Claim and Factor 3, and so on. Each factor could be viewed as a function of a group of original attitudinal variables, and the meaning of each factor is determined by the variables in that group. A detailed discussion of the Factor Analysis is provided in section 4.2.2.

A number of discrete choice models are available that differ in the assumptions made about the distribution of the error term (Train, 2003). For example, the Conditional Logit model's error term is assumed to have a type-I extreme value distribution. The Probit Logit model's error term is assumed to have a normal distribution. The discrete choice models typically used to estimate consumers' choice behaviours, are the Conditional Logit, the Mixed/Random Parameter Logit model, the Latent Class model, the Nested Logit, and the Ordered Probit model. This study focuses on estimation results from the Conditional Logit model, the Random Parameter Logit model and the Latent Class Model.

The Conditional Logit (CL) model is a standard and fundamental starting point from which to derive other advanced models in the family of discrete choice models. However, the limitations of the CL model are obvious as well. The major limitation is that the estimated coefficients of the attributes are fixed to be the mean values of all respondents' responses. It ignores the variation of the estimated coefficients and cannot handle preference heterogeneity among consumers. Consumer heterogeneity is an important issue in food markets, especially when dealing with differentiated products, such as functional food products, where target consumer preferences might be quite different from other consumers. The second major limitation of the CL model is its well-known IIA assumption or property (independence of irrelevant alternatives). The IIA property assumes that the ratio of the probability for any two alternatives is completely independent of the existence and attributes of any other alternatives (see Ben-Akiva and Lerman, 1985). It assumes that the errors are independently distributed across alternatives even for repeated choices, which is unrealistic. The CL model cannot avoid the restrictive substitution pattern of the IIA property (Louviere, Hensher and Swait, 2000). It is often necessary to relax the IIA assumption in practice. However, it is common in the literature to estimate the CL model and the estimated result serves as a benchmark for other discrete choice models.

Several different approaches have been developed to address the limitations of the CL model in the economics literature, such as the Mixed/Random Parameter Logit model, the Latent Class Model (LCM), Probit model and the Nested Logit model. The Mixed Logit (ML) model is a popular method to explore the unobserved heterogeneity in choices, as is the LCM. In this study, significant improvements in model fits were found from the estimation results of both the ML model and the LCM, compared with the estimation results of the CL model (see Chapter 5 for details).

The Mixed Logit model is very flexible and can approximate any random utility model (McFadden and Train, 2000). The Mixed Logit model was developed by Boyd and Mellman (1980), Jain, Vilcassim and Chintagunta (1994), Bhat (1998) and Train (1998), to identify a broad range of consumers' preference heterogeneity. According to Train (2003), the Mixed Logit probabilities are the integrals of standard logit probabilities over a density of parameters. The ML model assumes that rather than being fixed, the parameters of attributes follow certain specific distributions across the respondents in the sample. Specifically, the choice probability of the Mixed Logit model of individual *i* choosing alternative *j* can be expressed as:

$$\overline{P_{ij}} = \int P_{ij} f(\beta \mid \theta) d\beta \qquad (4.10)$$

Where θ represents the distribution parameters of coefficient β (such as the mean and covariance of β); P_{ij} is the standard logit probability function given in equation (4.3); coefficients

β are distributed with the probability density function $f(\beta \mid \theta)$ defined over a set of parameters θ. There is usually no closed form for the integration expression for $\overline{P}_{ij}$ in equation (4.10). Therefore, its likelihood function cannot be efficiently estimated with Maximum Likelihood estimation (Hu, Veeman and Adamowicz, 2005). However, the probability function $\overline{P}_{ij}$ in equation (4.10) can be estimated by a simulation method over the density function $f(\beta \mid \theta)$.

According to Train (2003), the procedure for the simulation method includes three steps. The probabilities for any given value of θ: (1) draw a value of β from the density function $f(\beta \mid \theta)$, and name it β^r with the superscript r = 1 to represent the first draw; (2) calculate the $P_{ij}(\beta^r)$ with the logit formula for the first draw; (3) repeat steps 1 and 2 many times (usually more than 100 times), and average the results. The average simulated probability can be expressed as:

$$\breve{P}_{ij} = \frac{1}{R} \sum_{R=1}^{R} P_{ij}(\beta^r) \tag{4.11}$$

Where R is the number of draws; $\breve{P}_{ij}$ is an unbiased estimator of $\overline{P}_{ij}$, and its variance decreases as R increases. The summation of $\breve{P}_{ij}$ is equal to 1 over alternatives, which is a useful property for forecasting. The simulated log likelihood function is given by inserting the simulated probabilities into the log likelihood function as the following question:

$$SLL = \sum_{i=1}^{I} \sum_{j=1}^{J} d_{ij} \ln \breve{P}_{ij} \tag{4.12}$$

Where d_{ij} is an indicator that d_{ij} =1 if individual *i* chose alternative *j* and zero otherwise. The maximum simulated likelihood estimation (MSLE) is derived by maximizing SLL over the value of θ (Train, 2003).

The Mixed Logit model is a weighted average of the logit formula over different values of parameters β, and the weights are given by the density function $f(\beta \mid \theta)$. Actually, the standard Conditional Logit model is a special case of the Mixed Logit model where the mixing distribution $f(\beta)$ is degenerate at fixed parameters b, $f(\beta) = 1$ for $\beta = b$ and 0 for $\beta \neq b$ (Train, 2003). The mixing distribution $f(\beta)$ can also be discrete when β takes a finite segment of distinct values. Suppose β takes S possible segment values labelled as $b_1, \ldots, b_S$, with probability H_s when $\beta = b_s$. In this case, the Mixed Logit model becomes the Latent Class Model (Train, 2003).

Although the Mixed Logit model explicitly accounts for preference heterogeneity by allowing estimated parameters to vary randomly over individuals, it might be sufficient and more interesting to use the LCM to identify consumer heterogeneity by separating individuals into several classes. Consumers within each class have similar preferences. Following McFadden (1986), Boxall and Adamowicz (2002) and Shen (2009), the LCM assumes that a discrete number of classes or segments of respondents are sufficient to account for preference heterogeneity among classes. The LCM allows the choice attribute data and individual consumer’s personal characteristics to simultaneously explain choice behaviour (Boxall and Adamowicz, 2002). This study also presents LCM estimations results in Chapter 5.

The latent classes capture the unobserved heterogeneity in the population, and each class is estimated with a different parameter vector. Note that in the Conditional Logit model, the vector β is not specific to an individual or segment. If we assume the existence of S segments in the population, the choice probability of individual i choosing alternative j in class s of the Latent Class Model is expressed as:

$$P_{ij|s} = \frac{\exp(\mu_s \beta_s X_j)}{\sum_{k=1}^{K} \exp(\mu_s \beta_s X_k)} \qquad (4.13)$$

Equation 4.13 is a standard probability specification of the Conditional Logit model for class s. The LCM simultaneously estimates the above probability equation and predicts the latent class probability H_{ij} of individual i being in class s. So the unconditional probability equation of the LCM is expressed as (Boxall and Adamowicz, 2002):

$$P_{ij} = \sum_{s}^{S} P_{ij|s} H_{ij} \qquad (4.14)$$

Another issue in the LCM concerns how to choose the number of classes, S. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are used to decide the number of classes, S (Louviere, Hensher and Swait, 2000, and Boxall and Adamowicz, 2002). The criterion indicates that the preferred number of S classes is found where the values of AIC and BIC are minimized (Louviere, Hensher and Swait, 2000).

The parameters estimated by the Discrete Choice models should not be interpreted by their absolute values which are not comparable, but must be jointly explained with other linked estimated parameters (Hensher, Rose and Greene, 2005). Willingness-To-Pay (WTP) is often adopted by researchers to jointly interpret the estimated parameters and identify the money values associated with changes in each attribute. The marginal WTP indicates the maximum amount that the respondent would be willing to pay in order to receive/avoid a particular attribute of the product (Burton et al., 2001). The marginal WTP can be derived as follows:

$$WTP_{x_k} = -\frac{\beta_k}{\beta_{price}} \qquad (4.15)$$

Where β_k is the estimated parameter of attribute x_k and β_{price} is the parameter for price, WTP_{x_k} represents the money value that respondents are willing to pay for the attribute of x_k of the product characteristics.

When interaction effects are included in the estimation function, Hu, Woods and Bastin (2009) suggest calculating marginal values as WTP estimates for the total effect of an attribute. For example, when considering demographic differences, sometimes interactions between demographic information and product attributes need to be included in an estimation model. A general formula to calculate marginal values for WTP estimates is:

$$WTP = -\frac{\beta_{attribute} + \beta_D * D}{\beta_{price}} \qquad (4.16)$$

where $\beta_{attribute}$ and β_{price} are the coefficients of an attribute and the price variable, respectively; D is a vector of the demographic variables being interacted with product attributes; β_D is the vector of corresponding coefficients associated with interaction terms; and $\beta_D * D$ appears when the attribute or price are used as interaction variables (Hu, Woods and Bastin, 2009). Notice that equation 4.15 actually is a special case of equation 4.16 when term $\beta_D * D$ is equal to zero.

This section has specified the econometric models and estimation methods used in this study. Sections 4.2 and 4.3, which follow, focus on the descriptive analysis of the survey data and present the Factor Analysis.

4.2 Descriptive Analysis

This section contains the descriptive analysis of sample characteristics and attitudinal characteristics for the survey data.

4.2.1 Sample Characteristics

The online survey was administered to respondents recruited from across Canada (with the exception of Quebec) in July 2009. As discussed in Chapter 3, 740 usable responses were received. Table 4.1 compares the sample in this study with the Canadian Census data on the basis of demographics. The sample was reasonably representative with respect to age, size of household, and number of children in the household. Females were over represented in the sample at 67.8% compared with 51.1% in the Canadian population. Recall that a screener question ensured that only those who were the primary household food shoppers were included in the sample, which likely explains the high proportion of female respondents. The mean values for household income and education were slightly higher than the Canadian population, which is to be expected with an internet-based survey.

Table 4.1 Socio-Demographic Characteristics of the Survey Participants and the Canadian Population

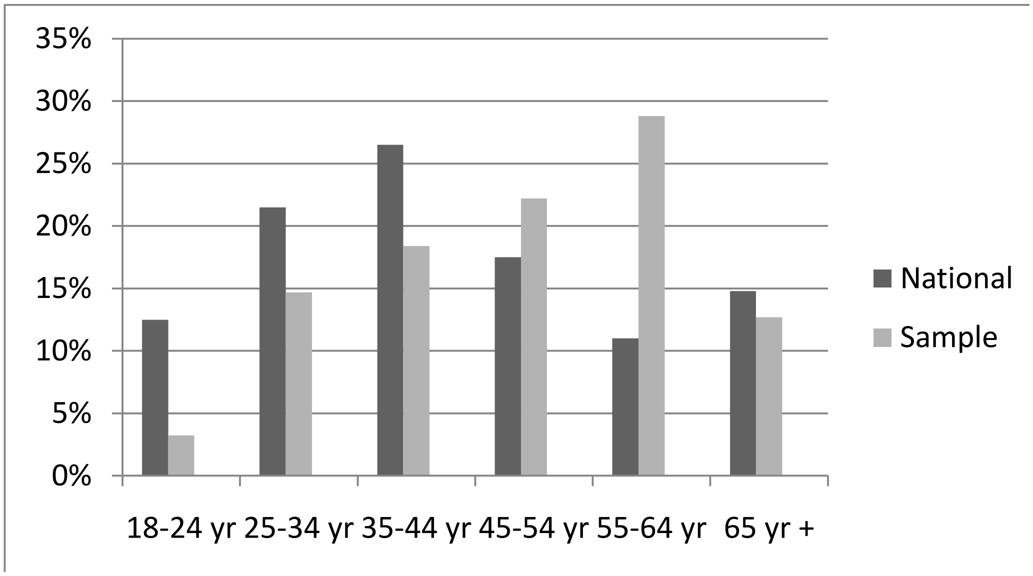
Demographic Characteristics	Sample	Canadian Population
Age	49.3	45.7[a]
Gender (Female)	67.8%	51.1%[a]
Size of Household	2.49	2.49
Number of Children under 18 in household	0.64	0.55
Income (mean) [b]	$58,953	$41,401
Education		
High school or less	35.3%	56.7%
College certificate or trade diploma	40.7%	36% [c]
University Bachelors degree	19.1%	
University Masters degree or higher	5%	7.1%

Source: Statistics Canada 2008 (Census 2006). a. Canadian population between 19-80 the same as the age range represented in the sample. b. average mean income values of each category, see figure 4.1 (b) for an income comparison between the sample and the Canadian population by categories. c. combination of university bachelors degree and college certificate.

Figure 4.1 compares the sample and the Canadian population on the basis of a number of socio-demographic variables: age, household income, and location. As shown in figure 4.1 (b) for the specific category comparisons, on average, the demographic distributions show that the sample data slightly over represent higher-income individuals. The sample in this study contains a higher percentage of older respondents (more than 45 years old) and a lower percentage of younger individuals (less than 45 years old). The respondents of this sample were randomly selected from all Canadian provinces with the exception of Quebec since the survey was only conducted in English. The sample represents a higher percentage of respondents from western Canada (British Columbia, Alberta, Saskatchewan and Manitoba), and a lower percentage of residents from Ontario and the Maritimes. Compared with the national data, with the above caveats noted, the data collected in this survey appears to be a reasonably representative sample of English speaking Canadians.

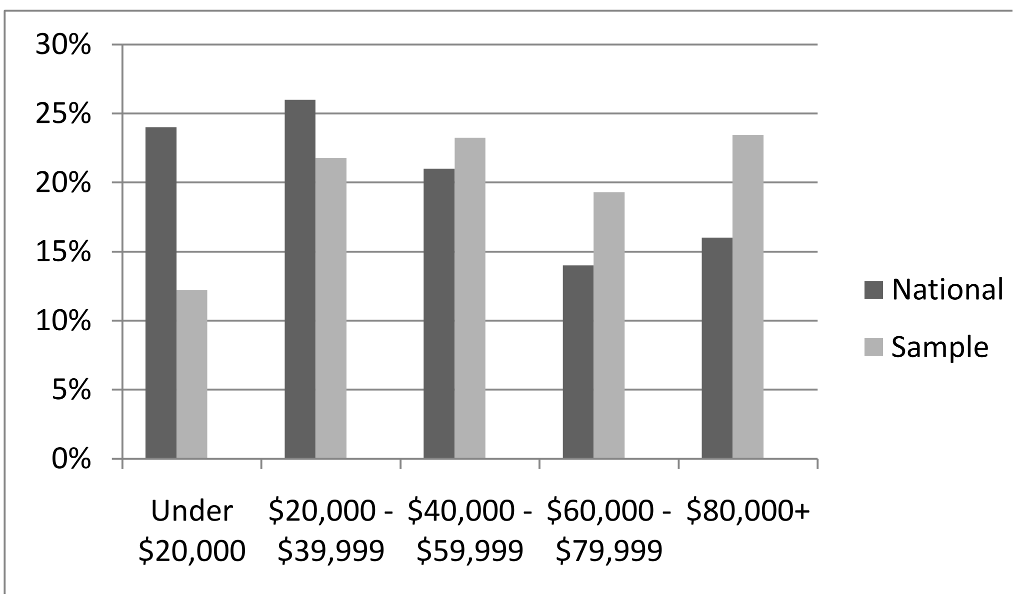
Figure 4.1 A Comparison of Socio-Demographic Distributions between the Sample and the Canadian Population

(a) Age



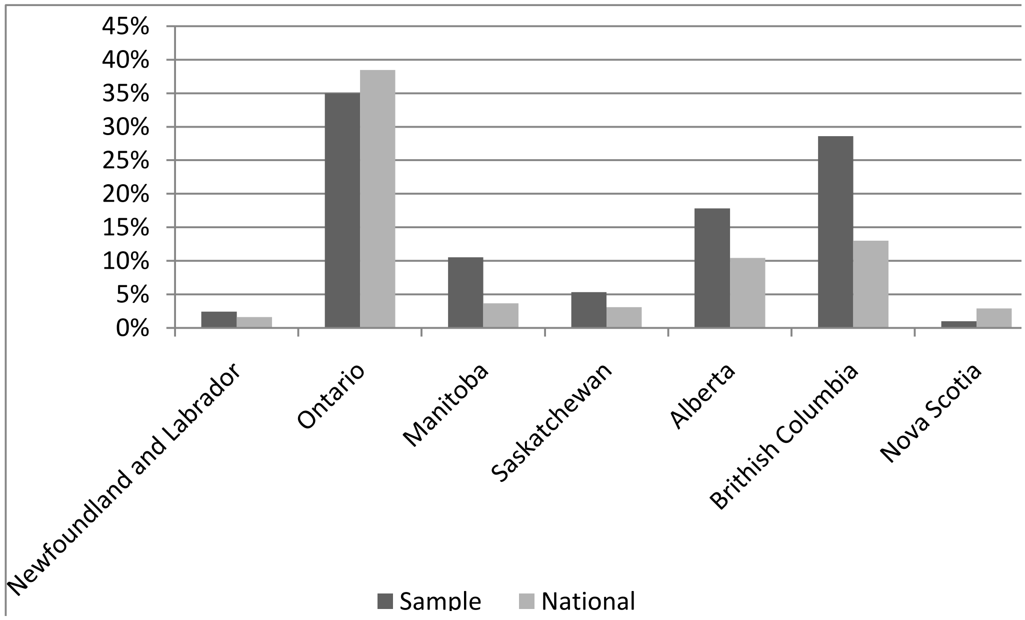
Source: Statistics Canada (2008) and Survey Data

(b) Income



Source: Statistics Canada (2008) and Survey Data

(c) Location



Source: Statistics Canada (2008) and Survey Data

4.2.2 Attitudinal Characteristics

The survey collected data on respondents' attitudes towards sources of health information and frequency of consumption of functional foods. This section describes the responses to these questions. Figure 4.2[7] represents the health information sources used by Canadian consumers and their trust in those health information sources. Figure 4.3 ranks the top three health information sources used by the respondents.

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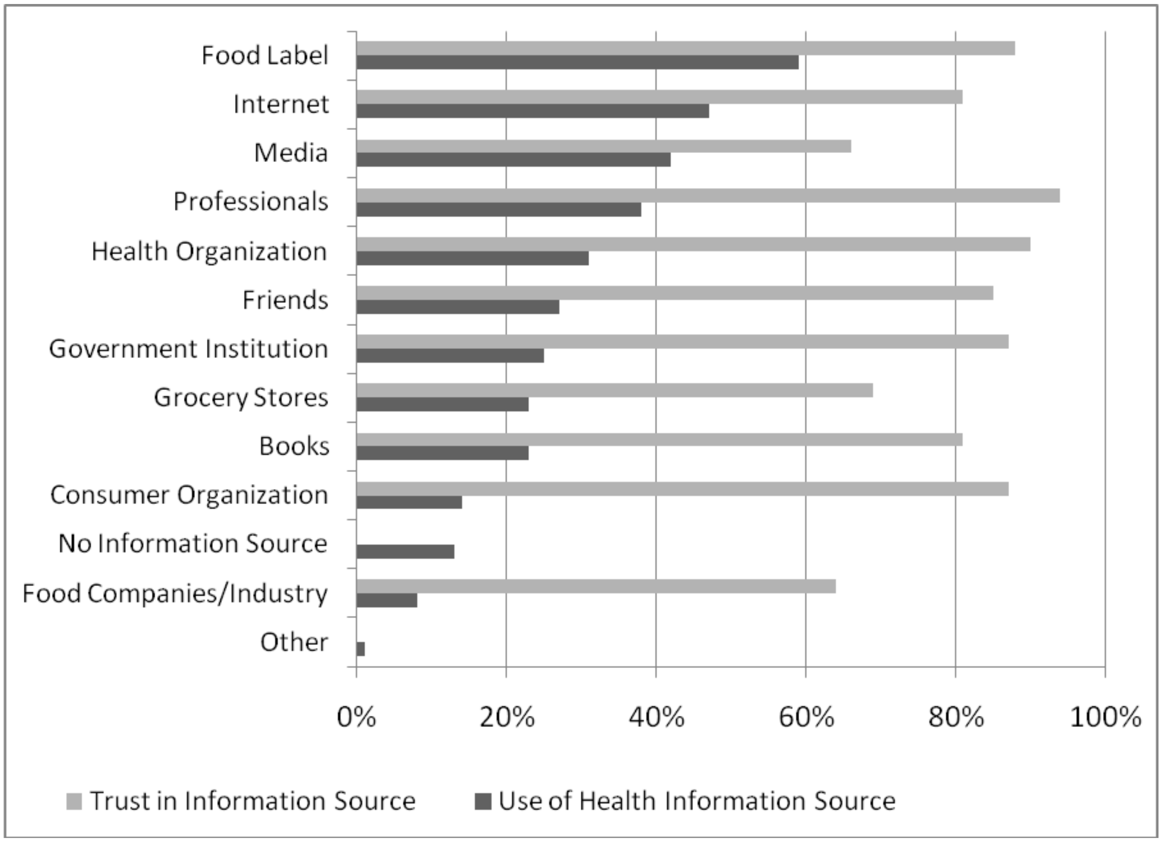
[7] Note that figure 4.2 cannot be used to make comparisons between light coloured bars (source of health information) and black bars (trust in those information sources). Instead comparisons should be made across categories for each of the two coloured bars.

Figure 4.2: Health Information Sources and Trust in those Information Sources (% of Respondents, n=740)



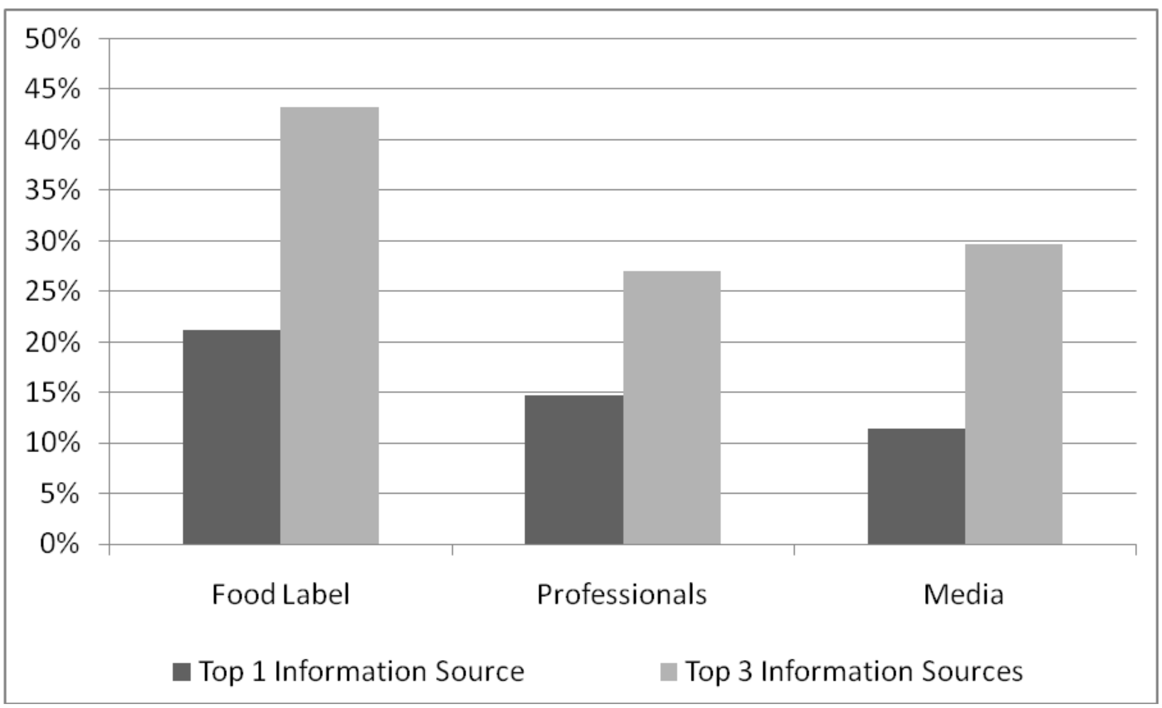
The question underlying figure 4.2 (dark bars) was: “Where do you typically get health information about food products? (Please check all that apply)”. This is a “yes” or “no” question for each information source. Figure 4.2 (dark bars) shows the percentage of respondents answering “yes” to each information source. The results in figure 4.2 (dark bars) shows that Canadian consumers’ most frequently used information source is ‘food labels’, with about 58.9% of respondents typically getting health information about food products from ‘food labels’. This result affirms the importance of the research topic in this study: the effects of labelling on functional food choices. Canadian consumers’ second most frequently used source of health information was the internet (46.9%), while, the third highest was the media (42.4%), such as TV, newspaper, radio, and magazines. Notice that only 7.6% of respondents claim that their health information source was ‘food companies/industry’.

The light coloured bars in figure 4.2 summarize responses to the question, “How much do you trust the following sources for accurate health information?” The original survey used seven-point Likert scales from “Don’t trust at all (1)” to “Completely trust (7)”. To simplify the results, respondents’ answers have been re-coded into a “0 or 1” format, where low levels of trust (1-3) were coded as “0”, and higher levels of trust (4-7) were coded as “1”. Figure 4.2 (light coloured bars) shows the percentage of respondents who identified the information source as highly trustworthy. The result also indicates that the top three trusted health information sources are: (1) professionals, such as doctors and nutritionists (94.3%); (2) health organizations, such as the Heart and Stroke Foundation of Canada (90.1%); and (3) food labels (88%). Note that “food companies/industry” earned the least amount of Canadian consumers’ trust as a source of health information for food products (64%).

Generally speaking, if a source of health information is more commonly used, the trust in that source is usually relatively high. For example, “food labels” is the source of health information for most respondents, and respondents also claim a higher level of trust in food labels (within the top 3). However, a conflicting result is found for “internet” and “media”. Although “internet” and “media” are frequently used health information sources, consumers have much lower levels of trust in those two sources compared with other information sources. This suggests that consumers regard the internet and media are less reliable but easily accessible information sources.

As mentioned above, food companies/industry receives the lowest score both for being a frequently used health information source and for the trust in that information source. However, notice that “food labels” are also made by food companies, which receives the highest score both for consumers’ trust levels and being a frequently used health information source. The reason is unclear but it might indicate that consumers believe the health information carried by food labels is subject to regulatory verification by agencies, such as Health Canada. Therefore, the role of verification organizations in assuring the credibility of the health information on food labels could be an important factor in consumers’ food choice decisions. The discrete choice experiment allows a closer examination of these potential relationships.

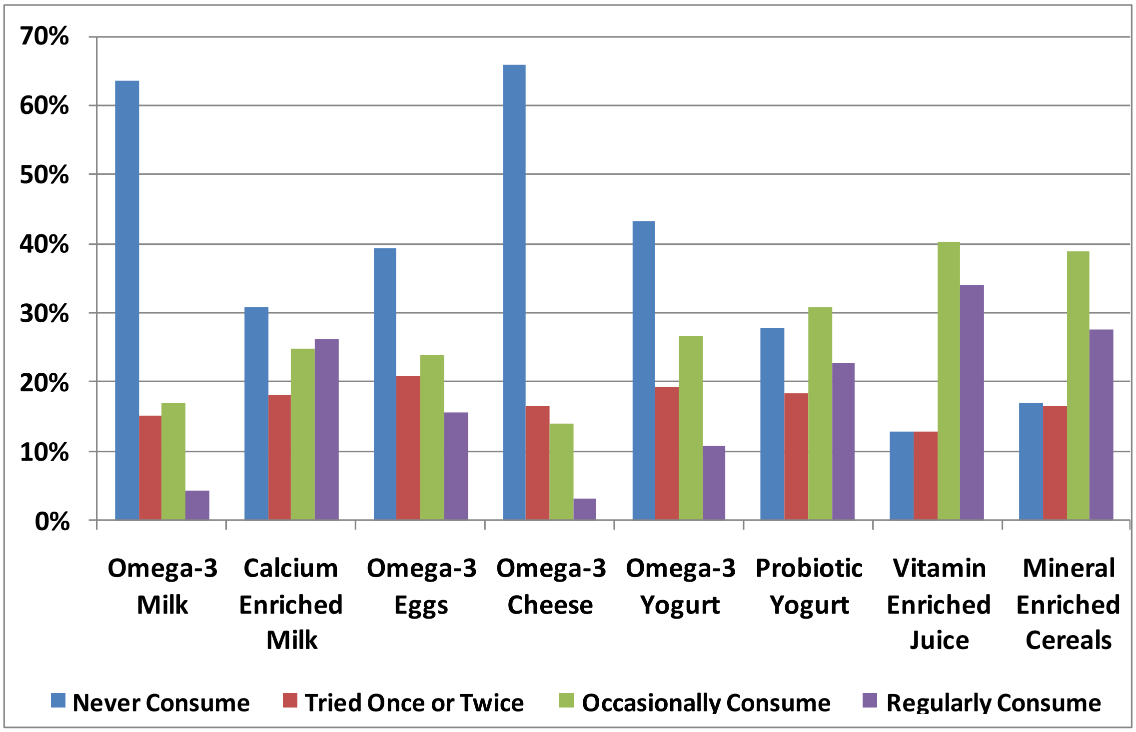
Figure 4.3: Top Ranked Health Information Sources (% of respondents, n=740)



The survey included the following question: “Please rank the top 3 sources you use most frequently”. Figure 4.3 presents the top ranked health information sources. The top three health information sources that Canadian consumers indicate they use most frequently are: (1) Food labels, (2) Professionals, such as doctors and nutritionists, and (3) Media, such as TV, newspaper, radio and magazines. The dark bars represent the percentage of respondents who rank that source as the top 1 most frequently used information source. The grey bars represent the percentage of respondents who rank that source within the top 3 most frequently used information sources. A few differences are worth noting. For example, about 15% of respondents rank health professionals as their number one information source, higher than the media (11.5%), while only 26% of respondents rank health professionals within their top 3 most frequently used information source, whereas 29.5% of respondents ranked media within their top 3 information source. However, food labels receive the highest response rates for both the number one information source or within the top three, indicating the importance of food labels to consumers' healthy food choice decisions.

The survey gathered data on the frequency with which respondents consumed different types of functional foods. Figure 4.4 displays this data. Among functional food products, vitamin enriched juice is consumed most frequently, followed by mineral enriched cereals and calcium enriched milk. Probiotic yogurt is also a relatively popular functional food product among survey respondents. Among the Omega-3 functional food products, Omega-3 eggs are consumed most frequently, followed by Omega-3 yogurt, Omega-3 milk and Omega-3 cheese.

Figure 4.4: The Frequency of Canadian Consumers' Functional Food Consumption (% of respondents, n=740)



Few respondents appear to consume Omega-3 milk, certainly fewer than calcium enriched milk, which likely reflects the availability of those two products in the Canadian marketplace, plus the fact that both function claims and risk reduction claims are allowed on calcium enriched products, whereas no health claim is yet allowed for Omega-3 functional foods in Canada. According to the data collected in the survey, on average a typical respondent household purchases 4.7 litres of milk in one week.

