University of Alberta

Three Essays on Consumer Behavior and Food Risks

by

Yulian Ding

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Agricultural and Resource Economics

Department of Rural Economy

Fall 2010
Edmonton, Alberta

Examining Committee

Michele Veeman, Rural Economy

Wiktor Adamowicz, Rural Economy

Sven Anders, Rural Economy

Denise Young, Economics

Sean Cash, Consumer Science, University of Wisconsin, Madison

Jill Hobbs, Bioresource Policy, Business & Economics, University of Saskatchewan

ABSTRACT

This thesis examines consumer behavior towards food risks in three different papers, focusing on two food concerns: genetically modified (GM) food and bovine spongiform encephalopathy (BSE). The first paper investigates the roles of different measures of trust on consumers' stated choices for functional GM/nonGM canola oil products. These analyses show that consumers' choices for GM/nonGM canola oil are influenced by both generalized trust and trust in food institutions. In general, trusting people are less likely to be in the group of respondents that can be characterized as being anti-GM; trusting people also tend to place a lower discount on the presence of a GM attribute.

The second paper focuses on the modeling of consumers' choices of foods with potential health and risk attributes. The analysis extends the linear compensatory utility model by allowing for use of attribute cutoffs in decision making. We find evidence that attribute cutoffs are commonly used by decision makers. Further, incorporating attribute cutoffs into the modeling of consumers' choices significantly improved the model fit. This paper also examines a potential problem of endogeneity that may be associated with respondents' self-reported cutoffs. Model estimates based on self-reported cutoffs differ substantially from those based on predicted cutoffs (where these are based on respondents' demographic characteristics); potential reasons include the possibility that self-reported cutoffs may be endogenous.

The third paper reports the impacts of habit and trust on consumers' responses to a series of three BSE incidents in Canada. We observe that households' reactions to the first two BSE events followed a similar pattern: households reduced their beef expenditure shares following the BSE announcements, but these subsequently recovered. We find that habit persistence reduced some households' initial negative reactions to the first BSE incident, but that these households modified their beef consumption habits following recurring BSE incidents. Assessing the impacts of trust on households' reactions to these BSE incidents, we find that trust tended to offset the negative effects of recurring BSE cases.

ACKNOWLEDGEMENTS

First and foremost, I want to thank my advisors Michele Veeman and Wiktor Adamowicz for their constant guidance and encouragement. Michele has walked me through all the stages of the writing of my thesis; Vic answered my never ending queries with patience and reason. Without them, I could not have possibly finished this work. I also thank the members of my committee, Dr. Sean Cash, Dr. Denise Young, Dr. Sven Anders, and Dr. Jill Hobbs for their sharp comments and valuable inputs. I would also like to thank Dr. Ellen Goddard for her mentorship.

I am grateful to Genome Canada and Genome Alberta who provided my research funding. I would also like to express my gratitude to Alberta Prion Research Institute, the Alberta Livestock Industry Development Fund, and the Consumer and Market Demand Network for providing funding for some of my research data and associated presentations of some of this work.

I owe thanks to the academic and support staff in the Department of Rural Economy. Thank you for all your help during my entire PhD journey. Thanks are also due to my fellow students. I cherish your company, support and friendship, which make all these years completing my degree amazing.

Finally, my thanks go to my beloved family. For my parents, I cannot thank you enough for what you have done for me. Your constant love and support have truly helped me become the person I am today. For my husband, Wenzhao, please accept my sincere gratitude. Your company makes my entire PhD journey so short and wonderful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1. Introduction

1.1. Background

Food safety and quality have become topical issues in society during the past decade. This may be driven by several factors. On the one hand, past and ongoing food safety incidents, as with bacterial contamination, animal diseases, and issues associated with release of genetically modified (GM) food appear to have fuelled growing public concerns about the safety of food products. Meanwhile, consumers' expectations for food safety and quality seem to be higher than ever before. Consumers may consider many factors to be of importance to food safety and quality, such as previous food safety events, whether a food is produced locally, or organically, or whether genetic engineering has been involved in food production. On the supply side, the food system has been going through substantial structural changes. Current food supply chains can involve many agents and networks, including farmers, processors, distributors, and retailers. It has been argued that the extended food supply chains and increasing global trade in food ingredients and finished food products have heightened the vulnerability of the current food system to food risks (Marsden et al., 2010). Consequently food safety, an issue of public health, is now a major focus on the political agenda worldwide.

Increasing consumer demand for food safety and quality has led to movements by both policy makers and the food industry. In the public sector, efforts have been made by governments on the national and international levels to improve food governance. For instance, the European Union (EU) has developed a food chain approach. This approach enforces a comprehensive set of standards throughout the food chain, from farm to fork, to minimize the potential risks of eating food (Aginam and Hansen, 2008). In the food industry, increasingly traceability is becoming an issue in ensuring quality as food moves through integrated supply chains (Pouliot and Sumner, 2008). Moreover, a growing

number of food companies have responded to issues related to food safety and quality by implementing private food safety standards in order to maintain and gain market shares and to meet growing consumer needs (Henson and Reardon, 2005).

There is evidence that consumer confidence in food safety has been declining in a number of countries due to multiple publicized food safety incidents (e.g., Consumer Reports National Research Center, 2008; Houghton et al., 2008). For example, according to the NPD group, a leading market research company, only 63% of the U.S. consumers agreed with the statement that food sold in supermarkets were safe in 2008 compared to 68% in 2004 (NPD Group, 2009). It has been argued that some consumer responses to food risks have been characterized as irrational and inconsistent with scientific findings (Verbeke et al., 2007). People tend to overestimate risks over which they have no control and underestimate risks related to their personal behaviors (Slovic, 1991). Considering that consumers' food safety perceptions may not always be well informed, some scholars suggest to provide consumers with more information on food safety and quality (e.g., Caswell and Mojduszka, 1996). Others, however, argue that consumers may have difficulty processing complex food safety information (Smith and Riethmuller, 2000). Since consumers' decision making on food safety and quality are crucial for the management of food risks, there is need to improve current understanding of how and why consumers react to food safety issues, what can be done to maintain or rebuild public confidence in food supplies, and how to promote health through improving food safety and quality.

Economic analyses on consumers and food safety have had two main focuses (Böcker, 2002). One concentrates on the impacts of publicized food safety incidents on consumer demand (Böcker, 2002). Examples of studies in this area include the impacts of BSE events on meat demand (Burton and Young, 1996; Peterson and Chen, 2005; Jin and Koo, 2003), the influence of media coverage of biotechnology on consumers' choices for biotech foods (e.g., Kalaitzandonakes et

al. 2004), and consumer responses to food recalls (e.g., Marsh et al., 2004). Previous literature, however, has mainly analyzed consumers' reactions to food scares at the aggregate level. There is growing interest in taking preference heterogeneity into consideration by examining micro-level household data.

A second focus of food safety literature, according to Böcker (2002), is related to cost-benefit analysis of food safety regulations. In general, two approaches have been employed to measure the value of food safety (Roberts and Marks, 1995). Some studies employ the cost-of-illness approach. Examples are Scharff et al (2008), Todd (1989), and Frenzen et al. (2005). The cost of illness approach estimates the social cost of foodborne diseases by aggregating medical costs and productivity losses associated with foodborne diseases (Roberts and Marks, 1995). This approach is simple and concrete, but does not measure society's willingness to pay to reduce food risks (Roberts and Marks, 1995; Hammit and Haninger, 2007). To fill this gap, recent studies tend to use the willingness-to-pay approach to assess consumer demand for increased food safety (e.g., Roberts, 2007; Hammit and Haninger, 2007). On the cost side, some previous studies focus on the impacts of implementing new food safety regulations on food production as well as their administrative costs (Antle, 1999). Economic research has been applied to assess the impacts of new regulations, such as the Hazard Analysis Critical Control Points (HACCP) and traceability, on the food industry (e.g., Antle, 2000; Banterle et al., 2006).

It has been argued that conventional literature related to food safety is somewhat limited in approach given the difficulty for consumers to assess risks associated with food products and their dependence on institutions to guarantee food safety (Lobb, 2005). Due to lack of knowledge, consumers tend to rely on trust in institutions and individuals involved in the food industry to judge food products (Lang and Hallman, 2005). Despite wide-spread recognition of the importance of incorporating trust into the analysis of consumer behavior under risk (Lobb, 2005), there is a limited body of studies linking trust to consumer

behavior in the context of food safety. Further, although multiple and recurring food safety incidents are not new phenomena, how these influence consumers' food purchasing behaviors over time remains largely unexplored.

1.2. Thesis objectives

Food safety incidents and their consequences illustrate the need to understand why and how individuals react to food risks. It is a general objective of this study to contribute to a better understanding of consumer behavior towards food risks. We focus on two areas of food concerns, involving the use of modern agricultural biotechnology to produce genetically modified (GM) food and bovine spongiform encephalopathy (BSE), disease of bovine animals. These involve different types of food risk situations: GM food is associated with issues and concerns that are brought about by technology innovation while concerns about BSE reflect potential risks for human health associated with an animal disease. Despite their differences, both GM food and BSE have caused concerns among many people and have been the subject of a number of studies that have drawn from a range of disciplines. It is expected that increased knowledge of consumers' decision making on GM food and BSE may contribute to a better understanding of the nature of consumer behavior towards food risks and to societal decision making regarding two broad categories of food risks, risks associated with technology innovation and risks associated with animal diseases.

There is increasing interest in links between peoples' food consumption and their health (Siró et al., 2008). Recognition that eating right can improve health, together with new scientific discoveries, has sparked interest in potential markets for functional foods. Functional foods are considered to be "any modified food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains" (Hasler, 2002, p. 3773). The market for functional foods has been growing rapidly (Verbeke, 2005). Modern agricultural biotechnology has the potential to improve particular food characteristics. There is growing interest in improving food quality through biotechnology. However, applying biotechnology

to food production remains a controversial topic in society at large. It is a widely held assumption that lack of trust may partly explain public concerns about GM foods (Gaskell et al., 2004). However, studying the role of trust in decision making is challenging as there is no general agreement on how to define and measure trust. In the first paper, correlations between different measures of trust as well as the influences of these measures of trust on consumers' stated choices are examined in the context of food with a health-related attribute (omega-3) that may be associated with food fortification or genetic modification.

It is the objective of Paper 2 to improve understanding of consumers' decision making processes in the context of how they choose among food products with potential health and risk characteristics. Stated choice experiments have been widely employed to study how consumers trade off different attributes relating to food safety and quality (e.g., Loureiro and Umberger, 2007). In a stated choice experiment, respondents are typically assumed to evaluate all attributes of product alternatives and to trade off between attributes when they choose among alternatives (Hensher et al., 2005). However, some previous literature on decision making suggests that noncompensatory decision strategies are commonly used by decision makers (Elrod et al., 2004; Swait, 2001). In these cases, estimating discrete choice models assuming all attributes have influenced the choice will generate biased estimates (Hensher et al., 2005). This issue is of particular importance in the case of GM food because there seem to be indications that some individuals who strongly wish to avoid GM content may use noncompensatory decision strategies when making their choices. A number of noncompensatory decision strategies involve the use of attribute cutoffs. Using cutoffs, at an initial screening stage consumers simplify their decision making by excluding alternatives that do not surpass attribute cutoffs and then choose only from the remaining alternatives (Huber and Klein, 1991). Paper 2 allows use of attribute cutoffs in decision making and incorporates attribute cutoffs into the modeling of consumers' choices for GM/nonGM foods. Moreover, we examine the potential

endogeneity of attribute cutoffs by using instrumental variables in model estimation.

In Paper 3, attention is focused on how consumers adjust their consumption patterns over time in response to multiple and recurring food safety incidents. Consumers' responses to BSE outbreaks have been intensively studied in many nations (e.g., Burton and Young, 1996; Maynard et al., 2008). However, the recurrence associated with BSE incidents has received little attention. Nor has the role of consumption habits and trust in shaping consumers' reactions to multiple and recurring BSE cases been examined. Paper 3 links habit persistence and trust to recurring BSE incidents in Canada by examining the dynamics of beef expenditure shares of selected Canadian households before and after these BSE incidents.

1.3. Thesis overview

In Chapters 2 and 3, consumers' stated preferences are examined in the context of functional GM/nonGM canola oil products. In Chapter 2 (Paper 1), the interrelationships between different measures of trust and the roles of these trust measures on consumers' food choices are analyzed. In Chapter 3 (Paper 2), consumers' stated choices for GM/nonGM canola oil products allowing use of attribute cutoffs in decision making are modeled and assessed. In Chapter 4 (Paper 3), revealed preference data are employed to study Canadian households' responses to the first three BSE incidents in Canada and the impacts of habit and trust on consumers' reactions. The overall conclusions and some potential extensions of this thesis research are outlined in Chapter 5.

References

Aginam, O. and C. Hansen. 2008. Food safety and trade liberalization in an age of globalization. United Nations University, *Policy Brief*, Number 6, 2008. http://www.ciaonet.org/pbei/unup/0010063/f_0010063_7806.pdf. Accessed 5 April 2010.

Antle, J.M. 2000. No such thing as a free safe lunch: the cost of food safety regulation in the meat industry. *American Journal of Agricultural Economics* 82: 310-322.

Antle, J.M. 1999. Benefits and costs of food safety regulation. *Food Policy* 24: 605-623.

Banterle, S., S. Stranieri, and L. Baldi. 2006. Voluntary traceability and transaction costs: an empirical analysis in the Italian meat processing supply chain. Paper prepared for presentation at the 99th EAAE seminar 'Trust and Risk in Business Networks', Bonn, Germany, February 8-10, 2006.

Böcker, A. 2002. Consumer response to a food safety incident: Exploring the role of supplier differentiation in an experimental study. *European Review of Agricultural Economics* 29(1): 29-50.

Burton, M. and T. Young. 1996. The impact of BSE on the demand for beef and other meats in Great Britain. *Applied Economics* 28(6): 687-693.

Caswell, J.A. and E.M. Mojduszka. 1996. Using information labeling to influence the market for quality in food products. *American Journal of Agricultural Economics* 78(5): 1248-1253.

Consumer Reports National Research Center. 2008. Food-Labelling Poll 2008: Final tables. November 11, 2008. NRC #2008.18. http://www.greenerchoices.org/pdf/foodpoll2008.pdf. Accessed 18 April 2010.