This sub-section has analyzed several characteristics of the sample population. The following section condenses the attitudinal and behavioural data gathered in the survey into a smaller set of factors for subsequent regression and data analysis.

4.3 Factor Analysis

Factor Analysis is a multivariate statistical method that allows data reduction and summarization. The purpose of Factor Analysis is to examine the relationships between variables and to find a way to condense or summarize the information contained in those original variables into a smaller set of factors for subsequent regression, correlation or discrimnant data analysis (Hair et al., 1992). Each factor can be treated as a dependent variable for a function of a group of original variables.

Boxall and Adamowicz (2002) incorporated Factor Analysis into a latent class approach to examine people's selection of wilderness recreation parks. Their paper illustrates a method of applying Factor Analysis within a latent class model to examine the heterogeneities among different groups of respondents, which is adopted in chapter 5 of this study (see section 5.7 for details). In general, Factor Analysis includes several key steps: 1) selecting variables related to the research problem and deriving the correlation matrix, 2) conducting common factor analysis and component analysis, 3) the rotation of factors, 4) determining the criteria for the number of factors to be extracted and criteria for the significance of factor loadings and, 5) naming factors and how to use factor scores (Hair et al., 1992).

In this study, Factor Analysis was conducted using SPSS. The first step in Factor Analysis involves choosing the variables related to the research problem. This study is about the effects of labelling on consumers' functional food choices, and the purpose of using Factor Analysis is to summarize variables and reduce data. In addition to the choice experiment, the survey gathered data on trust in health claims and labels, consumers' attitudes towards functional foods and their consumption behaviours, health status and demographic information. Although the data collected in the choice experiment is the primary vehicle for examining labelling effects, Factor Analysis enables the inclusion of summarized attitudinal and behavioural variables to explain the choice behaviours. In this study, socio-demographic variables were not included in the Factor Analysis because the objective is to examine whether the attitudinal information could help explain respondents' choice behaviours. Socio-demographic variables are examined separately.

To obtain the factor solutions, a factor matrix needs to be computed based on the calculation of a correlation matrix and the total variance of the variables. The computation of the factors determines the best linear combination of variables which account for more variance in the whole dataset than any other linear combination of variables. The first factor is the single best linear combination of variables among the dataset, and the second factor is the second best linear combination of variables subject to the constraint of being orthogonal to the first factor. To be orthogonal, the second factor must be derived from the remaining variance after the first factor has been extracted. In other words, the second factor could be viewed as the linear combination of variables which accounts for the most residual variance after the first factor's effect has been removed from the dataset (Hair et al., 1992). The same method is applied to derive the subsequent factors until the total variance has been removed. Taking the obtained factors as the columns and the original variables as the rows, a factor matrix has been constructed as shown in Table 4.2. The numbers inside the factor matrix are so-called 'factor loadings' which represent the correlation between the original variables and the factors. Factor loadings have a range of [-1,+1] and significance levels to measure the relationship between the original variables and the factors.

One commonly used criterion for factor extraction is the Latent Root (Eigenvalue) Criterion. Eigenvalue is the sum of squares for a column factor in the factor matrix, which represents the amount of variance accounted for by a factor. The larger the eigenvalue of a factor the more important is that factor. In Factor Analysis, only the factors having an eigenvalue greater than 1 are considered significant and all factors having an eigenvalue less than 1 are considered insignificant and disregarded (Hair et al, 1992). According to the Latent Root (Eigenvalue) criterion, in the factor matrix in Table 4.2, three factors are considered as the key/significant factors. The criterion for the significance of factor loadings is simple. A rule of thumb which has been used frequently as a preliminary examination of the factor matrix is as follows: factor loadings of +0.5 or more are considered to be very significant (Hair et al., 1992). In this study, the variables with factor loadings greater than +0.6 are selected as the main examined variables for each factor.

Factor scores can be computed for each factor if the analyst wishes to create an entirely new and smaller number of composite variables to replace the original set of variables (Hair et al, 1992). The original raw data and the factor loadings are utilized to compute factor scores for each individual respondent. The factor score of one factor for one individual is computed by multiplying the raw data of that individual with the corresponding factor loadings of the examined variables in the given factor and summing them together. Therefore, an individual who scores high on several variables that have high loadings for a factor obtains a high factor score on that factor.

Table 4.2: The Key/Component Factors in the Factor Analysis

	Factor 1: Attitudes towards Functional Foods	Factor 2: Trust in Health Claims and Nutrition Labels	Factor 3: Health Knowledge
Q19B: I trust nutrition labels on food products.	.126	**.835*** **	.151
Q19C: The health claims on food products are accurate.	.268	**.836*** **	.025
Q19D: I trust new food products.	.168	**.798*** **	.036
Q24A: Functional foods can maintain overall wellbeing and improve long-term health.	**.898*** **	.225	.077
Q24B: Functional foods may reduce the risk of certain chronic diseases.	**.918*** **	.192	.112
Q24C: Functional foods may prevent certain diseases.	**.894*** **	.183	.093
Q24D: Functional foods are necessary for a healthy diet and should be consumed regularly.	**.874*** **	.140	.006
Q24F: I am knowledgeable about health and nutrition.	.099	.131	**.902*** **
Q24G: My friends/relatives ask me for health or nutrition advice.	.063	.037	**.913*** **

Note: *** represents factor loadings that are +0.6 or more.

Table 4.2 shows that three factors were significant. Factor 1 captures respondents' attitudes towards functional foods, which is defined as "Attitudes towards Functional Foods". The 'positive' attitudes towards functional foods are hereafter captured by the beliefs that functional foods can maintain wellbeing and can reduce the risk of chronic disease or prevent certain diseases. The 'negative' attitudes towards functional foods are hereafter captured by the beliefs that functional foods cannot maintain wellbeing or reduce the risk of chronic disease or prevent certain diseases. Factor 2 measures consumers' trust in health claims, nutrition labels and new food products. Factor 3 measures health knowledge, capturing respondents who are knowledgeable about health and nutrition (e.g. their friends ask them for health and nutrition advice). In Factor Analysis, Cronbach's Alpha represents a coefficient of reliability and usually used to measure internal consistency of questionnaire (i.e. how closely related a set of items are as a group) (Cronbach, 1951). The criterion of using Cronbach's Alpha scores to represent factor's reliability is 0.7 (Cronbach, 1951). The alpha reliability scores of this analysis are 0.934, 0.803 and 0.799 for factor 1, 2, and 3, respectively, which captures a high reliability (internal consistency) by using different original variables to represent each factor. These factors are included in the econometric analysis discussed in the next chapter.

This chapter explained the econometric models and estimation methods used in this study. It also included the descriptive analysis of the survey data and presented the Factor Analysis. The estimation results of the econometric models are presented in Chapter 5 using the various estimation methods and discrete choice models discussed within this chapter.

Chapter 5: Results: the Effects of Labelling on Functional Food Choices

This chapter presents 7 sets of estimation results for the utility models developed in Chapter 4 to answer the following research questions: (1) what do Canadian consumers prefer: full labelling or partial labelling? If full labelling, what type of claim do they prefer? (2) how do they respond to the assurances of different verification organizations: government or third party? (3) to what extent do consumers value a specific functional ingredient (e.g. Omega-3), and (4) how do individual characteristics, such as the respondents' attitude, trust, knowledge and socio-demographic factors, influence their functional food choices. The 7 discrete choice models examine the responses of consumers to different product labelling strategies taking account of heterogeneity in consumer attitudes. In particular, some of the models recognize that different consumers make different choices depending on their current health status, the credibility of health claims, and the extent to which they believe that a change in a functional ingredient will lead to an improvement in their health status.

The models are: (1) the Conditional Logit model and Willingness-To-Pay (WTP) for the base model; (2) the Conditional Logit model with interaction effects between main variables; (3) the Conditional Logit Model with interaction effects of covariate variables and key factors; (4) the Mixed/Random Parameter Logit model and WTP for the base model; (5) the Latent Class Model for the base model; (6) the Latent Class Model with interaction effects of covariate variables and key factors; and (7) the Latent Class Model with class membership indicators. Table 5.1 describes the variables used in the seven models.

Table 5.1 Summary of the Variables for the Estimation Models

Attributes	Abbreviation	Description
Price	**Price**	The price adopted in the choice experiment for a two-litre carton of milk, ranging from $1.99 to $4.49.
Function Claim	**FC**	= 1 if the milk product has a function claim ('Good for your heart'), otherwise 0.
Risk Reduction Claim	**RRC**	=1 if the milk product has a risk reduction claim ('Reduces the risks of heart disease and cancer'), otherwise 0.
Disease Prevention Claim	**DPC**	=1 if the milk product has a disease prevention claim ('Helps to prevent coronary heart disease and cancer'), otherwise 0.
Heart Symbol	**Heart**	= 1 if the milk product has a red heart symbol, otherwise 0.
Government Verification	**GOV**	= 1 if the health claim on the milk product is verified by government (Health Canada), otherwise 0.
Third Party Verification	**TP**	= 1 if the health claim on the milk product is verified by a third party (Heart and Stroke Foundation), otherwise 0.
Omega-3	**OMG3**	= 1 if the milk product contains Omega-3, otherwise 0.
No Purchase	**NoPurchase**	=1 if the alternative is not to purchase any milk product in the choice set, otherwise 0.
	Interaction Variables (between main attributes)	
FC*Heart	-	= 1 if the milk product has both a function claim and a red heart symbol, otherwise 0.
RRC*Heart	-	= 1 if the milk product has both a risk reduction claim and a red heart symbol, otherwise 0.
DPC*Heart	-	= 1 if the milk product has both a disease prevention claim and a red heart symbol, otherwise 0.
RRC*GOV	-	= 1 if the milk product has both a risk reduction claim and a government verification for this claim, otherwise 0.
RRC*TP	-	= 1 if the milk product has both a risk reduction claim and a third party verification for this claim, otherwise 0.
DPC*GOV	-	= 1 if the milk product has both a disease prevention claim and

		a government verification for this claim, otherwise 0.
DPC*TP	**-**	= 1 if the milk product has both a disease prevention claim and a third party verification for this claim, otherwise 0.
	Exogenous Covariate Variables and Key Factors	
Heart Disease	**HeartDisease**	=1 if a respondent self-reported that he or she has heart disease, otherwise 0 (6.5% respondents claim they have heart disease in this sample).
Income	**Income**	Mean point of the income in 8 categories (respondents self-reported annual household income before taxes): < $25K is coded as $12.5K; $25K to $49.9K is coded as $37.5K; $50K to $74.9K is coded as $62.5K; $75K to $99.9K is coded as $87.5K; $100K to $124.9K is coded as $112.5K; $125K to $149.9K is coded as $137.5K; $150K to $174.5K is coded as $162.5K; >175K is coded as $187.5K Note: the "Income" variable is measured by the value of thousand dollars in all estimation results.
Education	**Edu**	Respondents self-reported highest education levels (4 categories): High school or less =0; College certificate or trade diploma =1; University Bachelors degree =2; University Masters degree or higher =3
Gender	**-**	=1 if the respondent is female, otherwise 0.
Attitudes towards functional foods	**Attitude**	Factor 1 of Factor Analysis in Table 4.2
Trust in health claims and nutrition labels	**Trust**	Factor 2 of Factor Analysis in Table 4.2
Health knowledge	**Knowledge**	Factor 3 of Factor Analysis in Table 4.2
	Interaction Variables (between the Main Attributes and the Covariate Variables or the Key Factors)	
RRC*HeartDisease	**-**	An interaction variable between the variables Reduction Claim and Heart Disease.

DPC*HeartDisease	-	An interaction variable between the variables Disease Prevention Claim and Heart Disease.
Omega-3*Income	-	An interaction variable between the variables Omega-3 and Income.
RRC*Edu	-	An interaction variable between the variables Risk Reduction Claim and Education.
Omega-3*Gender	-	An interaction variable between the variables Omega-3 and Gender.
RRC*Attitude	-	An interaction variable between the variables Risk Reduction Claim and Attitudes towards Functional Foods (Factor 1).
Omega3*Attitude	-	An interaction variable between the variables Omega-3 and Attitudes towards Functional Foods (Factor 1).
RRC*Trust	-	An interaction variable between the variables Risk Reduction Claim and Trust in Health Claims and Nutrition Labels (Factor 2).
GOV*Trust	-	An interaction variable between the variables Government Verification and Trust in Health Claims and Nutrition Labels (Factor 2).
Omega3*Knowledge	-	An interaction variable between the variables Omega-3 and Health knowledge (Factor 3).

5.1 Base Model: CL Estimates and WTP

In the base model (equation 4.6 in Chapter 4), the effects of the main attributes in the choice experiment are measured, including full labelling, partial labelling, verification organization, presence of Omega-3 and Price. Table 5.2 presents the CL and WTP results for the base model. The value of the Log Likelihood Function is -5275.028 and the Pseudo-R^2 is 0.25, indicating that the goodness of fit of this model is moderately good. All coefficients are statistically significant at the 1% level and with the expected signs. The WTP values of all attributes are also statistically significant at 1% and with the expected signs. WTP estimates provide a useful basis on which to compare the relative strength of preferences for the examined attributes.

Table 5.2: Base Model: CL Estimations and WTP

Variable	Coefficient	t-ratio	WTP ($/2 Litres)	t-ratio
Price	-1.461***	-47.618	-	-
Function Claim	.298***	2.915	.204***	2.913
Risk Reduction Claim	.679***	6.652	.465***	6.694
Disease Prevention Claim	.532***	5.300	.364***	5.299
Heart Symbol	.177***	3.901	.121***	3.895
Government Verification	.336***	5.184	.230***	5.173
Third Party Verification	.319***	4.969	.219***	4.977
Omega-3	.321***	3.512	.220***	3.558
No Purchase	-6.12***	-58.395	-4.187***	-66.370
Log Likelihood Function = -5275.028; Pseudo-R^2 = 0.25				
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**				

Specifically, the variables capturing full labelling: Function Claim, Risk Reduction Claim and Disease Prevention Claim, all have positive and significant coefficients which imply that consumers prefer these three types of health claims to be present on food labels compared with no health claim (base level). The variable Heart Symbol (partial labelling), has a positive and significant coefficient, indicating that consumers prefer a heart symbol to be present on Omega-3 milk products, compared with the no symbol (base level). Of interest for this study is which labelling format consumers are more likely to prefer, partial labelling or full labelling. Since the coefficients of the CL model are marginal utilities which are not comparable, Table 5.2 also presents the WTP results.

Comparing consumers' WTP for full labelling with their WTP for partial labelling in Table 5.2 shows that, on average, consumers are willing to pay an additional 12 cents for the heart symbol (partial labelling) for a two-litre carton of milk, compared with no symbol (base level). However, consumers are willing to pay 20 cents for a function claim relative to no health claim, which is almost twice the value of their WTP for a heart symbol. Consumers' WTP for a risk reduction claim is 47 cents, almost four times the value of their WTP for a heart symbol (12 cents), while the WTP for a disease prevention claim is 36 cents. The WTP results indicate that on average, consumers are more likely to prefer full labelling relative to partial labelling, and within full labelling, consumers are more likely to prefer a risk reduction claim.

The WTP for the variables Government Verification and Third Party Verification are both positive and significant, which implies that compared to having no verification by any outside party (the base level), consumers are willing to pay more when the labels include government or third party verifications of health claims. More specifically, consumers are willing to pay almost identical amounts: 23 cents extra for the government verification and 22 cents for the third party verification on a two-litre carton of milk, compared with no verification (base level).

The presence of Omega-3 (an alternative specific constant variable) has a positive and significant coefficient, indicating that, holding other variables constant, on average consumers prefer milk products enriched with Omega-3 compared with conventional milk. Consumers are willing to pay 22 cents more for the presence of Omega-3 per two-litre carton of milk. No Purchase (an alternative specific constant variable) has a negative and statistically significant coefficient, which implies that not purchasing any milk product in a given choice set, has a negative impact on consumer's utility. The unrealistic negative 'WTP' for No Purchase indicates how much consumers dislike not purchasing any milk product. Price also has a negative and significant coefficient which is consistent with economic theory: the higher the product's price, the lower the consumer's utility.

Table 5.3 shows the WTP differences between full labelling and partial labelling, and also between the government and third party verifications. A Wald test is used to test the significance of WTP differences among attributes. The coefficients of the first three 'WTP-difference' variables are positive and significant, indicating that consumers prefer a risk reduction claim relative to a disease prevention claim, they prefer a risk reduction claim relative to a function claim and they also prefer a disease prevention claim relative to a function claim. The insignificant coefficients of the last two 'WTP-difference' variables show that there is no statistical difference in consumers' preferences for a function claim and a heart symbol, and between the two types of verification organizations (Government and Third Party).

Table 5.3: Wald Test for Difference in WTP

Variable	Coefficient	St. Err.	T-ratio	Prob.
WTP_{RRC} - WTP_{DPC}	0.101	0.043	2.32	0.020
WTP_{RRC} - WTP_{FC}	0.261	0.044	5.872	0.000
WTP_{DPC} - WTP_{FC}	0.160	0.043	3.704	0.000
WTP_{FC} - WTP_{HS}	0.083	0.074	1.123	0.262
WTP_{GOV} – WTP_{TP}	0.012	0.045	0.257	0.797
Probability from Chi-squared [4] = .000				

According to the estimation results in Tables 5.2 and 5.3, consumers are more likely to prefer full labelling relative to partial labelling. Canadian consumers might believe that full labelling conveys more accurate health information about a product's health benefits than partial labelling. Recall that no statistically significant difference was found between a function claim and a heart symbol, suggesting that respondents, on average, regard a function claim such as "Good for your heart", as similar to a red heart symbol. Among the three full health claims, on average, consumers prefer a risk reduction claim and a disease prevention claim relative to a function claim. This could occur if consumers believe a function claim is relatively general and fairly weak (e.g. "this product is good for your heart"), and perhaps does not carry enough information about the product's health benefit.

It was clear from the results that, on average, respondents preferred a risk reduction claim relative to a disease prevention claim, even though the latter is a stronger claim. Perhaps consumers perceive a disease prevention claim as a drug claim and are wary of this claim on a food label. Also, Canadian consumers might be more familiar with a risk reduction claim on certain functional foods in the actual market place (e.g. in Canada, products enriched with calcium has been already labelled as 'reducing the risk of osteoporosis') compared with a disease prevention claim which is not permissible.

The results also show that respondents prefer to see verification of health claims, either by the government or a third party. Consumers' preferences between government verification (Health Canada) and a credible third party verification (Heart and Stroke Foundation) are similar, and they are willing to pay price premiums for these verifications. These results suggest that verification of health claims increases the credibility of health claims for Canadian consumers. Put differently, Canadian consumers' trust in functional foods could be increased by the presence of verifications of health claims on food labels. This has implications for how food manufacturers might best market a new functional food. However, it will remain important for government regulatory agencies to balance the needs of the food industry with the importance of protecting consumers from misleading health claims or false or unsubstantiated verifications by irresponsible third-party organizations or food companies.

As described in Chapter 4, the CL model in Table 5.2 provides a basic starting point for analysis using more advanced discrete choice models, such as the Random Parameter Logit model and the Latent Class Model. These models can explore different aspects of the consumer choice framework.

5.2 CL Model with Interaction Effects

As discussed above, the model in Table 5.2 is a base model for all other estimation results in this study. The estimation results in Table 5.4 extend the base model in Table 5.2 by adding in interaction effects between the main attributes of the choice experiment. Thus, we can evaluate the combined effect of health claims and source of verification, the combined effect of full and partial labelling, etc.

Table 5.4: CL Model with Interaction Effects between the Main Attributes

Variable	Coefficient	t-ratio
Price	-1.478***	-46.055
Function Claim	.110	.700
Risk Reduction Claim	.565***	3.460
Disease Prevention Claim	.458***	2.843
Heart Symbol	-.044	-.257
Government Verification	.249**	2.128
Third Party Verification	.431***	3.941
Omega-3	.457***	3.411
FC*Heart	.346*	1.728
RRC*Heart	.222	1.120
DPC*Heart	.185	.941
RRC*GOV	.223	1.389
RRC*TP	-.251	-1.625
DPC*GOV	-.012	-0.72
DPC*TP	-.126	-.829
No Purchase	-6.163***	-57.353
Log Likelihood Function = -5268.894; Pseudo-R^2 = 0.251		
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**		

As shown in equation (4.7) in Chapter 4, the design of the choice experiment in this study allows an examination of the existence of both main effects and interaction effects for the selected attributes. The model in Table 5.4 extends the base model in Table 5.2 by including the interaction between full labelling and partial labelling, and also the interaction between disease-related health claims and verification organizations. The values of the Pseudo-R^2 are 0.25 in both Table 5.4 and Table 5.2. Comparing the values of the Log Likelihood Functions in the two models (LL= -5268.894 in Table 5.4 and LL= -5275.028 in Table 5.2), according to the Likelihood Ratio (LR) test, the extended model in Table 5.4 has a borderline significance to improve the goodness of fit of the model relative to the base model in Table 5.2.

Nevertheless, an interesting industry implication of labelling effects might be explored in Table 5.4: whether the presence of a heart symbol strengthens or weakens health claims, compared with the presence of either a function claim or a heart symbol, respectively. Among the interaction variables in Table 5.4, FC*Heart represents the interaction effect between the function claim and heart symbol. Only the coefficient of this variable (FC*Heart) is positive and borderline significant at 10%, and all other coefficients for interaction variables are not statistically significant. Louviere, Hensher and Swait (2000) suggested that an interaction effect can be interpreted as an attribute having a complement/substitute relationship. Therefore, the variables Function Claim and Heart Symbol are complements in this model. Why do consumers value the interaction of function claim and heart symbol? It could be that the dual presence of these attributes is a stronger signal or cue for a health benefit. However, this result might not be robust. A post hoc analysis was conducted by taking out all the insignificant interaction variables and estimating a new model with just the significant interaction effect (FC*Heart); the coefficient of the FC*Heart becomes insignificant (see Appendix 1 for details). This may be because, the coefficient of FC*Heart, as reported in Table 5.4, is only borderline significant at the 10% level.

All other coefficients for the interaction variables in Table 5.4 are not significant, indicating that consumers' utilities are not affected by these interaction effects. For example, RRC*Heart has an insignificant coefficient, which means the combined effect of a risk reduction claim and the heart symbol does not have an impact on consumers' utilities. In other words, risk reduction claims may be strong enough on their own, adding a heart symbol to a risk reduction claim does not add any significant value. Similar interpretations apply to the other insignificant interaction variables. For example, the interaction variables between disease-related health claims and verification organizations are also insignificant, while the individual coefficients for health claims and verification organizations are all significant, indicating respondents do not value any particular combination of health claims and verifications, but they respond positively to each health claim or verification individually.

The model in Table 5.4 includes the interaction effects between the main attributes. The base model could be further extended by including the interactions between the main attributes and the covariates capturing consumers' attitudes or demographic information, as shown in the following model.

5.3 CL Model with Interaction Effects for Covariates and Key Factors

Table 5.5(a) presents the results for the utility model specified in equation 4.9 of Chapter 4. This model extends the base model (Table 5.2) by adding interaction effects between the main variables and the exogenous covariates and the key factors. The total effect of each attribute variable, when jointly considering the interaction effects and main effect, as reported in Table 5.5(a), is consistent with the base model reported in Table 5.2. The interaction effects between the main variables and the exogenous covariates and the key factors could identify the sources of consumer preference heterogeneity for certain attributes, as revealed in socio-demographic and attitudinal differences. The exogenous covariates in the final model include consumers' income, education, gender and whether they have heart disease. The three key factors are attitudes towards functional foods, their health knowledge and their trust in health claims and nutrition labels as described in Chapter 4.

The WTP estimates jointly consider the impacts of interaction variables and the original variables for various attributes and can provide a richer and more comprehensive interpretation of the corresponding coefficient estimates. Table 5.5(b) presents the WTP estimates for the CL model with the covariates and the key factors from Table 5.5(a). The WTP measures are calculated by the equation of marginal values (4.16) as introduced in Chapter 4.

Table 5.5 (a): CL Model with the Covariates and Key Factors

Variable	Coefficient	t-ratio
Price	-1.547***	-47.818
Function Claim	0.295***	2.811
Risk Reduction Claim	0.761***	6.367
Disease Prevention Claim	0.514***	4.945
Heart Symbol	0.185***	4.003
Government Verification	0.363***	5.431
Third Party Verification	0.359***	5.405
Omega-3	-0.083	-0.715
RRC*HeartDisease	0.537***	2.730
DPC*HeartDisease	0.623***	3.098
Omega-3*Income	0.005***	6.050
RRC*Edu	-0.136**	-2.327
Omega-3*Gender	0.220***	3.269
RRC*Attitude	0.139**	2.322
Omega-3*Attitude	0.655***	17.347
Omega-3*Knowledge	-0.113***	-3.521
RRC*Trust	0.224***	4.198
GOV*Trust	0.301***	5.469
No Purchase	-6.374***	-58.469
Log Likelihood Function = -4956.556; Pseudo-R^2 =0.295		
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**		

Table 5.5 (b): WTP of CL Model with the Covariates and Key Factors

Variable	WTP ($/2 litres)	t-ratio
Price	-	-
Function Claim	0.191***	2.809
Risk Reduction Claim:		
1) Without heart disease	0.492***	6.400
2) With heart disease	0.839***	6.036
3) With higher education (bachelors)	0.316***	3.986
4) With lower education (high school or less)	0.492***	6.400
5) With positive attitudes towards functional foods	0.599***	6.951
6) With negative attitudes towards functional foods	0.324***	2.941
7) With higher trust level	0.735***	7.695
8) With lower trust level	0.288***	3.141
9) Without heart disease, average education, average attitudes and average trust level	0.404***	5.913
10) Without heart disease, higher education, negative attitudes and lower trust level	-0.057	-0.470
11) With heart disease, lower education, positive attitudes and higher trust level	1.190***	7.826
Disease Prevention Claim:		
1) Without heart disease	0.332***	4.945
2) With heart disease	0.734***	5.322
Heart Symbol	0.120***	3.998
Government Verification:		
1) With higher level of trust	0.562***	7.855
2) With lower level of trust	-0.039	-0.580
Third Party Verification	0.232***	5.421
Omega-3:		
1) With higher income ($85,000)	0.236***	3.489
2) With average income ($60,000)	0.150**	2.262
3) With lower income ($35,000)	0.065	0.954
4) With positive attitudes towards functional foods	0.449***	5.634
5) With negative attitudes towards functional foods	-0.650***	-7.651
6) Male with average income, average attitudes and average knowledge	0.150***	2.262
7) Female with average income, average attitudes and average knowledge	0.293***	4.793
8) Male with lower income, negative attitudes and higher knowledge	-0.622***	-7.365
9) Female with higher income, positive attitudes and lower knowledge	0.969***	13.070
No Purchase	-4.120***	-69.273

***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**

The value of the Pseudo-R^2 is 0.295 in Table 5.5(a) and 0.25 in Table 5.2. Comparing the value of the Log Likelihood Function (LLF) in Table 5.5(a) (LL = -4956.556) with the value of LLF in Table 5.2 (LL = -5275.028), according to the LR test, the extended model in Table 5.5(a) significantly improves the model fit. Both the main effects and interaction effects are present in Table 5.5(a). The estimation results are consistent with the base model as in Table 5.2. For the main effects, all coefficients are significant at 1% with the expected signs, with the exception of Omega-3, indicating that consumers prefer the presence of full labelling, partial labelling and verification of health claims. The effect of consumers' preference for Omega-3 is captured by the combined effects of both the main effect and the interaction effects for this attribute. Although the coefficient is insignificant for the main effect of Omega-3, the coefficients of the effects of the interactions between Omega-3 and other individual characteristics are most positive and significant, such as Omega-3*Income, Omega-3*Gender and Omega-3*Attitude. Therefore, taking together the combined effects for Omega-3 are still positive and significant, which implies that in general consumers prefer Omega-3 to be present in milk products. For the estimation results in Table 5.5(a), the interpretation focuses on the interaction effects. All coefficients of the interaction effects are significant at 5% and with the expected signs.

In Table 5.5(b), the impacts of the attribute variables are illustrated in different scenarios that consider demographic differences. Among those covariates and factors, there are continuous and dummy variables. One practical method to calculate the marginal values is to use the sample mean for continuous variables and separate into different scenarios according to the different levels of dummy variables and calculate WTP at different levels of dummy variables. As mentioned by Hu, Woods and Bastin (2009), since the goal is to find how different consumers may value the product attributes differently, it would be interesting to see WTP at a high or low level of a covariate in addition to the evaluation at mean values. In this study, when calculating the WTP values in Table 5.5(b), two or three levels are chosen for each covariate or factor, which are higher, average or lower levels. This study also considers scenarios with combinations of different attribute levels.

The results show that consumers generally prefer full labelling over partial labelling. Among full labelling, the risk reduction claim is more effective in increasing respondents' purchase intentions. Therefore, this model focuses on examining different individuals' responses to the risk reduction claim by considering their demographic differences. Interactions between Risk Reduction Claim and four other variables were examined in this model, including respondents' pre-existing heart disease problems, their education levels, and factors 1 (attitude) and factor 2 (trust).

The positive and significant coefficient for RRC*HeartDisease in Table 5.5(a), indicates that respondents who self-reported that they are suffering from heart disease are sensitive to the presence of a risk reduction claim on food labels. If a risk reduction claim is present on a milk product it could significantly increase their purchase probabilities. In Table 5.5(b), according to the corresponding WTP estimates for a risk reduction claim (the first and second scenarios), on average, respondents without heart disease are willing to pay 49 cents and those with heart disease are willing to pay 84 cents, for the presence of a risk reduction claim on a two-litre carton of milk. The Wald test shows that the WTP difference between those two types of respondents (with and without heart disease) is positive and significant, indicating that respondents with heart disease are more likely to prefer the presence of a risk reduction claim, compared with individuals who don't have heart disease. As one might expect, consumers with heart disease are likely to pay more attention to health claims on food labels.

RRC*Edu in Table 5.5(a) is associated with a negative and significant coefficient, indicating that respondents with higher levels of education are less likely to respond to a risk reduction claim. In Table 5.5(b), according to the third and fourth scenarios for the risk reduction claim, on average, respondents with higher levels of education (e.g. a bachelors degree) are willing to pay 32 cents for a risk reduction claim on a two-litre carton of milk, compared to individuals with lower levels of education (e.g. high school or less) who are willing to pay 49 cents for the presence of a risk reduction claim. The Wald test indicates that higher educated respondents are less likely to prefer the risk reduction claim, relative to individuals with lower education. One possible explanation might be that better educated consumers have greater levels of scepticism towards risk reduction claims. This result is consistent with some marketing literature in the area of scepticism and advertising. For example, DeLorme, Huh and Reid (2009) conducted a study to investigate consumer advertising scepticism in the context of seeking information sources for prescription drugs. They found that the overall level of direct-to-consumer advertising scepticism was positively related to education, indicating that higher educated consumers tend to have more scepticism towards advertising.

RRC*Attitude is the interaction between factor 1 (Attitude) and the risk reduction claim (RRC). Factor 1 captures respondents' attitudes towards functional foods. The coefficient of RRC*Attitude is positive and significant in Table 5.5(a), indicating that respondents with positive attitudes towards functional foods are more likely to respond positively to risk reduction claims. The WTP values of the risk reduction claim (the fifth and sixth scenarios) in Table 5.5(b), show that respondents who have positive attitudes towards functional foods are willing to pay 60 cents for the presence of risk reduction claim on a two-litre carton of milk, whereas respondents who have negative attitudes towards functional foods are willing to pay only 32 cents. According to the Wald test, respondents with positive attitudes are more likely to prefer the presence of the risk reduction claim on food labels, compared with respondents who have negative attitudes towards functional foods. Notice that according to this result, even respondents with negative attitudes towards functional foods could still respond positively to the presence of risk reduction claims. This result implies that risk reduction claims are generally favoured by all respondents. It could add more value to functional foods if this type of claim is permitted to be used on food labels.

A similar interpretation applies to RRC*Trust. Factor 2 (Trust) captures respondents' trust in health claims, nutrition labels and new food products. The coefficient of RRC*Trust is positive and significant in Table 5.5(a). Respondents' WTP values for the presence of a risk reduction claim on a two-litre carton of milk in Table 5.6(b) are 74 cents for those with higher levels of trust and 29 cents for those with lower levels of trust. It implies that respondents who tend to be more trust of health claims, nutrition labels and new food products are more likely to pay more for the product if a risk reduction claim is present on food labels.

The last three scenarios of the WTP estimates for the risk reduction claim in Table 5.5(b), show different combined levels of heart disease problems, education, attitudes towards functional foods and trust in health claims. For example, in the ninth scenario, the WTP value is calculated at the sample average level. Since the majority of respondents (more than 90%) of this sample claim that they do not have heart disease, the combination of this scenario is for respondents who do not have heart disease, with average education (college certificate or trade diploma), average attitudes towards functional foods and average levels of trust on health claims. On average, they would like to pay 40 cents for the risk reduction claim on a two-litre carton of milk.

The lowest WTP for the risk reduction claim is shown in the tenth scenario in Table 5.5(b). The WTP for the risk reduction claim is insignificant, among those respondents who do not have heart disease, have higher education levels, with negative attitudes towards functional foods and lower levels of trust in health claims. This result means that their WTP is not statistically different from zero. The risk reduction claim seems not have any adverse effect and has the potential to become a significant value-added attribute for functional food in Canada, as long as this type of health claims is supported by sufficient scientific evidence.

In the eleventh scenario, it shows that the highest WTP for the risk reduction claims could be obtained from those respondents who have heart disease, with lower education, with positive attitudes towards functional foods and with higher levels of trust in health claims. They would pay on average $1.19 for the presence of a risk reduction claim on a two-litre carton of milk. This information might be particularly useful for functional food producers in terms of finding target consumer groups and developing marketing strategies. However, this finding also calls attention to the need for Canadian regulators to pay special attention to protecting this group of consumers who might be particularly susceptible to misleading health claims.

The coefficient for DPC*HeartDisease, is also positive and significant in Table 5.5 (a). The WTP values for the presence of a disease prevention claim on a two-litre carton of milk are 33 cents for respondents who do not have heart disease and 73 cents for respondents who have heart disease in Table 5.5(b). According to the Wald test, the WTP difference between individuals who have heart disease and who have not is positive and significant. Therefore, as expected, the results clearly show that the presence of a disease prevention claim on food labels is more likely to elicit a positive response from those consumers who suffer from heart disease.

Regarding the interaction effects with government verification, the coefficient of GOV*Trust is positive and significant. Respondents with higher levels of trust are willing to pay 56 cents for government verification of health claims on a two-litre carton of milk, while the WTP value is insignificant for individuals who have lower levels of trust. According to the Wald test, the WTP difference between respondents with higher levels of trust and lower levels is positive and significant. The result implies that respondents who tend to be more trusting of health claims, nutrition labels and new food products are more likely to increase their purchase intentions if a health claim is verified by a government organization.

Turning to the interaction effects for Omega-3, Omega-3*Income has a positive and significant coefficient, indicating that respondents with higher incomes respond more positively to Omega-3 milk products. The presence of Omega-3 on food labels could increase purchase intentions of those consumers with higher incomes, while lower income consumers are less sensitive to the presence of Omega-3 in milk products. As described in Table 5.1, the mean household income across categories of the sample is Can $60,000. In Table 5.5(b), respondents' WTP values for the presence of Omega-3 on a two-litre carton of milk, are 24 cents by those with higher incomes (e.g. Can $85,000), 15 cents by those with average incomes (Can $60,000, the average incomes of the sample) and insignificant for lower income respondents (e.g. Can $35,000). The Wald test shows that higher income individuals are more likely to prefer Omega-3 milk products relative to lower income consumers. If respondents' income is Can $35,000 or less, the presence of Omega-3 on a milk product will not affect their purchase intention. This suggests that higher income consumers are more likely to be able to afford the price premiums associated with milk products with additional health benefits.

The coefficient of Omega-3*Attitude is positive and significant indicating that respondents with positive attitudes towards functional foods are more likely to respond positively to Omega-3 milk products. As shown in Table 5.5(b), the WTP value for the presence of Omega-3 on a two-litre carton of milk, are 45 cents for those respondents with positive attitudes towards functional foods, and -65 cents for respondents with negative attitudes towards functional foods. Clearly, respondents with positive attitudes towards functional foods tend to prefer Omega-3 milk, while respondents with negative attitudes towards functional foods would need to be compensated by 65 cents to make them choose Omega-3 functional milk.

Omega-3*Knowledge is an interaction between Omega-3 and factor 3 (Health Knowledge), which has a negative and significant coefficient in Table 5.5(a), indicating that respondents with more health knowledge are less likely to respond to Omega-3 functional milk. The explanation might be that respondents with more health knowledge have greater levels of scepticism towards Omega-3 functional milk, or they might mainly consume Omega-3 ingredient from other food sources rather than from Omega-3 milk. This result is consistent with some health communication literature in the area of scepticism and knowledge. For example, Jallinoja and Aro (2000) examined the impact of knowledge on respondent's attitude towards gene. Their results showed that those respondents with the highest level of knowledge had more scepticism than those with the lowest level of knowledge.

Omega-3*Gender has a positive and significant coefficient in Table 5.5(a), which implies that female respondents are more sensitive to Omega-3 milk products relative to male respondents. Notice that the WTP estimates for Omega-3 are not shown in separate scenarios of just gender or health knowledge in Table 5.5(b). Although the coefficients of Omega-3*Gender and Omega-3*Knowledge are all significant, WTP estimates indicate that these effects might not be significant enough to translate into dollar values. Furthermore, the WTP estimates for Omega-3 (the sixth and seventh scenarios) in Table 5.5(b), show that male respondents in the sample with average incomes, average attitudes towards functional foods and average levels of health knowledge are willing to pay 15 cents for the presence of Omega-3 on a two-litre carton of milk, and female respondents with average income, attitudes and health knowledge are willing to pay 29 cents. The Wald test indicates that female respondents are more likely to prefer Omega-3 milk relative to male respondents.

Two different groups of respondents with multiple demographic differences are presented in the last two WTP scenarios, who might be willing to pay the lowest and highest amount of money for the presence of Omega-3 on a two-litre carton of milk. It shows that male respondents with lower incomes, negative attitudes towards functional foods and more health knowledge are most likely to dislike the Omega-3 milk and would need to be compensated by 62 cents to make them choose to consume Omega-3 milk. In comparison, female respondents with higher incomes, positive attitudes towards functional foods and less health knowledge are most likely to prefer Omega-3 milk and are willing to pay 97 cents for the Omega-3 attribute in a two-litre carton of milk. This information could form the basis of market segmentation strategies for functional food producers so as to focus on key target consumer groups.

In summary, the interaction effects in the CL model in Table 5.5(a) and Table 5.5(b) allow for a more detailed examination of which types of respondents tended to respond positively or negatively to the main attributes of functional foods examined in this study, including health claims, verification organization, and the presence of Omega-3. Specifically, interactions between a risk reduction claim and four other variables were explored, including heart disease problems, education levels, factor 1 (attitude) and factor 2 (trust). The results indicate that the effect of having a risk reduction claim on food labels is intensified among respondents self reporting as suffering from heart disease, possessing relatively lower education levels, having positive attitudes towards functional foods, and who trust health claims and nutrition labels. Furthermore, interactions between the presence of Omega-3 and four other variables were also explored: income, gender, factor 1 (attitude) and factor 3 (knowledge). The presences of Omega-3 in functional milk products is more likely to engender a positive response from consumers who are female, have higher incomes, have positive attitudes towards functional foods and consider themselves less knowledgeable about health. Consumers who tend to trust health claims and nutrition labels are more likely to respond positively to the government verification of health claims. These findings provide a starting point for the food industry or government regulatory agencies to begin to understand consumers' heterogeneous responses to health claims and the verifications of those health claims.

5.4 Base Model: the Random Parameter Logit Model and WTP

Table 5.6 presents the estimation results for the base model using the Random Parameter Logit (RPL) model, which is used to capture consumers' preference heterogeneity. Compared with the results of the CL model in Table 5.2, according to the LR test the goodness of fit of this model has a significant improvement in terms of the values of the Log Likelihood Function (-5275.028 in Table 5.2 v.s. -3845.335 in Table 5.6) and the Pseudo-R^2 (0.25 in Table 5.2 v.s. 0.531 in Table 5.6). As explained in Chapter 4, the values of the estimated parameters are fixed in the Conditional Logit model. In the RPL model, however, the estimated parameters are continuous and follow a certain distribution, and the density of the parameters can be specified to be normal or some other distribution (Train, 2003). There are two sets of estimated parameters in a RPL model. One set includes the estimated random/fixed parameters of the examined attributes, and the other set represents the standard deviations of the random parameters as shown in Table 5.6.

Table 5.6: Base Model: RPL and WTP Estimates

Variable	Coefficient	t-ratio	WTP ($/2 litres)	t-ratio
Mean value of Random parameters in utility function				
Omega-3	1.300***	6.539	0.524***	6.658
Risk Reduction Claim	1.043***	7.106	0.420***	7.200
Disease Prevention Claim	1.034***	6.833	0.416***	6.913
Heart Symbol	0.313***	4.653	0.126***	4.685
Government Verification	0.903***	8.225	0.364***	8.359
Third Party Verification	0.547***	5.428	0.220***	5.476
Mean value of Fixed parameters in utility function				
Price	-2.483***	-37.198	-	-
Function Claim	0.316**	2.162	0.127**	2.161
No Purchase	-9.214***	-44.364	-3.711***	-93.638
Standard deviations of random parameters				
Sd-Omega-3	4.046***	22.490	-	-
Sd-Risk Reduction Claim	0.641***	4.067	-	-
Sd-Disease Prevention Claim	1.258***	9.754	-	-
Sd-Heart Symbol	0.525***	4.374	-	-
Sd-Government Verification	1.104***	7.792	-	-
Sd-Third Party Verification	0.663***	3.453	-	-
Log Likelihood Function = -3845.335; Pseudo-R^2 = 0.531				
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**				

The estimation results in Table 5.6 are generally consistent with the results in Table 5.2 for the examined attributes. All random and fixed parameters are highly significant and with the expected signs. Consumers prefer all three types of health claims relative to no health claim (base level). They also prefer a heart symbol (partial labelling) to be present on food labels relative to no symbol. The respondents also prefer the verifications of health claims by government or third party compared with no verification (base level). They respond positively to milk enriched with Omega-3. Not buying any milk product or paying a higher price decreases their utilities.

However, some differences exist in terms of WTP estimations in the two models presented in Tables 5.2 and 5.6. First, when the base model is estimated by the Random Parameter Logit model in Table 5.6, consumer's WTP for government verification is 36 cents for a two-litre carton milk, which is significantly higher than their WTP for third party verification at 22 cents, indicating that government verification has a bigger impact on consumers' utilities than third party verification when heterogeneity of preferences is taken into account. In contrast, the model presented in Table 5.2 was unable to detect a significant difference between consumers' WTP for these two verification organizations. Second, the WTP values for a risk reduction claim and a disease prevention claim are close to each other, at about 42 cents for a two-litre carton of milk in the RPL model (Table 5.6). However, in the CL model (Table 5.2), consumers' WTP for a risk reduction claim is significantly higher than for a disease prevention claim. Third, consumers' WTP for Omega-3 in Table 5.6 is higher than in Table 5.2. These differences are the results of using different estimation methods. The fixed coefficients in the CL model can only estimate average values which assume that respondents' preferences are homogenous, while the random parameters in the RPL model allow for heterogeneity of preferences which tends to be more realistic. The goodness of fit of the RPL model is also better than the CL model.

The estimated standard deviations of the random parameters are all highly significant, which further indicates that it is necessary to include a mixed structure for the selected parameters in the CL model to improve the goodness of fit of the model. The significant standard deviations of the random parameters indicate that strong variations exist in consumers' preferences for whether the milk product is enriched with Omega-3, whether there is a risk reduction claim or a disease prevention claim on food labels, whether a heart symbol is present, and whether there is government or third party verification of the health claims.

The random parameters of the RPL model further identify the distribution of individual taste preferences in the population. For example, for a normal distributed parameter, which has a positive (negative) mean estimate, the share of respondents who have a positive (negative) view of that attribute can be calculated. Following Train (2003) and Hu, Veeman and Adamowicz (2005), for a random parameter $\beta \sim N(b, \sigma^2)$, the probability of $\beta < 0$, equals $\Phi[(0\text{-}b)/\sigma]$. $\Phi(\beta \mid b, \sigma^2)$ is the normal density of the standard normal distribution. The probability of $\beta > 0$, equals $1\text{-}\Phi[(0\text{-}b)/\sigma]$. The interpretation of the probabilities of $\beta < 0$ (> 0) is the percentage/share of respondents who have a negative (positive) view of an attribute. The RPL estimation results in Table 5.6 were obtained by assuming a normal distribution of the random parameters for the variables Omega-3, Risk Reduction Claim, Disease Prevention Claim, Heart Symbol, Government Verification and Third Party Verification. Table 5.7 reports respondents' heterogeneous preferences for the attributes with random parameters.

Table 5.7: Respondents' Heterogeneous Preferences for the Attributes with Random Parameters

Variable	Positive Percentage	Negative Percentage
Omega-3	62.55%	37.45%
Risk Reduction Claim	94.84%	5.16%
Disease Prevention Claim	79.39%	20.61%
Heart Symbol	72.57%	27.43%
Government Verification	79.39%	20.61%
Third Party Verification	79.67%	20.33%

In total, 62.55% of the respondents have positive views (37.45% with negative views) of the Omega-3 attribute, indicating that about two thirds consumers prefer the milk products containing Omega-3. The majority (94.84%) of respondents value a risk reduction claim positively relative to no health claim. There are 79.39% of respondents who value a disease prevention claim positively relative to no health claim. The heart symbol attribute is positively viewed by 72.57% of respondents. There are 79.39% and 79.67% of respondents who have positive values for government verification and third party verification, respectively, indicating that most consumers prefer government or third party verification relative to no verification. Clearly the respondents have different percentages of positive views (ranging from 62.55% to 94.84%) for the attributes listed in Table 5.7, indicating different degree of heterogeneity in consumers' responses to these attributes.

5.5 Base Model: LCM Estimates

Recognizing the limitations of the CL model that were discussed earlier, the Random Parameter Logit and Latent Class Models were used to incorporate heterogeneity in consumers' choices with a significant improvement in model fit compared with the CL results. Table 5.8 presents the estimation results of the LCM and WTP for the base (main effects) model. As discussed in Chapter 4, the CL model assumes that all consumers' preferences are homogeneous. While the LCM assumes that respondents can be intrinsically grouped into a number of latent classes where, in each class, consumers' preferences are still assumed to be homogenous but heterogeneous across classes (Boxall and Adamowicz, 2002). To identify the number of latent classes the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are employed. Both AIC and BIC are minimized when the number of latent classes is equal to four for this model, as presented in Table 5.8. The value of the Pseudo-R^2 is 0.61 in Table 5.8 and

0.25 for the CL model in Table 5.2. The value of the Log Likelihood Function (LLF) in this model is -3204.068, compared with the value of LLF in Table 5.2 (LL = -5275.028). Therefore, according to the LR test, the model fitness is significantly improved in the LCM compared to the CL model in Table 5.2.

Table 5.8: Base Model: LCM Estimation Results

	Class 1: Price Sensitive Consumers		**Class 2: Functional Milk Believers**		**Class 3: Verification Seekers**		**Class 4: Health Claims Rejecters**	
Variables	**Coefficients**	**WTP**	**Coefficients**	**WTP**	**Coefficients**	**WTP**	**Coefficients**	**WTP**
Price	-2.694*** (-34.528)	-	-2.838*** (-28.169)	-	-.433*** (-8.839)	-	-2.343*** (-12.728)	-
Function Claim	.005 (.024)	.002 (.024)	.937*** (4.776)	.33*** (4.718)	1.074*** (4.324)	2.477*** (3.748)	-1.183** (-2.304)	-.505** (-.305)
Risk Reduction Claim	.097 (.430)	.036 (.429)	1.122*** (5.836)	.395*** (5.83)	2.607*** (10.3)	6.014*** (6.649)	-.861 (-1.608)	-.368 (-1.606)
Disease Prevention Claim	-.031 (-.140)	-.011 (-.140)	1.467*** (7.125)	.517*** (7.218)	2.498*** (10.35)	5.765*** (6.804)	-.386 (-.773)	-.165 (-.769)
Heart Symbol	-.025 (-.202)	-.009 (-.203)	.094 (1.084)	.033 (1.084)	.429*** (7.144)	.989*** (5.805)	.205 (.729)	.088 (.735)
Government Verification	-.023 (-.143)	-.009 (-.143)	.236 (1.383)	.083 (1.410)	1.318*** (12.527)	3.042*** (7.781)	.777** (2.299)	.331** (2.373)
Third Party Verification	.108 (.692)	.040 (.692)	.384** (2.471)	.135** (2.511)	.829*** (7.858)	1.913*** (5.759)	.689** (2.042)	.294** (2.064)
Omega-3	-.016 (-.080)	-.006 (-.080)	5.05*** (28.519)	1.78*** (29.463)	1.603*** (4.856)	3.698*** (4.775)	1.247*** (2.828)	.532*** (2.858)
No Purchase	-11.35*** (-39.642)	-4.21*** (-47.136)	-8.57*** (-22.354)	-3.02*** (-26.97)	-.946*** (-3.094)	-2.18*** (-3.359)	-4.809*** (-11.574)	-2.05*** (-48.87)
Log Likelihood Function = -3204.068. Pseudo-R^2 = 0.61; T-ratios in brackets. **Estimated Latent Classes Probabilities (Number of Latent Classes = 4)**								
		Coefficient (t-ratio)				**Coefficient (t-ratio)**		
Probability of Class 1		**.550*** (15.883)**		**Probability of Class 3**		**.148*** (10.589)**		
Probability of Class 2		**.256*** (21.595)**		**Probability of Class 4**		**.046*** (3.345)**		

In this LCM, there exist four different preference groups with the estimated latent classes' probabilities of 55%, 25%, 15% and 5%. As Nilsson, Foster and Lusk (2006) explain these are the probabilities of a randomly chosen respondent belonging to the first, second, third or fourth class, respectively.

In the first latent class in Table 5.8, only the coefficients for Price and No Purchase are statistically significant and with the expected signs. Other coefficients are not significant. These results indicate that consumers within this class do not value Omega-3 milk or any of the labelling attributes (including both full labelling and partial labelling) or verifications. These consumers appear to be indifferent to functional milk with Omega-3 or conventional milk. Price is the only determining factor when they make milk purchase decisions. Therefore, this class is referred to as "Price Sensitive Consumers". Compared with other classes, the WTP for No Purchase is the highest amount for this group, indicating that respondents' utilities in this class suffer the largest discount from not buying a milk product. There is a 55% probability that a randomly chosen individual belongs to this class, indicating that a slight majority of respondents (at least 55% of the sample population) still have no clear preference between conventional milk and Omega-3 enriched milk.

In the second latent class almost all coefficients are statistically significant and with the expected signs, with the exception of the variables Heart and Government Verification. There is a 25% probability that a randomly chosen individual belongs to this class. Consumers in this class prefer all three types of full health claims over the absence of a health claim, but they do not respond to partial labelling. The WTP values are 33 cents, 40 cents and 52 cents for the function claim, the risk reduction claim and the disease prevention claim, respectively, indicating that these consumers have a stronger preference for a disease prevention claim. Consumers in this class prefer Omega-3 enriched milk and are willing to pay a fairly high amount ($1.78) for this attribute. This class is named "Functional Milk Believers". Consumers in this class also prefer verification by a third party and are willing to pay 14 cents for this attribute, but they do not value government verification.

In the third latent class all of the coefficients are highly significant and with the expected signs. Consumers in this class respond positively to full labelling, partial labelling, verification organizations and the presence of Omega-3. The WTP estimated for these attributes are very high. For example, these consumers are willing to pay price premiums as much as $2.48, $6.01, $5.77 and $0.99 for a function claim, a risk reduction claim, a disease prevention claim and a heart symbol, respectively, indicating that those consumers have a stronger preference for a risk reduction claim. These consumers are willing to pay $3.04, $1.91 and $3.70 for the government verification, third party verification and the presence of Omega-3. Unlike consumers in the second class, consumers in this class have a strong preference for government verification as indicated by its highly positive and significant WTP value. Within this class, consumers are more likely to prefer government verification of health claims relative to third party verification. These consumers' WTP for the presence of Omega-3 are also the highest amount within the four classes. Compared with other classes, respondents within this group most concern about and are willing to pay the highest amount for the verification of health claims. Therefore, this class is referred to as "Verification Seekers". There is a 15% probability that a randomly chosen individual belongs to this class. The WTP values for consumers in this class seem unrealistically high and may reflect one of the shortcomings of the hypothetical nature of the choice experiment. These WTP estimates are perhaps better interpreted as indications of the relative strength of preferences rather than absolute values. As shown in the next section, adding covariates into the estimation of the LCM appears to be a good way to derive more reasonable WTP estimates.

In the fourth latent class, the coefficients for risk reduction and disease prevention claims are negative but not significant. The effect of Function Claim is significant, but negative. The coefficient for Heart Symbol is positive but not significant. It appears that consumers in this group do not believe in either full labelling or partial labelling. They especially dislike the function claim. Therefore, this class is referred to as “Health Claims Rejecters”. These consumers prefer the presence of Omega-3, but they would like to see verifications, either by the government or a third party. One possible interpretation of the behaviours of consumers in this group is that they might not value any type of health claim without verification; they only respond positively to verification. There is only a 5% probability that a randomly chosen individual belongs to this class.

In summary, according to the estimation results in Table 5.8, consumers’ preferences are heterogeneous for full labelling, partial labelling, verification organizations and the presence of Omega-3 across four latent classes. For example, for the price sensitive consumers in the first class, they do not value any labelling or the Omega-3 attribute. Price is the only determining factor when they make milk purchase decisions. Data indicate that at least 55% of the population belongs to this group who have no particular preference between conventional milk and Omega-3 milk. Therefore, reducing price is likely to be the most efficient strategy to make this group of consumers purchase Omega-3 milk. Comparing consumers’ preferences for full labelling with partial labelling, three explicit health claims are preferred by consumers in class 2 and 3. The use of a Heart Symbol (partial labelling), is only preferred by the third class. Therefore, according to the estimation of this LCM model, full labelling is an effective communication tool to about 40% of the population, whereas, partial labelling can only effectively communicate with 15% of the population.

5.6 LCM Model with Interaction Effects of Covariates and Key Factors

Table 5.9(a) represents the LCM estimation results for an extended model with the interaction effects between some of the main variables and the exogenous covariates and the key factors. The AIC and BIC criteria are employed to identify the number of latent classes in this LCM. Both AIC and BIC are minimized when the number of latent classes is equal to four. The value of the Pseudo-R^2 is 0.622 in this model, compared with 0.61 in the model presented previously in table 5.8. The value of the Log Likelihood Function (LLF) in this model is -3100.954, compared with the value of LLF (LL = -3204.068) in table 5.8. According to the LR test, this model has a significant improvement in the goodness of fit over the LCM base model in table 5.8. Table 5.9 (b) presents the WTP estimates for the total effect of each attribute according to the estimation results in table 5.9 (a). Given the hypothetical nature of the choice experiment, the WTP estimates are most usefully interpreted as relative measures of the strength of preferences. The WTP estimates in table 5.9 (b) allows a comparison of the impacts of various attributes both within and cross different latent classes.

The interaction effects contained in Table 5.9 (a) work as explanatory variables to further identify consumer heterogeneity. For the main attributes reported in table 5.9 (a) and the WTP estimates for the total effect of each attribute reported in Table 5.9 (b), consumers' preferences for the product attributes in each latent class are consistent with the estimation results in Table 5.8. Accordingly, the names of those latent classes in Table 5.8 are still suitable for this model, although of course the class probabilities are different.

Table 5.9 (a): LCM with Interaction Effects for the Covariates and Key Factors

	Class 1: Price Sensitive Consumers	Class 2: Functional Milk Believers	Class 3: Verification Seekers	Class 4: Health Claims Rejecters
Variable	**Coefficient (t-ratio)**	**Coefficient (t-ratio)**	**Coefficient (t-ratio)**	**Coefficients (t-ratio)**
Price	-3.071*** (-29.029)	-3.700*** (-21.138)	-0.880*** (-22.723)	-1.981*** (-15.583)
Function Claim	0.075 (0.311)	0.510* (1.709)	0.470*** (2.849)	-0.086 (-0.219)
Risk Reduction Claim	0.030 (0.102)	1.480*** (4.032)	1.734*** (8.952)	-0.146 (-0.319)
Disease Prevention Claim	-0.022 (-0.093)	1.198*** (3.720)	1.653*** (10.258)	0.319 (0.804)
Government Verification	-0.099 (-0.522)	0.536** (2.062)	0.870*** (9.047)	0.873*** (3.885)
Third Party Verification	0.067 (0.394)	1.061*** (4.181)	0.666*** (7.433)	0.373 (1.402)
Heart Symbol	-0.014 (-0.097)	0.040 (0.309)	0.273*** (5.424)	0.647*** (3.671)
Omega-3	-0.214 (-0.766)	2.350*** (5.747)	1.688*** (5.144)	0.617 (1.641)
RRC*Attitude	0.104 (0.608)	-0.468 (-1.638)	0.298*** (4.219)	0.472* (1.658)
Omega-3*Attitude	0.217** (2.513)	14.462*** (16.518)	0.152 (1.174)	1.470*** (11.317)
Omega-3*Knowledge	-0.144** (-2.015)	-2.018*** (-10.380)	-0.344** (-2.421)	-0.448*** (-4.645)
RRC*Trust	-0.011 (-0.070)	-0.111 (-0.578)	0.295*** (3.678)	-0.240 (-1.078)
GOV*Trust	0.090 (0.609)	0.252 (1.173)	0.267*** (4.001)	0.780*** (4.735)
RRC*HeartDisease	0.484 (0.871)	0.301 (0.421)	-0.669** (-2.431)	14.113 (0.545)
DPC*HeartDisease	-0.034 (-0.064)	-0.014 (-0.016)	-0.130 (-0.492)	12.363 (0.478)
Omega-3*Income	0.00499** (2.489)	0.00735 (1.591)	0.00548 (1.387)	-0.0104*** (-3.909)
RRC*Edu	-0.004 (-0.023)	-0.240 (-1.113)	-0.276*** (-2.993)	0.149 (0.620)
Omega-3*Gender	0.473*** (2.779)	7.845*** (14.880)	0.861*** (2.952)	1.791*** (9.510)
No Purchase	-12.518*** (-34.60)	-14.042*** (-22.659)	-4.697*** (-8.840)	-3.780*** (-12.980)

Log Likelihood Function = -3100.954; Pseudo-R^2 = 0.622;
Estimated Latent Classes Probabilities (Number of Latent Classes = 4)

	Coefficient (t-ratio)		Coefficient (t-ratio)
Probability of Class 1	**0.491*** (34.776)**	**Probability of Class 3**	**0.216*** (13.179)**
Probability of Class 2	**0.226*** (13.977)**	**Probability of Class 4**	**0.067*** (3.787)**

Table 5.9 (b): WTP of LCM with Interaction Effects for the Covariates and Key Factors

Variable	Class 1: Price Sensitive Consumers WTP ($/2 litres)	Class 2: Functional Milk Believers WTP ($/2 litres)	Class 3: Verification Seekers WTP ($/2 litres)	Class 4: Health Claims Rejecters WTP ($/2 litres)
Price	-	-	-	-
Function Claim	0.0243 (0.311)	0.138* (1.704)	0.534*** (2.822)	-0.043 (-0.219)
Risk Reduction Claim:				
1) With heart disease, average education level, average attitudes and trust level	0.166 (0.896)	0.417** (2.119)	0.897*** (2.604)	7.125 (0.545)
2) Without heart disease, average education level, average attitudes and trust level	0.009 (0.106)	0.335*** (4.073)	1.657*** (8.451)	0.001 (0.007)
Disease prevention Claim:				
1) With heart disease	-0.018 (-0.101)	0.320 (1.361)	1.730*** (5.206)	6.402 (0.490)
2) Without heart disease	-0.007 (-0.093)	0.324*** (3.748)	1.878*** (10.243)	0.161 (0.806)
Heart Symbol	-0.004 (-0.097)	0.011 (0.309)	0.310*** (5.472)	0.326*** (3.961)
Government Verification				
with average trust level	-0.032 (-0.525)	0.145** (2.132)	0.989*** (9.584)	0.441*** (3.973)
Third Party Verification	0.022 (0.394)	0.287*** (4.456)	0.757*** (7.254)	0.188 (1.404)
Omega-3:				
1) Female with average income, average attitudes and health knowledge	0.182*** (2.580)	2.875*** (22.458)	3.268*** (10.012)	0.902*** (5.322)
2) Male with average income, average attitudes and health knowledge	0.028 (0.347)	0.754*** (9.090)	2.291*** (9.031)	-0.002 (-0.012)
No Purchase	-4.077*** (-43.398)	-3.795*** (-81.657)	-5.335*** (-8.808)	-1.908*** (-35.472)

Estimated Latent Classes Probabilities (Number of Latent Classes = 4); T-ratios in brackets.