Elrod, T., R.D. Johnson, and J. White. 2004. A new integrated model of noncompensatory and compensatory decision strategies. *Organizational Behavior and Human Decision Processes* 95(1): 1-19.

Frenzen, P.D., A. Drake, and F.J. Angulo. 2005. Economic cost of illness due to Escherichia coli O157 infections in the United States. *Journal of Food Protection* 68 (12): 2623-2630.

Gaskell, G., N. Allum, W. Wagner, N. Kronberger, H. Torgersen, J. Hampel, and J. Bardes. 2004. GM foods and the misperception of risk perception. *Risk Analysis* 24(1): 185-194.

Hammitt, J.K. and K. Haninger. 2007. Willingess to pay for food safety: Sensitivity to duration and severity of illness. *American Journal of Agricultural Economics* 89(5): 1170-1175.
Hasler, C.M. 2002. Functional foods: Benefits, concerns and challenges–A position paper from the American Council on Science and Health. *The Journal of Nutrition* 132: 3772-3781.

Hensher, D.A., J. Rose, and W.H. Greene. 2005. The implication on willingness to pay of respondents ignoring specific attributes. *Transportation* 32: 203-222.

Henson, S. and T. Reardon. 2005. Private agri-food standards: Implications for food policy and the agri-food system. *Food Policy* 30: 241-253.

Houghton, J.R., G. Rowe, L.J. Frewer, E. van Kleef, G. Chryssochoidis, O. Kehagia, S. Korzen-Bohr, J. Lassen, U. Pfenning, and A. Strada. 2008. The quality of food risk management in Europe: Perspectives and priorities. *Food Policy* 33(1): 13-26.

Huber, J. and N.M. Klein. 1991. Adapting cutoffs to the choice environment: The effects of attribute correlation and reliability. *The Journal of Consumer Research* 18(3): 346-357.

Jin, H. J. and W. W. Koo. 2003. The effect of the BSE outbreak in Japan on consumers' preferences. *European Review of Agricultural Economics* 30(2): 173-192.

Kalaitzandonakes, N., L.A. Marks, and S.S. Vickner. 2004. Media coverage of biotech foods and influence on consumer choice. *American Journal of Agricultural Economics* 86(5): 1238-1246.

Lang, J. T., and W.K. Hallman. 2005. Who does the public trust? The case of genetically modified food in the United States. *Risk Analysis* 25(5): 1241-1252.

Lobb, A. 2005. Consumer trust, risk and food safety: A review. *Food Economics-Acta Agriculturae Scandinavica*, Section C, 2(1): 3-12.

Loureiro, M.L. and W.J. Umberger. 2007. A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. *Food Policy* 32: 496-514.

Marsden, T., R. Lee, A. Flynn, and S. Thankappan. 2010. *The new regulation and governance of food*. Routledge, New York.

Marsh, T.L., T.C. Schroerder, and J. Mintert. 2004. Impacts of meat product recalls on consumer demand in the USA. *Applied Economics* 36: 897-909.

Maynard, L.J., E. Goddard, and J. Conley. 2008. Impact of BSE on beef purchases in Alberta and Ontario quick-serve restaurants. *Canadian Journal of Agricultural Economics* 56 (3): 337-351.

NPD Group. 2009. NPD finds most American agree foods from supermarkets are safe but percentage is slipping. http://www.npd.com/press/releases/press_090330.html. Accessed 8 May 2010.

Peterson, H. H. and Y. Chen. 2005. The impact of BSE on Japanese retail meat demand. *Agribusiness* 21(3): 313-327.

Pouliot, S. and D.A. Sumner. 2008. Traceability, liability, and incentives for food safety and quality. *American Journal of Agricultural Economics* 90(1): 15-27.

Roberts, T. 2007. WTP estimates of the societal costs of U.S. food-borne illness. *American Journal of Agricultural Economics* 89(5): 1183-1188.

Roberts, T. and S. Marks. 1995. Valuation by the cost of illness method: The social costs of Escherichia coli O157: H7 foodborne disease. In *Valuing Food Safety and Nutrition,* edited by J.A. Caswell, pp. 173-205. Westview Press, Boulder, Colorado.

Scharff, R.L., J. McDowell, and L. Medeiros. 2008. Economic cost of foodborne illness in Ohio. *Journal of Food Production* 72(1): 128-136.

Siró, I., E. Kápolna, B. Kápolna, and A. Lugasi. 2008. Functional food, product development, marketing and consumer acceptance–A review. *Appetite* 51: 456-467.

Slovic, P. 1991. Beyond numbers: A broader perspective on risk perception and risk communication. In *Acceptable evidence: Science and values in risk management,* edited by D.G. Mayo and R.D. Hollander, pp. 48-65. Oxford University Press, New York.

Smith, D. and P. Riethmuller. 2000. Consumer concerns about food safety in Australia and Japan. *British Food Journal* 102(11): 838-855.

Swait, J. 2001. A non-compensatory choice model incorporating attribute cutoffs. *Transportation Research Part B: Methodological* 35(10): 903-928.

Todd, E.C.D. 1989. Cost of acute bacterial foodborne disease in Canada and the United States. *International Journal of Food Microbiology* 9(4): 313-326.

Verbeke, W., L.J. Frewer, J. Scholderer, and H.F. De Brabander. 2007. Why consumers behave as they do with respect to food safety and risk information. *Analytica Chimica Acta* 586: 2-7.

Verbeke, W. 2005. Consumer acceptance of functional foods: Socio-demographic, cognitive and attitudinal determinants. *Food Quality and Preference* 16(1): 45-57.

CHAPTER 2. The roles of generalized trust and trust in the food system on consumers' food choices

2.1. Introduction

Trust plays an important role in individual's decision making in situations involving risk and uncertainty (Lewis and Weigert, 1985). According to Luhmann (1979), the role of trust is to reduce complexity. By providing internal security, trust allows a risk-taking decision to be made in a simple way, and is considered a functional strategy to reduce complexity under risk (Lewis and Weigert, 1985). A negative relationship between trust and perceived risk has been documented by literature on responses to risk (e.g., Sjöberg, 2001; Siegrist and Cvetkovich, 2000), although the range of these correlations varies widely (Sjöberg and Herber, 2008). There is growing interest in understanding the role of trust in studies of consumer behavior towards food risks.

In spite of growing interest in the role of trust, there is no general agreement from various trust-related studies on how to interpret the concept of trust. Some authors conceive of trust as a generalized expectancy which an individual develops through various personal experiences and which remains stable over one's lifetime (e.g., Rotter, 1967; Couch and Jones, 1997). In contrast, others argue that trust is situation-specific and situational differences have greater impacts on behavior than does personality differences (e.g., Driscoll, 1978; Mischel, 1968). In the economic literature, much work has focused on the study of generalized trust and institutional trust. Generalized trust, according to Uslaner (2008, p104), "is based on the world view that 'most people can be trusted' ". Institutional trust, as another type of trust, reflects one's confidence in institutions (Luhmann, 1979). Most studies on trust and food risks are directed towards the impacts of trust in institutions, including trust in information sources, on consumers' reactions (e.g., Lobb et al., 2007) and trust in the regulatory system (e.g., Lang and Hallman, 2005). To date, little research has examined

incorporating generalized trust into studies of consumers' behavior towards food risks. Nor has the relationship between generalized trust and trust in institutions involved in the food system been examined. This study investigates these issues in the context of food with health-related attributes (omega-3 content) that may be associated with fortification or genetically modified (GM) ingredients.

We choose to study generalized trust and institutional trust in the context of GM food for several reasons. First, there is ongoing debate and skepticism surrounding GM food. On the one hand, the biotechnology industry emphasizes the potential of biotechnology to improve nutritive components of food. On the other hand, international environmental NGOs and others are concerned about safety and other impacts of GM food (OECD, 2000). Consumers face conflicting information from different sources and the consequences for health and the environment of agricultural biotechnology continues to be contested in public debate. Trust comes into play in situations involving contested interests and controversy about expertise (Clarke, 1999). Given uncertainties associated with GM food, we expect that an individual's generalized trust, which partly reflects his/her world view, will affect his/her response to GM food.

Further, most consumers have little knowledge of GM food and cannot rely on personal experience to evaluate this but are "forced to substitute trust for knowledge" (Lang and Hallman, 2005, p1242). Modern food supply chains involve many agents and networks in a complex system. The long length of time and the large numbers of actors involved in food production and marketing can make it difficult to assure the safety of food products. It is possible that at least some consumers' confidence in the food system is declining in the light of recent high profile food safety incidents that have been evident worldwide (De Jonge et al., 2004). This might also affect consumers' acceptance of GM food. In the light of these influences, we expect that both generalized trust and trust in the food system will influence consumers' purchasing decisions on GM food. We also

postulate that people who are less trusting in general will also exhibit lower levels of trust in institutions

2.2. Literature review

2.2.1 The varieties of trust

Uslaner (2002) has provided an in-depth discussion of the meaning of trust. Uslaner maintains that there are two types of trust: moralistic trust, which remains stable over time and does not depend on personal experiences, and strategic trust, which is based on experience and is fragile (Uslaner, 2002). It is held that "Moralistic trust is a value that rests on an optimistic view of the world and one's ability to control it" (Uslaner, 2008, p. 103). Other scholars hold a similar view, that trust has a moral foundation (e.g., Mansbridge, 1999; Yamigishi and Yamigishi, 1994). Mansbridge (1999) uses the term 'altruistic trust', while Yamigishi and Yamigishi (1994) refer to 'general trust'. Unlike moralistic trust, "strategic trust reflects our expectations about how people will behave" (Uslaner, 2002, p. 23).

Generalized trust, which measures a person's belief that 'most people can be trusted', is mainly seen to be moralistic trust (Uslaner, 2002). Uslaner also holds that although generalized trust is somewhat affected by experience, its major foundation is one's moral values (Uslaner, 2002). Supporting this view, the examination by Uslaner (2001) of two panel surveys (the 1972-74-79 American National Election Study and the 1965-1973-1982 Parent-Child Socialization study), concluded that generalized trust was stable over time. In another study Glaeser et al. (2000) found that current trusting behavior was positively related to past trusting behavior, suggesting the existence of a relatively stable component of trust. However, the concept of trust applied in most economic studies refers to strategic trust (Soroka et al., 2007). Soroka et al. (2007) examined the correlation between generalized trust and trust in the context of a lost wallet. These researchers found weak linkages between generalized trust and specific trust (viewed as trust in a specific situation) (Soroka et al., 2007). Soroka et al. (2007)

also concluded that generalized trust is closely related to cultural learning, while specific trust is more related to personal experiences.

A substantial body of the literature on trust distinguishes between interpersonal trust and trust in institutions (Newton, 2007). Even so, Uslaner (2008) holds that institutional trust is also strategic trust, since people evaluate institutions based on their past experiences. The importance of institutional trust in societal risk management has been widely acknowledged in the risk literature (Poortinga and Pidgeon, 2003). Trust in institutions has been found to be negatively related to perceived risks in several circumstances, such as the acceptance of gene technology (Siegrist, 2000) and support of nuclear power (e.g., Siegrist et al., 2000). Lewis and Weigert (1985, p. 969) argue that "the primary function of trust is sociological". According to Lewis and Weigert (1985), trust as a social experience has cognitive, emotional and behavioral dimensions. Modern society has a complicated structure and social interactions often take place between people who do not know each other well (Lewis and Weigert, 1985). As a result, it is argued that social order is largely based on system trust, rather than personal trust (Lewis and Weigert, 1985). The relationship between generalized trust and institutional/political trust has also been examined in the political science literature, demonstrating evidence that these two types of trust are related (e.g., Hall, 1999). Regarding the explanation of the correlation between generalized trust and institutional trust, some argue that generalized trust predicts institutional trust, while others suggest the reverse causality (Rothstein and Stolle, 2002).

2.2.2 The measurement of trust

The attitudinal question "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" has been widely used to measure generalized trust in economic literature (e.g., Glaeser et al., 2000). Surprisingly, the meaning of this question has received little attention. Glaeser et al. (2000) view this as an interesting but vague question. Uslaner (2002)

argues that this question measures generalized trust well since no context is imposed on it. Smith (1997), however, finds answers to the generalized trust question to be sensitive to questionnaire context effects, which can bias people's judgment of this question. The importance of trust in strangers as a measure of generalized trust has been emphasized by numbers of scholars, including Uslaner (2002), Eisenberg (2002) and Glaeser et al. (2000). Eisenberg argues that trust between strangers is important for all social relations and is close to Uslaner's 'moralistic trust' (Eisenberg 2007; Uslaner, 2002). Glaeser et al. (2000) examined the explanatory power of attitudinal questions on trust in predicting trusting and trustworthy behaviors in standard trust games[1]. They found that attitudinal measures of trust predicted trustworthy behavior rather than trusting behavior (Glaeser et al., 2000). Trust in strangers was considered to reflect generalized trust well by both Uslaner (2001) and Glaeser et al. (2000). Glaeser et al. (2000) noted that behavioral measures of generalized trust are rare in the existing literature although it would be desirable to have some such indicators.

Institutional trust is of particular importance given the prominence of organizations and institutions in modern society (Lang and Hallman, 2005). The main function of trust, as suggested by Luhmann (1979), is to reduce complexity and to facilitate modern society to handle uncertainty. Some scholars argue that in modern society trust is no longer bestowed and needs to be earned by institutions (e.g., Giddens, 1990). Although the importance of institutional trust has been well recognized, the measurement of trust in institutions remains a challenging task. Institutional theories suggest that trust in institutions is based on people's judgment of institutional performance (Mishler and Rose, 2001). Satisfactory performance generates trust in institutions while untrustworthy performances cause skepticism and distrust (Mishler and Rose, 2001). The World Values Survey (WVS) and the General Social Survey (GSS) measure institutional trust as a one-dimension concept by asking respondents to rank their confidence in certain

[1] See Glaeser et al. (2000) for the design of trust games. Trusting behavior refers to how much money the senders choose to send to the receivers. Trustworthiness is measured by the amount of money returned by the receivers.

institutions on a scale, from " a great deal of confidence" to "hardly any confidence at all". However, some scholars argue that trust is a multidimensional concept (e.g., Frewer et al., 1996; Siegrist et al., 2005). For example, Frewer et al. (1996) studied consumer trust in different information sources in the context of food risks. These researchers concluded that two factors affected trust, one related to accuracy and caring and the other related to distortion (Frewer et al., 1996). Peters et al. (1997) suggested that 'knowledge and expertise', 'openness and honesty' and 'concern and care' are three dimensions of trust in environmental risk communication. Lang and Hallman (2005) measured trust in institutions based on four dimensions: competence, transparency, public interest and honesty. Although the measurements of trust vary among empirical studies, it seems that competency, honesty and public interest are the most common factors used in empirical studies.