	Coefficient (t-ratio)		Coefficient (t-ratio)
Probability of Class 1	**0.491*** (34.776)**	**Probability of Class 3**	**0.216*** (13.179)**
Probability of Class 2	**0.226*** (13.977)**	**Probability of Class 4**	**0.067*** (3.787)**

In the first latent class (Price Sensitive Consumers) in Table 5.9(a) and in Table 5.9(b), there is a 49% probability of a respondent falling into this group. In terms of the main effects, only Price and NoPurchase have significant coefficients with the expected signs. The respondents in class 1 are relatively uninterested in Omega-3 milk and do not value any of the full labelling, partial labelling, verification organizations or Omega-3. They are more likely to be conventional milk consumers. Omega-3*Attitude, Omega-3*Income and Omega-3*Gender are interactions between the presence of Omega-3 and three other variables. They are the only three positive and significant interaction variables in class 1, indicating that those respondents with positive attitudes towards functional foods, with higher incomes or being female are still more likely to positively respond to the presence of Omega-3 in milk products, although on average, the respondents in this class are price sensitive. Omega-3*Knowledge is an interaction between Omega-3 and the health knowledge factor (factor 3). Notice that, as shown in Table 5.9(a), the coefficients of Omega-3*Knowledge are negative and significant across four classes, indicating that respondents with higher health knowledge in this sample are more likely to be scepticism toward Omega-3 functional milk, compared with those with lower health knowledge. Furthermore, in Table 5.9(b), respondents' WTP estimates for the main attributes are all insignificant in class 1, with the exception of one group of respondents' WTP for Omega-3. This group of respondents are female with average incomes, average attitudes towards functional foods and average health knowledge. On average, they are willing to pay 18 cents for the Omega-3 attribute on a two-litre carton of milk. Compared with the respondents with similar social-demographic and attitudinal characteristics in other classes, the WTP of this group for Omega-3 is the smallest amount relative to the other classes.

Class 2, labelled as Functional Milk Believers, consists of a group of respondents who moderately prefer Omega-3 milk, as shown by the positive and significant coefficients and WTP estimates for the Omega-3 attribute. Those respondents prefer full labelling relative to partial labelling, indicated by the positive and significant WTP estimates for the three explicit health claims, and by the insignificant coefficient and WTP estimate for partial labelling. Table 5.9(b) shows that the WTP for a disease prevention claim is similar with their WTP for a risk reduction claim for the respondents who do not have heart disease. For those respondents who have heart disease, their WTP for a risk reduction claim is higher than for a disease prevention claim. This group of respondents value the verifications of health claims both by the government and a third party. Their WTP is relatively higher for third party verification, while respondents in other classes are willing to pay more for the government verification than they are for verification by a third party. There is a 22.6% probability that a respondent would belong to this class.

For the interaction effects in class 2, the coefficient of Omega-3*Attitude is positive and significant, indicating respondents with positive attitudes towards functional food in this class tend to respond more positively to the presence of Omega-3 in milk products. The negative and significant coefficient of Omega-3*Knowledge captures the effect that respondents with higher levels of self-reported health knowledge tend to discount the presence of Omega-3 in milk relative to respondents with lower health knowledge. Omega-3*Gender has positive and significant coefficient, which implies that female respondents exhibit stronger preferences for Omega-3 milk.

In the third latent class of Tables 5.9(a) and 5.9(b), respondents exhibit relatively strong preferences for Omega-3, the presence of a health claim, and the verifications of health claims. The WTP values for those attributes are fairly high in this class as reported in Table 5.9(b). In fact, they are the highest levels among the four classes. Particularly, these respondents exhibit the strongest WTP for verification of health claims. Therefore, this class is again named as the 'Verification Seekers'. There is a 21.6% probability of a randomly chosen respondent falling into this class. As revealed by the higher WTP estimates for full labelling and partial labelling, these respondents' preferences for the labelling effects are the highest across the four classes. Both government and third party verifications are valued by respondents in this group, with a higher WTP for government verification. Unlike class 2, respondents in this class also value the presence of a red heart symbol on food labels.

With respect to the interaction effects, respondents who self-declare higher levels of trust in health claims and nutrition labels (factor 2) tend to respond more positively to the government verification and risk reduction claims. Respondents in this group with higher levels of education also tend to discount risk reduction claims. Respondents in this segment with positive attitudes towards functional foods (factor 1) are more likely to prefer risk reduction claims. Female respondents in this group tend to respond positively to the presence of Omega-3 in milk products.

Finally, class 4 is a relatively small segment with a 6.7% probability that a randomly chosen individual belongs to this class. Respondents in this class are 'Health Claim Rejecters', since they do not value any type of full health claims. However, they prefer partial labelling, indicated by the positive and significant coefficient and WTP. Females are more likely to prefer Omega-3 milk relative to male respondents in this class, when these respondents are evaluated at average income, average attitudes towards functional foods and average health knowledge levels. This class values government verification more than third party or no verification. However, respondents who self-declared higher levels of health and nutrition knowledge (factor 3) and respondents with higher income levels, tend to discount the presence of Omega-3 in milk products, which may reveal some scepticism among those respondents with respect to the health effects associated with Omega-3 milk.

The LCM presented in Tables 5.9(a) and 5.9(b) incorporates covariates and key factors through interaction terms to capture the heterogeneity within each latent class. The following LCM with membership indicators extends the LCM base model to identify the source of heterogeneity across the latent classes.

5.7 The LCM Model with Class Membership Indicators

Preference heterogeneity is critical to understanding consumer demand for functional foods. It is difficult to examine the heterogeneity in a random utility model because an individual's characteristics are invariant among the choice sets in the choice experiment. One way to solve this problem is by interacting individual characteristics with the main attributes in the choice experiment, as shown in Table 5.5(a) and 5.9(a). Adamowicz et al. (1997) adopted this method to identify preference heterogeneity. The limitations of using the interaction variables method, however, are that a priori selection of key individual characteristics and attitudes is necessary, and only a limited selection of individual specific variables can be involved (Boxall and Adamowicz, 2002). Another method by which to identify preference heterogeneity is to use the Random Parameter Logit model to allow the estimated parameters to vary randomly across individuals. The limitation of this approach is that it is not well-suited for explaining the sources of heterogeneity and those sources might closely relate to the characteristics of individual consumers (Boxall and Adamowicz, 2002).

A promising way to solve these problems is to extend the Latent Class Model to consider the observed constituent variables of the class membership (McCutcheon 1987; Boxall and

Adamowicz, 2002). The LCM with class membership indicators offers a better way to incorporate and explain the sources of preference heterogeneity. Notice that the method of interacting individuals' characteristics with main attributes in the LCM focuses on capturing heterogeneity *within* each latent class, such as that shown in Table 5.9(a); the LCM with class membership indicators focuses on explaining the sources of heterogeneity *across* the latent classes, which provides added insights as to the sources of heterogeneity. Table 5.10 presents the results of the LCM with class membership indicators.

Table 5.10: LCM with the Class Membership Indicators

	Class 1: Price Sensitive Consumers		Class 2: Functional Milk Believers		Class 3: Verification Seekers		Class 4: Health Claims Rejecters	
Variable	**Coefficient**	**WTP**	**Coefficient**	**WTP**	**Coefficient**	**WTP**	**Coefficient**	**WTP**
Price	-2.52*** (-35.121)	-	-2.73*** (-29.222)	-	-0.394*** (-7.601)	-	-1.56*** (-10.284)	-
Function Claim	-0.035 (-0.168)	-0.014 (-0.168)	0.891*** (4.625)	0.326*** (4.582)	1.142*** (4.351)	2.895*** (3.616)	-1.43*** (-2.843)	-0.916*** (-2.763)
Risk Reduction Claim	0.082 (0.395)	0.032 (0.395)	1.134*** (5.956)	0.415*** (5.969)	2.690*** (10.067)	6.821*** (6.005)	-0.377 (-0.760)	-0.241 (-0.753)
Disease Prevention Claim	-0.023 (-0.116)	-0.009 (-0.116)	1.435*** (7.142)	0.525*** (7.257)	2.573*** (10.049)	6.524*** (6.139)	-0.158 (-0.327)	-0.101 (-0.326)
Government Verification	0.026 (0.178)	0.010 (0.178)	0.195 (1.195)	0.072 (1.213)	1.275*** (11.258)	3.232*** (6.809)	1.825*** (5.793)	1.167*** (5.970)
Third Party Verification	0.164 (1.151)	0.065 (1.150)	0.375** (2.517)	0.137** (2.553)	0.890*** (7.892)	2.256*** (5.298)	0.842** (2.295)	0.539** (2.320)
Heart Symbol	-0.024 (-0.210)	-0.009 (-0.210)	0.090 (1.065)	0.033 (1.066)	0.430*** (6.827)	1.091*** (5.268)	0.636*** (2.713)	0.407*** (2.835)
Omega-3	0.011 (0.061)	0.004 (0.061)	4.864*** (28.585)	1.781*** (28.854)	2.409*** (4.889)	6.107*** (4.554)	0.875** (2.145)	0.560** (2.110)
No Purchase	-10.2*** (-42.922)	-4.06*** (-56.041)	-8.42*** (-22.206)	-3.081*** (-26.378)	-2.106** (-2.563)	-5.340** (-2.502)	-2.37*** (-6.530)	-1.514*** (-13.988)

	Class 1: Price Sensitive Consumers	Class 2: Functional Milk Believers	Class 3: Verification Seekers	Class 4: Health Claims Rejecters
Constant	**2.005*** (7.495)**	**0.991*** (3.352)**	0	-0.941 (-1.607)
Income	**-0.0095*** (-2.725)**	-0.0042 (-1.095)	0	-0.0048 (-0.555)
Education	0.230 (1.516)	0.130 (0.774)	0	-0.159 (-0.425)
Heart Disease	**-0.790* (-1.826)**	-0.627 (-1.359)	0	-0.944 (-0.821)
Attitude	**-0.770*** (-5.350)**	-0.115 (-0.739)	0	**-0.801*** (-2.714)**
Trust	**-0.567*** (-4.297)**	**-0.426*** (-2.985)**	0	-0.358 (-1.286)

Log Likelihood Function = -3174.479. Pseudo-R^2 = 0.613; T-ratios in brackets.
Estimated Latent Classes Probabilities (Number of Latent Classes = 4)

	Coefficient		Coefficient
Probability of Class 1	**0.569**	**Probability of Class 3**	**0.137**
Probability of Class 2	**0.266**	**Probability of Class 4**	**0.028**

Rather than including the exogenous covariates and factors as interaction effects, Table 5.10 presents the base model with these variables used to explain class membership. Those covariates such as income, education, health disease and key factors from the Factor Analysis are used to help explain class membership. The AIC and BIC criteria are used to identify the number of latent classes in this LCM. Again, four latent classes are identified. The estimation results in Table 5.10 have a Log Likelihood Function of -3174.479 with a Pseudo-R^2 of 0.613, indicating the model is a relatively good fit. The estimated class probabilities for the four latent classes are 56.9%, 26.6%, 13.7% and 2.8%, respectively. Two sub-tables are included in Table 5.10, the top half is the estimated coefficients and WTP values for the four segments, while lower section contains the estimated parameters for the class membership indicators. The estimated coefficients and WTP values for the four latent classes in Table 5.10 are consistent with the estimation results of the LCM for the base model in Table 5.8, which means that the distributions of consumers' preference heterogeneity are very similar in both models. Therefore, the adopted group names for Tables 5.8 and 5.9(a) are also suitable for Table 5.10.

As the estimation results of coefficients and WTP values in the top half of Table 5.10 are similar to the results in Table 5.8, the explanation would not be repeated here (see Table 5.8 for the details). In this model, focus is placed on explaining class membership indicators. The lower section in Table 5.10 presents the estimated parameters for the class membership indicators. The parameters for the third class ("Verification Seekers") are all equal to zero due to their normalization during estimation (Boxall and Adamowicz, 2002). Therefore, the other three classes are described relative to the third class. Three exogenous covariates (income, education and heart disease) and two key factors (attitude and trust) have been selected as the membership indicators to explain the sources of heterogeneity across classes.

The coefficient for the membership indicator, Income, is negative and significant in class 1, indicating that compared with the respondents in class 3 (Verification Seekers), lower income respondents are more likely to fall into class 1 (Price Sensitive Consumers). In other words, the respondents' average income is relatively lower in the first class of "Price Sensitive Consumers" relative to the third class of "Verification Seekers". The coefficients for Income are insignificant in the other two classes (class 2 and class 4), which implies that income does not explain the source of heterogeneity across the latent classes of 2, 3, and 4. Put differently, no obvious income-different effects exist across the latent classes of "Verification Seekers", "Functional Milk Believers", and "Health Claims Rejecters". Unlike Income, Education have insignificant parameter estimates in the latent class 1, 2 and 4, indicating that education levels do not explain the source of heterogeneity across the four latent classes.

The membership indicator, Heart Disease, is negative and significant in class 1, indicating that consumers with heart disease are more likely to belong to the third class of "Verification Seekers" relative to the "Price Sensitive Consumers". Thus, on average, consumers with heart disease are more likely to be "Verification Seekers" than "Price Sensitive Consumers". This membership indicator does not explain the source of heterogeneity across the other three latent classes.

Attitude towards functional food represents factor 1 as described in table 5.1, with negative and significant parameters in class 1 and 4. It captures the fact that respondents with positive attitudes towards functional foods are more likely to belong to the third class of "Verification Seekers", compared with the "Price Sensitive Consumers" and the "Health Claims Rejecters". In contrast, this membership indicator does not explain the source of heterogeneity between "Verification Seekers" and "Functional Milk Believers".

Trust (factor 2), is negative and significant in classes 1 and 2, indicating that respondents who tend to have more trust in health claims, nutrition labels and new food products are more likely to belong to the third class of “Verification Seekers”, compared with “Price Sensitive Consumers” and “Functional Milk Believers”. However, this indicator does not explain the source of heterogeneity between “Verification Seekers” and “Health Claims Rejecters”. The constant parameter is positive and significant in the first and second latent classes, indicating that there are some other unobservable variables not included in the model that could also explain the source of heterogeneity across the latent classes.

In summary, seven discrete choice models have been examined: (1) a Conditional Logit model and WTP for the base model; (2) a Conditional Logit model with interaction effects between main variables; (3) a Conditional Logit Model with interaction effects for covariates and key factors; (4) a Random Parameter Logit model and WTP for the base model; (5) a Latent Class Model and WTP for the base model; (6) a Latent Class Model with interaction effects for covariates and key factors; and finally (7) a Latent Class Model with class membership indicators. These models have enable a systematic evaluation of the effects of different types of labelling information on consumer attitudes, the influence of behavioural, attitudinal and demographic factors, and the existence of heterogeneity within the sample population.

5.8 Conclusion

The growing market for functional foods, especially functional dairy products, provides a potential opportunity to improve the health of Canadians and enable the development of a new value-added food sector. With the growing interest among consumers in the link between diet and health, and the credence nature of the health attributes in functional food products, labelling plays a key role in consumers’ choices.

This estimation results chapter has the objective of answering the research questions related to labelling effects as described in Chapter 1. Seven different estimation models have been used in this chapter to examine various relationships with respect to different types of labelling effects on Canadian consumers' functional food choices. They are all discrete choice models based on random utility theory, including the Conditional Logit (CL) model, the Random Parameter Logit (RPL) model and the Latent Class Model (LCM). The CL model is basic but essential to derive other advanced models in the family of discrete choice models.

The CL model has several major limitations as indicated in section 4.1. The RPL model and the LCM have been adopted in this chapter to address the limitations of the CL model. They are popular methods to explore the unobserved heterogeneity in choices. Significant improvements in the goodness of fit were found in the RPL model and the LCMs, compared with the CL base model. The estimation results of the RPL model in this study indicate that strong variations exist in consumers' preferences for: whether the milk product is enriched with Omega-3; whether there is a health claim or a heart symbol present on food labels; and whether those health claims are verified by the government or a third party. The LCM assumes that respondents can be intrinsically grouped into a number of latent classes. Four latent classes have been identified in the LCMs presented in this chapter. What is more, the LCM with class membership indicators offers an excellent way to incorporate and explain the sources of heterogeneity.

WTP estimates for the main attributes were also provided for each of the discrete choice models. The WTP method provides a means of interpreting the estimated parameters and identifying the monetary values associated with changes in those attributes. Given the hypothetical nature of the choice experiment, the WTP estimates are most usefully interpreted as relative measures of the strength of preferences. The WTP values conjointly considering main effects and the interaction effects for key socio-demographic and attitudinal variables allow further identification of the heterogeneity in consumers' preferences for the main labelling attributes.

According to the results from the seven models, full labelling is superior to partial labelling. Among the different types of full health claims, a risk reduction claim is the most preferred health claim by respondents. The specific preference ordering of full labelling and partial labelling is found to be as follows: on average, a risk reduction claim is preferred or at least no less than a disease prevention claim; and a disease prevention claim is preferred to a function claim or the use of a symbol (partial labelling). The results reveal that there is no significant difference between a function claim, such as "good for your heart" and partial labelling in the form of a red heart symbol.

The rules surrounding the use of structure-function claims in Canada are somewhat more onerous than in the United States. For example, the US does not require pre-approval of the use of a structure-function claim. These results suggest that the use of a heart symbol on functional food products in the Canadian market may be just as effective as a structure-function claim. Thus, while consumers (and obviously functional food manufacturers) in Canada might benefit from the extension of risk reduction claims or disease prevention claims to a wider range of food products (albeit only where these claims are scientifically justifiable), it is not clear that there is as much to be gained from a consumer's perspective by a relaxation of the rules around the use of a structure-function claim since the same information can be conveyed through the use of a symbol. Two caveats are important, however: first the analysis only examines heart health claims and the use of a heart symbol – the connection between the two being fairly self-evident – structure-function claims pertaining to other health conditions (such as digestive health) may be more difficult to convey clearly through the use of visual imagery. Second, the issue of consumer protection from fraudulent or misleading health claims has not been addressed in this study. The use of structure-function health claims, or indeed visual imagery, to imply a health benefit that is not present in a product obviously would not assist consumers in making informed decisions about (genuinely) functional foods.

Verification of health claims appears to be important to those consumers for whom health claims matter. The CL model shows that, on average, consumers responded positively to verification of a health claim by either a government agency or a credible third party. The RPL model shows that consumers' preferences for the assurance of government and third party verifications of health claims are heterogeneous. While the results indicate that consumers' perceptions of government verification are relatively superior to third party verification, the LCM results reveal a more nuanced picture, with evidence of heterogeneity in consumer attitudes towards the source of verification, as has been found in other recent studies (see for example, Innes and Hobbs, 2011 and Uzea, Hobbs and Zhang, 2010). In general though, verification by a government agency (Health Canada) appears to be important to those respondents who also tended to value the presence of Omega-3 in a milk product (classes 2, 3, and 4), while reactions to third party verification (Heart and Stroke Foundation) are less consistent.

With respect to consumers' acceptance of the Omega-3 functional ingredient and the effects of other attitudinal and behavioural factors, the results show that the presence of Omega-3 does not have a universal appeal to all consumers; it appeals to segments of consumers. For example, having Omega-3 in milk products produces more positive perceived utility for the consumers who have higher levels of income. Omega-3 also receives more positive responses from female consumers with more positive attitudes towards functional foods. These asymmetric responses may be deeply rooted in consumers' personal, social and psychological differences. Behavioural economic research, such as the reference-dependent effects derived from Prospect Theory in psychology, might help to explain the reasons and source of these heterogeneous responses. The following chapter focuses on examining the existence of reference-dependent effects in consumers' functional food choices.

Chapter 6: Reference-Dependent Effects in Consumers' Functional Food Choices

Psychology opens another door for this study to examine consumers' preference heterogeneity in their choice decisions about functional foods. Originally developed from psychology, Prospect Theory (Kahneman and Tversky, 1979) and the Reference-Dependent Model (Tversky and Kahneman, 1991) have been widely applied in economic decision theory. As discussed in Chapter 2, the information asymmetry inherent in functional foods creates uncertainty for consumers about the presence/absence of a functional ingredient (e.g. Omega-3) and about the health effects of functional foods. Labelling plays a key role in informing consumers about health outcomes, therefore reducing uncertainty. However, different labelling scenarios in the choice experiment reveal the actual/alternative product attributes (e.g. price or Omega-3) which might be different from consumers' reference levels. The difference between an actual and reference level of the attribute creates a so-called reference-dependent effect (Hu, Adamowicz and Veeman, 2006). Reference-dependent effects are caused by consumers weighing losses from a reference point more than equivalent sized gains (loss aversion) (Tversky and Kahneman, 1991).

Following Chapters 4 and 5, this chapter continues to take Random Utility Theory as the underlying theoretical framework and uses the stated preference survey data to examine the existence of reference-dependent and loss aversion effects in Canadian consumers' functional food choices. Building on the base model in Chapter 4, this chapter constructs utility functions that incorporate reference-dependent effects and tests the existence of those effects. This helps to extend and further our understanding of the overall effects of the price and Omega-3 attributes, two of the main attributes examined in Chapter 5. Furthermore, the extended models in this chapter incorporate psychological characteristics to understand consumers' heterogeneous choices for Omega-3 functional milk. This chapter focuses on testing the reference-dependent effects for a functional ingredient (e.g. Omega-3) and for price. The Conditional Logit model is adopted to estimate these reference-dependent effects. The sources of heterogeneity for the reference-dependent effects are also examined through the inclusion of demographic variables and three attitudinal factors described in Chapter 4. This chapter includes six sub-sections: (1) general introduction and background, (2) introduction of Prospect Theory, (3) the Reference-Dependent Model and modelling reference-dependent effects, (4) data and econometrics models, (5) estimation results and (6) conclusions.

6.1 Introduction

Consumer goods are generally categorized as having three types of attributes: search, experience and credence (Nelson, 1970). The quality of a credence attribute cannot be determined either before or after purchase (e.g. the nutritional component of the food). Functional foods are usually considered to be foods with credence attributes. Since (in the absence of labelling) the functional properties cannot be inferred by the consumer before or even after purchase, consumers face uncertainty regarding the functional components of foods. Even with the presence of labelling, information uncertainty is also apparent in the functional foods market with respect to whether the functional health claim is credible, which depends on whether consumers believe that consumption of functional foods leads to specific health outcomes.

In neoclassical economic theory, expected utility theory is often used to analyze consumer choice behaviour under uncertainty. In expected utility theory, human rationality is one of the fundamental assumptions: it assumes that a consumer's rational choice should be consistent and coherent. A great deal of evidence in the literature shows that individual consumers sometimes behave ‘inconsistently’ and ‘irrationally’, which violates the predictions of expected utility theory. In Prospect Theory, Kahneman and Tversky (1979) described decision problems that violate the requirement of consistency and coherence, and they “trace these violations to the psychological principles that govern the perception of decision problems and the evaluation of options” (p.453). Prospect Theory evaluates decisions between alternatives which involve risk, i.e. alternatives with uncertain outcomes (e.g. gambling). In 1991, Tversky and Kahneman extended Prospect Theory and proposed a consumer choice model incorporating loss aversion in riskless choice (e.g. negotiations[8]), the so-called Reference-Dependent Model (RDM). The central assumption of the RDM (also for Prospect Theory), is that losses and disadvantages have a greater impact on preferences than gains and advantages (Tversky and Kahneman, 1991).

In the RDM, the reference-dependent effects are used to measure the value of changes involving a gain or a loss compared with a reference point and the changes to the reference point might lead to reversals of preference. The RDM and Prospect Theory evaluate the changes or differences of attributes rather than the absolute magnitudes. For example, the attributes of brightness, loudness or temperature, are evaluated by the past or present experience defined as a reference point, and the values are perceived according to this reference point. Therefore, the temperature could be evaluated as hot or cold depending on which reference level it has been compared to. The same principle also applies to non-sensory attributes such as health, prestige and wealth (Kahneman and Tversky, 1979).

[8] Loss aversion can be involved in negotiations, since experimental evidence indicates that negotiators are less likely to achieve agreement when the attributes over which they bargain are framed as losses than when they are framed as gains (Tversky and Kahneman, 1991).

Think about the example of purchasing a milk product. First, consider yourself as a typical conventional milk consumer. Suppose one morning you find that the conventional milk is used up. When you go to the grocery store, you consider purchasing Omega-3 milk which is claimed to have health benefits. In this case, will you evaluate the Omega-3 milk independent of your typically consumed conventional milk? Will you consider the extra health ingredient (Omega-3) as a gain in terms of improved product quality? On the other hand, to take the opposite case, if you typically consume Omega-3 milk and consider buying conventional milk on this shopping trip, will you evaluate this conventional milk independent of Omega-3 milk? Will you treat the missing health ingredient (Omega-3) as a loss with respect to product quality? Would you have the same intensity of feeling about the 'gain' and 'loss' of the Omega-3 in the above two cases? Extensive empirical evidence suggests that losses will be weighed more heavily than the same magnitude of gains, which is well-known as the property of loss aversion (Tversky and Kahneman, 1991).

Some of the literature about modelling heterogeneous consumer choices focuses on taste heterogeneity, and it might be tempting to make the behavioural assumption that all differences in consumers' choices are reflected in their taste variations. This is likely to be an over statement. At least, there might be some reference-dependent effects in the RDM that could be used to explain part of the heterogeneity in choices (Hu, Adamowicz. and Veeman, 2006). Reference-dependent effects reflect the fact that individuals with different reference points could treat the same choice decision as a gain or a loss. A gain for one individual might be treated as a loss by another. In the economics and marketing literature, reference-dependent effects have been recognized for decades. A number of studies have focused on how to capture and measure reference-dependent effects, such as Koszegi and Rabin (2006), Munro and

Sugden (2003), Suzuki, Tyworth and Novack (2001), Bell and Lattin (2000), Prelec (1998), Ordonez (1998), Lattin and Bucklin (1989) and Winer (1986). Miljkovic (2005) conducted a review of the hypothesis of perfect rationality regarding rational choice and irrational individual behaviour. Putler (1992) developed a theoretical consumer choice model incorporating reference price effects. Price reference effects have been examined in the marketing literature, e.g. Winer (1988) and Briesch et al. (1997). Some researchers developed models of brand choice incorporating price reference behaviours, e.g. Winer (1986), Kalwani et al. (1990) and Lattin and Bucklin (1989).

Hardie, Johnson and Fader (1993) model loss aversion and reference-dependent effects in brand choice. The authors argue that consumer choice is influenced by the position of brands relative to multi-attribute reference points. They use the most recent brand purchased by each household as the reference brand. They found that consumers perceive losses from a reference point more than equivalent sized gains (loss aversion). Using scanner data, they generate a Multinomial Logit Model to incorporate reference-dependent effects for price and quality attributes. The developed model provides a better fit in both estimation and prediction than a standard Multinomial Logit Model, and the model's coefficients demonstrate significant loss aversion. Their model provides insights for the development of the econometric models in this study.

Dhami and al-Nowaihi (2007) made a comparison between Prospect Theory and Expected Utility Theory for the issue of people paying taxes. The authors argue that given relatively low audit probabilities and penalties, why should people pay taxes. According to Expected Utility Theory, evasion should be extremely attractive. So why do most taxpayers not evade? Expected utility theory is unable to explain this. If people evade taxes, the loss will be the small probability of being caught and charged a penalty. The results show that the magnitude of tax evasion predicted by Prospect Theory is consistent with the data, since Prospect Theory characterizes individuals as loss averse with respect to certain reference income and they overweigh small probabilities while underweighting large ones. The authors conclude that Prospect Theory can explain the tax evasion puzzle and the behaviour of taxpayers also provides strong support for Prospect Theory.

Some researchers have examined reference-dependent effects for consumer promotions, such as Kalwani and Yim (1992) and Lattin and Bucklin (1989). Kalwani and Yim (1992) conducted an experimental study regarding price promotion and consumer price expectations. The study examined the impact of price promotion on consumers' price expectations and brand choice through an interactive computer-controlled experiment. The authors argue that price promotion, by introducing a product at a lower than regular price, is shown to have an adverse effect on subsequent sales, because consumers adopt the low promotion price as a reference and consider the regular price as unacceptable and greater than the price they expect to pay. The authors conclude that in the case of price expectations, promotion expectation losses loom larger than gains, which is consistent with Prospect Theory. This study suggests that although offering frequent price promotions can increase short term gains in sales, those sales increases may be offset by the losses in sales caused by consumers not receiving the promotion prices they expected.

The reference-dependent and loss aversion effects related to consumers' functional food choices are examined in this chapter. In addition to the reference-dependent effect for price, this chapter also examines the reference-dependent effect for the functional ingredient (e.g. Omega-3), a credence characteristic. The sources of heterogeneity for these reference-dependent effects are also examined. The following section provides an overview of Prospect Theory and the Reference-Dependent Model.

6.2 Prospect Theory

As mentioned previously, in the standard consumer decision-making models, Expected Utility Theory is typically used to model consumers' choice behaviors, in which the utility of a choice is represented by the sum of the possible outcomes weighted by their probabilities. Prospect Theory focuses on the changes in the current level of wealth and defines the changes as gains or losses relative to a reference level. In contrast, Expected Utility Theory only focuses on the final asset, and therefore only uses the 'final value of change in wealth' as a main variable in the utility function. In Prospect Theory (Kahneman and Tversky, 1979), the overall value function of a prospect (V) is expressed as:

$$V(x,p;y,q) = \pi(p)v(x) + \pi(q)v(y) \tag{6.1}$$

Where $v(.)$ is the value function which measures the value of deviations from the reference point (i.e. gains or losses); $v(x)$ and $v(y)$ are associated with the subjective value of outcomes x and y, respectively. It assumes that $v(0) = 0$, a basic property of the overall value function. π is the weighting function which is associated with each probability of prospect; $\pi(p)$ and $\pi(q)$ reflect the impact of the probability of p and q on the over-all value of the prospect, respectively. However, the weighting function is not a conventional probability function, and it measures the desirability of a prospect due to its possible outcomes. π is an increasing function of probability p. $\pi(0) = 0$, and $\pi(1) = 1$ imply an impossible event and a must-occur event, respectively. Another important property of the weighting function is that $\pi(p)>p$ for low probabilities and $\pi(p)<p$ for high probabilities, but evidence shows that for all $0<p<1$, $\pi(p)+$

$\pi(1\text{-}p)<1$ (Kahneman and Tversky, 1979). This property shows that individuals tend to overreact to events with a smaller probability, and under react to events with larger probabilities. See Kahneman and Tversky (1979), Laibson and Zeckhauser (1998), and Drazen (1998), for the details of the summarized properties of the weighting function.

Notice that both the value function and the weighting function are subjective measures and they vary across individuals. The value function is defined as gains or losses relative to a certain reference point. The reference point is also a subjective measure, and each individual might have a different level of reference which means they might have different views of gains or losses relative to one reference point. Prospect Theory originally focused on the analysis of decision making under uncertainty and was represented by an asymmetric S-shaped value function as depicted in Figure 6.1, in which value is measured by gains or losses rather than final assets. The value function includes two segments: the reference level which is treated as the reference point, and the magnitude of the change (positive or negative) which depends on the reference point. The following section discusses the S-shaped value function in the context of the reference-dependent model.