2.2.3 Trust and GM food

The importance of trust in determining consumers' reactions to GM food has been widely acknowledged (Costa-Font et al., 2008). Several analyses have investigated who consumers trust for information on GM food (e.g., Huffman, 2003) and how consumers' trust in different institutions influences their acceptance of and willingness to pay for GM food (e.g., Christoph et al., 2006; Hossain and Onyango, 2004). A number of studies found trust in institutions to be an important factor determining consumers' acceptance of GM food (e.g., Govindasamy et al., 2004; Siegrist, 2000). Using United States survey data, Hossain and Onyango (2004) found consumers' acceptance of GM food with enhanced nutrients to be significantly affected by their trust in scientists' expertise on biotechnology and in government's will to take care of the public interest. Others, however, argue that there is no strong connection between trust and risk perception of GM food. For example, Poortinga and Pidgeon (2005) contend that whether people accept GM food or not is largely determined by their general view towards GM food rather than their trust in the government's ability to regulate GM food. Christoph et al. (2006) related trust to consumers' attitudes towards and

willingness to pay for GM food. These authors concluded that while trust in scientists, government regulations and the food industry significantly affected consumers' stated attitudes towards GM food, there was no evidence that they also affected consumers' purchasing decisions, as exhibited in a choice experiment (Christoph et al., 2006). However, other scholars have concluded that people who are less trusting in government, firms and scientists are less likely to purchase GM food (Soregaroli et al., 2003; Onyango, 2003). The current study adds to the limited literature on how trust may affect consumers' purchasing behavior regarding GM food. Moreover, we incorporate generalized trust into the study of consumer decision-making on GM food by examining the correlation between generalized trust and trust in the food system as well as the impacts of both generalized trust and trust in the food system on consumers' choices for GM food.

2.3. Data

Data for this study were collected through a Canada-wide internet-based survey that was conducted in the form of a marketing assessment involving stated choices of canola oils with selected attributes. Canola oil was identified as the product focus since this is commonly consumed by Canadian households and allows avoidance of biases associated with product unfamiliarity. Furthermore, canola is Canada's major oilseed crop and canola oil has been widely used as an ingredient in food products.

Following development of an initial draft questionnaire focused on the questions of interest, this was assessed by two focus groups of members of the public conducted in February 2009 recruited through the Population Research Laboratory (PRL) at the University of Alberta. The recruited sample consisted of people who were 18 years or older; did more than 50% of household grocery shopping; and bought canola oil from time to time. The purpose of the focus group discussion was to consider the attributes of a canola oil product and to gain opinions and comments on the form and presentation of the draft questionnaire.

Four attributes were considered as important factors affecting consumers' choices of a canola oil product. These are price, country of origin, omega-3 content and GM/non-GM derivation. Following revision of the initial draft, a professional marketing company was contracted to provide samples for pretests of the questionnaire and to draw a final sample of 1,000 respondents from the company's Canada-wide consumer panel that would be reasonably representative of the Canadian grocery shopping population. To test the validity of the survey design and the levels of the attributes which described alternative products, two pre-tests of the revised draft survey were conducted in June and July 2009. Levels of prices were adjusted based on analysis of the first pre-test data set. The final survey was formally implemented during July to August 2009.

The questionnaire is attached in Appendix A. The survey contains five sections. The first of these queries different measurements of generalized trust. These include attitudinal questions adopted from the GSS and questions that had been designed by Glaeser et al. (2000) which measure trust in strangers and past trusting behaviors. A second section questions respondents' preferences for the various food attributes. This component of the survey will be discussed in detail in the next chapter. The third section of the survey simulates market purchases using a stated choice experiment. The attributes and levels of each attribute are presented in table 2.1. The survey uses a fractional factorial design which considers both main effects and two-way interactions between attributes. Each choice set consists of three options: two canola oil products and a 'no purchase' option. The experimental design generated a total of 48 choice sets. These were blocked into 8 segments with 6 choice questions in each segment. The fourth section of the survey queries trust in four institutions involved in the food system (government, farmers, manufacturers and retailers) in the context of food safety. These rating questions on trust included six queries for each institution that were designed by De Jonge (2008). This approach measures trust on three dimensions: competency, honesty and public interest and has been demonstrated to be valid by De Jonge (2008). In addition to collecting information on respondents' health

beliefs and behaviors, risk perceptions and demographic characteristics were also obtained in the last sections of the questionnaire.

Internet-based surveys drawn from a marketing panel have several advantages compared with mail or telephone surveys. In general, internet surveys are more cost-effective and more efficient in terms of data collection and processing. In this study, respondents viewed pictures that depicted canola oils and their labels, and the computer technology readily enabled randomized choice questions, as required by the experimental design, and the survey was applied on a national basis. It would be difficult to apply a realistic choice experiment through telephone survey and mail surveys tend to have low response rates. The disadvantage of use of an internet survey drawn from a marketing panel is that this excludes people who have no access to internet. However, this limitation is tempered by the popularity of internet usage among Canadians. According to Statistics Canada (2008), 73% of the Canadian population used internet in 2007. A recent Ipsos Reid survey indicated that about 82% of Canadians had internet access at home in 2009 (Ipsos Canada, 2009).

The recruitment for and application of the final survey were carried out by a marketing company that has a representative Canadian consumer panel composed of 80,000 households with over 150,000 individuals. Two rounds of invitations were sent to the panelists by the company's Online Project team. A total of 2,857 panelists participated in the survey with full completion of 1,009 surveys. Tables 2.2a-c allow comparison of the demographic characteristics of the sample that completed the survey with the Canadian population. Table 2.2a shows the distributions of different age groups for the sample and the Canadian population. The sample consists of people who are at least 18 years old and can be compared with Statistics Canada's Census year data (for 2006) on the Canadian population 18 years and over. Relative to age, the sample is slightly biased towards older people compared with the general adult population. The proportion of people with some college education and above in the sample is higher than is the case for the

Canadian population aged 20 years and over[2]. The geographic distribution of survey respondents is similar to that of the Canadian population. Comparing income levels between the sample and the Canadian population: the sampled respondents have an average household income of $61,751.15, slightly lower than the average household income of $69,548 suggested by the 2006 Canadian Census (Statistics Canada, 2006 Census (d)). Regarding gender distribution, there are more females than males in the sample, 58.4% versus 41.6%. However, given that the survey focuses on food consumption and women tend to do more of the household grocery shopping, this is considered to be relatively realistic. Overall, the sample is judged to match observable characteristics of the Canadian population reasonably well.

2.4. Testing correlations between different trust measures

The correlation between the two types of trust, generalized trust and trust in institutions in the context of food safety, is examined to test the hypothesis that people who have less trust in people in general also exhibit lower levels of trust in institutions. The empirical measure of generalized trust that is employed mainly relies on the attitudinal question "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (we term this "the trust question") However, although this question is widely cited, it is difficult to interpret, as are respondents' answers to this question (Glaeser et al., 2000). In consideration of this concern, following Glaeser et al. (2000), the survey includes not only this question, but also two other queried attitudinal questions from the GSS to measure people's confidence in other people. These are "Do you think most people would try to take advantage of you if they got a chance, or would they try to be fair?" ("fair question"), and "Would you say that most of the time people try to be helpful, or that they are mostly just looking out for themselves?" ("help question"). Answers to these three GSS attitudinal questions are summarized in figure 2.1. Figure 2.1 shows that the majority of the survey

[2] We compare a measure of education levels of the sample with that for Canadian population of 20 years age and over, in the nearest census year, due to lack of national data on the education levels for the population 18 years and over in the study period.

respondents (576 out of 1,009) express the belief that one 'can't be too careful in dealing with people'. Meanwhile, almost the same number of people stated that most people would try to be fair and helpful. In addition to these GSS questions, we also applied several questions developed by Glaeser at al. (2000) to measure people's trust in strangers and their previous trusting behaviors. Trust in strangers has been suggested as a good proxy for generalized trust (Uslaner, 2001) and questions about one's past trusting behaviors are used in the literature as behavioral measures of generalized trust (e.g., Glaeser et al., 2000). Respondents' answers to questions on trust in strangers and past trusting behaviors are given in tables 2.3 and 2.4 respectively. As can be seen in table 2.3, only a small proportion of respondents indicated disagreement with the statement "You can't trust strangers anymore" (3.9% strongly disagree and 22.9% somewhat disagree). Table 2.4 shows how often people lend money or personal possessions to friends. In general, people lend personal possessions to friends more often than they lend money. About 10% of respondents stated that they always lend personal possessions to friends when they ask, while only 5% said they always lend money to friends.

The correlations between these different measures of generalized trust, measured by Spearman's correlation coefficients since the data are ordinal form, are shown in table 2.5. We find that these different measurements of generalized trust are all correlated to at least some degree. There is a strong association between two past trusting behaviors, lending money and lending possessions. We also observe that a relatively strong correlation exists between having trust in strangers and generalized trust as measured by the three GSS questions (trust, fair, and help).

Recent high profile incidents of food scares and their consequences have sparked interest among scholars in assessing consumers' trust in the food system. However, there is no consensus on how to measure trust in the food system. The current food system has a complex structure, which involves many institutions

and individuals. In this study, we focus on four such agents: the government, farmers, food manufacturers and food retailers. These are frequently cited in the risk literature as important actors in the food system, with the government as a regulator of food safety, farmers and manufacturers as food producers, and retailers as the sellers of food products to consumers. We measure consumers' trust in these four groups from a viewpoint of three dimensions: their competency, honesty and actions in the public interest. Following De Jonge (2008), trust in each group was measured by responses to six statements that relate to the three dimensions. Respondents were asked to indicate their agreements/disagreements with each statement using a Likert scale (1='strongly agree' to 5='strongly disagree'). The overall trust score for each institution was calculated by adding up rating scores across all six items for each respondent. Figure 2.2 compares survey respondents' expressions of trust in different institutions in the food system based on the means of the trust scores for each institution, averaged across survey respondents. By their construction, a smaller number indicates a higher level of trust. In general, the average scores for respondents' trust in different agents in the food system do not differ very much. The mean scores vary from 16.1 (trust in farmers) to 19.38 (trust in retailers), indicating that farmers are the most trusted among the four agents examined in this study while retailers are the least trusted. Table 2.6 presents the correlations between trust in different institutions in the food system; these indicate that the measures of trust in different agents are correlated, which is not surprising since the agents are all involved in the same system and consumers' trust in each agent may reflect, to some extent, their trust in the food system overall.

We proceed to relate generalized trust to trust in different institutions and trust in the food system overall [3]. Table 2.7 shows that the correlations between generalized trust (measured by the trust question only) and trust in institutions are significantly positive, which suggests that people who tend to trust others also

[3] Trust in the food system overall is measured by adding up individual's rating scores for trust in government, farmers, manufacturers and retailers.

express more trust in the food system. To further assess the relationship between generalized trust and trust in institutions expressed by respondents, we divide the sample into two groups, based on answers to the generalized trust question. One group consists of people who believe that "most people can be trusted" while the other group includes people who chose the response "can't be too careful in dealing with people". Comparison of responses between these two groups suggests that people who are less trusting in others score higher in their rating scores for trust in food institutions and the differences in the rating scores between the trusting group and the less trusting group are statistically significant, suggesting that people who are less trusting in general also exhibit lower levels of trust in institutions and in the food system (see table 2.8).

2.5. Trust and consumers' food purchasing behaviors

We proceed to integrate the survey questions on trust with consumers' stated food purchasing behavior in the context of GM/non-GM canola oils. It has been documented that individual consumers differ considerably in their acceptance of GM foods (e.g., Hu et al., 2004). Some refuse to purchase GM food products while others are not at all concerned about GM food (Siegrist et al., 2005). Given uncertainties surrounding gene technology, it is reasonable to postulate that differences in trust may account for some of the intrapersonal differences in consumers' reactions to GM food. We expect that generalized trust plays a role in consumers' decision making on GM food given that generalized trust is "a value that rests on an optimistic view of the world and one's ability to control it" (Uslaner, 2008, p103). Thus, consumers' responses to GM food may be shaped by whether or not they hold an optimistic view of the world. However, GM-derived food has been categorized by critics as food products that may have uncertain health effects. Thus, it can also be expected that consumers' purchases of GM food may be influenced by whether or not they trust the food system to guarantee the safety of their food product purchases. We test these hypotheses in the framework of random utility theory using both latent class (LC) models and conditional logit (CL) econometric models. We commence the analysis using LC

models to investigate how trust affects consumers' membership of market segments which are composed of individuals that have similar behaviors, and proceed to examine further the relationship between trust and the GM attribute in the stated choices made by survey respondents, using the standard approach of CL modeling of interacting various measures of trust with the GM attribute.