6.3 The Reference-Dependent Model

Derived from Prospect Theory, the reference-dependent model develops a consumer choice model involving loss aversion in riskless choice and measures the value of changes involving a gain or a loss compared with a reference point; and changes in the reference point might lead to reversals of preference. According to the psychological analysis of value, reference levels play a large role in preference construction. People are more sensitive to an outcome valued as a gain or a loss compared with a reference level, than the absolute final outcomes. The central assumption of the model is that losses and disadvantages have a greater impact on preferences than gains and advantages (Tversky and Kahneman, 1991).

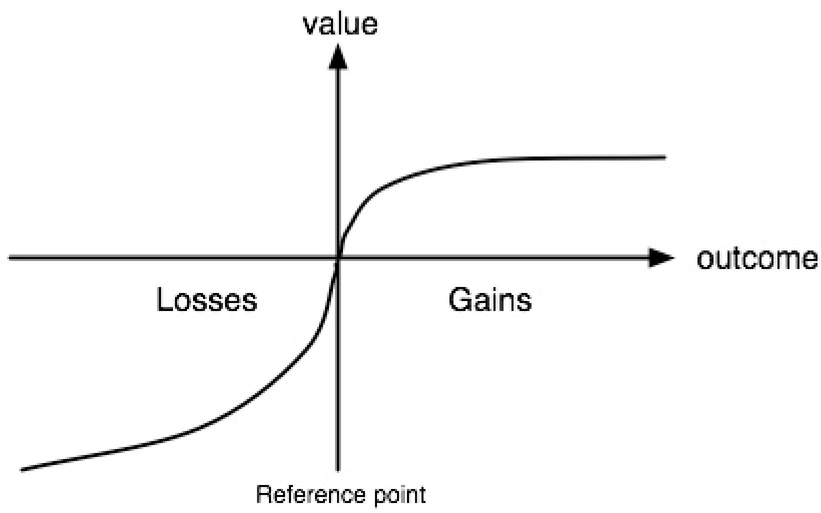


Figure 6.1: An Illustration of a Value Function

Source: Tversky and Kahneman (1991)

In the reference-dependent model, outcomes are expressed as gains or losses from a neutral reference outcome. As illustrated in Figure 6.1, the value function is commonly asymmetrically S-shaped, concave above the reference point and convex below it. There are three essential properties of the value function summarized by Tversky and Kahneman (1991, p.1039): first, "Reference dependence: the carriers of value are gains and losses defined relative to a reference point." Individuals' preferences depend on a reference point, and the changes of reference point might lead to reversals of preference; second, "Loss aversion: the function is steeper in the negative than in the positive domain; losses loom larger than corresponding gains." Since losses dominate, people will work harder to avoid losses than to obtain gains; third, "Diminishing sensitivity: the marginal value of both gains and losses decreases with their size".

For example, the difference in value between gains of $1 and $10 is greater than the difference between gains of $101 and $110, similarly for the case of losses.

In the reference-dependent model, the value function R_i is expressed as follows:

$$R_i(x_i) = \begin{cases} u_i(x_i) - u_i(r_i) & if \quad x_i \geq r_i \\ \lambda * [u_i(x_i) - u_i(r_i)] & if \quad x_i < r_i \end{cases} \tag{6.2}$$

Where $R_i(.)$ is the reference value function and $u_i(.)$ is the utility function which are associated with the reference state r_i. The first equation captures the reference gain effect and the second equation captures the reference loss effect. λ is a parameter which can be described as a coefficient of loss aversion with a restriction that λ is greater than 1. This expression comes from the central assumption of the RDM, which is that losses and disadvantages have greater impacts on preferences than gains and advantages.

Tversky and Kahneman (1991) concluded that if a choice could be viewed as a package of product attributes, each attribute could be described by a value function specific to that attribute. An individual could judge the value of each attribute based on his perceived reference point and make a choice decision relevant to that reference point. In Random Utility Theory, a consumer's utility of choosing a product is determined by the product's attributes and the utility is also a function of the product's attributes. Thus, Random Utility Theory could be re-specified as the value function by adding in reference-dependent variables in the reference-dependent model (Tversky and Kahneman, 1991; Hu, Adamowicz and Veeman, 2006).

6.3.1 Modelling Reference-Dependent Effects

Standard consumer utility theory assumes that when making decisions, preferences do not depend on current assets. Thus, in the case of a decision to consume a healthier food product, standard consumer utility theory would not take into account a consumer's current situation. This assumption greatly simplifies the analysis of consumers' choice decisions. According to a psychological analysis of value, reference levels play a large role in determining preferences. Understanding the determinants of consumers' perception of the health effects of functional foods could provide insights into the extent to which consumers are likely to change their consumption patterns in response to new information. The regulatory environment governing allowable labelling claims affects consumers' reference points by altering the information set available to consumers. Reference-dependent effects reflect the fact that individuals with different reference points could make heterogeneous choice decisions. Thus, a utility function need to be constructed that depends on the reference condition.

In modelling reference-dependent effects, a critical challenge is to identify the reference point for each respondent. In the literature, particularly in experimental studies, reference points are often presented or manipulated in the choice scenarios. For example, Kahneman, Knetsch and Thaler (1990) used a decorated mug as a tool of manipulation in their experimental study. They found that the monetary equivalent for the compensation for "losing the mug" is greater than the monetary value required to "gain" the same mug. Hardie, Johnson and Fader (1993) also argue that "in experimental studies, reference points can be manipulated by changing the status quo or by varying a target or norm" (P382). In their study, they used the most recent brand purchased by each household as the reference point. They argue that the currently held alternative could be the status quo and therefore a natural candidate for comparison. Suzuki, Tyworth and Novack (2001) adopted a similar method in a transportation study.

The methods used in the above mentioned studies are very effective in clearly defining the reference points when reference attributes are objective. Hu, Adamowicz and Veeman (2006) further developed a method to define reference points when reference attributes are latent or credent by considering respondents' perceptions for credence attributes of food products. In their study, respondents' perceptions were determined by asking them whether the bread they most often bought contained GM ingredients. This information was used as the reference point for the GM attribute.

In this study, the reference-dependent effect of Omega-3 is a key variable to be examined. Like GM ingredients in Hu, Adamowicz and Veeman's (2006) study, Omega-3 is also a credence attribute for functional food products. Following the method used by Hu, Adamowicz and Veeman (2006), this study establishes reference points by asking respondents' about the milk products they typically purchase.

According to Tversky and Kahneman (1991), the random utility function could be taken to mimic the value function of the reference-dependent model. Based on ordinary Random Utility Theory, *E(u)* captures the average expected utilities for all consumers. Consumers have different expected utilities from a given product. For an individual consumer *i*, his utility function could be expressed as:

$$u_i = E(u_i) + \varepsilon_i \qquad \varepsilon \to N(0, \delta^2) \tag{6.3}$$

First, take the reference-dependent effect of price as an example, assuming that all variables are constant in the utility function with the exception of price. The utility function for consumer *i* choosing alternative *j* could be expressed as:

$$u_{ij} = u_0 - P_j - \lambda PL_j + PG_j + \varepsilon_j \qquad \varepsilon \to N(0, \delta^2) \tag{6.4}$$

where variable PL_j captures the difference between the reference price and the observed price when the observed price is above the reference price; PG_j captures the difference between the reference price and the observed price when the observed price is below the reference price; variable P_j is the observed/actual price and the constant u_0 captures a base level of utility from consuming the product. The restriction that $\lambda > 1$ captures the asymmetric response above and below the reference point, which means the decision maker is loss averse. For empirical applications, the test for the presence of loss aversion is that the estimated value of λ is significantly greater than one (Bell and Lattin, 2000).

The gain and loss variables generated in this study follow the dummy variable method of Hardie, Johnson and Fader (1993) and Hu, Adamowicz and Veeman (2006). This method creates dummy variables that reflect “gains” and “losses” from the reference points. Respondents in this study were asked: “how much would you expect to pay for a 2-litre carton of milk enriched with Omega-3?” That price information is taken as the reference point for price which is the reference price (P_r) of Omega-3 milk. In the choice experiment, let the price of Omega-3 milk in an alternative in each choice set be taken as the alternative/observed price (P_a). Comparing P_r with P_a, if $P_a < P_r$, $PG_j = 1$, otherwise 0; if $P_a > P_r$, $PL_j = 1$, otherwise 0. If $P_r - P_a = 0$, then $PG_j = PL_j = 0$. Based on these definitions of reference-dependent variables, price gain = price loss = 0 ($PG_j = PL_j = 0$) in the fourth (no purchase) alternative in each choice set (Hu, Adamowicz and Veeman, 2006). In this study, since the research question focuses on consumers' reactions to the changes in the price of Omega-3 milk (not conventional milk), it assumes that there is no price gain or price loss ($PG_j = PL_j = 0$) in the third alternative in each choice set (the conventional milk alternative).

Respondents in this study were also asked: "what is the price of the 2-litre carton of milk you typically purchase?" This price information also has the potential to be used as the reference point for price (both for Omega-3 and for conventional milk). Statistical analysis of the survey data indicates that the variation is not statistically significant between this price information and the price information used in the choice experiment. Therefore, the variation is quite small for these two sets of price data. Testing also showed that no price gain or loss effect is observed if this price information is taken as the reference point for price. Considering the pre-testing and specific research questions of interest, respondents' expectation of the price they would expect to pay for a 2-litre carton of Omega-3 milk is taken as the reference point for price in this study, as explained above.

Second, consider a utility function with a reference-dependent effect for Omega-3 (functional ingredient). Assume all variables are constant in the utility function with the exception of the Omega-3 and price attributes, thus the utility function could be expressed as:

$$u_{ij} = u_0 - P_j + Omega3_j + Omega3G_j - \lambda * Omega3L_j + \varepsilon_j \qquad (6.5)$$

$Omega3G_j$ and $Omega3L_j$ represent the reference-dependent gain and loss effects for the Omega-3 attribute. In the survey, respondents were asked "Is the milk you typically purchase Omega-3 enriched milk?" This information provides the reference point for the Omega-3 attribute, $Omega\text{-}3_r$. When a respondent perceives that the milk he or she typically purchases is enriched with Omega-3, Omega-3_r =1, otherwise Omega-3_r = 0. In the choice experiment, the actual presence of Omega-3 in a milk product is labelled (for the first two alternatives in each choice set). When the milk product is explicitly labelled as containing Omega-3, Omega-3_a = 1, otherwise Omega-3_a = 0. As mentioned previously, the presence of Omega-3 is a credence characteristic both in terms of its presence (in the absence of labelling) and its efficacy. For the convenience of terminology, it is defined that when Omega-3_a – Omega-3_r =1, Omega3G_j = 1 and Omega3L_j = 0; when Omega-3_r – Omega-3_a =1, Omega3L_j = 1 and Omega3G_j = 0. Again, based on the definitions of reference-dependent variables and the particular choice experiment design in this study, the fourth alternative (no purchase) in each choice occasion, Omega3G_j = Omega3L_j = 0 for the Omega-3 attribute.

In this study, the usable sample size is 740 respondents. About 30% of respondents expect to pay $2.69 or less for a 2-litre carton of Omega-3 milk. Respondents who expect to pay $3.59, $4.49 or more for a 2–litre carton of Omega-3 milk account for 50%, 12% and 8% of the sample, respectively. Regarding the presence of Omega-3 in their purchased milk products, a total of 5.3% of the respondents claimed that they typically purchase Omega-3 enriched milk. A total of 16.6% of the respondents claimed that they typically purchase milk enriched with a health ingredient other than Omega-3, such as calcium or another ingredient. In this study, each respondent was presented with eight choice sets, and each choice set contained three alternatives described by different attribute combinations. In total, there are 17,760 ‘milk products’ included in this survey data. According to the definition of gains and losses for price and Omeag-3 as defined above, 47% of the alternatives created a gain and 2.6% (about 500 alternatives) created a loss for the Omega-3 attribute, while, 50.4% of the alternatives did not involve any gains or losses for Omega-3. In terms of price, 14.6% and 34% of the alternatives involved gains and losses for price, respectively, and the remaining alternatives (51.4%) did not involve any gains or losses for price. These numbers suggest that there might be some gains or losses related to reference-dependent effects for the price and Omega-3 attributes in this study.

Notice that one possible reference-dependent effect of a key attribute, health claim, is not included in this study. As introduced in Chapter 1, unlike in the United States, explicit Omega-3 health claims (whether a function, risk reduction or disease presentation claim) are not currently permitted on food labels or in advertisements in Canada. In the Canadian food market Omega-3 enriched milk cannot currently be labelled with a full health claim. In this study, it is assumed that Canadian consumers have not consumed Omega-3 enriched milk with a health claim in another country, such as the United States. Therefore, it is impossible to generate reference-dependent variables for the presence/absence of a formal Omega-3 health claim, but would be an interesting area for future research.

According to the notion of loss aversion in the reference-dependent model, people tend to prefer to avoid losses over acquiring gains. Psychologically, losses are much more powerful than gains. As explained, a reference-dependent effect for health claim could not be generated in the same way as for the price and Omega-3 attributes. Recall the estimation results in Chapter 5 where it was concluded that consumers are more likely to prefer risk reduction claims and disease prevention claims relative to function claims. One way to explain the results is by consumer's taste variation as shown in Chapter 5, since risk reduction claims and disease prevention claims are more concrete claims, while function claims might be more abstract. In addition, the effect of message framing might provide another way to explain the results (Tversky and Kahneman, 1981). In the health claim framing literature, Kleef, Trijp and Luning (2005) mentioned that health claims may be formulated to focus attention on its potential to provide a benefit or gain (e.g. function claim), or on its potential to prevent or avoid a loss (e.g. risk reduction claim). Their results found that reduced disease risk-framed health claims have significantly higher purchase intention ratings than enhanced function-framed health claims. To some extent in this study, the function claim ("Good for your heart") might be taken as one way to represent a gain effect from a health claim. The risk reduction claim ("Reduces the risks of heart disease") and the disease prevention claim ("Helps to prevent coronary heart disease") might be treated as a way to express loss avoidance in a health claim. The concept of loss aversion from the reference-dependent model might provide another potential explanation of this result. People are expected to be more sensitive to an outcome valued as loss avoidance than as a gain. It is not the reality of loss that matters but peoples' perceptions. This suggests that an individual's perception of a function claim phrased as a general health improvement (gain effect), might be expected to have less impact on his/her preference than a risk reduction claim or disease prevention claim which is phrased as loss avoidance. We expect that people will be willing to pay higher to avoid losses than to obtain gains.

This section has modelled the reference-dependent effects for price and the presence of Omega-3. The following section specifies the econometric models to measure the reference-dependent effects for these attributes.

6.4 Data and Econometric Model

The data used in this chapter are obtained from the stated preference survey described in Chapter 3. Due to the overlap between the data set used in this chapter and in Chapter 5, only the unique part of the data which is related to the reference-dependent effects is mentioned here. To measure the reference points for price and Omega-3, each respondent was asked how much he or she expected to pay for a 2-litre carton of milk enriched with Omega-3, and whether the milk product he or she typically purchases is Omega-3 enriched milk. Respondents' answers to those questions are treated as their perceived reference levels for the price and Omega-3 attributes. In the choice experiment, each product contains different levels of price and presence/absence of Omega-3. Respondents' choices in each choice set were observed, and the choices that they made were taken as the actual levels for the price and Omega-3 attributes. Since each respondent completed 8 choice sets, each respondent has 8 observations. The difference between the reference point and the actual observed choice is used to generate the reference-dependent effects for the price and Omega-3 attributes for each respondent. Table 6.1 summarizes the variable descriptions for the reference-dependent model.

Table 6.1: Variable Descriptions for the Reference-Dependent Model

Attributes	Abbreviation	Description
Price	**Price**	The price adopted in the choice experiment for a two-litre carton of milk, ranging from $1.99 to $4.49.
Function Claim	**FC**	= 1 if the milk product has a function claim ('Good for your heart'), otherwise 0.
Risk Reduction Claim	**RRC**	=1 if the milk product has a risk reduction claim ('Reduces the risks of heart disease and cancer'), otherwise 0.
Disease Prevention Claim	**DPC**	=1 if the milk product has a disease prevention claim ('Helps to prevent coronary heart disease and cancer'), otherwise 0.
Heart Symbol	**Heart**	= 1 if the milk product has a red heart symbol, otherwise 0.
Government Verification	**GOV**	= 1 if the health claim on the milk product is verified by government (Health Canada), otherwise 0.
Third Party Verification	**TP**	= 1 if the health claim on the milk product is verified by a third party (Heart and Stroke Foundation), otherwise 0.
Omega-3	**Omega3**	= 1 if the milk product contains Omega-3, otherwise 0.
No Purchase	**NoPurchase**	=1 if an alternative represents 'not to purchase any milk product' in the choice set, otherwise 0.
Reference-Dependent Variables		

PG	-	= 1 if the alternative price involves a gain which means it is below the respondent's reference price, otherwise 0.
PL	-	= 1 if the alternative price involves a loss which means it is above the respondent's reference price, otherwise 0.
Omega3G	-	= 1 if the alternative involves a gain in Omega-3 attribute, otherwise 0.
Omega3L	-	= 1 if the alternative involves a loss in Omega-3 attribute, otherwise 0.
Exogenous Covariate Variables and Key Factors		
Heart Disease	**HeartDisease**	=1 if a respondent self-reported that he or she has heart disease, otherwise 0 (as defined in Table 5.1).
Income	**Income**	A demographic variable representing respondent's income, as defined in Table 5.1.
Age	**Age**	A demographic variable representing respondent's age
Attitudes towards functional food	**Attitude**	Factor 1 from the factor analysis in table 4.2
Trust in health claims and nutrition labels	**Trust**	Factor 2 from the factor analysis in table 4.2
Health knowledge	**Knowledge**	Factor 3 from the factor analysis in table 4.2

With the specified attributes and levels of milk products in the choice experiment, consumer *i* will choose his/her preferred alternative *j* in each choice set if and only if the utility associated with alternative *j* is greater than other alternatives. According to Random Utility Theory, the indirect utility of consumer *i* choosing alternative *j* can be expressed as the following function:

$$\mathbf{U_{ij} = ß_1 NoPurchase + e_j} \quad \textbf{(6.6)}$$

$$\mathbf{U_{ij} = (1\text{-}NoPurchase)*(ß_2 FunctionClaim_j + ß_3 RiskReductionClaim_j +}$$

$$\mathbf{ß_4 DiseasePreventionClaim_j + ß_5 HeartSymbol_j + ß_6 Gov_j + ß_7 ThirdParty_j}$$

$$+ \text{ß}_8\textbf{Omega-3}_j + \text{ß}_9\textbf{Price}_j + \text{ß}_{10}\textbf{PriceGain}_j + \text{ß}_{11}\textbf{PriceLoss}_j + \text{ß}_{12}\textbf{Omega3Gain}_j + \text{ß}_{13}\textbf{Omega3Loss}_j) + e_j \qquad (j \neq \text{no purchase}) \qquad \textbf{(6.7)}$$

Most variables in equation (6.7) are described in Chapter 4 and will just be briefly repeated here. NoPurchase is a dummy variable that equals 1 if an alternative represents 'not purchase any of the milk products' in the choice set and equals 0, otherwise. Omega-3 is an alternative specific constant variable equal to 1 if the milk product includes Omega-3 ingredient and equal to 0, otherwise. The health claims attribute is separated as four dummy variables: Function Claim, Risk Reduction Claim, Disease Prevention Claim and No Claims. The verification organization attribute is represented by three dummy variables, Government, Third Party and None. Heart is a dummy variable equal to 1 if the milk product has a red heart symbol, otherwise 0. Price is the retail price of the milk product in alternative j. *ß*s are the estimated parameters and e_j is the error term.

As defined in section 6.3.1, Omega3G_j and Omega3L_j are two dummy variables which represent whether the choice involves a gain or a loss with respect to the presence of the Omega-3 attribute in a choice option. In equation (6.7), Omega3Gain_j is an interaction variable between Omega3G_j and Omega-3_j, because the gain effect for Omega-3 can only occur when the actual option contains the Omega-3 ingredient. Similarly, Omega3Loss_j captures the interaction between the Omega3L_j and the third alternative specific constant which represents the absence of the Omega-3 attribute, because the loss effect for Omega-3 can only arise when the actual option does not contain Omega-3. For the price attribute, PG_j and PL_j are the gain and loss effects for the price of Omega-3 milk which are also described in section 6.3.1. PriceGain_j and PriceLoss_j are two interaction variables that interact variables PG_j and PL_j with the actual price to capture the reference-dependent effects for the price attribute. According to the loss aversion prediction of the reference-dependent model, the value function should be steeper in the loss domain than the gain domain since losses are expected to have a larger impact on consumers' preferences than gains. To be consistent with the prediction, the magnitude of the coefficient for $PriceLoss_j$ is expected to be greater than the coefficient for $PriceGain_j$. Similarly, the magnitude of the coefficient for $Omega3Loss_j$ is expected to be greater than the coefficient for $Omega3Gain_j$. According to the prediction, the coefficients for $Omega3Gain_j$ and $PriceGain_j$ should be positive while the coefficients for $Omega3Loss_j$ and $PriceLoss_j$ should be negative.

Equation (6.8) specifies a random utility function including interaction effects between the reference-dependent variables and some exogenous demographic and attitudinal variables. These interaction effects help to test consumers' heterogeneous responses to the reference-dependent variables. The indirect utility function with interaction effects of consumer *i* choosing alternative *j* can be expressed as the following function:

$$\begin{aligned} \mathbf{U_{ij}} = {} & \mathbf{(1\text{-}NoPurchase)^*(ß_2FunctionClaim_j + ß_3RiskReductionClaim_j +} \\ & \mathbf{ß_4DiseasePreventionClaim_j + ß_5HeartSymbol_j + ß_6Gov_j + ß_7ThirdParty_j} \\ & \mathbf{+ ß_8Omega\text{-}3_j + ß_9Price_j + ß_{10}PriceGain_j + ß_{11}PriceLoss_j + ß_{12}Omega3Gain_j +} \\ & \mathbf{ß_{13}Omega3Loss_j + \gamma_n Z_n{}^*X_j) + e_j} \qquad \mathbf{(6.8)} \end{aligned}$$

In this equation, the main effect variables and the reference-dependent variables for the price and Omega-3 attributes are the same as in equation (6.7). Where Z_n represents the selected exogenous covariate variables (e.g. income, education, heart disease and three key factors from the Factor Analysis); X_j represents the reference-dependent variables for Price and Omega-3 that can be interacted with Z_n; γ_n represents the coefficients of those interaction variables. For example, Z_n*X_j can be specified as interaction variables, such as $\text{Income}_i*\text{PriceLoss}_j$, $\text{HeartDisease}_i*\text{Omega3Gain}_j$, $\text{Attitude}_i*\text{Omega3Gain}_j$, etc.

The five covariates (Income, HeartDisease and three key factors) were considered to have the potential to explain the source of the reference-dependent effects examined in this study. The following prior beliefs are informing the choice of variables: higher income consumers are expected to be less price sensitive than those consumers with lower incomes. Respondents who suffer from heart disease are expected to be more concerned with obtaining an Omega-3 gain than those who do not have heart disease. Consumers who have positive attitudes towards functional foods, with more health knowledge or who tend to trust health claims or nutrition labels, are assumed to be more sensitive to obtaining gains or 'suffer' more from losses with respect to the presence of Omega-3 than those who do not have positive attitudes towards functional foods, have less health knowledge or tend to be trusting of health claims or nutrition labels.

This section has specified two models of the random utility function with reference-dependent effects. The next section presents the estimation results for those models. The Conditional Logit model is used to obtain estimation results.

6.5 Estimation Results

Table 6.2(a) presents the estimation results for two Conditional Logit models with reference-dependent effects. The first CL model presents the results according to equation (6.7), which contains both reference-dependent variables and main variables. The second CL model presents the results according to equation (6.8), which includes the reference-dependent variables, the main variables and the interaction variables. Table 6.2(b) presents the WTP estimates for the results shown in Table 6.2(a). It should be noted that an RPL model including reference-dependent effects was also estimated. Since the RPL model's results are similar to the CL model in Table 6.2(a), the RPL estimates are presented in the Appendix 2, and the discussion in this chapter focuses on the CL model results.

Comparing the estimation results for the first CL model in Table 6.2(a) with the base model in Table 5.2 in Chapter 5, the only difference between those two models is the inclusion of reference-dependent effects in Table 6.2(a). The values of the log likelihood functions are -5146.678 in Table 6.2(a) and -5275.028 in Table 5.2, and the Pseudo-R^2 are 0.268 and 0.25, respectively. According to the LR test, there is a significant improvement in model fit for the CL model in Table 6.2(a).

The estimated main effects in the CL model in Table 6.2(a) and Table 6.2(b) are similar to the results in Table 5.2 in Chapter 5. As mentioned in Chapter 5, all the coefficients for the main variables are significant at 1% and with the expected signs. On average, respondents prefer all three types of full health claims relative to no health claim (base level). They also prefer a heart symbol to be present on food labels relative to no symbol. They positively respond to the verifications of health claims by a government agency or a third party. They also prefer milk products enriched with Omega-3, but they dislike not purchasing any milk product or paying a higher price. The discussion of results in this chapter will focus on the reference-dependent effects.

Table 6.2 (a): Conditional Logit Estimates with Reference-Dependent Effects

	CL Model		CL Model with Interaction Effects	
Variable	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**
PriceGain	-0.044	-1.022	-0.044	-0.979
PriceLoss	-0.187***	-4.899	-0.256***	-5.905
Omega-3Gain	-0.542*	-1.697	-0.501	-1.565
Omega-3Loss	-1.673***	-4.555	-2.117***	-4.644
Price	-1.243***	-29.076	-1.327***	-29.874
Function Claim	0.323***	3.095	0.313***	2.935
Risk Reduction Claim	0.721***	6.926	0.738***	6.927
Disease Prevention Claim	0.568***	5.553	0.588***	5.613
Heart Symbol	0.196***	4.221	0.205***	4.328
Government Verification	0.377***	5.710	0.418***	6.150
Third Party	0.310***	4.740	0.344***	5.100
Omega-3	0.975***	2.802	0.951***	2.716
Income*PriceLoss	-	-	0.001***	4.670
HeartDisease*Omega-3Gain	-	-	0.593***	4.325
Attitude*Omega-3Gain	-	-	0.661***	19.254
Trust*Omega-3Gain	-	-	0.271***	8.366
Knowledge*Omega-3Gain	-	-	-0.108***	-3.353
Attitude*Omega-3Loss	-	-	-0.427	-1.513
Trust*Omega-3Loss	-	-	0.130	0.480
Knowledge*Omega-3Loss	-	-	0.902***	2.851
No Purchase	-5.625***	-43.239	-5.864***	-43.458

Log Likelihood Function of CL Model = -5146.678; Pseudo-R^2 = 0.268

Log Likelihood Function of CL Model with Interaction Effects = -4873.861; Pseudo-R^2 = 0.307

***,** and *** indicate significant at the 10%, 5% and 1% level, respectively.**

Table 6.2 (b): WTP Estimates with Reference-Dependent Effects

	CL Model		CL Model with Interaction Effects	
Variable	**WTP ($/2 litres)**	**t-ratio**	**WTP ($/2 litres)**	**t-ratio**
PriceGain	-	-	-	-
PriceLoss	-	-	-	-
Omega-3Gain	-0.436*	-1.695	^	^
Omega-3Loss	-1.346***	-4.511	^	^
Price	-	-	-	-
Function Claim	0.260***	3.077	0.236***	2.920
Risk Reduction Claim	0.579***	6.819	0.556***	6.833
Disease Prevention Claim	0.457***	5.478	0.443***	5.544
Heart Symbol	0.158***	4.167	0.154***	4.276
Government Verification	0.303***	5.578	0.315***	6.005
Third Party	0.250***	4.708	0.259***	5.070
Omega-3	0.784***	2.760	0.717***	2.676
^Omega-3Gain :				
1) With heart disease, average attitude, knowledge and trust levels.			0.069	0.267
2) Without heart disease, and with average attitude, knowledge and trust levels.	-	-	-0.378	-1.563
^Omega-3Loss:				
With average attitude, knowledge, and trust levels.	-	-	-1.596***	-4.602
No Purchase	-4.524***	-48.379	-4.420***	-51.321
***,** and *** indicate significant at the 10%, 5% and 1% level, respectively.**				
"^" indicates that the WTP estimates have been moved to the last part of the table				

The reference-dependent effects for Price and the presence of Omega-3 are measured in the first CL model in Table 6.2(a). The coefficient for Price is negative and significant, which is consistent with expectations. The coefficient for PriceGain is not significant, indicating that consumers do not value the gain on price very much, perhaps because milk products are relatively cheap and affordable for most consumers. However, the coefficient for PriceLoss is negative and highly significant, indicating that the effect of a price loss has a significant and negative impact on consumers' utility. Both the effects of price gain and price loss should be included in the overall effect of price. The magnitude of the coefficient for PriceLoss is greater than for PriceGain. The findings of the reference-dependent effects for price are consistent with the properties of Prospect Theory: the consumer's value function has a different slope in the gain than in the loss domain; they react differently in those domains, which means consumers are concerned with losses more than gains.

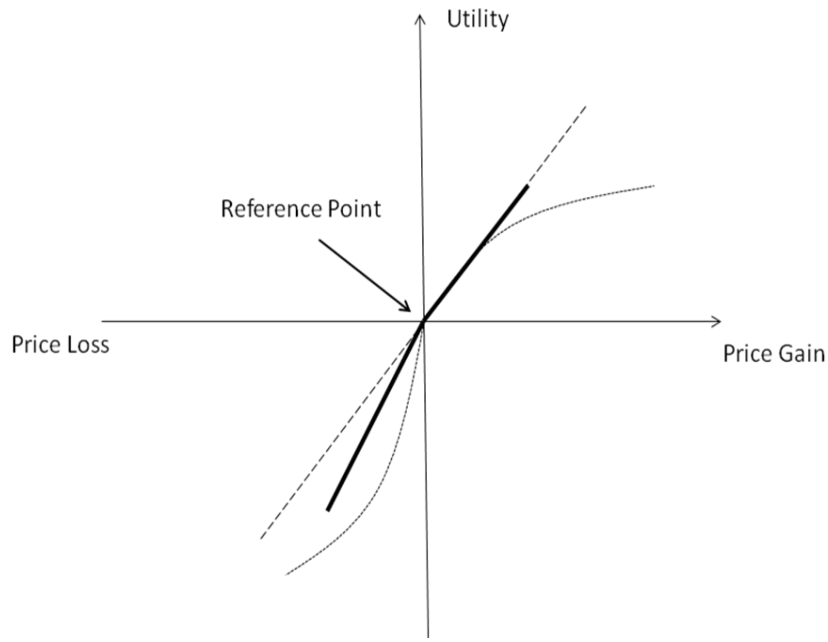
The reference-dependent effects for Omega-3 are also measured in the first CL model in Table 6.2(a). The coefficient for Omega-3 is positive and significant, which implies that the presence of Omega-3 could increase the probability of consumers purchasing the product. The coefficient for Omega-3Gain in this model appears to be negative and borderline significant at the 10% level. This is unexpected and one potential explanation might be that Omega-3 gain effect captures consumers' responses to the presence of Omega-3 when it is not expected. In this study, 47% of the respondents involve Omega-3 gains in the purchase simulation, which means those consumers claimed that they typically consume conventional milk but switch to Omega-3 milk in the choice experiment. Their responses to the unexpected presence of Omega-3 might be heterogeneous. The negative coefficient of Omega-3Gain indicates that on average, the unexpected presence of Omega-3 has a negative impact on consumers' utility. However, notice that the combined effects of variable Omega-3 and Omega-3Gain are still positive, indicating that the overall effect of the Omega-3 attribute still has a positive impact on consumers' utility.