2.5.1 Econometric models and results

2.5.1.1 Econometric models

In this study, survey respondents faced choices among different canola oil products. Each choice set consisted of three alternatives, two canola oils and a 'no purchase' option. The model postulates that individual (n) obtains a certain level of utility (U_{nj}) from choosing oil j. According to random utility theory, U_{nj} is modeled as $U_{nj}=V_{nj}+\varepsilon_{nj}$, where V_{nj} is a function of the attributes of oil j (x_j) and the attributes of the individual (z_n), and ε_{nj} denotes a random component of the utility function. The probability that individual n chooses oil i over oil j is:

$$\begin{aligned} P_{ni} &= \text{Prob}\,(U_{ni} > U_{nj} \quad \forall i \neq j) \\ &= \text{Prob}\,(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \ \forall i \neq j) \end{aligned} \qquad (1)$$

Assuming that the error terms are independently, identically distributed (iid) extreme values, and a linear relationship applies between V_{nj} and x_j, the conditional logit choice probability of individual n choosing oil i takes the form:

$$P_{ni} = \frac{e^{\beta' x_i}}{\sum_j e^{\beta' x_j}} \qquad (2)$$

where β is a vector of parameters to be estimated. Relative to the conditional logit (CL) model, the mixed logit model is more flexible and can accommodate a wide range of taste variation among consumers (Train, 2003). As a special case of the mixed logit model, the latent class (LC) model assumes the existence of several segments in the population where each segment has its own preferences. Assume

there are m segments, so β takes m specific values, $\beta_1, \cdots \beta_m$. Denote the probability of individual n in segment m as s_{nm}. Equation (2) becomes:

$$P_{ni} = \sum_{m=1}^{M} s_{nm} \left(\frac{e^{\beta_m' x_i}}{\sum_j e^{\beta_m' x_j}} \right) \quad (3)$$

Following Boxall and Adamowicz (2002), consider that the probability that individual n belongs to segment m is determined by a latent function G_{nm}^{*}. The factors that influence an individual's membership in segments are the individual's socioeconomic characteristics (Z_n) which are observable. We specify G^{*}_{nm} as a linear function of Z_n as follows:

$$G^{*}_{nm} = \lambda_m' Z_n + \xi_{nm} \quad (4)$$

where λ_m is a vector of parameters and ξ_{nm} is an error term. Following Boxall and Adamowicz (2002), we assume that the error terms in equation (4) follow an iid extreme value distribution. Then the probability of individual n being in segment m is:

$$s_{nm} = \frac{e^{\lambda_m' Z_n}}{\sum_{m=1}^{M} e^{\lambda_m' Z_n}} \quad (5)$$

With s_{nm} as the probability that individual n belongs to segment m, $0 \le s_{nm} \le 1$ and $\sum_{m=1}^{M} s_{nm} = 1$. Substituting equation (5) into equation (3), the probability of individual n choosing oil product i is given by:

$$P_{ni} = \sum_{m=1}^{M} \left[\frac{e^{\lambda_m' Z_n}}{\sum_{m=1}^{M} e^{\lambda_m' Z_n}} \right] \left[\frac{e^{\beta_m' x_i}}{\sum_j e^{\beta_m' x_j}} \right] \quad (6)$$

Instead of grouping consumers based on their observable characteristics, the LC approach provides a way both to understand heterogeneous preferences based on consumers' choices and to relate the identified heterogeneous preferences to observable consumer characteristics. In the context of GM/nonGM food choices, there is evidence that consumers tend to split into segments with distinctive

perceptions of GM food (Hu et al., 2004). We expect that some consumer segments are more disapproving of GM food than others and that the respondents in the 'anti-GM' segment are less trusting in terms of both measures of generalized trust and trust in the food system.

2.5.1.2 Results from estimating LC models

One question associated with the estimation of a LC model is how to determine the number of latent segments among the sampled consumers. Statistical methods provide no guide on this and the possible range of the number of segments is potentially from 1 to the number of the respondents. A common approach to determine the number of segments is to estimate the model iteratively by setting the number of segments as 1, 2, …, N. The estimation procedure stops when there are no significant improvements in the model fit based on the selected statistic criteria. Following Gupta and Chintagunta (1994), Swait (1994), Boxall and Adamowicz (2002) and Hu et al. (2004), we determine the number of segments based on the following criteria: the Log likelihood (LL), ρ^2, the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC). Models that vary only in the inclusion of different measures of trust were estimated via maximum likelihood methods using NLOGIT Version 4 (Greene, 2007). Table 2.9[4] presents statistics on the model fit when the segment number equals 1, 2, 3, and 4 respectively.

Table 2.9 clearly shows that the model improves as the number of segments increases, which suggests the existence of heterogeneity in preferences. Regarding the optimal number of segments, the selected criteria statistics suggest that 4 segments are optimal. The log likelihood estimates increase when an additional segment is added. The ρ^2 is the highest with 4 segments. Moreover, the model with 4 segments has a minimum AIC and BIC. However, there is a

[4] We estimated several models which differ only in the trust variable since we have a variety of trust measures in our survey. In general these models give consistent results, although there are slight differences between parameters in different models. The statistics presented in Table 2.9 are from the model in which trust is measured by trust in strangers.

convergence problem for the smallest segment in the case of a 4-segment model. Therefore, we select the 3-segment model as the most appropriate. Supporting this decision, table 2.9 indicates that the gain from adding a 4th segment to the model is much smaller than from the addition of a 3rd segment.

We present the results from estimating the LC models in two steps. First, we examine the preferences of respondents in the different segments. We then analyze how individuals' socioeconomic characteristics, in particular trust, affect an individual's segment membership. Since trust is an abstract and hard-to-measure concept we adopted a variety of trust measures from different sources to examine the predictive power of these different measures on consumers' choices. Estimation of models that vary only in the inclusion of different measures of trust all suggest the existence of three segments with similar characteristics. As a representative example, we present the results of segment characteristics from the model in which trust is measured by trust in strangers. Table 2.10 shows the coefficients for different segments and the standard deviations of these coefficients. In general, both the 1-segment and 3-segment models tell a similar story. Consumers are averse to not purchase any canola oil, as the alternative specific constant of the "no purchase" option is negative and significant in all the models. The coefficients for the label descriptors of "enhanced omega-3" and "contains omega-3" are positive and significant, suggesting that consumers prefer omega-3 oil content to conventional canola oil (this had been defined as having lower omega-3 content, see table 2.1). Regarding which label description is more attractive, it seems that the majority of consumers value "contains omega-3" more than they value "enhanced omega-3". Not surprisingly, we found that, overall, consumers do not like canola oils with GM ingredients and are willing to pay a premium for canola oil labeled as "non-GM". Canola oils produced in Canada are more valued by the Canadian consumers than those produced in the US.

Considering preferences of consumers in different segments, one striking feature of segment 1 is that the coefficient on the GM attribute is negative and its

absolute value is the largest among all the three segments. We therefore label segment 1 as “anti-GM consumers”. Compared with segments 1 and 3, respondents in segment 2 place more value on omega-3. The coefficients of both “enhanced omega 3” and “contains omega 3” are larger in this segment than in the others. Consequently we label segment 2 as “pro-omega 3 consumers”. Consumers’ preferences in the 3rd segment are characterized by a strong effect of price in their choice decisions: the absolute value of the coefficient on price is much larger in segment 3 than in segments 1 and 2. Thus, this group is termed “price sensitive consumers”. Another characteristic associated with segment 3 is that members of this group attach a large negative value (-6.473) to the “no purchase” option, i.e., they view not purchasing a canola oil as an appreciable utility loss.

In order to test the hypothesis that less trusting consumers are more averse to the GM-derived food product, we relate individual’s segment membership to his/her socioeconomic characteristics, which include gender, age, region of residency, education, income and trust (see Appendix 2.1 for the definitions of these variables). The results of the 3-segment model indicate the existence of an anti-GM segment and we expect that consumers who are trusting are less likely to be in the anti-GM segment. We tested this hypothesis in the context of both generalized trust and trust in the food system by varying equation (4) through the inclusion of different measures of trust. Table 2.11 provides information on the predictive power of generalized trust on an individual’s segment membership. Following the example of Glaeser et al. (2000), we tested four different measures of generalized trust: 1) generalized trust based on respondents’ answers to the standard trust question; 2) generalized trust which measures one’s confidence in other people including trust, help and fair; 3) generalized trust which is measured by trust in strangers; and 4) generalized trust based on an individual’s past trusting behavior (the frequency of lending personal possessions to others). Models (1)-(4), reported in table 2.11, examine these four different measures of generalized trust; these models vary only in their measures of generalized trust.

Regarding model estimation, the coefficients for one of the 3 segments are set at 0 automatically by the program for identification purposes. We omit model estimates for the base segment, for which all the coefficients are set at 0, and present the coefficients for the membership variables for the two other segments in each of the 4 models (see table 2.11).

In general the findings are consistent between models (1)-(4) (table 2.11). Males are less likely to be in the anti-GM group than are females. Older people exhibit more dislike for the GM product. Consumers in the price sensitive segment exhibit higher levels of education and are residents of regions other than Quebec. Pro-omega 3 consumers tend to have a lower level of education and be residents of Quebec. We examined the role of generalized trust using four different measures. We found that generalized trust based on respondents' answers to the standard trust question of "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" has no predictive power on consumers' segment membership (see Model (1) in table 2.11). Nor does a trust index (constructed by adding up answers to the trust, help and fair questions) predict segment membership (Model (2)). However, having trust in strangers and past trusting behavior predict consumers' membership well. Model (3) suggests that those who trust strangers are less likely to be in the anti-GM segment. Model (4) indicates that people who report that they always lend personal possessions to others are less likely to be in the anti-GM segment. These findings are consistent with concerns raised by Glaeser et al. (2000), which question the predictive power of the generalized trust measured by the standard trust question on trusting behavior. However, the finding that people who trust strangers and who state that they always lend personal possessions to others are less averse to GM oils suggests that there is a component of trust which is stable over time and across situations.

Table 2.12 provides information on how respondents' trust in the food system affects their segment membership. We examined the role of trust in different

institutions as well as trust in food system overall. In estimating models (1)-(4) we investigate the role of trust in government, farmers, manufacturers and retailers respectively. Estimation of model (5) focused on how trust in food system overall affects segment membership. Responses to the survey queries on trust in institutions were measured using Likert scales. We created three dummy variables for the trust of respondents in each institution based on respondents' answers to these questions. For example, trust in government is represented by the three dummy variables, "trust in government" 1-3, with 1 indicating the most trusting responses and 3 the least trusting responses. Models (1)-(5), with model (2) as an exception, all suggest that consumers who exhibit trust in the cited food institutions are less likely to be in the anti-GM group compared with consumers who do not trust the food system. Trust in farmers is an interesting case. It seems that respondents view farmers differently from other institutions since model (2) shows that an individual's segment membership is not affected by their trust in farmers[5].

2.5.2 Results from estimating CL models

This section reports on CL model versions in which measures of trust are related directly to the GM attribute. Unlike the LC approach, by interacting different trust measures with the GM attribute, CL models allow direct examination of how the measures of generalized trust and trust in food institutions affect respondents' valuation of the GM attribute. We expect that trust will tend to offset negative perceptions of GM food. Thus those who exhibit trust in others and in the system of food institutions are expected to value the GM attribute more. The results of the CL model estimations are presented in table 2.13.

[5] Since the correlations between several different measures of generalized trust and trust in food institutions are not very high, we also estimated models which include both generalized trust and trust in food institutions, for example, including trust in strangers and trust in farmers in the same model. We found that including both generalized trust and trust in one of the food institutions in the same model has little impact on the characteristics of different consumer segments. However, the inclusion of trust in food institutions in the model does affect the significance of some measures of generalized trust, specifically, trust in strangers and past trusting behavior, depending on the specific food institution included.

Table 2.13 presents results for nine model versions which differ only in the interactions between trust and the GM attribute[6]. The definitions of the variables are given in Appendix 2.2. Models (1)-(9) provide similar findings. The alternative specific constant of the "no purchase" option (ASC3) is negative and significant in each of the models, suggesting that consumers are averse to the "no purchase" option. Consumers value the health benefits of omega-3: the coefficients on both "enhanced omega-3" and "contains omega-3" are positive and significant. Consistent with expectations and previous empirical analyses, overall consumers do not prefer GM-derived canola oil: canola oils labeled as non-GM are preferred. Canadian consumers prefer domestic canola oils over canola oils produced in the U.S.

Preference heterogeneity is considered by interacting the characteristics of individuals with the attributes of the product alternatives. We found respondents' demographic characteristics to affect their valuations of the GM attribute and the omega-3 attributes. Males tend to value GM oils more than females. Age has a negative impact on the valuation of the GM attribute. People residing in the province of Quebec dislike GM oil more than do people who reside in other regions of Canada. We also found that respondents with a university degree were more averse to GM-derived canola oils than those with lower levels of education. Regarding the omega-3 attribute, people with a university degree place more value on the health benefit of omega-3 than those with less education. Older people prefer canola oils labeled as "enhanced omega-3" more than those labeled as "contains omega-3".

To test hypotheses that both generalized trust and trust in food institutions have positive effects on consumers' valuation of the GM attribute, we interacted the different trust measures with the GM attribute. In model versions (1)-(4), the interacted trust variable is a measure of generalized trust, while trust in food

[6] The specification of model (4) is slightly different from the others because the explanatory power of the trust variable in model (4) is sensitive to the model specification. We present a specification in which the trust variable has a significant effect on respondents' choices of GM oils.

institutions is the trust variable included in model versions (5)-(9). As suggested by the results from the LC models, we found no evidence that generalized trust, measured by the standard trust question, “Generally speaking, would you say that most people can be trusted or that you can’t be too careful in dealing with people?” and by an aggregated trust index (based on the summation of recoded numerical responses to the three GSS attitudinal questions which we term: trust, fair and help), affected respondents’ valuation of the GM attribute. The coefficients on these two interactions are not significant (model versions (1) and (2)). In model versions (3), we interact trust in strangers with the GM attribute; the coefficient on this interaction is positive and significant, suggesting that those who trust strangers value the GM attribute more than those who do not exhibit trust in strangers.

The explanatory power of the measure of past trusting behavior (the frequency of lending personal possessions to others) on valuations of the GM attribute is tested in model version (4). In model version (4), the coefficient on the interaction between trusting behavior and the GM attribute is positive and significant, suggesting that respondents who often lend personal possessions to others value the GM attribute more than those who lend possessions to others less frequently. However, this finding is not stable across the models. Model (4) is one of the specifications in which trusting behavior is found to have a significant impact on the valuation of the GM attribute.

In models (5)-(9) the variables expressing trust in the four different institutions involved in the food system, as well as trust in the food system overall, are interacted with the GM attribute. The coefficients on all these interactions are positive and significant, suggesting that trust in food institutions offsets negative perceptions of GM food. Respondents who trust food institutions value the GM attribute more than those have less trust in institutions. The findings that trust in government, farmers, manufacturers and retailers affects consumers’ decision-making on GM food suggest recognition that the functioning of the food system

in its entirety is affected by the functioning of the different institutions involved in this system.

2.6. Conclusions

This study examines the correlations between different measures of trust as well as the predictive power of different trust measures on consumers' food purchasing behavior indicated by their stated choices. We find that people's responses to different measures of generalized trust are correlated. Measures of institutional trust, assessed for four food system agents in terms of respondents' assessments of the competency, honesty and public interest exhibited by these agents, are also correlated. Further, comparison of responses of people who believe that "most people can be trusted" relative to those who chose the response "can't be too careful in dealing with people" suggests that people who are less trusting in others also exhibit lower levels of trust in institutions in the food system. Integrating attitudinal measures of trust with consumers' food choices using LC and CL econometric models, we found that trust in strangers and trust in food institutions predict consumer preferences well in the context of GM food, while a widely used measure of generalized trust, which is based on a person's view of whether "most people can be trusted," does not predict these choices. In terms of trusting behaviors, our results suggest that those who indicate that they always lend personal possessions to others are less averse to GM food and tend to value the GM attribute more (or discount it less).