The coefficient for Omega-3Loss is negative and highly significant at 1%, indicating that respondents tend to discount Omega-3 losses in their utilities, and prefer not losing this attribute if the milk products they typically consume already contained Omega-3. This result is generally consistent with Prospect Theory: losses have larger impacts on consumers' utilities than gains.

Figure 6.2 presents a graphical interpretation of the reference-dependent effects according to the results from the first CL model in Table 6.2(a) and the base model in Table 5.2. In graph (a) and graph (b) in Figure 6.2, the dashed lines represent the coefficients of attributes (Price and Omega-3) when reference-dependent effects are ignored, as per Table 5.2. To make an easier comparison, note that the coefficient of Price is taken as its absolute value. The solid lines represent the results when reference-dependent effects are considered as in Table 6.2(a). The dotted lines represent the S-shaped value function illustrated by Prospect Theory.

Figure 6.2: Reference-Dependent Effects for Price and Omega-3

Graph (a): Price



Graph (b): Omega-3

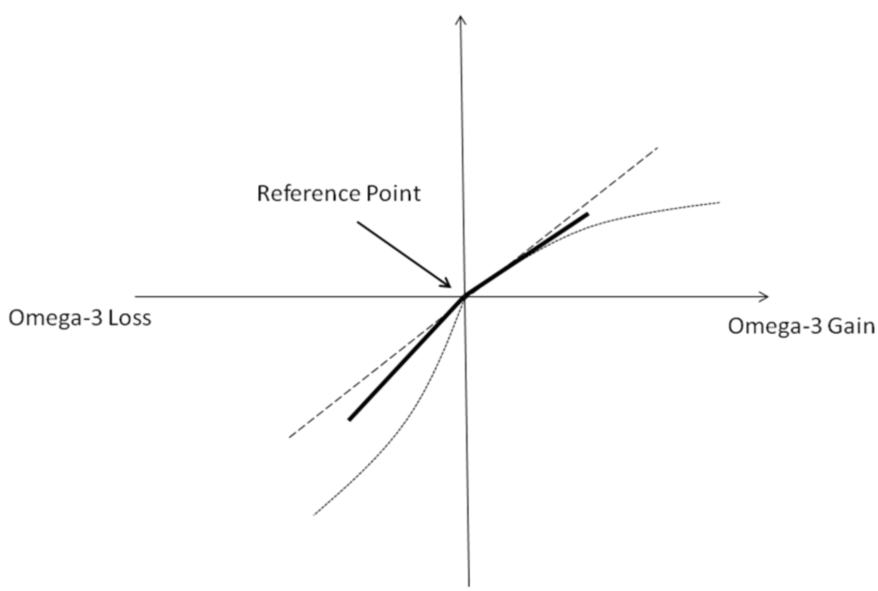


Table 6.2(a) also presents a CL model with interaction effects between the reference-dependent variables and exogenous variables. The value of the log likelihood function is -4873.861 and the Pseudo-R^2 is 0.307, which according to the LR test, suggests a significant improvement in the goodness of fit over the first CL model in Table 6.2(a). All the coefficients of the main effects in the second CL model have similar values and significant levels to the previously reported CL model in Table 6.2(a). Therefore, the interpretations of the main effects are similar to the first CL model. The reference-dependent effects in the second CL model need to be considered by the conjoint effects of the reference-dependent variables and their interaction terms. The specific interpretation is follows.

The interaction effects in the second CL model of Table 6.2(a) need to be interpreted in combination with the relevant reference-dependent variable. As indicated above, the coefficient for PriceLoss is negative and highly significant, indicating that the effect of a price loss has a significant negative impact on consumers' utility. The coefficient for Income*PriceLoss is positive and significant, which reduces the overall magnitude of the price loss effect (PriceLoss and Income*PriceLoss). Respondents with higher incomes are less likely to be hurt by a price that is higher than their reference price, which means they are less price sensitive than lower income consumers.

Recall that the coefficient of Omega-3Gain is insignificant in the CL model with interaction effects, indicating that consumers do not value this attribute in general. However, the coefficient for HeartDisease*Omega-3Gain is positive and significant, which increases the overall magnitude of the Omega-3 gain effect (Omega3Gain and HeartDisease*Omega-3Gain). Respondents with heart disease are more likely to respond positively to an Omega-3 gain, and prefer the presence of Omega-3 for a two-litre carton of milk, when they currently do not consume Omega-3 milk. Therefore, respondents with heart disease might believe that Omega-3 could generate a health gain, but they don't currently consume Omega-3 milk.

The coefficients for Attitude*Omega3Gain and Trust*Omega3Gain are all positive and significant, which all increase the overall magnitude of the Omega-3 gain effect. While, the coefficients for Knowledge*Omega3Gain is negative and significant, which decrease the overall magnitude of the Omega-3 gain effect. As discussed in Chapter 4, 'Attitude', 'Trust' and 'Knowledge' are the three key attitudinal factors from the Factor Analysis. Respondents who have positive attitudes towards functional foods, more trust in health claims and nutrition labels or with less health knowledge, tend to positively respond to the Omega-3 gain effect. Or in other words, although these respondents currently might not consume Omega-3 milk, they are likely to believe the health benefits of Omega-3. These respondents are more sensitive to the Omega-3 gain effect relative to those who do not have positive attitudes towards functional foods, who tend to be less trust of health claims and nutrition labels, or who have more health knowledge. Note that as discussed in Chapter 5, respondents with more health knowledge in this study tend to be more scepticism toward Omega-3 milk, and this finding is consistent with some health communication literature, such as Jallinoja and Aro (2000).

However, according to the WTP estimates in Table 6.2(b), the WTP values for Omega-3 gain are not significant, indicating that regardless of whether respondents have heart disease, those with average attitudes towards functional foods, average health knowledge and trust levels towards health claims and nutrition labels, are not willing to pay a significant amount of money for the Omega-3 gain attribute. Therefore, although the coefficient of HeartDisease*Omega3Gain is positive and significant, WTP estimates indicate that these effects might not be significant enough to translate into dollar values.

As mentioned above, the coefficient for Omega-3Loss is negative and significant, which implies that the Omega-3 loss effect has a negative impact on consumers' utility. The coefficient for Knowledge*Omega-3Loss is positive and significant, which decreases the overall magnitude of the Omega-3 loss effect and makes it less noticeable. Respondents with more health knowledge seem less likely to believe the health benefits of Omega-3. Therefore, they are less sensitive to, and tend to 'suffer' less from, the absence of Omega-3 when they usually purchase Omega-3 milk. The coefficients for Attitude*Omega-3Loss and Trust*Omega-3Loss are insignificant, which do not affect the overall magnitude of the Omega-3 loss effect. These results indicate that respondent's attitudes towards functional food or trust in health claims or nutrition labels seem not able to explain consumer's heterogeneous response to Omega-3 loss effect.

Nevertheless, the WTP estimates in Table 6.2(b) show that respondents who have average attitudes towards functional foods, average health knowledge and trust levels towards health claims and nutrition labels, would need to be compensated $1.60 to lose the Omega-3 attribute if they regularly consume milk products enriched with Omega-3.

6.6 Conclusions

Prospect Theory and the reference-dependent model (RDM) modify Expected Utility Theory under uncertainty to accommodate apparently 'irrational' but 'real' observations about human behaviour. In the RDM, the reference-dependent effect is used to measure the value of change involving a gain or a loss compared with a reference point. This chapter examines the reference-dependent effects for 'Omega-3 gain or loss' and 'price gain or loss' based on Prospect Theory and the reference-dependent model. This chapter constructs utility functions including reference-dependent effects and tests the existence of those effects. The analysis finds evidence for the existence of reference-dependent and loss aversion properties. It suggests that the reference-dependent effects for price and Omega-3 exist and are empirically verifiable. Consumers' choice decisions could be influenced by the differences between reference points and alternative observations. The results show that the reference-dependent effects for price gain, price loss, and Omega-3 loss are all directly consistent with Prospect Theory. However, the results for the Omega-3 gain effect are somewhat more complicated, requiring the inclusion of interaction effects in the estimation model to be consistent with Prospect Theory. Reference-dependent effects and loss aversion are evident for the price and Omega-3 attributes in this study. As predicted by Prospect Theory, the losses tend to have a greater impact on consumers' preferences than the gains.

The results presented in this chapter differ from previous studies in that the source of reference point effects are explained through consumers' demographic and attitudinal characteristics by adopting interaction effects in the Conditional Logit model. Income, HeartDisease, Attitude, Knowledge and Trust (three key factors) are used to explain consumers' heterogeneous responses to the reference-dependent effects for price and Omega-3. Income and whether an individual suffers from heart disease are found to be two important personal characteristics to explain consumers' diversified choices. In general, and unsurprisingly, consumers with higher incomes are found less likely to suffer from a price loss. Consumers who suffer from heart disease are more likely to obtain an Omega-3 gain effect from the milk products, which indicate they pay more attention to health impacts relative to those who do not suffer from heart disease. Attitudes towards functional foods, health knowledge and trust in labels (three key factors) can help to explain the sources of heterogeneity surrounding the reference-dependent effects.

The loss aversion property of the RDM opens another door to study the functional foods market. According to the psychological principle of loss aversion, promotional messages for functional foods could emphasize disease risk reduction rather than general health benefits, since losses tend to dominate and people are expected to work harder to avoid losses than to obtain gains. We can therefore expect the food industry to favour the use of stronger health claims. This has two key implications for the regulatory environment governing allowable health claims: the extent to which consumers are expected to adopt functional foods in response to health claims, and second, the incentives that firms have to adopt health claims which imply disease risk reduction functions. Government regulatory agencies should be aware that health claims containing health information related to gains or loss avoidance might have distinct influences on consumers' motivations to purchase functional foods. Therefore, agencies regulating health claims need to be careful to control what types of health claims are permissible on food labels. At the same time, the regulatory agency should also be aware that because of consumers' asymmetric responses to health information including gains and loss avoidance, food companies have strong incentives to lobby the government to allow health claims to imply disease risk reduction functions. Therefore, tight regulation of allowable claims is very important in protecting consumers.

A limitation of this study is that a relatively small proportion of respondents incur an Omega-3 loss in this study. However, this limitation might also be explained as an important finding or implication to the food industry, since a relatively small portion of consumers who currently consume Omega-3 milk are very hard to convert back to consume conventional milk anymore. Consumers seem to be loyalty to consume Omega-3 milk if they take Omega-3 milk as their reference points. Further research might help to test these results, particularly if there are more consumers taken Omega-3 milk as their reference levels in future. It will be interesting to see in the long run, the implications for Canadian consumers' functional food choices when their reference points for functional milk change.

Chapter 7: Implications and Conclusions

It has been argued that consumers' growing interest in functional foods provides value-added growth opportunities to the Canadian agri-food sector (Agriculture and Agri-Food Canada, 2009). Consumers' response to functional foods is a relatively new research area with many unanswered questions regarding public awareness of the health-enhanced properties of functional foods. Given the credence nature of functional foods, labelling plays a key role in helping consumers making informed consumption choices. This study has examined the effects of labelling and verification of health claims through an analysis of consumers' stated preferences for a specific functional food product, Omega-3 milk. In addition to consumers' perceptions of the credibility of health claims verified by different organizations, some other potential influences on consumers' decisions were also considered, such as attitudes towards functional foods, consumers' health status and knowledge, trust in labels per se, socio-demographics and the existence of reference-dependent effects for key attributes.

This research is one of the first studies to examine the effects of different types of health claim labelling simultaneously. Specifically, this study investigated function claims, risk reduction claims and disease prevention claims, in combination with other ways of signalling health benefits, such as the use of a heart symbol, on Canadian consumers' functional food choices. This study contributes to the knowledge in this domain by providing a comparative analysis of different types of labelling strategies. The extant knowledge of labelling effects in the formats of risk reduction claims, disease prevention claims and symbols on functional foods is limited. One of the primary contributions of this study is addressing this gap in the literature. There is also limited research regarding the credibility verification of health claims for functional food, especially at the national level within Canada. To enrich the knowledge in this area, this study examines the verification effects of different organizations for the credibility of health claims across Canada, including a government organization (e.g. Health Canada) and a third party (e.g. the Heart and Stroke Foundation). Another contribution of this study is to extensively apply the psychographic segmentation analysis into the functional food sector, by using both attitudinal and socio-demographic factors to identify and explain different segmentations of Canadian functional food consumers. The findings of this study might be particularly useful to the functional food industry and Canadian regulators, to help understand consumers' perception of functional food labels, developing marketing strategies for different consumer segments, and establishing an effective regulation system of health claims for the Canadian functional food sector.

This chapter includes three sections: (1) summary of major research findings, with respect to full labelling and partial labelling, effects of different verification organizations, the role of attitudinal and demographic information, the reference-dependent effects and choosing a proper discrete choice model; (2) implications for the functional food industry and public policy; (3) limitations of this thesis and avenues for future research.

7.1 Summary of Major Research Findings

7.1.1 Full Labelling and Partial Labelling

For the government regulatory agency that decides which types of health claims for functional foods are permissible, it is important to sufficiently understand how each type of health claim affects consumers' choice decisions. In Canada, the regulatory environment governing health claims for functional foods is somewhat more restrictive relative to some other countries, such as the United States. While arguably this may offer more protection to consumers from misleading health claims, it also means that food companies, as a consequence, often resort to visual imagery, such as a red heart symbol, to imply certain health benefits. This type of labelling strategy has been referred to 'partial labelling' in this study. Correspondingly, 'full labelling' refers to explicating formal health claims on food labels, ranging from function claims, to risk reduction claims, to disease prevention claims. Note that "full labelling" refers to explicit health claims on food labels and "partial labelling" means to use an image or visual cue to implicitly signal a health benefit. In this study, data was collected from an online survey including a choice experiment administrated to 740 usable respondents across Canada in the summer of 2009. This thesis uses discrete choice modelling to examine the participants' responses to different labelling strategies (full and partial) for milk enriched with Omega-3.

The results indicate that full labelling is strongly preferred over partial labelling, especially for risk reduction claims. The preference ordering for health claims (full labelling) reveals that, on average, a risk reduction claim is preferred or at least no less than a disease prevention claim by most respondents and a disease prevention claim is preferred relative to a function claim. While certain types of risk reduction claims are permissible in food products in Canada and the United States, disease prevention claims are not. There is no significant difference in consumers' preferences between a function claim (such as "Good for your heart") and partial labelling in the form of a red heart symbol. Although a risk reduction claim for Omega-3 is already allowed in the United States, such a claim has not yet been approved in Canada. This study finds that Canadian consumers' responses to a risk reduction claim on Omega-3 milk are quite positive, especially when verified by a government agency. Therefore, an approval of risk reduction claims for Omega-3 functional ingredients might deserve a careful consideration by the Canadian regulatory agency, assuming that there is sufficient scientific evidence to support such a claim since it remains important to balance the objectives of informing consumers with protecting them from misleading information.

7.1.2 Effects of Different Verification Organizations

Establishing the credibility of health claims is another challenge faced by the functional food industry. Health claims need to be credible to the consumers to be effective as a marketing tool. The credence characteristic inherent in a functional attribute makes it difficult for consumers to evaluate the accuracy of health claims. Verification of claims by independent organizations provides an opportunity for the functional food manufacturers to bolster the credibility of the health claims on their products. This thesis examines the credibility of health claims verified by different organizations, including a government organization (e.g. Health Canada) and a third party certification (e.g. the Heart and Stroke Foundation). The results show that government or third party verifications are preferred by the respondents relative to no verification. The respondents showed more trust in the verification made by a government agency, or at least no less, than the third party in different WTP estimates for verifications in different discrete choice modelling analysis (the RPL model and the CL model). The Latent Class Model results reveal a more nuanced picture, with evidence of heterogeneity in consumer attitudes towards the source of verification. More specifically, verification by a government organization appears to be important to those respondents who also tended to value more highly the presence of Omega-3 in a milk product, while reactions to third party verification are less consistent.

7.1.3 The Role of Attitudinal and Demographic Information

Another major finding of this study is that consumers' prior attitudes and their socio-demographic status helps explain their choice decisions and should be included in research assessing consumer preferences. For example, the results show that consumers with positive attitudes towards functional foods are more likely to respond positively to the presence of Omega-3 or risk reduction claims relative to those who have negative attitudes towards functional foods. Consumers' health knowledge and their trust in health claims and nutrition labels are also found to influence their choices for functional foods. Furthermore, consumers' health status and key socio-demographic attributes, such as income and education, also help to explain their choice decisions. For food companies wishing to better understand how to communicate health benefits to target consumer segments, these dimensions of the consumer attitudes are important considerations.

This study finds that respondents with higher education levels tend to respond negatively to the presence of a risk reduction claim. One possible explanation is that better educated consumers might have greater levels of scepticism towards risk reduction claims. Actually, this finding is consistent with marketing literature in the area of scepticism and advertising, such as DeLorme, Huh and Reid (2009). The implication of this finding is that, functional food companies may need to provide more evidence to reduce the scepticism of higher educated consumers, such as verification by a credible third party or public agency.

The results of the LCM with class membership indicators further identify the source of heterogeneity among different consumer segments. For example, compared with the Price Sensitive Consumers (class 1), consumers who are Verification Seekers (class 3) tend to have higher incomes, have suffered from heart disease, have generally more positive attitudes towards functional foods and are more likely to trust health claims and nutrition labels.

The descriptive analysis of the survey data shows that: (1) 'food labels' receives the highest score for being a frequently used health information source, and respondents also claim a higher trust level in food labels (one of the top 3 most trusted sources), indicating the importance of food labels to consumers' healthy food choices; (2) although 'internet' and 'media' receive higher response rates for being frequently used health information sources (among the top 3 most frequently used sources), consumers' trust levels in those two sources are relatively lower. Consumers might perceive that the internet and the media are less reliable information sources but are easily accessible; (3) food companies/industry receives the lowest scores both for being a frequently used health information source and for the trust in that information source. This suggests that the functional food industry needs to enhance its communications with consumers via labels and improve the credibility of health claims through government or third-party verifications. The influence of health professionals is another way helping the food industry to communicate with consumers.

7.1.4 Reference-Dependent Effects

In the reference-dependent model, consumers' utilities are assumed not only to depend on the absolute value of attributes, but also on changes around these attributes' reference points, so-called reference-dependent effects. The empirical model developed in this study incorporates reference-dependent effects into classical random utility theory to explain consumers' judgment and decision making behaviour in the context of functional food choices. The results indicate that consumers' utilities could be changed if the price for Omega-3 milk diverges from consumers' reference levels. The directions of these changes are different depending on whether it occurs as a gain or a loss. In this study, as expected, price loss is observed to have a negative impact on consumers' utility, while price gain does not have an obvious impact. The magnitude of the price loss coefficient is larger than the price gain, consistent with the properties of the reference-dependent model.

In addition to the 'price gain and loss effects', this study also examined a second type of reference-dependent effect - the 'Omega-3 gain and loss effects'. Omega-3 loss is found to have a negative impact on consumers' utility. The impact of Omega-3 gain, however, is somewhat more complex in this study. For example, in the base CL model, consumers' responses are significant and negative towards the Omega-3 gain effect, as is also the case for the RPL model in Appendix 2. However, when considering interaction effects with socio-demographic and attitudinal variables in another CL model, the total effect of Omega-3 gain is no longer significant. Therefore, the estimates of the reference-dependent effect for Omega-3 are less consistent with the prediction of Prospect Theory.

The results of the conjoint effects indicate that overall consumers do not value the presence of Omega-3 in the milk products if their typical consumed milk does not contain Omega-3, however, for those consumers who have higher incomes, suffer from heart disease, have positive attitudes towards functional foods, have lower levels of health knowledge or are more likely to trust health claims and nutrition labels, they tend to respond positively to the Omega-3 gain effect. Generally speaking, the inclusion of reference-dependent effects in choice models offers a better explanation of consumers' choice behaviours by considering the effect of key attributes diverging from a consumer's reference point.

7.1.5 Choosing a Proper Discrete Choice Model

This study has chosen three types of discrete choice models to estimate labelling effects and reference-dependent effects related to consumers' functional food choices: the Conditional Logit (CL) model, the Random Parameter Logit (RPL) model and the Latent Class Model (LCM). Although it has some limitations, the CL model is the standard starting point for deriving other advanced discrete choice models. For those researchers who choose to use discrete choice models, the CL model is a good first step. One major limitation of the CL model is that it assumes that all respondents' preferences are homogeneous and the estimated coefficients are fixed to be mean values of participants' responses.

To identify consumer preference heterogeneity, more advanced discrete choice models need to be applied, such as the RPL model and LCM. For example, the results of the RPL model indicate that strong variations exist in consumers' preferences for whether milk is enriched with Omega-3. As suggested by McFadden and Train (2000), if a researcher's major concern is to look for a highly flexible choice model, the RPL might be a good choice since it can approximate any random utility model. LCM assumes that respondents can be intrinsically grouped into a number of latent classes (Boxall and Adamowicz, 2002). Within each class, consumers' preferences are still assumed to be homogenous, but preferences are heterogeneous across classes. For example, four distinctive latent classes have been identified in this study. Furthermore, the class membership indicators in the LCM offer a better way to incorporate and identify the sources of heterogeneity in consumer choices indicated in this study. Therefore, if researchers believe that a discrete number of segments are sufficient to account for preference heterogeneity, LCM is a good choice to capture the unobserved heterogeneity among classes.

Compared with the basic CL model, significant improvements in the goodness of fit were found from the results of both the RPL model and the LCMs.

7.2 Implications

7.2.1 Implications for the Functional Food Industry

Health claims on food labels are one of the key issues in developing a successful market for the functional foods industry, given the credence nature of functional attributes. This study provides insights for the functional food sector through a better understanding of how consumers perceive health claims and how labelling could influence their functional food choices. For example, the results show that consumers respond positively to more detailed health claims (full over partial labelling), and that having government or third party verifications could significantly increase the acceptability of a new functional food compared with having no verification of health claims. Although the use of a visual image ('partial labelling') is the main labelling format in the current Canadian functional foods market because of the particular labelling rules in Canada, this study suggests that food manufacturers would benefit from the ability to make more precise health claims. The results also suggest that the use of a heart symbol on functional food products in the Canadian market may be just as effective as a function claim.

The CL model results indicate that, on average, consumers' levels of trust are close for a government agency and a reputable third party for the verification of health claims. This result shows that food manufacturers might have options when applying for certification of verified health claims. The rules of obtaining verification of health claims might be more flexible from third parties than from government agencies. However, clearly, the level of protection for consumers might decrease if obtaining verification from third parties. Therefore, public policy makers need to realize this type of possibility and develop appropriate policies to protect consumers and maximize social welfare. Public policy implications are discussed in the next section.

Moreover, the implications derived from the LCMs could help the Canadian functional food industry to identify target consumer groups with different characteristics for the purpose of developing marketing strategies. For example, the LCMs group the respondents into four latent classes. The respondents in class 1 (“Price Sensitive Consumers”, 55% of participants) appear to be indifferent to functional milk with Omega-3. Price is the only determining factor when they make milk purchase decisions. This result indicates that the majority consumers of milk products still have no clear preference between conventional milk and Omega-3 enriched milk. Therefore, reducing price could enable functional food companies to increase market share with this target group. Class 2 (“Functional Milk Believers”) and class 3 (“Verification Seekers”) are the major functional food consumers (about 40% of participants in total), whose purchase intention and willingness to pay will increase with the presence of the three types of full health claims. Therefore, food companies have strong incentives to lobby the regulatory agency governing health claims to allow function claim or risk reduction claim for Omega-3 enhanced food products.

The results also indicate that gender, income, health status, consumers’ attitudes toward functional foods, their health knowledge and their trust in health claims and nutrition labels are sources of heterogeneity in consumers’ preferences for functional foods. Therefore, functional food manufacturers can focus their marketing efforts and target the consumer segments that are more likely to purchase their products. For example, these results suggest that one target group the Omega-3 milk companies could focus on is consumers who have heart disease, since those consumers are more sensitive to the presence of Omega-3 in milk products and are willing to pay more for Omega-3 milk. Functional food companies could also generally focus on higher income consumers, since this study finds that they are willing to pay higher price premium for Omega-3 milk products. Of course, in the real word, food companies need to simultaneously consider more influential factors beyond just income effect to expend their businesses. For example, the result of this study shows that lower educated respondents with heart disease who have positive attitudes toward functional food and higher level of trust are willing to pay the highest amount for the risk reduction claim to be present on Omega-3 milk. The result also shows that female consumers with higher income, positive attitudes towards functional food and lower health knowledge are willing to pay the highest for milk enriched with Omega-3. These two groups of consumers might be desirable target segments for the functional food manufacturers. This has obvious implication for the types of messaging a functional food manufacturer would like to use and the type of potential consumer these manufacturers will try to reach. However, these findings should also meanwhile call attention of Canadian regulators to protect these groups of consumers who might be particularly susceptible to misleading health claims.

It was also determined that professionals, such as doctors and nutritionists (94.3%), Health organizations (90.1%) and Food labels (88%) are the top three health information sources that respondents trust. This has implications for how to transmit information to potential consumers. Food companies could inform these groups about the health benefits of Omega-3 milk which might be an effective, albeit indirect, means of filtering this information through to final consumers.

The loss aversion property from the reference-dependent model provides additional insights into the functional food market. According to Prospect Theory, it is expected that people will work harder to avoid losses than to obtain gains. Food companies might have an incentive to emphasize "disease (risk) reduction" rather than "general health benefits", since loss avoidances tend to have more influence on consumers' preferences than gains. Therefore, functional food companies have incentives to use disease (risk) reduction functions on health claims if they can successfully lobby for those types of disease (risk) reduction claims to be used on food labels in Canada. This study also found that those respondents who already frequently consume Omega-3 milk seem dislike to convert back to consume conventional milk. Otherwise, their utility might significantly discount which is captured by the Omega-3 loss effect. This is a clear and also important implication for the food industry to make effort to provide more opportunities to consumers to consume Omega-3 milk. Price deduction or promotion could be useful marketing strategies to have more consumers earn experience with Omega-3 milk.

7.2.2 Public Policy Implications

In Canada, given the particular labelling environment regarding allowable health claims on functional foods, a better understanding of consumers' reception to various health claims is particularly important for making effective public policy choices. The results of this study suggest that Canadian consumers are receptive to both full labelling (i.e. function claims, risk reduction claims and disease prevention claims) and partial labelling (i.e. using symbol as cues) formats. This is a clear indication that public policy makers need to pay attention to effectively regulating health claims for functional foods. Overly restrictive regulation of health claims could impair the communication between the functional food manufacturer and interested consumers with respect to clear and valid health information by limiting the range and types of acceptable health claims. However, overly lax regulation of health claims can leave consumers vulnerable to misleading and deceptive health claims regarding apparent functional properties of foods. An effective regulation system for health claims has the potential of promoting social welfare by improving the health of Canadians and reducing health care costs. If the goal of public policy is to identify which type of health claims could most effectively communicate health benefits to consumers, the results in this study suggest that risk reduction claims might be the best option in conveying health benefits to Canadian consumers and help them to make informed choices. Of course, to be socially optimal, the regulatory system needs to establish standards to ensure the risk reduction claims are truthful and not misleading, and based on sufficient health and scientific evidence.

Another public policy implication of this study concerns the rules for function claims and disease prevention claims. In Canada, the rules surrounding the use of function claims may be more onerous than that in the United States. However, this type of 'restrictive' rule might be necessary in terms of protecting consumers from misleading health claims. As the analysis in this study shows the use of a heart symbol, as currently used in the Canadian functional foods market, may be just as effective in communicating a health benefit as using a function claim. Therefore, it might be necessary for the development of a set of standards and rules to regulate the food industry using a symbol or visual cue on functional food from the point of view of consumer protection. Currently, disease prevention claims are regulated as drug claims and not permitted to be used on food products in both Canada and the United States. The results in this study indicate that credible disease prevention claims are not resisted by many Canadian consumers for functional food products. Therefore, if enough scientific evidence became available to support the role of functional foods in preventing certain types of chronic diseases, policy makers may want to consider the option of allowing certain disease prevention claims to be applied to food products in the future. Again, from the perspective of consumer protection it will be critical that sufficient scientific evidence exists to warrant such a strong health claim. If disease prevention claims were allowed, consumers are very likely to believe and respond to them, so tight regulation of allowable claims remains very important in protecting consumers.

If the regulatory system is equivocal on what types of health claims should be approved and how those health claims are approved, it will be difficult for the system to protect consumers from misleading health claims and also limit the development of the Canadian functional food industry. Indeed, it remains an important challenge for regulators to develop an efficient system that balances effectively communicating health information and preventing deceptive claims, and balances the imperative of protecting consumers' interests and satisfying companies' marketing requirements.

Claims about health effects are credence attributes, which means even in the presence of a labelled health claim, information asymmetry may still be present if consumers are uncertain about the validity of the health claim. Public policy makers should be aware that the verification of health claims plays an important role in reducing consumers' uncertainty and making health claims more credible. The quality assurance made by verification organizations provides a means of establishing the credibility of health claims. The results in this study suggest that Canadian consumers are more likely to choose functional food products if a government agency (e.g. Health Canada) or a reputable third party (e.g. Heart and Stroke Foundation) has verified the health claims. Therefore, it is also important for the government regulatory agency to codify and standardize the rules for third party endorsement of health claims. A set of accurate and transparent standards are very important not only for regulating truthful and not misleading health claims, but also for monitoring the verification of health claims by different organizations.

7.3 Limitations and Future Research

This thesis focuses on examining the labelling and reference-dependent effects in Canadian consumers' functional food choices. A choice experiment is adopted as the research methodology. One limitation of this study is associated with the hypothetical nature of the stated preference approach, since respondents are asked to state their preference values but actual choice behaviour may differ. Consumers may provide unrealistic statements if there is no cost to over (or under-) stating their willingness to pay. Estimation bias may be present due to strategic behaviour by respondents, especially when consumers are unfamiliar with the product (e.g. a food product with a new functional attribute), their stated willingness to pay may be inaccurate. In this study, although Omega-3 milk products have already been available in the Canadian functional food market for quite a few years, health claims pertaining to Omega-3 are still not allowed in Canada. Therefore, the examined product, Omega-3 milk with potential health claims, is still a hypothetical product. Other methods or the revealed preference method could be applied if health claims for Omega-3 are allowed in the Canadian functional food market in the future.

Other methods, such as experimental auctions, have been widely discussed in the literature associated with economic evaluation methods and could be used in future research on this topic. As discussed by Hu, Adamowicz and Veeman (2006), it is broadly believed that the use of experimental auctions in consumer research can capture the true willingness to accept a product and reduce the bias caused by strategic behaviour. However, the costs of conducting auctions on representative samples are usually relatively higher than the Stated Preference Method and as a result, sample sizes tend to be smaller. The other drawback of auctions that precluded their use in this study is the requirement to have the product (in this case Omega-3 milk with different labelled health claims) available for respondents to 'purchase' in the auction. Nevertheless, comparison of the methods and results between those two types of data (the Stated Preference Method vs. auction) might be interesting for future research.

Data for this study were collected through an online survey across Canada with the exception of Quebec in the summer of 2009. Thus, another limitation of this study is that the survey data omits respondents from Quebec since the survey was conducted only in English due to resource constraints. Future research could expand to include respondents in Quebec, where food choices and attitudes towards health may differ for cultural reasons.

Furthermore, the effects of full labelling and partial labelling are only derived from a single product, Omega-3 milk. Two additional caveats are particularly important. First, the analysis only examines heart health claims and the use of a heart symbol for Omega-3 milk, and the connection between the two labelling formats is fairly self-evident. The claims pertaining to other health conditions (such as digestive health) may be more difficult to convey clearly through the use of visual imagery. Furthermore, it is unclear whether there are "spill-over" effects between different categories of functional food products. For example, whether consumers' attitudes and purchase behaviour for Omega-3 milk in this study could be used to explain consumers' acceptance of other categories of functional foods, such as vitamin enriched juice or mineral enriched cereals. Second, the issue of consumer protection from fraudulent or misleading health claims has not been addressed in this study. Future research could focus on examining the existence of spill-over effects and the issues of protecting consumers from misleading health claims.

Considering the emergent nature of the functional food industry in Canada, future studies should take a longitudinal approach in tracking the dynamics and co-evolution among government policies, industry practices, and consumer behaviours and health outcomes. A related future research area is the economic analysis of the labelling effects and verification effects along the supply chain of functional food products, including the analyses of strategic decisions by farmers/producers, processors, retailers, exporters and other stakeholders. For example, the regulatory uncertainty and the credibility problem for health claims could influence producers' investment in research and development for novel functional foods. It could directly affect the differentiation and availability of functional food products produced by processors and marketed by retailers. Therefore, this is a rich area for further research analysis.

One more extension of this research is related to modelling reference point change effects and making comparisons of respondents' attitudes over multiple periods of time. In this study, the data were collected within one survey and respondents' reference points are assumed to be fixed. Over time, respondents' reference levels might change with their familiarity with the examined products in the market which may reshape their decision making processes. For example, if risk reduction health claims are permitted for Omega-3 milk in the future, it would be interesting to see whether individual's preferences change as a result of changes in their reference points for health claims. This type of study would need consumer panel data where consumers' preferences for product attributes could be tracked by researchers over time. The use of longitudinal consumer panels is a promising avenue for future research.

References:

Agriculture and Agri-Food Canada (AAFC) (1995). Nutraceuticals/Functional Foods Exploratory Survey on Canada's Potential. Monograph, 1995, Canada.

Agriculture and Agri-Food Canada (AAFC), News Release (2007). Canada's new government invests $721,000 in natural health products. Available online at: http://www.agr.gc.ca/cb/index_e.php?s1=n&s2=2007&page=n70605 (Accessed on August 9, 2010)

Agriculture and Agri-Food Canada (2009). Functional Foods and Nutraceuticals. Commentaries. http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1170856376710 (accessed on Nov 15, 2010)

Adamowicz, W. L., J. J. Louviere and M. Williams (1994). Combining Revealed and Stated Preference Method for Valuing Environmental Amenities. Journal of Environmental Economics and Management, 26: 271-292.

Adamowicz, W. L., J. D. Swait, P. C. Boxall, J. J. Louviere and M. Williams (1997). Perceptions Versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation. Journal of Environmental Economics and Management, 32: 65-84.

Adamowicz, W. L., P. Boxall, M. Williams and J. Louviere (1998). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. American Journal of Agricultural Economics, 80(February): 64-75.

Akerlof, G. A. (1970). The Market for 'Lemons': Quality Uncertainty and the Market Mechanism. Quarterly Journal of Economics, 84: 488-500.

Anders, S. and A. Moser (2010). Consumer Choice and Health: the Importance of Health Attributes for Retail Meat Demand in Canada. Canadian Journal of Agricultural Economics, 58 (2): 249-271.

Barry, B. and T. S. Bateman (1996). A Social Trap Analysis of the Management of Diversity. The Academy of Management Review, 21(3): 757-790.

Basu, K. S., J. E. Thomas and S. N. Acharya (2007). Prospects for Growth in Global Nutraceutical and Functional Food Markets: A Canadian Perspective. Australian Journal of Basic and Applied Sciences, 1(4): 637-649.

Batsell, R. R. and J. J. Louviere (1991) Experimental Analysis of Choice. Marketing Letters, 2(3): 199-214.

Bech-Larsen, T. and K. G. Grunert (2003). The Perceived Healthiness of Functional Foods: a Conjoint Study of Danish, Finnish and American Consumers' Perception of Functional Foods. Appetite, 40(1): 9-14.

Bell R. D. and J. M. Lattin (2000). Looking for Loss Aversion in Scanner Panel Data: The Confounding Effect of Price Response Heterogeneity. Marketing Science, 19(2): 185-200.

Ben-Akiva, M. and S.R. Lerman. (1985). Discrete Choice Analysis : Theory and Application to Travel Demand. Cambridge, Mass: MIT Press.

Bhat, C. (1998). Accommodating Variations in Responsiveness to Level-of-Service Measures in Travel Mode Choice Modeling. Transportation Research Part A, (32): 455-507.

Blamey, R., J. J. Louviere and J. Bennett (2001). 'Choice Set Design' in the Choice Modeling Approach to Environmental Valuation. Ed. J. Bennett an R. Blamey. Northampton. Publisher: Edward Elgar.

Blend, J. R. and E. O. van Ravenswaay. (1999). Measuring consumer demand for ecolabeled apples. American Journal of Agricultural Economics, 81: 1072–1077.

Bloch A., and C A. Thomson. (1995). Position of the American Dietetic Association: Phytochemicals and Functional Foods. Journal of the American Dietetic Association, ADA report, 95(4): 493-496.

Bond C. A., D. D. Thilmany and J. K. Bond (2008). What to Choose? The Vaule of Label Claims to Fresh Produce Consumers. Journal of Agricultural and Resource Economics, 33(3): 402-427.

Boxall, C. P. and W. L. Adamowicz (2002). Understanding Heterogeneous Preferences in Random Utility Models: A Latent Class Approach. Environmental and Resource Economics, 23: 421-446.

Boyd, J. and J. Mellman (1980). The Effect of Fuel Economy Standards on the U.S. Automotive market: A Hedonic Demand Analysis. Transportation Research A 14, 367-378.

Briesch, R.A., L. Krishnamurthi, T. Mazumdar, and S.P Raj. (1997). A Comparative Analysis of Reference Price Models. Journal of Consumer Research, 24(2): 202-214.

Burton, M., D. Rigby, T. Young and S. James (2001). Consumer Attitudes to Genetically Modified Organisms in Food in the UK. European Review of Agricultural Economics, 28 (4): 479-498.

Canadian Food Inspection Agency (2009). Guide to Food Labelling and Advertising, Chapter 8- Health Claims. Regulatory Document. http://www.inspection.gc.ca/english/fssa/labeti/guide/ch8e.shtml (accessed on October 1, 2010)

Carson, R. T., J. J. Louviere, D. A. Anderson, P. Arabie, D. S. Bunch, D. A. Hensher, R. M. Johnson, W. F. Kuhfeld, D. Steinberg, J. Swait, H. Timmermans and J. B. Wiley (1994). Experimental Analysis of Choice. Marketing Letters, 5(4), 351-368.

Cash, S. B., E. W. Goddard and M. Lerohl (2006). Canadian Health and Food: the Links between Policy, Consumers and Industry. Canadian Journal of Agricultural Economics, 54(4): 605-629.

Caswell, J. A. (2000). An evaluation of risk analysis as applied to agricultural biotechnology. Agribusiness, 16(1): 115–23.

Caswell, J., C. Noelke and E. Mojduszka (2002). Unifying Two Frameworks for Analyzing Quality and Quality Assurance for Food Products. In Global Food Trade and Consumer Demand for Quality, edited by B. Krissoff, M. Bohman and J. Caswell, 43-61. New York: Kluwer Academic Publishers.

CFIA [Canadian Food Inspection Agency] (2001). Labelling of Foods from Biotechnology in Canada. http://www.inspection.gc.ca/english/sci/biotech/conse.shtml#labeti

Chase, D., T. Nilsson, J. P. Emunu, D. McCann-Hiltz and Y. Peng (2007). Canadian Consumer Attitudes and Purchasing Behaviour of Omega-3 Products. Working paper, Research Project Number CMD-07-04, Consumer & Market Demand Agricultural Policy Research Network.

Cox, D.N., A. Koster and C. G. Russell (2004). Predicting Intentions to Consumer Functional Foods and Supplements to Offset Memory Loss Using an Adaptation of Protection Motivation Theory. Appetite, 43: 55-64.

Cranfield, J., B. J. Deaton and S. Shellikeri (2009). Evaluating Consumer Preferences for Organic Food Production Standards. Canadian Journal of Agricultural Economics, 57(1): 99-117.

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Test. Psychometrika, 16(3): 297- 334.

Crowley, L. (2008). Canada seeks opinion on health claims review. News Release. Available online at: http://www.nutraingredients.com/Product-Categories/Vitamins-premixes/Canada-seeks-opinion-on-health-claims-review (accessed on July 7, 2010)

CSIRO Human Nutrition (2004). Functional Foods. CSIRO Human Nutrition, Australia. http: //www.foodscience.csiro.au/functional-foods.htm (accessed May 2006).

Darby, M.E. and E. Karni (1973). Free Competition and the Optimal Amount of Fraud. Journal of Law and Economics, 16(1): 67-88.

DeFelice, S. (2007). DSHEA Versus NREA (The Nutraceutical Research and Education Act) and the Three Nutraceutical Objectives. The Foundation for Innovation of Science in Medicine. Commentaries.

DeJong, N., M.C. Ocke, H.A.C. Branderhorst and R. Friele (2003). Demographic and Lifestyle Characteristics of Functional Food Consumers and Dietary Supplement Users. British Journal of Nutrition, 89(2): 273-81.

DeLorme, D., J. Huh, and L. N. Reid (2009). DTC Advertising Skepticism and the Use and Perceived Usefulness of Prescription Drug Information Sources. Health Marketing Quarterly, 26: 293–314.

Dhami, S. and al-Nowaihi, A. (2007). Why do people pay taxes? Prospect theory Versus Expected Utility Theory. Journal of Economic Behaviour & Organization, 64: 171-192.

D'Innocenzo, L. (2006). The future is ripe. Bio Business, XII: 20-24.

Doyon, M. and J. Labrecque (2008). Functional Food: a Conceptual Definition. British Food Journal, 110(11): 1133-1149.

Drazen, P. (1998). The Probability Weighting Function. Econometrica, 66(3): 497-527.

Foreign Affairs and International Trade Canada (FAIT) (1995). Canada-Japan Collaborative Research and Development for Food Ingredients, Additives and Functional Foods: Identifying Potential Canadian Partners. Monograph, 1995, Canada.

FAO/WHO (2001). Evaluation of health and nutritional properties of powder milk and live lactic acid bacteria. Food and Agriculture Organization of the United Nations and World Health Organization Expert Consultation Report.

FDA (2004). FDA announced qualified health claims for omega-3 fatty acids. http://www.fda.gov/SiteIndex/ucm108351.htm (accessed on July 8, 2010)

FDA (2009a). 8: Claims. Guidance for Industry: A Food Labelling Guide. FDA Guidance Document. http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/FoodLabelingGuide/ucm064908.htm#health (accessed on March 1, 2011)

FDA (2009b). Appendix C: Health Claims. Guidance for Industry: A Food Labelling Guide. FDA Guidance Document. http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/FoodLabelingGuide/ucm064919.htm (accessed on March 1, 2011)

FDA (2009c). Appendix D: Qualified Health Claims. Guidance for Industry: A Food Labelling Guide. FDA Guidance Document.

http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/FoodLabelingGuide/ucm064923.htm (accessed on March 1, 2011)

Federal Trade Commission (2006). Before the Department of Health and Human Services, Food and Drug Administration. In the Matter of Assessing Consumer Perceptions of Health Claims; Public Meeting; Request for Comments, Docket No. 2005N-0413. January 17.

Fitzpatrick, C. K. (2003). Functional foods and nutraceuticals: exploring the Canadian Possibilities. Research Report, University of Manitoba, Winnipeg.

Fitzpatrick, C. K. (2004). Regulatory Issue Related to Functional Foods and Natural Health Products in Canada: Possible Implications for Manufacturers of Conjugated Linoleic Acid. The American Journal of Clinical Nutrition, 79: 1217S-1020S.

Fowler, F. J. (1995). Improving Survey Questions: Design and Evaluation. Applied Social Research Methods Series, Volume 38. Sage Publication, Inc. Library of Congress Cataloging-in-Publication Data. Printed in the United States of America

Galesic, M. and M. Bosnjak (2009). Effects of Questionnaire Length on Participation and Indicators of Response Quality in a Web Survey. Public Opinion Quarterly, 73(2): 349-360.

Garretson, J.A. and S. Burton (2000). Effects of Nutrition Facts Panel Values, Nutrition Claims, and Health Claims on Consumer Attitudes, Perceptions of Disease-Related Risks, and Trust. Journal of Public Policy & Marketing, 19(2): 213-227.

Gilbert, L. (2000). Marketing Functional Foods: How to Reach Your Target Audience. AgBioForum, 3(1): 20-38.

Greene, P. E. and V. Srinivasan (1978). Conjoint Analysis in Consumer Research: Issues and Outlook. Journal of Consumer Research, 5: 103-123

Hailu, G., A. Boecker, S. Henson and J. Cranfield (2009). Consumer valuation of functional foods and nutraceuticals in Canada. A conjoint study using probiotics. Appetite, 52: 257-265.

Hair, F. J., R. E. Anderson, R. L. Tatham and W. C. Black (1992). Multivariate Data Analysis with Readings. 3rd Edition. Macmillan Publishing Company, New York.

Hanemann W. M. (1994). Valuing the Environment Through Contingent Valuation. The Journal of Economic Perspectives, 8(4): 19-43.

Hardie, B. G. S., E. J. Johnson and P. S. Fader (1993). Modelling Loss Aversion and Reference Dependence Effects on Brand Choice. Marketing Science, 12(4): 378-394.

Health Canada (1998a). Nutraceutical and Functional Food and Health Claims on Foods. Health Canada, Policy Paper. Available online at: http://www.hc-sc.gc.ca/fn-an/label-etiquet/claims-reclam/nutra-funct_foods-nutra-fonct_aliment-eng.php (Accessed on August 18, 2010)

Health Canada, (1998b). Regulations Amending the Food and Drug Regulations (948 — Novel Foods). Food and Drugs Act, Canada Gazette, part II, 133.22: 2376 – 2439. http://canadagazette.gc.ca/partII/1999/19991027/pdf/g2-13322.pdf (Accessed on August 18, 2010)

Health Canada (2003). Regulations Amending the Food and Drug Regulations (Nutrition Labeling, Nutrition Claims and Health Claims). Canada Gazette Part II. January 2003. http://gazette.gc.ca/archives/p2/2003/2003-01-01/html/sor-dors11-eng.html (Accessed on July 1, 2010)

Health Canada (2007). Managing Health Claims for Foods in Canada: Towards a Modernized Framework. Discussion Paper, Food Directorate, Health Products and Food Branch, Health Canada. http://www.hc-sc.gc.ca/fn-an/consult/_man-gest_health_claims-allegations_sante/index-eng.php (Accessed on September 1, 2009)

Health Canada (2010a). Food and Nutrition: Health Claims Assessments. http://www.hc-sc.gc.ca/fn-an/label-etiquet/claims-reclam/assess-evalu/index-eng.php (accessed on January 15, 2010)

Health Canada (2010b). Food and Nutrition: Oat products and Blood Cholesterol Lowering. http://www.hc-sc.gc.ca/fn-an/label-etiquet/claims-reclam/assess-evalu/oat-avoine-eng.php (accessed on January 15, 2010)

Health Canada (2010c). Food and Nutrition: Plant Sterols (Phytosterols) in Food. http://www.hc-sc.gc.ca/fn-an/label-etiquet/claims-reclam/assess-evalu/phytos-index-eng.php (accessed on January 15, 2010)

Heller I. R., Y Taniguchi and T. Lobstein (1999). Functional Foods: Public Health Boon or 21st Century Quackery? the International Association of Consumer Food Organizations Report in 1999. http://www.cspinet.org/reports/functional_foods/index.html (accessed on July 8, 2010)

Hensher, D. A., J. M. Rose, and W. H. Greene (2005). Applied Choice Analysis, A Primer. Cambridge Press, New York.

Hilliam, M. (2000). Functional food-How big is the market? The world of Food Ingredients, 12: 50-52.

Holmes, T. P. and W. A. Adamowicz (2003). Chapter 6: Attribute-Based Methods. in A Primer on Nonmarket Valuation. edited by P.A. Champ K.J. Boyle and T.C. Brown. Dordrecht: Kluwer Academic Publishers, 171-219.

Hovde C. S., C. J. Wachenheim, R. Hearne and W. Nganje (2007). Identifying Market Preferences for High Selenium Beef. Working paper, Agribusiness and Applied Economics Report No. 611. Availabe online at: http://ageconsearch.umn.edu/bitstream/7633/1/aer611.pdf (Accessed on August 17, 2010)

Hu, W., M. M. Veeman and W. L. Adamowicz (2005). Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information. Canadian Journal of Agricultural Economics, 53(1): 83-102.

Hu, W., W. L. Adamowicz. and M. M. Veeman (2006). Labelling Context and Reference Point Effects in Models of Food Attribute Demand. American Journal of Agricultural Economics, 88(4): 1034-1049.

Hu, W., T. Woods and S., Bastin (2009). Consumer Acceptance and Willingness to Pay for Blueberry Products with Nonconventional Attributes. Journal of Agricultural and Applied Economics, 41(1): 47-60.

Huber, J. and K. Zwerina (1996) The Importance of Utility Balance and Efficient Choice Designs, Journal of Marketing Research, 33: 307-317.

Innes, B.G. and J.E. Hobbs (2011). Does it Matter Who Verifies Production-Derived Quality? Canadian Journal of Agricultural Economics, 59(1): 87-107.

Jain, D., N. Vilcassim, and P. Chintagunta (1994). A Random-Coefficients Logit Brand Choice Model Applied to Panel Data. Journal of Business and Economic Statistic, 12(3): 317-328.

Jallinoja, P., and A. R. Aro (2000). Does Knowledge Make a Difference? The Association Between Knowledge About Genes and Attitudes Toward Gene Tests. Journal of Health Communication, 5(1): 29 - 39.

Johnson, F. R., B. Kanninen, M. Bingham and S. Ozdemir (2007). Experimental Design for Stated Choice Studies, in Valuing Environmental Amenities Using Stated Choice Studies. In B. J. Kanninen (ed.), 159-202. Springer, Dordrecht, the Netherlands.

Kahneman, D. and A. Tversky (1979). Prospect Theory: An Analysis of Decision under Risk, Econometrica, 47(2): 263-292.

Kahneman, D., J. L. Knetsch and R. Thaler (1990). Experimental Tests of the Endowment Effect and the Coase Theorem. Journal of Political Economy, XCVIII, 1325-1348.

Kalwani, M. U., C. K. Yim, H. J. Rinne and Y. Sugita (1990). A Price Expectations Model of Customer Brand Choice. Journal of Marketing Research, 27(August): 251-262.

Kalwani, M. U. and C. K. Yim (1992). Consumer Price and Promotion Expectations: An Experimental Study. Journal of Marketing Research, 29(February): 90-100.

Kanninen, B. J. (2002). Optimal Design for Multinomial Choice Experiments, Journal of Marketing Research, 39: 214-217.

Kleef, E., H. C.M. Trijp and P. Luning (2005). Health claim-food product compatibility and the impact of health claim framing on consumer evaluation, Appetite, 44(2005): 200-308

Koszegi, B. and M. Rabin (2006). A Model of Reference-Dependent Preferences, Quarterly Journal of Economics, 121: 1133-1166.

Kozup, J.C., E.H. Creyer, and S. Burton (2003). Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items. Journal of Marketing, 97(April): 19-34.

Kroes, P. E. and R. J. Sheldon (1988). Stated Preference Methods: An Introduction. Journal of Transport Economics and Policy, 22(1): 11-25.

Krosnick, J. A. and D. F. Alwin (1987). An Evaluation of a Cognitive Theory of Response Order Effects in Survey Measurement. Public Opinion Quarterly, 51: 201-219.

Krosnick, J. A. (1991). Response Strategies for Coping with the Cognitive Demands of Attitude Measure in Surveys. Applied Cognitive Psychology, 5: 213-236.

Kuhfeld, W. F., R. D. Tobias, and M. Garratt (1994) Efficient Experimental Design with Marketing Research Applications. Journal of Marketing Research, 21: 545-557.

Kuhfeld, W. F. (1997). Efficient Experimental Designs Using Computerized Searches. Working paper for the Sawtooth Software Research Paper Series, SAS Institute, Inc. Available online at: http://www.cs.uiowa.edu/~gwoodwor/AdvancedDesign/KuhfeldTobiasGarratt.pdf (Accessed on August 10, 2010)

Kuhfeld, W. F. (2005) Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint, and Graphical Techniques. SAS 9.1 Edition, TS-722, Cary, NC: SAS Institute.

L'Abbe, R. M., L. Dumais, E. Chao and B. Junkins (2008). Health Claims on Foods in Canada. The Journal of Nutrition, 138: 1221S-1227S.

Labreque, J., M. Doyon, F. Bellavance and M. Kolodinsky (2006). Acceptance of Functional Foods: A Comparison of French, American, and French Canadian Consumers. Canadian Journal of Agricultural Economics, 54: 647-661.

Laibson, D. and R. Zeckhauser (1998). Amos Tversky and Ascent of Behavioural Economics. Journal of Risk and Uncertainty, 16: 7-47.

Lancaster, K. J. (1966). A new approach to consumer theory. Journal of Political Economy, 74: 132-157.

Larue, B., G. E. West, C. Gendron and R. Lambert (2004). Consumer Response to Functional Foods Produced by Conventional, Organic, or Genetic Manipulation. Agribusiness, 20(2): 155-166, published online in Wiley InterScience: www.interscience.wiley.com

Lattin, J. M. and R. E. Bucklin (1989). Reference Effects of Price and Promotion on Brand Behaviour. Journal of Marketing Research, 26: 299-310.

Lindlof, T. R. and B. C. Taylor (2002). Qualitative Communication Research Methods, 2nd Edition. Thousand Oaks, CA: Sage.

Louviere, J. J. (1988). Conjoint Analysis Modeling of States Preference: A Review of Theory, Method, Recent Developments and External Validity. Journal of Transport Economics and Policy, 22: 93-119.

Louviere, J. J., D. A. Hensher and J. D. Swait (2000). Stated Choice Methods, Analysis and Application. Cambridge Press, United Kingdom.

Louviere, J. J. and G. Woodworth (1983). Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data. Journal of Marketing Research, 20: 350-367.

Lusk, L. J. and N. Parker (2009). Consumer Preferences for Amount and Type of Fat in Ground Beef. Journal of Agricultural and Applied Economics, 41(1): 75-90.

Malhotra, N. (2008). Completion Time and Response Order Effects in Web Surveys. Public Opinion Quarterly, 72(5): 914-934.

Malla, S., J. E. Hobbs and O. Perger (2007). Valuing the Health Benefits of a Novel Functional Food. Canadian Journal of Agricultural Economics, 55: 115-136.

Malla, S.M., J.E. Hobbs and O. Perger (2005). Estimating the Health Care Savings from Trans Fat-Free Canola in Canada. Food Economics, 2(3-4): 175-184.

Manski, C. (1977). The Structure of Random Utility Models. Theory and Decision, 8: 229-254.

McCutcheon, A. L. (1987). Latent Class Analysis. Sage University Papers Series: Quantitative Applications in the Social Sciences Number 07-064. Newbury Park, CA: Sage Publications.

McFadden, D (1974). Conditional Logit Analysis of Qualitative Choice Behavior. In Frontiers in Econometrics. P. Zarembka (ed). New York: Academic Press. Chapter four: 105-142. Available online at: http://elsa.berkeley.edu/reprints/mcfadden/zarembka.pdf (Accessed on August 10, 2010)

McFadden, D (1986). The Choice Theory Approach to Market Research, Marketing Science, 5(4): 275-297.

McFadden, D. and K. Train (2000). Mixed MNL Models of Discrete Response. Journal of Applied Econometrics, 15: 447-470.

Menrad, M., B. Husing, K. Menrad, T. Rei, S. Beer-Borst, and C. A. Zenger (2000). Functional Food. TA 37/2000. Bern: Schweizerischer Wissenschafts und Technologierat.

Menrad K. (2003). Market and marketing of functional food in Europe, Journal of Food Engineering, 56: 181–188.

Miljkovic, D. (2005). Rational Choice and Irrational Individuals or Simply an Irrational Theory: A Critical Review of the Hypothesis of Perfect Rationality. The Journal of Socio-Economics, 34(5): 621-634.

Morikawa, T., M. Ben-Akiva and D. McFadden (2002). Discrete Choice Models Incorporating Revealed Preferences and Psychometric Data. Econometric Models in Marketing, 16: 29-55.

Munro, A. and R. Sugden (2003). On the theory of Reference-Dependent Preferences. Journal of Economic Behaviour & Organization, 50: 407-428.

Nelson, P. (1970). Information and Consumer Behaviour. Journal of Political Economy, 81: 729-754.

Nilsson, T., K. Foster and J. L. Lusk (2006). Marketing Opportunities for Certified Pork Chops. Canadian Journal of Agricultural Economics, 54: 567-583.

Nutrition Business Journal (2007). The Global Nutrition Industry VI. Nutrition Business Journal, **5**/6: 3–47.

Ordonez, L. D. (1998) The Effect of Correlation Between Price and Quality in Consumer Choice. Organizational Behavior and Human Decision Processes, 75(3): 258-273.

Peng, Y., G. E. West and C. Wang (2006). Consumer Attitudes and Acceptance of CLA-Enriched Dairy Products. Canadian Journal of Agricultural Economics 54(4): 663-684

Poulsen, J. (1999). Danish consumers' attitudes towards functional foods. MAPP working paper, 62. Aarhus School of Business. www.mapp.asb.dk/wppdf/wp62.pdf

Prelec, D. (1998). The Probability Weighting Function. Econometrica, 66(3): 497-527.

Putler, D. S. (1992). Incorporating Reference Price Effects into a Theory of Consumer Choice. Marketing Science, 11 (Summer): 287-309.

Quagrainie, K. K., J. Unterschultz and M. Veeman (1998). Effects of Product Origin and Selected Demographics on Consumer Choice of Red Meats. Canadian Journal of Agricultural Economics, 46: 201-219.

Reid, G., M. E. Sanders, H. R. Gaskins, G. R. Gibson, A. Mercenier, R. Rastall, M. Roberfroid, I. Rowland, C. Cherbut, R.T. Klaenhammer (2003). New Scientific Paradigms for Probiotics and Prebiotics. Journal of Clinical Gastroenterology, 37(2): 105–118.

Roe, B., A.S. Levy, and B.M. Derby (1999). The Impact of Health Claims on Consumer Search and Product Evaluation Outcomes: Results from FDA Experimental Data. Journal of Public Policy & Marketing, 18(1): 89-105.

Roosen, J., J. L. Lusk and J. A. Fox (2003). Consumer demand for and attitudes toward alternative beef labelling strategies in France, Germany, and the UK. Agribusiness, 19(1): 77–90.

Rousu, M., W. Huffman, J. F. Shogren and A. Tegene (2004). Estimating the public value of conflicting information: The case of genetically modified foods. Land Economics, 80(1): 125–35.

Samuelson, P. (1938). A Note on the Pure Theory of Consumers' Behaviour. Economica, 5: 61-71.

Shen, J. (2009) Latent class model or mixed logit model? A comparison by transport mode choice data. Applied Economics, 41(22): 2915 – 2924.

Smith, B. L., M. Marcotte and G., Harrison (1996). A Comparative Analysis of the Regulatory Framework Affecting Functional Food Development and Commercialization in Canada, Japan, the European Union and the United States of America, Monograph, March 31, Canada.

Sorenson, D. and J. Bogue (2005). Market-Oriented New Product Design of Functional Orange Juice Beverages: A Qualitative Approach. Journal of Food Products Marketing, 11(1): 57-73.

Statistics Canada (2003). Functional Foods and Nutraceutical Survey 2003. Available online at: http://www.statcan.ca/Daily/English/031006/d031006c.htm (Accessed on August 16, 2010).

Statistics Canada (2007). Functional Foods IX. Functional Foods and Nutraceuticals Survey. Nutrition Business Journal. http://investincanada.gc.ca/eng/industry-sectors/agri-food/natural-health.aspx (accessed August 16, 2010)

Statistics Canada (2008). Census 2006. Available online at: http://www12.statcan.ca/census-recensement/2006/as-sa/index-eng.cfm (Accessed on August 20, 2010).

Steiner, B., F. Gao and J. Unterschultz (2010). Alberta Consumers' Valuation of Extrinsic and Intrinsic Red Meat Attributes: A Choice Experimental Approach. Canadian Journal of Agricultural Economics, 58(2): 171-189.

Suzuki, Y., J. E. Tyworth and R. A. Novack (2001). Airline Market Share and Customer Service Quality: A Reference-Dependent Model. Transportation Research Part A, 35: 773-788.

Tebbens, J. (2005). Functional foods and nutraceuticals: the development of value-added food by Canadian firms. Statistics Canada. Science, Innovation and Electronic Information Division. Available online at : http://dsp-psd.pwgsc.gc.ca/Collection/Statcan/88F0006X/88F0006XIE2005016.pdf (Accessed on August 10, 2010)

Train, K. (1998). Recreation Demand Models with Taste Variation. Land Economics, 74: 230-239.

Train K. E. (2003). Discrete Choice Methods with Simulation, Cambridge University Press.

Tversky, A. and D. Kahneman (1981). The Framing of Decisions and the Psychology of Choice. Science, New Series, 211(4481): 453-458.

Tversky, A. and D. Kahneman (1991). Loss Aversion in Riskless Choice: A Reference-Dependent Model. The Quarterly Journal of Economics, 106(4): 1039-1061.