The finding of strong correlations between different trust measures and correlations between trusting behaviors suggest that there is a stable component of trust. However, how well this component is captured by the standard question, "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" is a concern. In this study, we found no evidence that this measure of generalized trust predicts consumers' food choices. However, we did observe that the measure of generalized trust is positively correlated with trust in food institutions. This raises the question of

"What exactly does the generalized trust question measure? ". From their study, Glaeser et al. (2000) concluded that the generalized trust measure predicts, and consequently measures, trustworthy behavior rather than trusting behavior. The explanation provided by Sapienza et al. (2007) is that trust contains two components: one is belief-based and the other is preference-based. It is held that generalized trust measures the belief-based component of trust, while trusting behaviors measure the preference-based component of trust (Sapienza et al., 2007). If the generalized trust question has little predictive power on behavioral propensities, as suggested by this study, there is a need for a trust measure which captures the preference component of trust. Trust in strangers and past trusting behaviors are of interest for this, since these are found to predict behaviors well, both in the context of the food issues considered here and in previous literature (e.g., Glaeser et al., 2000). However, we must also acknowledge the possibility that the lack of predictive power of the generalized trust question on consumers' choices for GM oil may be due to generalized trust having little impact on consumer behavior in the context of food. Future studies testing the general validity of the various trust measures in other contexts should be of interest.

This paper has several policy implications. The results suggest that consumers' trust in food institutions influences their decision-making on GM food. Moreover, consumers' choices of GM food are affected by their trust in specific institutions involved in the food system as well as their trust in the food system as a whole. Respondents' evaluations of different institutions in the food system tend to be correlated suggesting that consumers do not tend to separately judge different major food institutions. Trust in the functioning of the food system evidently depends on the functioning of the various institutions involved in the food system. It follows that to maintain and foster consumers' trust in the food system, the performance of all the components of that system should be maintained. In this study, we explicitly modeled the role of the aggregate measure of institutional trust, which we termed trust overall. Future studies that decompose such trust measure into the specific trust components of competency, honesty and

public interest may determine whether some of these components matter more. However, in the case of GM food, the finding that generalized trust (measured by trust in strangers and past trusting behavior) also affects consumers' choices of GM food, suggests that that some concerns about GM-derived food are related to individual's world views and may be beyond the control of the food system.

Table 2.1 Attributes, attribute levels and the definitions of the attributes and levels used in the experiment on stated choices of canola oils

Attribute	Attribute level [a]	Definition [b]
Omega-3 content	Contains Omega-3	Any regular canola oil has some level of omega-3 fatty acids. Manufacturers may choose to state this on the label as "contains omega-3 fatty acids".
	Enhanced Omega-3	While ordinary canola oil has a certain level of omega-3 fatty acids, the type and level of omega-3 fatty acids in canola oil can be increased and enhanced through genetically modifying/engineering (GM/GE) canola plants. Enhanced omega-3 fatty acids can also be achieved without the use of GM/GE by fortification.
	No label indicated	
GM ingredients	Contains GM/GE	GM/GE is a modern agricultural biotechnology which involves the transfer of genetic material from one organism to another. Through GM/GE, it is easier to introduce new traits without changing other traits in the plant or animal. GM/GE also makes it possible to introduce traits from other species, something not possible with traditional breeding methods.
	No GM/GE	
	No label indicated	
Country of origin	Product of Canada	This means that the canola oil is Canadian grown and processed.
	Product of US	This means that the canola oil is imported from the US where it was grown and processed.
Price	$2.50/litre $5.00/litre $7.50/litre	

[a] This column indicates product labels used in the choice experiment.

[b] This column gives the definitions of the attributes and their levels.

Table 2.2a Distributions of age of the study sample (2009) and the Canadian population (2006), expressed in percentages

Age group	Sample (18+)	Population (18+)
24 and below	0.06	0.12
25-34	0.15	0.16
35-44	0.21	0.19
45-54	0.22	0.20
55-64	0.17	0.15
65 and over	0.19	0.18

Source of Canadian Population data: Statistics Canada, 2006 Census (a)

Table 2.2b Distributions of education levels for the study sample (2009) and the Canadian population (2006), expressed in percentages

	Sample	Population (20+)
Some High School or less	6.94	15.66
High School Graduate	26.86	22.7
Some College or Technical School	25.27	13.29
College or Technical School Graduate	9.32	20.28
Some University	14.57	5.38
University degree and above	17.05	22.68

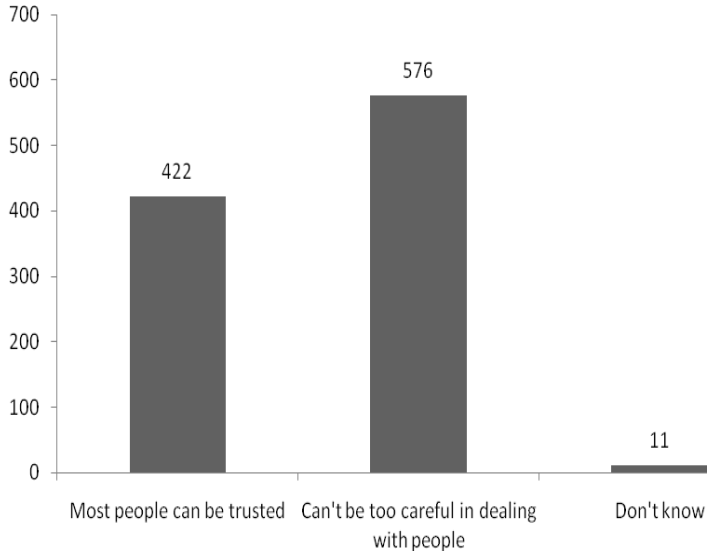
Source of Population data: Statistics Canada, 2006 Census (b)

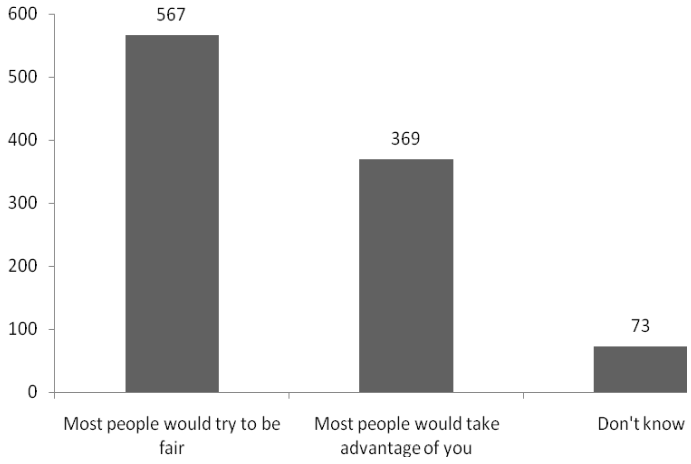
Table 2.2c Regional distributions of population of the study sample (2009) and the Canadian population (2006), expressed in percentages

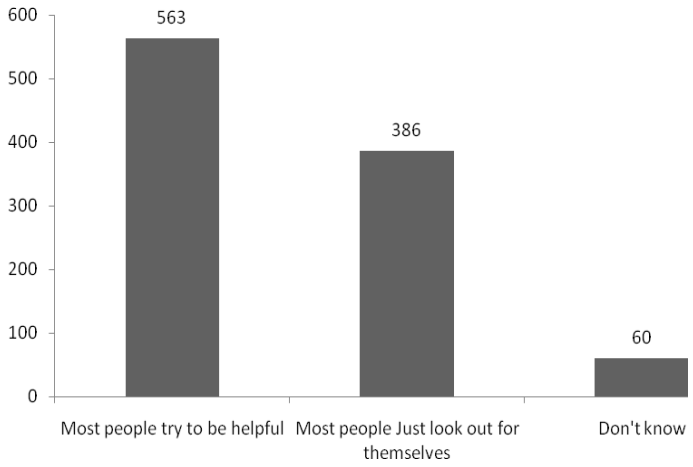
	Sample	Population
Alberta	10.7	10.41
British Columbia	12.49	13.01
Manitoba	5.15	3.63
New Brunswick	3.47	2.31
Newfoundland and Labrador	0.5	1.6
Nova Scotia	1.98	2.89
Ontario	33.6	38.47
Quebec	27.75	23.87
Saskatchewan	4.36	3.06

Source of Population data: Statistics Canada, 2006 Census (c)

Figure 2.1 Frequency of respondents' answers to three attitudinal questions: "trust", "fair", and "help"







Note: Trust question: Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?

Fair question: Would you think post people would try to take advantage of you if they got a chance, or would they try to be fair?

Help question: Would you say that most of the time people try to be helpful, or that they are mostly just looking out for themselves?

Table 2.3 Frequency of respondents' answers to the question on trust in strangers, expressed in percentages

	Strongly disagree	Somewhat disagree	Neither agreee nor disagree	Somewh at agree	Strongly agree
You can't trust strangers anymore.	3.9	22.9	22.2	39.6	11.4

Table 2.4 Frequency of respondents' answers to the question on past trusting behaviors, expressed in percentages

	Always	Most of the time	Sometimes	Rarely	Never
How often, if ever, do you lend money to friends when they ask?	5.2	20.5	30.2	30.4	13.7
How often, if ever, do you lend personal possessions to friends when they ask?	10.3	34.2	33.5	18.1	3.9

Table 2.5 Correlation coefficients between different measures of generalized trust expressed by survey respondents [a]

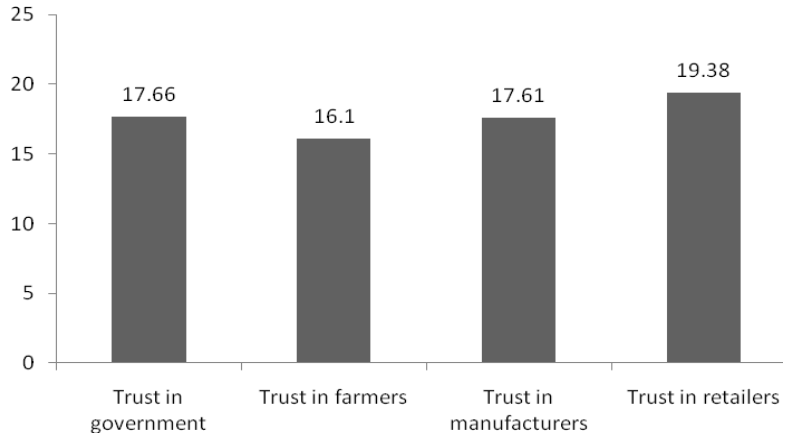
	Generalized trust	Trust index	Trust in strangers	Money lending	Possession lending
Generalized trust [b]	1.00	0.80	0.37	0.18	0.27
Trust index [c]		1.00	0.46	0.14	0.28
Trust in strangers			1.00	0.16	0.23
Money lending				1.00	0.53
Possession lending					1.00

[a] Correlations are measured by Spearman's rho; all correlations are significant at the 0.01 level of significance.

[b] Generalized trust is measured by the GSS trust question "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" only.

[c] The trust index is constructed by adding up numerical responses to three GSS attitudinal questions (trust, fair and help). The original answers to the three questions were recoded for comparability with smaller numbers indicating higher levels of trust.

Figure 2.2 Mean scores of trust in different institutions in the food system



Note: Following De Jonge (2008), the overall trust score for each institution was calculated by adding up rating scores across all six items for each respondent. The means of the trust scores for each institution are calculated by averaging the overall trust scores for each institution across survey respondents.

Table 2.6 Correlation coefficients between measures of trust in different institutions [a]

	Trust in government	Trust in farmers	Trust in manufacturers	Trust in retailers
Trust in government	1.00	0.32	0.57	0.44
Trust in farmers		1.00	0.49	0.49
Trust in manufacturers			1.00	0.55
Trust in retailers				1.00

[a] The correlations, measured by Spearman's rho, are all significant at the 0.01 level of significance.

Table 2.7 Correlation coefficients between generalized trust and trust in institutions [a]

	Trust in government	Trust in farmers	Trust in manufacturers	Trust in retailers	Trust in food system
Generalized trust [b]	0.07*	0.13**	0.14**	0.14**	0.15**

[a] Correlations are measured by Spearman's rho. * and ** denote significance levels of 0.05 and 0.01 respectively.

[b] Generalized trust is measured by the GSS trust question "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" only.

Table 2.8 Comparison of rating scores for trust in institutions between the trusting group and not trusting group

	Most people can be trusted	Can't be too careful in dealing with people	Mean difference	t value	Sig.
Trust in government	17.18	18.02	-0.84	-2.32	0.02
Trust in farmers	15.28	16.69	-1.41	-4.23	0
Trust in manufacturers	16.81	18.23	-1.42	-4.39	0
Trust in retailers	18.54	20.05	-1.51	-4.54	0
Trust in food system	67.82	72.99	-5.17	-4.88	0

Table 2.9 Test criteria to determine the optimal number of segments in the estimation of the latent class model

Number of segments	Number of the parameters (P)	Log likelihood at convergence (LL)	Log likelihood evaluated at 0 (LL0)	ρ^2 [a]	AIC [b]	BIC [c]
1	7	-5145.132	-6650.999	0.226	10304.26	10351.223
2	21	-4774.982	-6650.999	0.282	9591.964	9732.842
3	35	-4529.534	-6650.999	0.319	9129.068	9363.865
4	49	-4412.164	-6650.999	0.337	8922.328	9251.043

Sample size is 6,054 choices from 1,009 respondents (N)

[a] ρ^2 is calculated from 1-LL/LL0

[b] AIC (Akaike Information Criterion) is calculated from 2P-2LL.

[c] BIC (Bayesian Information Criterion) is calculated from -2LL+P*ln(N)

Table 2.10 Results of the 1-segment and 3-segment models of consumer preferences for different canola oils

	1-segment model	Segment 1 (Anti-GM consumers)	Segment 2 (Pro-omega3 consumers)	Segment 3 (price sensitive consumers)
ASC3 [a]	-2.004	-0.775	-1.733	-6.473
	(0.069)	(0.172)	(0.105)	(0.204)
Enhanced omega 3	0.392	0.257 [b]	0.618	0.424
	(0.049)	(0.122)	(0.055)	(0.109)
Contains omega 3	0.430	0.511	0.587	0.489
	(0.051)	(0.123)	(0.058)	(0.109)
GM	-0.829	-2.579	-0.558	-0.485
	(0.051)	(0.209)	(0.058)	(0.103)
NonGM	0.271	0.379	0.275	0.251 [b]
	(0.048)	(0.098)	(0.061)	(0.111)
Canada	0.657	1.619	0.617	0.545
	(0.039)	(0.112)	(0.037)	(0.090)
Price	-0.455	-0.507	-0.118	-1.289
	(0.011)	(0.030)	(0.011)	(0.040)

[a] ASC3 means the alternative specific constant of the "no purchase" option.

[b] This indicates that the coefficients are significantly different from zero at the 5% significance level. Other coefficients are significantly different from zero at the 1% significance level.

Table 2.11 Results of segment membership models examining the roles of different measures of generalized trust

	Model (1)		Model (2)		Model (3)		Model (4)	
	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Pro-omega3 consumers	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Price sensitive consumers
Constant	0.635***	0.383*	0.334**	-0.142	0.663***	0.524***	0.633***	0.492***
	(0.198)	(0.204)	(0.169)	(0.187)	(0.186)	(0.191)	(0.177)	(0.184)
Male	-0.412**	0.124	-0.575***	-0.090	-0.411**	0.097	-0.403**	0.105
	(0.199)	(0.199)	(0.203)	(0.208)	(0.201)	(0.199)	(0.201)	(0.200)
Age	0.419***	0.023	0.438***	-0.013	0.384***	0.016	0.384***	0.017
	(0.102)	(0.103)	(0.111)	(0.112)	(0.102)	(0.103)	(0.102)	(0.103)
QC	-0.217	-0.431*	0.041	0.392*	-0.186	-0.448**	-0.185	-0.448**
	(0.217)	(0.228)	(0.233)	(0.236)	(0.214)	(0.225)	(0.215)	(0.225)
High school and below	-0.251	-0.381*	0.150	0.367*	-0.258	-0.400*	-0.235	-0.385*
	(0.204)	(0.209)	(0.216)	(0.221)	(0.204)	(0.209)	(0.205)	(0.210)
Income	0.256	0.176	0.108	-0.169	0.262	0.198	0.213	0.160
	(0.273)	(0.283)	(0.275)	(0.300)	(0.276)	(0.283)	(0.277)	(0.285)
Generalized trust	-0.249	-0.080						
	(0.201)	(0.200)						
Trust index			0.007	0.019				
			(0.044)	(0.045)				
Trust in strangers					-0.374*	-0.298		
					(0.218)	(0.216)		
Trusting behavior							-0.524*	-0.296
							(0.316)	(0.295)
Log likelihood	-4477.691		-3971.801		-4529.534		-4529.703	
Pseudo R^2	0.319		0.321		0.319		0.319	

***, **, * represents significance levels of 1%, 5% and 10%, respectively.

Table 2.12 Results of segment membership models examining the roles of trust in institutions

	Model (1)		Model (2)		Model (3)		Model (4) [a]		Model (5) [b]	
	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Price sensitive consumers	Anti-GM consumers	Price sensitive consumers
Constant	1.054***	0.569**	0.870***	0.526*	1.046***	0.569**	-0.296	0.665*	1.111***	-0.265
	(0.223)	(0.238)	(0.255)	(0.274)	(0.224)	(0.239)	(0.390)	(0.399)	(0.330)	(0.467)
Male	-0.408**	0.089	-0.428**	0.102	-0.408**	0.114	-0.414**	0.096	-0.426**	0.115
	(0.203)	(0.200)	(0.204)	(0.203)	(0.207)	(0.203)	(0.202)	(0.202)	(0.199)	(0.199)
Age	0.391***	0.038	0.347***	0.002	0.349***	0.020	0.024***	0.000	0.362***	0.001
	(0.104)	(0.104)	(0.104)	(0.105)	(0.106)	(0.104)	(0.007)	(0.007)	(0.102)	(0.103)
QC	-0.162	-0.428*	-0.238	-0.464**	-0.234	-0.480**	-0.272	-0.503**	-0.239	-0.383*
	(0.217)	(0.226)	(0.218)	(0.229)	(0.221)	(0.227)	(0.217)	(0.228)	(0.215)	(0.225)
High school and below	-0.159	-0.355*	-0.179	-0.356*	-0.135	-0.342	-0.167	-0.346	-0.142	-0.386*
	(0.209)	(0.211)	(0.207)	(0.212)	(0.212)	(0.213)	(0.206)	(0.212)	(0.204)	(0.210)
Income	0.294	0.216	0.259	0.209	0.238	0.158	0.267	0.178*	0.274	0.235
	(0.284)	(0.287)	(0.279)	(0.287)	(0.285)	(0.287)	(0.279)	(0.288)	(0.275)	(0.283)
Trust in government1	-1.174***	-0.361								
	(0.280)	(0.273)								
Trust in government2	-0.611***	-0.100								
	(0.227)	(0.238)								
Trust in farmers1			-0.425	-0.239						
			(0.277)	(0.290)						
Trust in farmers2			-0.350	0.046						
			(0.252)	(0.265)						
Trust in manufacturers1					-1.368***	-0.383				
					(0.301)	(0.283)				

Table 2.12 Continued

Trust in manufacturers2					-0.512**	0.110				
					(0.225)	(0.236)				
Trust in retailers1							-0.860***	-0.502*		
							(0.326)	(0.319)		
Trust in retailers2							-0.449**	-0.284		
							(0.212)	(0.222)		
Trust in food system1									-1.000***	0.424
									(0.359)	(0.476)
Trust in food system2									-0.557*	-0.741
									(0.321)	(0.455)
Log likelihood	-4519.621		-4528.457		-4516.616		-4526.636		-4520.107	
Pseudo R^2	0.320		0.319		0.321		0.319		0.320	

***, **, * represents significance levels of 1%, 5% and 10%, respectively.

[a] In Model (4), age is the actual age of the respondents (not the normalized age). The price data are normalized; (i.e., price is de-meaned and then divided by standard deviation).

[b] In Model (5), the price data are normalized; (i.e., price is de-meaned and then divided by standard deviation).

Table 2.13 Results of the conditional logit models examining the roles of different measures of trust on consumers' valuation of the GM attribute

	Model (1)	Model (2)	Model(3)	Model(4)	Model(5)	Model(6)	Model(7)	Model(8)	Model(9)
ASC3	-2.019***	-2.058***	-2.021***	-2.004***	-2.027***	-2.026***	-2.036***	-2.025***	-2.024***
	(0.070)	(0.074)	(0.069)	(0.069)	(0.069)	(0.069)	(0.070)	(0.069)	(0.069)
Enhanced omega 3	0.373***	0.408***	0.366***	0.350***	0.367***	0.365***	0.365***	0.367***	0.372***
	(0.058)	(0.062)	(0.058)	(0.055)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)
Contains omega 3	0.429***	0.447***	0.426***	0.433***	0.426***	0.424***	0.420***	0.424***	0.426***
	(0.052)	(0.055)	(0.052)	(0.051)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)
GM	-0.897***	-0.868***	-0.896***	-0.882***	-1.192***	-1.175***	-1.335***	-0.976***	-1.723***
	(0.084)	(0.091)	(0.077)	(0.079)	(0.097)	(0.116)	(0.101)	(0.089)	(0.177)
NonGM	0.277***	0.262***	0.273***	0.270***	0.275***	0.273***	0.276***	0.273***	0.274***
	(0.048)	(0.051)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
Canada	0.657***	0.678***	0.665***	0.664***	0.664***	0.665***	0.664***	0.662***	0.664***
	(0.039)	(0.041)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
Price	-0.457***	-0.462***	-0.459***	-0.456***	-0.460***	-0.460***	-0.462***	-0.459***	-0.460***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Male*GM	0.350***	0.411***	0.342***	0.339***	0.333***	0.360***	0.362***	0.342***	0.358***
	(0.086)	(0.090)	(0.085)	(0.085)	(0.086)	(0.086)	(0.086)	(0.085)	(0.086)
Age*contains omega 3	-0.109***	-0.103**	-0.102**		-0.101**	-0.102**	-0.101**	-0.102**	-0.104**
	(0.041)	(0.044)	(0.041)		(0.041)	(0.041)	(0.041)	(0.041)	(0.041)
Age*GM	-0.192***	-0.154***	-0.180***		-0.161***	-0.147***	-0.136***	-0.163***	-0.149***
	(0.044)	(0.049)	(0.043)		(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
QC*GM	-0.261**	-0.223**	-0.292***	-0.370***	-0.295***	-0.254**	-0.268***	-0.275***	-0.229**
	(0.104)	(0.108)	(0.102)	(0.100)	(0.102)	(0.103)	(0.103)	(0.102)	(0.103)
Univ*GM	-0.246**	-0.212**	-0.250**	-0.212**	-0.195**	-0.186*	-0.149	-0.196**	-0.165*
	(0.098)	(0.103)	(0.098)	(0.097)	(0.098)	(0.098)	(0.098)	(0.098)	(0.098)
Univ*enhanced omega 3	0.129	0.106	0.142*	0.147*	0.138*	0.143*	0.139*	0.141*	0.135
	(0.083)	(0.088)	(0.083)	(0.082)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)
Income*GM	0.099	0.097	0.094		0.083	0.111	0.104	0.103	0.097
	(0.121)	(0.129)	(0.120)		(0.121)	(0.121)	(0.121)	(0.120)	(0.121)

Table 2.13 Continued

Income*enhanced omega 3	-0.132	-0.151	-0.132		-0.126	-0.136	-0.121	-0.133	-0.126
	(0.110)	(0.117)	(0.109)		(0.109)	(0.109)	(0.109)	(0.109)	(0.109)
Generalized trust *GM	0.099								
	(0.088)								
Trust index*GM		-0.096							
		(0.094)							
Trust in strangers*GM			0.163*						
			(0.094)						
Trusting behavior*GM				0.139*					
				(0.084)					
Trust in government1*GM					0.641***				
					(0.116)				
Trust in government2*GM					0.447***				
					(0.098)				
Trust in farmers1*GM						0.326***			
						(0.121)			
Trust in farmers2*GM						0.418***			
						(0.110)			
Trust in manufacturers1*GM							0.854***		
							(0.123)		
Trust in manufacturers2*GM							0.595***		
							(0.098)		
Trust in retailers1 *GM								0.265*	
								(0.140)	

Table 2.13 Continued

Trust in retailers2*GM								0.193**	
								(0.091)	
Trust in food system1*GM									1.071***
									(0.180)
Trust in food system2*GM									0.832***
									(0.169)
Log likelihood	-5058.388	-4467.687	-5110.569	-5125.329	-5094.192	-5104.675	-5082.581	-5108.995	-5092.328
R^2	0.218	0.222	0.219	0.217	0.221	0.219	0.223	0.219	0.221

***, **, * represents significance levels of 1%, 5% and 10%, respectively.

Appendix 2.1 Definitions of respondents' socioeconomic, demographic and attitudinal variables used in the latent class models

Variables	Definitions
Gender	1=male; 0=female
Age	the age of a respondent (normalized)
Region of residency	1=QC; 0=other regions
Education	1=High school and below; 0=otherwise
Income	1=income<$35,000; 0=otherwise
Generalized trust	1="most people can be trusted" 0="can't be too careful in dealing with people"
Trust index	1=a respondent has strong confidence in others 0=otherwise (These two groups are divided by the median of the overall trust score which is the sum of GSS trust, fair and help.
Trust in strangers	1=one trusts strangers; 0=otherwise
Trusting behavior	1=one always lends personal possessions to others; 0=otherwise
Trust in government1-3 Trust in farmers1-3 Trust in manufacturers1-3 Trust in retailers1-3 Trust in food system1-3	1 represents the most trusting group; 2 represents the second trusting group; the base is the least trusting group

Appendix 2.2 Definitions of respondents' socioeconomic, demographic and attitudinal variables used in the conditional logit models

Variables	Definitions
Gender	1=male; 0=female
Age	the age of a respondent (normalized)
Region of residency	1=QC; 0=other regions
Education	1=university degree and above; 0=otherwise
Income	1=income<$35,000; 0=otherwise
Generalized trust	1="most people can be trusted" 0="can't be too careful in dealing with people"
Trust index	1=a respondent has strong confidence in others 0=otherwise (These two groups are divided by the median of the overall trust score which is the sum of GSS trust, fair and help.
Trust in strangers	1=one trusts strangers; 0=otherwise
Trusting behavior	1=one lends personal possessions to others frequently; 0=otherwise
Trust in government1-3 Trust in farmers1-3 Trust in manufacturers1-3 Trust in retailers1-3 Trust in food system1-3	1 represents the most trusting group; 2 represents the second trusting group; the base is the least trusting group

References

Boxall, P.C. and W.L. Adamowicz. 2002. Understanding heterogeneous preferences in random utility models: A latent class approach. *Environmental and Resource Economics 23*(4): 421-446.

Christoph, I.B., J. Roosen, and M. Bruhn. 2006. Willingness to pay for genetically modified food and non-food products. Selected paper for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California. http://ageconsearch.umn.edu/bitstream/21303/1/sp06ch11.pdf. Accessed 10 Feb 2008.

Clarke, L. 1999. *Mission improbable: Using fantasy documents to tame disaster*. University of Chicago Press, Chicago.

Costa-Font, M., J.M. Gil, and W.B. Traill. 2008. Consumer acceptance, valuation of and attitudes towards genetically modified food: Review and implications for food policy. *Food Policy* 33(2): 99-111.

Couch, L. L. and W.H. Jones. 1997. Measuring levels of trust. *Journal of Research in Personality* 31(3): 319-336.

De Jonge, J. 2008. *A monitor for consumer confidence in the safety of food.* Unpublished PhD Dissertation, Wageningen University, the Netherlands.

De Jonge, J., L. Frewer, H. van Trijp, H. R. Jan Renes, et al. 2004. Monitoring consumer confidence in food safety: An exploratory study. *British Food Journal* 106 (10/11): 837-849.

Driscoll, J. W. 1978. Trust and participation in organizational decision making as predictors of satisfaction. *Academy of Management Journal* 21(1): 44-56.