Uzea, A.D., J.E. Hobbs and J. Zhang. (2010). Activists and Animal Welfare: Quality Verifications in the Pork Sector. Working paper. Department of Bioresource Policy, Business & Economics, University of Saskatchewan

Verbeke, W. (2005). Consumer Acceptance of Functional Foods: Socio-Demographic, Cognitive and Attitudinal Determinants. Food Quality and Preference, 16: 45-57.

Wansink, B. (2003). How Do Front and Back Package Labels influence Beliefs about Health Claims? The Journal of Consumer Affairs, 37(2): 305-316.

West, G. E., C. Gendron, B. Larue and R. Lambert (2002). Consumers' Valuation of Functional Properties of Foods: Results from a Canada-wide Survey. Canadian Journal of Agricultural Economics, 50(4): 541-558.

Weststrate, J.A., van Poppel, G. and Verschuren, P.M. (2002). Functional foods, trends and Future. British Journal of Nutrition, 88(S2): 233-235.

Winer, R. S. (1986). A Reference Price Model of Brand Choice for Frequently Purchased Products. Journal of Consumer Research, 13(September): 250-256.

Winer, R. S. (1988). Behavioral Perspective on Pricing: Buyers' Subjective Perceptions of Price Revisited, in T. M. Devinney (Ed.), Issues in Pricing. Theory and Research, Lexington, MA: Lexington Books.

World Health Organization (WHO) (2002). World Health Report. World Health Organization, Geneva.

World Health Organization (WHO) (2005). Preventing Chronic Diseases: a Vital Investment. http://www.who.int/chp/chronic_disease_report/en/ (accessed on August 15, 2010)

World Nutraceuticals (2006). Industry Study with Forecasts to 2010 & 2015. The Freedonia Group, Cleveland, OH USA.

Zou, N., and J. Hobbs (2006). Modeling Functional Food Choice and Health Care Impacts: A Conceptual Analysis. Working paper, Research Project Number CMD-06-02, Consumer and Market Demand Agricultural Policy Research Network. http://www.consumerdemand.re.ualberta.ca/Publications/CMD%2006-02.pdf

Appendix 1: Post Hoc Estimation for the CL Model with Interaction Effects between the Main Attributes

Variable	Coefficient	t-ratio
Price	-1.468***	-46.887
Function Claim	0.235**	2.056
Risk Reduction Claim	0.682***	6.686
Disease Prevention Claim	0.536***	5.347
Heart Symbol	0.134**	2.365
Government Verification	0.327***	5.004
Third Party Verification	0.309***	4.770
Omega-3	0.355***	3.727
No Purchase	-6.133***	-57.976
FC*Heart	0.146	1.241
Log Likelihood Function = -5274.259; Pseudo-R^2 = 0.25		
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**		

This table is an example to show that the results in Table 5.4 are not robust, since when all the insignificant interaction variables from Table 5.4 are removed and the model re-estimated, the originally marginally significant coefficient (FC*Heart) becomes insignificant. The reason might be that the coefficient of FC*Heart, reported in Table 5.4, is only borderline significant at the 10% level.

Appendix 2: Estimation Results of the RPL Model Including Reference-Dependent Effects

Variable	Coefficient	t-ratio	WTP ($/2 Litre)	t-ratio
Mean value of Random parameters in utility function				
PriceGain	0.14	1.23	-	-
PriceLoss	-0.71***	-6.27	-	-
Omega3Gain	-2.79***	-3.49	-1.05***	-3.50
Omega3Loss	-2.38**	-2.19	-0.90**	-2.19
Mean value of Fixed parameters in utility function				
Price	-2.65***	-29.88	-	-
Function Claim	0.38**	2.51	0.14**	2.50
Risk Reduction Claim	1.29***	8.30	0.49***	8.23
Disease Prevention Claim	1.06***	7.00	0.40***	6.95
Heart Symbol	0.34***	5.47	0.13***	5.42
Government Verification	0.94***	9.17	0.36***	8.95
Third Party	0.74***	7.00	0.28***	7.00
Omega-3	4.88***	5.53	1.84***	5.43
No Purchase	-9.71***	-36.23	-3.67***	-88.88
Standard deviations of random parameters				
Sd-PriceGain	0.89***	10.88	-	-
Sd-PriceLoss	1.12***	13.59	-	-
Sd-Omega3Gain	4.40***	17.03	-	-
Sd-Omega3Loss	3.50***	5.53	-	-
Log Likelihood Function = -3485.646; Pseudo-R^2 = 0.575				
***,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.**				

This table presents RPL model estimates including reference dependent effects. It should be clear that these results are very similar to the first CL model in Table 6.2(a), with the exception that the magnitude of the coefficient for the variable Omega-3Gain is slightly larger than the coefficient of the variable Omega-3Loss. Therefore, this result seems to be less consistent with the prediction of Prospect Theory, which assumes that the effect of a looming loss is larger than the effect of a looming gain. However, according to the LR test, the goodness of fit for this RPL model is better than the first CL model in Table 6.2(a). Two reasons might help to explain the results. First, as indicated by the standard deviation of random parameters in this model, respondents' responses to an Omega-3 gain are more heterogeneous than to an Omega-3 loss. There might be a relatively large proportion of respondents who have negative views of an

Omega-3 gain when Omega-3 milk is not their regularly consumed milk product. Second, as indicated in chapter 6, a relatively small proportion of respondents incur an Omega-3 loss. Further research might help to explain this result, when more consumers have Omega-3 milk as their reference point in the future.

Appendix 3: Post Hoc Estimation for the Unused/Unqualified Data Set

As mentioned in Chapter 3, some unqualified data were not used in the formal analysis in this study. The unqualified data include those respondents who completed the survey too quickly and who did not pass the “trap” questions. Some post hoc estimation are examined by using the unqualified data in this analysis. Although the researcher expected that the unused/unqualified data set is problematic and may provide inconsistent and not robust estimation results, it might be still interesting to conduct a further check. To the researcher’s knowledge, this type of work has been rarely done in the literature.

In the choice experiment section of the survey, two “trap” questions were added to weed out respondents who gave inconsistent or illogical answers. One “trap” question was an asymmetric dominated choice set with a logical answer. The other “trap” question was an identical repeat of an earlier choice set, which was used to check whether a respondent’s answers were consistent. This idea has been mentioned by Fowler (1995), who gave a set of evaluative strategies to find out how well answers to survey questions produce valid measurements in one of his well-known survey research methods textbooks. One of the strategies Fowler recommended was to measure the consistency of answers of the same respondents at two points in time. Fowler (1995) said: “reinterviewing a sample of respondents, asking the same questions twice and comparing the results, can provide useful information about the validity and reliability of answers … when questions pertain to situations or events unlikely to change between the two data collections, differences in answers to the same question can be inferred to imply error.” Using trap questions to flag the problematic respondents was also highly recommended by the marketing research company who administrated the online survey. Therefore, two “trap” questions were used in this study as indicators to enhance data quality. In total, there were 95

(10%) respondents who provided inconsistent or illogical answers to the two “trap” questions. Their data were considered invalid and were removed from the data analysis.

The respondents who completed the survey too quickly are also weeded out, since they may not thoughtfully consider the questions. They may perceive an incentive to complete the questionnaire as quickly as possible and collect the benefits (e.g. sweepstakes). Their approach might be simply to provide the appearance of compliance to minimize effort in responding to surveys (Krosnick and Alwin, 1987 and Krosnick, 1991). Some researchers, such as Malhotra (2008), found that it is problematic to have respondents complete surveys too quickly in self-administrated web surveys since they may not have considered the questions thoughtfully. More specifically, Malhotra (2008) found that low-education respondents who completed the survey most quickly were most prone to primacy effects (bias toward selecting earlier response choices) when completing items with unipolar rating scales. He suggested that extremely quick completion time may be a valuable criterion in filtering out participants or their data. He also suggested that the reported results of statistical models should be robust to the removal of completion time outliers. Galesic and Basnjak (2009) supported the above statements by finding that answers to questions positioned later in surveys were completed faster, shorter and more uniform than those positioned at the beginning.

Considering the length of the survey in this study, based on the pilot study results, respondents can rarely complete the survey less than 15 minutes. Therefore, respondents who completed the survey too quickly (within 10 minutes) were not included in the sample. In total, there were 5% (47 respondents) were found to answer the survey too quickly, which is consistent with Malhotra’s study in 2008.

The followings are some post hoc estimation by using the unqualified data of those respondents who completed the survey too quickly and who did not pass the "trap" questions.

Table Appendix 4(1): Base Model: CL Estimations and WTP Using the Unqualified Data Sample (n = 142)

Variable	**Coefficient**	**t-ratio**	**WTP ($/2 Litres)**	**t-ratio**
Price	-0.842***	-15.641	-	-
Function Claim	**0.056**	**0.274**	**0.066**	**0.274**
Risk Reduction Claim	0.416**	2.066	0.494**	2.058
Disease Prevention Claim	0.706***	3.543	0.838***	3.489
Heart Symbol	0.249***	2.996	0.296***	2.970
Government Verification	0.465***	3.691	0.552***	3.632
Third Party Verification	0.465***	3.568	0.552***	3.537
Omega-3	**0.195**	**1.053**	**0.231**	**1.067**
No Purchase	-4.171***	-20.019	-4.954***	-19.876
Log Likelihood Function = -1204.867; **Pseudo-R^2=0.12**				
*, ** and *** indicate significant at the 10%, 5% and 1% levels, respectively.				

This base model is estimated by using the unqualified data sample, and a similar model has been estimated in Table 5.2 in Chapter 5 by using the qualified data sample. Compared with the results in Table 5.2, one of the major differences is that the coefficients of variable Function Claim and Omega-3 are not significant anymore, indicating respondents in the unused data set do not value the function claim or Omega-3 attributes to be present in milk products. The second important difference is that the Pseudo-R^2 is only 0.12 in this model (0.25 in Table 5.2), indicating that the goodness of fit of this model is poor.

Table Appendix 4(2): Base Model: RPL and WTP Estimates Using the Unqualified Data Sample (n = 142)

Variable	Coefficient	t-ratio	WTP ($/2 litres)	t-ratio
Mean value of Random parameters in utility function				
Omega-3	**1.190*** **	**3.272**	**1.046*** **	**3.347**
Disease Prevention Claim	0.830***	3.351	0.730***	3.321
Government Verification	0.794***	4.799	0.698***	4.858
Mean value of Fixed parameters in utility function				
Price	-1.137***	-14.641	-	-
Function Claim	-0.091	-0.377	-0.080	-0.378
Risk Reduction Claim	**0.352**	**1.512**	**0.309**	**1.505**
Heart Symbol	0.324***	3.392	0.285***	3.414
Third Party Verification	0.561***	3.540	0.493***	3.565
No Purchase	-5.042***	-19.060	-4.433***	-23.631
Standard deviations of random parameters				
Sd-Omega-3	2.879***	9.403	-	-
Sd-Disease Prevention Claim	0.957***	3.970	-	-
Sd-Government Verification	0.560***	1.879	-	-
Log Likelihood Function = -1004.737; **Pseudo-R^2 = 0.36**				
*,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.				

Table Appendix 4(2) presents the results of the base model estimated by the Random Parameter Logit (RPL) model using the unqualified data set. Compared with the results of the CL model in Table Appendix 4(1), according to the LR test of the Log Likelihood Function and the Pseudo-R^2, the goodness of fit of this model has a significant improvement. However, different from the results of the CL model in Table Appendix 4(1), the coefficient of Risk Reduction Claim is not significant anymore and the coefficient of Omega-3 become significant in this RPL model, indicating that respondents in the unused data set prefer Omega-3 attribute and do not value the risk reduction claim to be present on milk products. The results of the two models using the same data set are not consistent. These inconsistent results indicate that the estimation results are not robust for the unused/unqualified data set. As expected, the quality of the unused data set is low and the estimation are not reliable.

Table Appendix 4(3): Socio-Demographic Characteristics of the Participants in the Qualified and Unqualified Data Sample

Demographic Characteristics	Qualified Sample (n = 740)	Unqualified Sample (n = 142)
Age	49.3	43.6
Gender (Female)	67.8%	62%
Size of Household	2.49	2.71
Income (mean)	$58,953	$61,082
Education		
High school or less	35.3%	38%
College certificate or trade diploma	40.7%	38.7%
University Bachelors degree	19.1%	16.2%
University Masters degree or higher	5%	7%

Table Appendix 4(3) shows a comparison of the socio-demographic characteristics of the respondents in the qualified and unqualified data sample. Overall, no significantly statistical differences have been found in these two data samples. However, the differences for characteristics of Age and Gender are borderline significant. The average age is 5.7 years younger and there are 5% more male participants in the unqualified sample. No statistical differences have been found for the characteristics of Income, Education and Size of Household in these two samples.

When taking a close look at the specific answers to survey questions responded by those participants in the unqualified data sample. Quite a few respondents gave the answers that followed certain 'fixed patterns', such as "C,C,…,C,C" and "A,B,A,B,…,A,B". This observation might help to explain that some of the respondents may not thoughtfully consider the questions. Therefore, considering all of above findings, it is necessary to weed out the "noise" data of those respondents who completed the survey too quickly and who did not pass the "trap" questions.

Someone might ask: "how will the estimation look like if combining both the qualified and unqualified data together?" The following estimations are derived from the combined/total data sample.

Table Appendix 4(4): Base Model: CL Estimations and WTP Using the Total Data Sample (n = 882)

Variable	Coefficient	t-ratio	WTP ($/2 Litres)	t-ratio
Price	-1.330***	-50.492	-	-
Function Claim	0.239***	2.621	0.179***	2.619
Risk Reduction Claim	0.609***	6.710	0.458***	6.740
Disease Prevention Claim	0.554***	6.209	0.417***	6.204
Heart Symbol	0.193***	4.872	0.145***	4.864
Government Verification	0.372***	6.493	0.280***	6.472
Third Party Verification	0.346***	6.013	0.260***	6.020
Omega-3	0.285***	3.503	0.215***	3.546
No Purchase	-5.742***	-61.811	-4.317***	-68.130
Log Likelihood Function =-6539.238 ; Pseudo-R^2=0.22				
*, ** and *** indicate significant at the 10%, 5% and 1% levels, respectively.				

Table Appendix 4(4) presents the base CL model which is estimated by using the total data sample. Compared with the results in a similar CL model in Table 5.2 using the qualified data sample, the results in these two models are generally consistent, although the goodness of fit of the model in Table 5.2 is better. However, the results are not consistent with the following RPL estimate.

Table Appendix 4(5): Base Model: RPL and WTP Estimates Using the Total Data Sample (n = 882)

Variable	Coefficient	t-ratio	WTP ($/2 litres)	t-ratio
Mean value of Random parameters in utility function				
Omega-3	1.222***	6.983	0.561***	7.107
Function Claim	**0.116**	**0.881**	**0.053**	**0.880**
Disease Prevention Claim	0.924***	7.241	0.424***	7.290
Heart Symbol	0.300***	5.520	0.138***	5.547
Government Verification	0.944***	9.981	0.434***	10.219
Mean value of Fixed parameters in utility function				
Price	-2.177***	-40.596	-	-
Risk Reduction Claim	0.802***	6.509	0.368***	6.560
Third Party Verification	0.592***	7.087	0.272***	7.183
No Purchase	-8.297***	-49.291	-3.811***	-93.133
Standard deviations of random parameters				
Sd-Omega-3	4.042***	22.665	-	-
Sd-Function Claim	1.030***	8.638	-	-
Sd-Disease Prevention Claim	1.064***	8.729	-	-
Sd-Heart Symbol	0.312**	2.303	-	-
Sd-Government Verification	1.172***	10.170	-	-
Log Likelihood Function =-4915.367; Pseudo-R^2 = 0.50				
*,** and *** indicate significant at the 10%, 5% and 1% levels, respectively.				

Table Appendix 4(5) shows the RPL model using the total data sample. Compared with the results in the RPL model in Table 5.6 using the qualified data sample, the major difference is that the coefficient of variable Function Claim is not significant anymore, indicating in general, the respondents in the total sample do not value the function claim on milk products. In addition, the variable Function Claim has fixed parameters in Table 5.6, but has random parameter with significant standard deviation in table Appendix 4(5), indicating that respondents in the total sample have strong variation in their preference for whether the function claim is present on milk products. Furthermore, compared the results in Table Appendix 4(4), the coefficient of variable

Function Claim is not significant anymore in this model. The results of the two models using the same data set are not consistent, indicating that the results are not robust by using the total data sample, caused by some “noise” data in the unqualified data set. When using the qualified data sample, the estimation results are robust and consistent as shown in Chapter 5. Therefore, it is reasonable for this study to remove those “noise” data from the total data set and use the qualified data sample in the formal analysis.

The above findings should have some important implications to improve data quality and produce valid measurements in terms of web survey methodology.

Appendix 4: The Survey

Dear respondents,

This survey is being conducted by researchers in the Department of Bioresource Policy Business & Economics at the University of Saskatchewan. The purpose of the survey is to examine peoples' food choices including attitudes toward diet and health.

The information collected in this survey will help us to better understand the factors which affect consumers' food consumption and purchase decisions, and how consumers make decisions about foods with different health effects.

Your responses and opinions are very important to us and they will be completely anonymous and confidential. All data will be aggregated and individual respondents will not be identifiable. The information from the survey will be used only for the purposes of academic research. If you have any other questions, please do not hesitate to contact us. Thank you.

Sincerely,

Ningning Zou (Researcher)

Ph.D. Candidate in Department of Bioresource Policy Business and Economics

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[Screener Question 1]

Do you consume (cows) milk at least once per month?	
A.	**Yes**
B.	**No**

[Screener Question 2]

Are you one of the primary food grocery shoppers in your household?	
A.	**Yes**
B.	**No**

Respondents that answer YES to the above 2 questions should proceed with the survey

Those answering 'no' should exit from the survey

Q1. What size of milk do you typically purchase at the grocery store? (Please check all that apply)	
A.	Less than 1 litre carton of milk
B.	1 litre carton of milk
C.	2 litre carton/jug of milk
D.	4 litre jug of milk
E.	Other, please specify_______

Q2. Approximately how much do you usually pay for the milk you typically purchase at the grocery store? (Please complete all that apply)		
A.	Less than 1 litre carton of milk	$_______
B.	1 litre carton of milk	$_______
C.	2 litre carton/jug of milk	$_______
D.	4 litre jug of milk	$_______
E.	Other, please specify_______	$_______

Q3. Approximately how much milk does your household usually purchase in a typical week?
_____________ Litres

Q4. What is the fat level of the milk you typically purchase? (Please check all that apply)	
A.	**0% (Skim)**
B.	**1%**
C.	**2%**
D.	**3.25% (Homo)**

Q5. What is the price of the 2-litre carton of milk you typically purchase? (If you don't often purchase a 2-litre carton of milk, how much would you expect to pay for a 2-litre carton of milk?) $____________ (OR pick from a range below if you are unsure)	
A.	**$1.99 or less**
B.	**$2.00 - $2.99**
C.	**$3.00 - $3.99**
D.	**$4.00 - $4.99**
E.	**$5.00 or more**

Q6. How important are the following when you purchase milk?							
	Not at all Important **1**	**2**	**3**	**4**	**5**	**6**	**Very Important** **7**
A. Price							
B. Additional health Ingredients (e.g. milk enriched with omega-3)							
C. Fat level							
D. Health Claims							
E. Brand							
F. Nutrition							
G. Food Safety							

Choice Experiment

In the next few questions we would like you to imagine that you are in a grocery store buying a 2-litre carton of milk. We are going to show you examples of different types of 2 litre cartons of milk with the following features:

Milk Product Features

Feature	Explanation
1. Additional Ingredient **(Omega3)**	**“Omega3” on the package means the milk product was enriched with Omega-3.**
2.Health Claims	**Some of the milk products feature a health claim.**
3.Verifying Organization **of Health Claims**	**For some of the milk products, an organization has verified that the health claim is accurate. This might be Health Canada (government) OR the Heart and Stroke Foundation (a Third Party organization).**
4. Symbol **on package** 	**Some of the milk products feature a symbol on the package such as a red heart.**
5. Price	**Retail price of a 2-litre carton of milk.**

Here is an example

<table>
<tr><th>Attributes</th><th>Option A</th><th>Option B</th><th>Option C</th><th>Option D</th></tr>
<tr><td>Symbol on Package</td><td rowspan="4">
</td><td rowspan="4">
</td><td rowspan="4">
</td><td rowspan="4">I would not purchase any of these milk products.</td></tr>
<tr><td>Additional Ingredient</td></tr>
<tr><td>Health Claims</td></tr>
<tr><td>Verifying Organization of Health Claims</td></tr>
<tr><td>Price</td><td>$3.59</td><td>$4.49</td><td>$2.69</td><td></td></tr>
<tr><td>Choices</td><td>□</td><td>□✓</td><td>□</td><td>□</td></tr>
</table>

Option A is a 2-litre carton milk **enriched with Omega3**. It has a health claim **“Reduces the Risks of Heart Disease and Cancer”**, verified by the **Heart & Stroke Foundation**. This carton of milk costs $3.59.

Option B is a 2-litre carton milk **enriched with Omega3**. It has a health claim **“Helps to Prevent Coronary Heart Disease and Cancer”**, verified by **Health Canada**. This carton of milk costs $4.49.

Option C is a **carton of 2-litre regular milk** and costs $2.69.

Option D can be selected if you would not buy options A, B, or C.

In this example, option B was chosen.

For the following eight questions, assume that you are shopping in a real store and plan to buy a milk product. You will be asked to choose one option each time. Please do not compare the options on different screens.

Q7. Assume **that the options below are the only milk products available in the grocery store on that shopping trip and that this is the fat level and brand of milk that you typically purchase.** Please choose **ONE** option from the following four choices.

<table>
<tr><th>Attributes</th><th>Option A</th><th>Option B</th><th>Option C</th><th>Option D</th></tr>
<tr><td>Symbol</td><td rowspan="4">
</td><td rowspan="4">
</td><td rowspan="4">
</td><td rowspan="4">I would not purchase any of these milk products.</td></tr>
<tr><td>Ingredient</td></tr>
<tr><td>Health Claims</td></tr>
<tr><td>Verifying Organization of Health Claims</td></tr>
<tr><td>Price</td><td>$4.49</td><td>$2.69</td><td>$1.99</td><td></td></tr>
<tr><td>Choices</td><td>□</td><td>□</td><td>□</td><td>□</td></tr>
</table>

Q15. How much would you expect to pay for a 2-litre carton of milk enriched with Omega-3? $________ (OR – choose from the range below)	
A.	**$1.99 or less**
B.	**$2.00 - $2.99**
C.	**$3.00 - $3.99**
D.	**$4.00 - $4.99**
E.	**$5.00 or more**

Q16. How much would you expect to pay for a 2-litre carton milk enriched with Omega-3?	
A. When the retail price of a 2 litre carton of <u>regular</u> of milk is <u>$2.69</u>	**$____________________**
B. When the retail price of a 2 litre carton of <u>regular</u> of milk is <u>$1.99</u>	**$____________________**
C. When the retail price of a 2 litre carton of <u>regular</u> of milk is <u>$3.59</u>	**$____________________**

Q17. Please tell us about the milk you <u>typically</u> purchase:			
A. Does the milk you typically purchase have a health claim on its package?	Yes	No	I don't know
B. Does the milk you typically purchase have a general health claim on its package? (e.g. 'Good for your heart')	Yes	No	I don't know
C. Does the milk you typically purchase have a risk reduction claim on its package? (e.g. 'Reduces the risk of heart disease')	Yes	No	I don't know
D. Does the milk you typically purchase have a symbol implying a health benefit (e.g. such as a 'red heart') on the package?	Yes	No	I don't know
E. Does the milk you typically purchase have the Heart & Stroke Foundation 'Health check' symbol on its package?	Yes	No	I don't know
F. Is the milk you typically purchase Omega-3-enriched milk?	Yes	No	I don't Know
G. Is the milk you typically purchase enriched with a health ingredient other than Omega-3, such as calcium or probiotics, etc? (please specify________)	Yes	No	I don't Know

Q18. What is the primary dietary source from which you obtain Omega-3? (Please check one only)	
A.	Omega-3 Nutritional Supplement.
B.	Milk enriched with Omega-3.
C.	Other foods containing Omega 3, but not milk.
D.	I rarely consume anything with Omega3.
E.	I never consume anything with Omega3.
F.	I don't know.

The following questions ask about food labels and how you find out information about the food you consume

Q19. Below is a list of statements, please indicate how much you agree or disagree on the scale provided							
	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. I regularly read labels on food I purchase.							
B. I trust nutrition labels on food products.							
C. The health claims on food products are accurate.							
D. I trust new food products.							
E. I pay attention to symbols on food packaging (e.g. a red heart) rather than health claims.							
F. I am a very trusting person.							

Q20. Where do you typically get health information about food products? (Please check all that apply.)		
A.	Professionals, such as doctors, nutritionists, etc.	□
B.	Health organization such as Heart and Stroke Foundation of Canada, etc.	□
C.	Government institution, such as Health Canada, etc.	□
D.	Media, such as TV, newspapers, radio, magazines	□
E.	Books	□
F.	Food labels	□
G.	Food companies/ industry	□
H.	Grocery stores	□
I.	Friends	□
J.	Internet	□
K.	Consumer organizations	□
L.	Other, please specify ___________________	□
RANKING	Please rank the top 3 sources you use most frequently. 1.___________________ 2. ___________________ 3.____________________	

Q21. How much do you trust the following sources for accurate health information?							
	Don't trust at all 1	2	3	4	5	6	Completely Trust 7
A. Professionals, such as doctors, nutritionists, etc.							
B. Health organization such as Heart and Stroke Foundation of Canada, etc.							
C. Government institution, such as Health Canada, etc.							
D. Media, such as TV, newspapers, radio, magazines							
E. Books							
F. Food labels							
G. Food companies/ industry							
H. Grocery stores							
I. Friends							
J. Internet							
K. Consumer organizations							

Q22. Have you ever heard of the term 'functional food'?	
A.	Yes
B.	No
C.	I don't know.

<u>Definition of Functional Foods:</u>

Health Canada (1999) defines that functional foods are similar in appearance to, or may be, a conventional food, consumed as part of a usual diet, and are demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions.

Q23. These are some examples of functional foods. Please indicate how often you consume these products.

	Never Consume	Tried Once or Twice	Occasionall y Consume	Regularly Consume
A. Omega-3 Milk				
B. Milk enriched with Calcium				
C. Omega-3 Eggs				
D. Omega-3 Cheese				
E. Omega-3 Yogurt				
F. Probiotic Yogurt				
G. Juice enriched with Vitamins (e.g. Vitamin C)				
H. Cereals enriched with Minerals (e.g. Calcium)				

Q24. Please indicate how much you agree or disagree with the following statements?							
	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. Functional foods can maintain overall wellbeing and improve long-term health.							
B. Functional foods may reduce the risk of certain chronic diseases.							
C. Functional foods may <u>prevent</u> certain diseases.							
D. Functional foods are necessary for a healthy diet and should be consumed regularly.							
E. I am concerned about whether functional foods are safe.							
F. I am knowledgeable about health and nutrition.							
G. My friends/ relatives ask me for health or nutrition advice.							
H. Cardiovascular disease and cancer are the two leading causes of death in Canada.							
I. Probiotic ingredients help digestive health.							

Q25. Please indicate the extent to which you agree or disagree with the following statements.							
	Strongly Disagree 1	**2**	**3**	**4**	**5**	**6**	**Strongly Agree 7**
A. I often introduce foods to my diet which may provide health benefits.							
B. I often eat foods with added vitamins and supplements.							
C. Eating is a better way to obtain health benefits than taking nutritional supplement like vitamins.							
D. Milk is a good product and I try to include it in my diet.							
E. I often eat a lot of fruit and vegetables.							
F. I often eat foods containing fibre.							
G. I often eat fast food.							
H. I often consume too much fat in my meals.							
I. I often consume too much sugar in my meals.							

Q26. What kind of role do you believe that your diet (i.e. what you eat) plays in your overall health?						
Not important at all 1	**2**	**3**	**4**	**5**	**6**	**Vitally Important** **7**
☐	☐	☐	☐	☐	☐	☐

Q27. How would you describe your current health status?						
Poor 1	**2**	**3**	**4**	**5**	**6**	**Excellent** **7**
☐	☐	☐	☐	☐	☐	☐

Q28. How much control do you believe that you have over your own health?						
No Control at all 1	**2**	**3**	**4**	**5**	**6**	**Complete Control** **7**
☐	☐	☐	☐	☐	☐	☐

Q29. Please indicate whether you suffer from or have a family history of the following health problem(s).		
	yourself	your family members
A. Cancer	□	□
B. Cardiovascular (heart) disease	□	□
C. Diabetes	□	□
D. High blood pressure	□	□
E. High cholesterol	□	□
F. Digestive problems	□	□
G. Immune system deficiency	□	□
H. Osteoporosis	□	□
I. Weight control	□	□
J. Other(Please specify)	__________	___________

Q30. Please indicate how much you agree or disagree on the scale provided							
	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. I try to prevent health problems before I feel any symptoms.							
B. I am concerned that my family history's health problem(s) might happen to me in the future.							
C. I am concerned that I am at risk of developing heart disease or cancer.							
D. I am on a special diet because of my doctor's advice.							

Q31. In general, how much pressure/stress are you normally under?						
No Stress **0**	**1**	**2**	**3**	**4**	**5**	**Lots of Stress** **6**
□	□	□	□	□	□	□

Q32. How often do you exercise?	
A.	**Frequently (4 times per week or more)**
B.	**Often (2 to 3 times per week)**
C.	**Sometimes (once per week)**
D.	**Rarely**
E.	**Never**

Q33. In general, do you think you are:						
Underweight 1	**2**	**3**	**About Right** **4**	**5**	**6**	**Overweight** **7**
□	□	□	□	□	□	□

Q34. Do you smoke?	
A.	Yes
B.	No

Q35. Are you a male or female?	
A.	Male
B.	Female

Q36. In which year were you born? 19 ___ ___

Q37. Please indicate the number of people in your household.						
	0	1	2	3	4	5 or more
A. How many people live with you in your household (Including yourself)?						
B. How many seniors (aged 65 or over) live in your household?						
C. How many children less than 3 years of age live in your household?						
D. How many children older than 3 years of age live in your household?						

Q38. Please indicate the first three digits of your postal code: ___ ___ ___
Or please indicate in which province you are currently living. __________

Q39. Please indicate the highest level of education you have completed.	
A	**High school or less**
B	**College certificate or trade diploma**
C.	**University Bachelors degree**
D.	**University Masters degree or higher**

Q40. For comparison purposes only, which of the following describes your annual household income <u>before</u> taxes?	
A.	**Less than $25,000**
B	**$25,000 to $49,999**
C.	**$50,000 to $74,999**
D.	**$75,000 to $99,999**
E.	**$100,000 to $124,999**
F.	**$125,000 to $149,999**
G.	**$150,000 to $174,999**
H.	**$175,000 or above**

Comments

If you have any questions about this research or wish to be informed about the outcome of the research please contact

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