Eisenberg, A. 2007. Equality, trust and multiculturalism. In *Social capital, diversity, and the welfare state*, edited by F. M. Kay and R. Johnston , pp. 67-92. UBC Press, Vancouver.

Frewer, L. J., C. Howard, D. Hedderley, and R. Shepherd. 1996. What determines trust in information about food-related risks? Underlying psychological constructs. *Risk Analysis*, 16(4): 473-486.

Giddens, A. 1990. *The consequences of modernity*. Stanford University Press, Stanford.

Glaeser, E. L., D.I. Laibson, J.A. Scheinkman, and C.L. Soutter. 2000. Measuring trust. *Quarterly Journal of Economics*, 115(3): 811-846.

Govindasamy, R., B. Onyango, W. Hallman, H. Jang, and V. Puduri. 2004. Public approval of plant and animal biotechnology in Korea: An ordered probit analysis. Joint 2004 Northeast Agricultural and Resource Economics Association and Canadian Agricultural Economics Society Annual Meeting, Halifax, Nova Scotia, Canada. http://ageconsearch.umn.edu/bitstream/18180/1/wp040016.pdf. Accessed 3 Nov 2009.

Greene, W.H. 2007. *NLOGIT version 4.0: reference guide*. Econometric Software, Inc.

Gupta, S. and P.K. Chintagunta. 1994. On using demographic variables to determine segment membership in logit mixture models. *Journal of Marketing Research* 31(1): 128-136.

Hall, P. A. 1999. Social capital in Britain. *British Journal of Political Science* 29(3): 417-461.

Hossain, F. and B. Onyango. 2004. Product attributes and consumer acceptance of nutritionally enhanced genetically modified foods. *International Journal of Consumer Studies,* 28(3): 255-267.

Hu, W., A. Hunnemeyer, M. Veeman, W. Adamowicz, and L. Srivastava. 2004. Trading off health, environmental and genetic modification attributes in food. *European Review of Agricultural Economics* 31(3): 389-408.

Huffman, W. E. 2003. Consumers' acceptance of (and resistance to) genetically modified foods in high-income countries: Effects of labels and information in an uncertain environment. *American Journal of Agricultural Economics* 85(5): 1112-1118.

Ipsos Canada. 2009. Internet access in Canada reaches all time high. http://www.ipsosna.com/news/pressrelease.cfm?id=4567. Accessed 27 Oct 2009.

Lang, J. T. and W.K. Hallman. 2005. Who does the public trust? The case of genetically modified food in the United States. *Risk Analysis* 25(5): 1241-1252.

Lewis, J. D. and A. Weigert. 1985. Trust as a social reality. *Social Forces* 63(4): 967-985.

Lobb, A. E., M. Mazzocchi, and W.B. Traill. 2007. Modelling risk perception and trust in food safety information within the theory of planned behaviour. *Food Quality and Preference* 18(2): 384-395.

Luhmann, N. 1979. *Trust and power*. Wiley, Chichester, UK.

Mansbridge, J. 1999. Altruistic trust. In *Democracy and trust*, edited by M. Warren, pp. 290-309. Cambridge University Press, New York.

Mishler, W. and R. Rose. 2001. What are the origins of political trust? Testing institutional and cultural theories in post-communist societies. *Comparative Political Studies* 34(1): 30-62.

Mischel, W. 1968. *Personality and assessment*. Wiley, New York.

Newton, K. 2007. Social and political trust. In *Oxford handbook of political behavior*, edited by R.J. Dalton and H. Klingemann, pp. 342-361. Oxford University Press, New York.

OECD. 2000. Genetically modified foods: Widening the debate on health and safety. http://www.oecd.org/dataoecd/34/30/2097312.pdf. Accessed 6 Mar 2010.

Onyango, B. 2003. Consumer acceptance of genetically modified foods: Role of product benefits and perceived risks. 2003 Annual Conference of the Food Distribution Research Society, Biloxi, Mississippi. http://ageconsearch.umn.edu/bitstream/18182/1/wp030012.pdf. Accessed 7 Nov 2009.

Peters, R. G., V.T. Covello, and D.B. McCallum. 1997. The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk Analysis* 17(1): 43-54.

Poortinga, W. and N.F. Pidgeon. 2003. Exploring the dimensionality of trust in risk regulation. *Risk Analysis* 23(5): 961-972.

Poortinga, W. and N.F. Pidgeon. 2005. Trust in risk regulation: Cause or consequence of the acceptability of GM food? *Risk Analysis* 25(1): 199-209.

Rothstein, B. and D. Stolle. 2002. How political institutions create and destroy social capital: An institutional theory of generalized trust. Paper prepared for the 98th meeting of the American Political Science Association in Boston, MA. http://www.allacademic.com/meta/p_mla_apa_research_citation/0/6/5/2/5/p65250_index.html. Accessed 9 Jul 2009.

Rotter, J. B. 1967. A new scale for the measurement of interpersonal trust. *Journal of Personality* 35(4): 651-665.

Sapienza, P., A. Toldra, and L. Zingales. 2007. Understanding trust. NBER working paper no. 13387. http://www.cepr.org/pubs/new-dps/dplist.asp?dpno=6462.asp. Accessed 12 November 2009.

Siegrist, M., H. Gutscher, and T.C. Earle. 2005. Perception of risk: The influence of general trust, and general confidence. *Journal of Risk Research* 8(2): 145-156.

Siegrist, M. 2000. The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis* 20(2): 195-204.

Siegrist, M. and G. Cvetkovich. 2000. Perception of hazards: The role of social trust and knowledge. *Risk Analysis* 20(5): 713-720.

Siegrist, M., G. Cvetkovich, and C. Roth. 2000. Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis* 20(3): 353-362.

Sjöberg, L. 2001. Limits of knowledge and the limited importance of trust. *Risk Analysis* 21(1): 189-198.

Sjöberg, L. and M.W. Herber. 2008. Too much trust in (social) trust? The importance of epistemic concerns and perceived antagonism. *International Journal of Global Environmental Issues* 8(1/2): 30-44.

Smith, T.W. 1997. Factors relating to misanthropy in contemporary American society. *Social Science Research* 26(2): 170-196.

Soregaroli, C., S. Boccaletti, and D. Moro. 2003. Consumers' attitude towards labeled and unlabeled GM food products in Italy. *International Food and Agribusiness Management Review* 6(2): 111-127.

Soroka, S. N., R. Johnston, and K. Banting. 2007. Ethnicity, trust, and the welfare state. In *Social capital, diversity, and the welfare state*, edited by F. M. Kay and R. Johnston, pp. 279-303. UBC Press, Vancouver.

Statistics Canada. 2008. Canadian internet use survey. The Daily. June 12, 2008. http://www.statcan.gc.ca/daily-quotidien/080612/dq080612b-eng.htm. Accessed 16 Oct 2009.

———. 2006 Census (a). Table: Age (123) and Sex (3) for the population of Canada, Provinces, Territories and Federal Electoral Districts. http://www12.statcan.gc.ca/english/census06/data/topics/RetrieveProductTable.cfm?TPL=RETR&ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=88983&PTYPE=88971,97154&RL=0&S=1&ShowAll=No&StartRow=1&SUB=0&Temporal=2006&Theme=66&VID=0&VNAMEE=&VNAMEF= . Accessed 27 Nov 2009.

———. 2006 Census (b). Table: Highest Certificate, Diploma or Degree, Age Group and Sex for the Population 15 Years and Over of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census.

http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=93609&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=75&VID=0&VNAMEE=&VNAMEF=&GID=837928. Accessed 27 Nov 2009.

———. 2006 Census (c). 2006 community profiles. http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/details/page_SelReg2.cfm?Lang=E&Geo1=CSD&Code1=3559062&Geo2=PR&Code2=48&Data=Count&SearchText=Alberta&SearchType=Begins&SearchPR=01&B1=All&Custom=. Accessed 28 Nov 2009.

———. 2006 Census (d). Statistics Canada catalogue no. 97-563-XCB2006045. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837928&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=94592&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=81&VID=0&VNAMEE=&VNAMEF=. Accessed 27 Nov 2009.

Swait, J. 1994. A structural equation model of latent segmentation and product choice for cross-sectional revealed preference choice data. *Journal of Retailing and Consumer Services* 1(2): 77-89.

Train, K.E. 2003. *Discrete choice methods with simulation*. Cambridge University Press, New York.

Uslaner, E. M. 2008. Trust as a moral value. In *The handbook of social capital*, edited by D. Castiglione, J.W. van Deth, and G. Wolleb, pp. 101-121. Oxford University Press, New York.

Uslaner, E. M. 2002. *The moral foundation of trust*. Cambridge University Press, New York.

Uslaner, E. M. 2001. Trust as a moral value. Prepared for the conference, "Social Capital: Interdisciplinary Perspectives", University of Exeter, United Kingdom. http://huss.exeter.ac.uk/politics/research/socialcapital/papers/uslaner.pdf. Accessed 14 Sept 2009.

Yamagishi, T. and M. Yamagishi. 1994. Trust and commitment in the United States and Japan. *Motivation and Emotion* 18(2): 129-166.

CHAPTER 3. The influence of attribute cutoffs on consumers' choices for a functional food with potential health and risk attributes

3.1. Introduction

Traditional economic theory assumes that consumers are rational, utility-maximizing decision makers, with complete information about choice tasks. Lancaster (1966) extended traditional consumer theory by assuming that consumers obtain utility from the characteristics of a good rather than the good per se. Further extending this concept, the linear compensatory choice model, which assumes that consumers evaluate the attributes of alternative products or services and trade off between the attributes when they choose among alternatives, has been widely used in studying consumers' choice behavior (e.g., McFadden, 1974). Some scholars, however, argue that consumers have cognitive limits in processing information (e.g., Simon, 1955; Tversky and Kahneman, 1974) and note evidence that choice heuristics are commonly used in consumers' decision-making processes (Bettman et al., 1991; Payne et al., 1988).

Swait (2001) maintains that noncompensatory decision strategies are widely used by decision makers. Using a noncompensatory decision strategy, the decision maker bases his/her assessment of an alternative on just some of the attributes of the alternative instead of making tradeoffs between all attributes of an alternative (Elrod et al., 2004). Previous literature has documented a variety of noncompensatory decision rules, such as elimination-by-aspects[7] (EBA) (Tversky, 1972), lexicographic decision strategies[8] (Wright, 1975), and conjunctive and

[7] Using an elimination-by-aspects (EBA) decision strategy, decision makers evaluate alternatives based on a set of aspects. One aspect is examined at a time and the alternatives that do not include the aspect are rejected. The process continues till only one alternative is left.

[8] Using a lexicographic decision strategy, decision makers first rank the importance of attributes and then evaluate alternatives starting from the most important attribute. The alternative that surpasses other alternatives on the most important attribute is chosen. Otherwise, the process continues till one alternative is chosen.

disjunctive decision rules[9] (Elrod et al., 2004). Recognizing the common use of noncompensatory decision strategies, some have questioned the robustness of a linear compensatory choice model in predicting consumer behavior under various choice settings (e.g., Johnson and Meyer, 1984).

A number of noncompensatory decision strategies involve the use of attribute cutoffs. For example, the conjunctive decision strategy implies that decision makers discard an alternative if it does not meet the threshold of any one of the attributes (Elrod et al., 2004). A large body of literature on decision making suggests that attribute cutoffs are often used by consumers to simplify their choices (Huber and Klein, 1991; Bettman et al., 1991; Tversky, 1972). By implementing cutoffs, decision makers exclude alternatives that do not exceed the relevant attribute cutoffs from their choice sets at a screening stage and then choose only from the alternatives remaining in the reduced choice set (Huber and Klein, 1991). Where this is the case, taking attribute cutoffs into consideration in choice models is of importance in providing a more precise specification of consumers' decision making processes and allowing researchers to study consumer's choices in a more realistic manner (Swait, 2001; Elrod et al., 2004).

A number of studies have employed linear compensatory utility models to examine consumers' preferences for foods derived from modern agricultural biotechnology, commonly referred to as genetically modified (GM) foods (e.g.,Burton et al., 2001; Onyango et al., 2006). It has been recognized that consumers differ considerably in their acceptance of GM foods (Hu et al., 2004; Siegrist et al., 2005). Some people refuse to consider consumption of food with GM ingredients, while others have no concern about this issue (Siegrist et al., 2005). A growing body of literature on consumption decisions regarding foods with GM ingredients takes consumers' preference heterogeneity into consideration by using latent class (LC) models and random parameters logit

[9] The conjunctive decision rule rejects the alternatives that do not meet all the attribute thresholds, while the disjunctive decision rule accepts the alternatives that surpass at least one of the attribute thresholds.

(RPL) models (Hu et al., 2004; Christoph et al., 2006; Onyango et al., 2006). However, so far, little work has been done to link heterogeneous consumer preferences to the use of attribute cutoffs in decision making in studying consumers' choices for GM/nonGM food. It is reasonable to postulate that consumers may encounter cutoff constraints when they choose between food products with/without GM ingredients. This study incorporates attribute cutoffs into the modeling of consumer choices in the context of food with health-related attributes (omega 3 content) that may be associated with genetic modification. As well, we examine the problem of endogeneity that may be associated with attribute cutoffs (Swait, 2001) by linking cutoffs to respondents' demographic characteristics.

3.2. Literature review

There is growing interest in understanding the processes underlying consumers' decision-making. Payne et al. (1988) pointed out that individuals tend to adjust their decision strategies in response to varying choice tasks and time pressures to be effective in decision making. It remains a challenging task to understand when and why a decision strategy is chosen. Some argue that the selection of a decision strategy is determined by the costs and benefits associated with particular instances of decision making (e.g., Shugan, 1980). For example, based on studies on a small group, Russo and Dosher (1983) found that decision makers selected those decision strategies which minimized their cost (effort) to make particular choices.

Literature on decision making has documented a number of factors which influence selection of decision strategies, including the choice environment, the characteristics of the decision maker, the complexity of the choice task and time pressure (Swait and Adamowicz, 2001; Payne et al., 1988; Wright, 1974). Payne et al. (1993) provide a comprehensive literature review on the influence of choice environments on decision making. Facing a decision task, individuals tend to vary in their abilities to process information and often exhibit cognitive limits in

decision making (Heiner, 1983). De Palma et al. (1994) found evidence that an individual's ability to process information affects his/her judgment of the optimal choice and selection of the decision strategies. The importance of the complexity of a decision task in determining the selection of decision strategies has been demonstrated in a number of studies (e.g., Johnson and Meyer, 1984; Tversky and Shafir, 1992; Heiner, 1983). Johnson and Meyer (1984) found that respondents are more likely to use elimination strategies when choice size increases. Tversky and Shafir (1992) concluded that individuals tend to defer their decision making or to seek new options when they face strong conflicts between alternatives. It is a common finding that the tendency for an individual to use simplified decision strategies increases when the decision tasks become more complex (Payne et al., 1988; Wright, 1974).

An attribute cutoff is the minimum acceptable level that an individual sets on an attribute (Huber and Klein, 1991). Previous literature suggests that attribute cutoffs are frequently used by decision makers (Huber and Klein, 1991; Klein and Bither, 1987). The tendency to use an attribute cutoff increases as the choice task becomes more complex (Payne, 1976), or when decision makers are under time pressure or exposed to more distractions (Wright, 1974). However, eliciting information on cutoff usage in decision making remains a challenge. Previous literature identifies attribute cutoffs based on self-reported values (Swait, 2001), process tracing methods (Klein and Bither, 1987), and observed choices (Elrod et al., 2002). Regarding the elicitation of cutoffs from respondents, there is no agreement on when and how to query respondents about this. Swait (2001) identifies respondents' cutoffs based on a single cutoff-related question, but suggests that multiple questions may be useful to reduce measurement errors. Process tracing approaches, which include verbal protocols and information boards (information boards record respondents' search for information on choice alternatives), provide methods by which researchers may attempt to follow decision makers' cognitive processes (Ford et al., 1989). However, these approaches may also interfere with respondents' decision making (Elrod et al.,

2002) and are not practical unless the research is conducted in a laboratory setting (Swait, 2001). Green et al. (1988) examines the consistency between respondents' self-reported cutoffs and their subsequent choices. These authors find that while respondents frequently violated their self-reported cutoffs, they were less likely to violate a cutoff associated with an important attribute (Green et al., 1988).

There is a considerable literature on the development of models to accommodate the use of cutoffs in decision making. Some studies assume that decision making involves two stages and model attribute cutoffs using a two-stage decision model (Swait and Ben-Akiva, 1987; Roberts and Lattin, 1991). It is hypothesized that at the first stage, decision makers screen the alternatives and eliminate from further consideration those that fail to meet cutoff levels; at the second stage, decision makers choose from the remaining alternatives (Roberts and Lattin, 1991). However, the two-stage choice model is very difficult to estimate (Swait, 2001). In contrast, Swait (2001) incorporates attribute cutoffs into the linear compensatory utility model. This model penalizes cutoff violations, but does not reject alternatives that violate cutoff constraints (Swait, 2001). Elrod et al. (2004) propose an integrated model which allows for compensatory, conjunctive and disjunctive decision strategies. This model requires no information on self-reported cutoffs. Instead, information on cutoffs is obtained based on observed choices. Violations of cutoffs are not allowed in this approach.

Although there is growing interest in incorporating cutoffs into choice modeling, the issue of endogeneity of self-reported cutoffs has received little attention. Swait (2001) argues that attribute cutoffs are not exogenous to choices but are jointly determined with choices. There is empirical evidence that attribute cutoffs are not fixed and that individuals adjust their cutoffs during their decision making (e.g., Klein and Bither, 1987; Huber and Klein, 1991). Huber and Klein (1991) conclude that individuals adjust their cutoffs when they have more information about the attributes and decision tasks, while Klein and Bither (1987) observe different cutoffs to apply with differences in the utility structures that

different people may employ. Given endogeneity that may be associated with respondents' self-reported cutoffs, incorporating self-reported cutoffs directly into the modeling of consumers' choices may generate biased estimates. This study models consumers' choices for canola oil products with potential health and risk attributes, allowing the use of attribute cutoffs in decision making. Moreover, we examine the potential endogeneity of cutoffs by instrumenting respondents' self-reported cutoffs with predicted cutoffs. We predict respondents' cutoffs based on their demographic characteristics, since these are exogenous to their choices.

3.3. A utility model with compensatory cutoffs

Intuition and casual observation suggest that people may not always adhere to their self-stated cutoffs. Instead, they may view these as statements of desired cutoff levels which they are willing to modify. Consequently, individuals may suffer a utility penalty rather than completely eliminate a desired alternative. We follow this chain of reasoning in adopting the model developed by Swait (2001), which penalizes rather than rejects an alternative that violates cutoff constraints. The model proposed by Swait (2001) extends the linear compensatory utility model in two aspects: first, it allows for the use of attribute cutoffs in decision making; second, it allows for violations of cutoffs. The following is a brief description of the model (for further details, see Swait, 2001).

Suppose individual n faces a choice task of choosing one alternative from choice set C, which contains several alternatives. Each alternative is characterized by K attributes, $Z_i = [X_i, p_i]'$; p_i denotes the price of alternative i and X_i represents the other $(K-1)$ attributes of alternative i. Individual n obtains utility $U_n(X_i, p_i)$ by consuming alternative i. We also assume that individual n is subject to an income constraint, M_n. The utility maximization problem for individual n is:

$$\max \sum_{i \in C} \delta_{ni} U_n(X_i, p_i)$$

$$\text{s.t.} \quad \sum_{i \in C} \delta_{ni} = 1,\ \delta_{ni} \in \{0,1\},\ \sum_{i \in C} \delta_{ni} p_i \le M_n,\ \forall i \in C \tag{1}$$

where δ_{ni} is a choice indicator. If individual n chooses alternative i, $\delta_{ni} = 1$; otherwise, $\delta_{ni} = 0$.

Model (1) represents a linear compensatory utility model. Considering that individual n may have constraints for the acceptable range of an attribute, we define a_K and b_K as the lower and upper bounds for the K attributes where $a_K = [a_1, a_2, \cdots, a_k]'$, $b_K = [b_1, b_2, \cdots, b_k]'$, $-\infty < a_k \le b_k < +\infty$. By incorporating noncompensatory cutoffs into model (1), the optimization problem becomes:

$$\max \sum_{i \in C} \delta_{ni} U_n(X_i, p_i)$$

$$\text{s.t.} \sum_{i \in C} \delta_{ni} = 1,\ \delta_{ni} \in \{0,1\},\ \sum_{i \in C} \delta_{ni} p_i \le M_n,\ \forall i \in C$$

$$\delta_{ni} a_K \le \delta_{ni} Z_i \le \delta_{ni} b_K \tag{2}$$

Model (2) requires that individual n can only choose an alternative which meets the attribute constraints. As suggested by Green et al. (1988), individuals often violate their self-reported cutoffs. Allowing decision makers to violate the attribute constraints at a cost, the extended model takes the following form:

$$\max \sum_{i \in C} \delta_{ni} U_n(X_i, p_i) + \sum_{i \in C} \sum_{k} \delta_{ni} (\lambda_k g_{ik} + \gamma_k h_{ik})$$

$$\text{s.t.} \sum_{i \in C} \delta_{ni} = 1,\ \delta_{ni} \in \{0,1\},\ \sum_{i \in C} \delta_{ni} p_i \le M_n,\ \forall i \in C \tag{3}$$

where g_{ik} and h_{ik} denote the amounts of violations, $g_{ik} = a_k - Z_{ik}$ and $h_{ik} = Z_{ik} - b_k$; λ_k and γ_k are parameters indicating utility penalties.

Model (3) can capture a variety of decision strategies (Swait, 2001). For example, when there are no violations of attribute cutoffs, i.e., $g_{ik} = h_{ik} = 0$, this model becomes a compensatory utility model (i.e., model (1)). Model (3) can also accommodate a conjunctive decision strategy (in which an alternative is

eliminated for not meeting the cutoff constraints on any one of its attributes) by setting the appropriate utility penalty (λ_k, γ_k) to $-\infty$ (Swait, 2001).

3.4. Data and descriptive analyses

Data employed for this study were collected through the Canada-wide internet-based stated choice survey described in Chapter 2. A description of the previously-noted features of the survey design and data collection process is not repeated here. In addition to the survey questions noted in Chapter 2, respondents were asked a series of short questions on their stated preferences for various food attributes. These were directed at the attributes employed in the previously-described choice experiment with the goal of eliciting attribute cutoffs from respondents. In that experiment, canola oil products are described by the four attributes of country of origin, omega-3 content/characteristics, GM/nonGM derivation and price. Cutoffs were queried prior to the choice experiment, so that self-reported cutoffs would not be affected by the attribute levels appearing in the choice experiment. Respondents were asked the following set of four questions, which correspond to the four attributes. The lead-in queries to each of the four question sets are: (1) "When purchasing canola oil, which of the following statements best represents how the country of origin influences your purchase decision?" ; (2) "Which of the following statements best describes your attitudes toward buying foods with fortified ingredients?"; (3) "Which of the following statements best describes your behavior when it comes to buying foods that have ingredients that are genetically modified or genetically engineered?"[10]; (4) "When you purchase a bottle of canola oil, say 1 litre in size, is there always a maximum price you will pay? If yes, which of the following represents the maximum price you will pay for a one litre bottle of canola oil?"

Several alternative cutoff options are offered for each of the four attributes. Options for the query on country of origin are: (1) My decision depends on the

[10] Regarding queries (2) and (3), definitions of food fortification and genetic modification/engineering are offered. For these definitions, see the attached questionnaire (Appendix A).

specific canola oil; (2) I only purchase canola oils produced in Canada; (3) I only purchase canola oils produced in the U.S.; (4) I do not care. Regarding the query on food fortification, three options are offered: (1) My decision depends on the specific food with fortified ingredients; (2) I am not willing to purchase any food with fortified ingredients; (3) I am indifferent towards foods with/without fortified ingredients. Options corresponding to the query on the GM attribute are: (1) My decision depends on the specific food with GM/GE ingredients; (2) I am not willing to purchase any food with GM/GE ingredients; and (3) I am indifferent towards foods with/without GM/GE ingredients. For the price attribute, respondents who indicated having a price cutoff were requested to choose one of the four offered price ranges to indicate the maximum price they would pay. The applicability and presentation of the cutoff questions were initially assessed by a focus group of members of the public recruited in Edmonton. Initial analyses of data from two pre-tests of the revised survey gave a further means to assess the appropriateness of cutoffs before the implementation of the final Canada-wide survey.

Table 3.1 reports the numbers and corresponding percentages of respondents who reported having attribute cutoffs. A large proportion of survey respondents, 336 out of 1,009, said that they only purchase canola oils produced in Canada. In view of previous studies of Canadians' attitudes, we did not find it surprising that almost 40% (38.95%) of respondents indicated that they are not willing to purchase food with GM ingredients. In general, it appears that respondents were generally willing to accept enhancement of food nutrients through fortification of ingredients—only 84 respondents indicated that they are not willing to purchase food with fortified ingredients. The price cutoffs chosen by respondents vary. Some 40% of the respondents indicated that they do not have a maximum price for the purchase of a bottle of canola oil. Among those with price cutoffs, 11.6% said they are not willing to pay more than $2.49 for a one litre bottle of canola oil; 38.9% chose a maximum price in the range of $2.5 to $4.99; and 7.73% indicated their maximum willingness to pay to be a price in the range of $5 to $7.49.

Examining the demographic characteristics of consumer segments that have different preferences for food attributes: from table 3.2a the demographic characteristics of respondents who indicate only purchasing Canadian canola oil can be compared with those who do not care whether or not a canola oil is produced in Canada. As can be seen in table 3.2a, older people are more likely only to purchase canola oil produced in Canada. The average age of respondents who chose "I only purchase canola oil produced in Canada" is 53.46, appreciably higher than the average age of respondents who chose either "My decision depends on the specific canola oil" or "I do not care". Table 3.2a also shows that the education level of respondents who state that they only purchase Canadian oil is relatively lower than for other groups. Only 16.4% of this group have a university degree or above. Regarding consumers' preferences for food with fortified ingredients, a very small proportion of respondents (8.3%) indicate that they are not willing to purchase food with fortified ingredients (table 3.2b). Among these, the majority are men (59.5%), and the proportion of people with a university degree or above is much higher than for the other groups where respondents do not have a cutoff for food with fortified ingredients (40.5% versus 17%). Table 3.2c indicates that among respondents who are not willing to purchase GM food, 62.5% are women and 22% have a university degree or above. From table 3.2d, we can compare the demographic characteristics of respondents who state that they have a maximum price for a 1 litre bottle of canola oil and those who do not. As can be seen, relative to people who do not indicate a maximum price for canola oil, people with a price cutoff have a lower level of income and education. The average income for respondents who have a price cutoff is $63,811.8, while the average income for respondents who do not have a price cutoff is $76,129.63. The percentage of people with a university degree or above is also lower for people who have a price cutoff relative to those who do not (17.8% versus 22%).

3.5. Incorporating self-reported cutoffs into the modeling of consumers' choices for a functional food

There is growing interest in the future market for functional food which is directed at increasing the nutritive characteristics of particular foods. This has been pursued by fortification, and may also be achieved by plant breeding, including through the application of modern agricultural biotechnology techniques. However, applying transgenic methods of biotechnology to food production is a controversial topic in society at large. This study examines consumers' preferences for canola oil products which vary in omega-3 content (which is increasingly recognized as important to health), and may be associated with genetic modification. Details about the attribute selection and experimental design of the choice experiment were described in Chapter 2. That chapter presents analyses of consumers' choices using conditional logit (CL) and latent class (LC) models, while focusing on trust expressed by respondents. In the current chapter, the previous analyses are extended by incorporating attribute cutoffs into the choice modeling. As suggested by the summary of initial responses in table 3.1, appreciable proportions of respondents reported having attribute cutoffs. We expect that taking these attribute constraints in decision making into consideration in modeling will improve the model fit and explanation of choice behavior.

In section 3 above we introduced a utility model which allows for compensatory cutoffs in decision making (see model (3)). Here we proceed to examine consumers' choices based on that model. We assume initially that the respondents' self-reported cutoffs are exogenous to their choices. Dummy variables are created indicating whether there are violations of cutoffs. For example, if a respondent stated that he/she only purchases canola oils produced in Canada, a canola oil produced in the United States leads to a violation of the Canada-related cutoff for this respondent. Applying model (3) to consumers' choices for canola oils, the utility function takes the form:

$U_{ni} = \beta_1 \text{Nopurchase} + e_{ni}$, i= "no purchase"

$U_{ni} = (1\text{-Nopurchase})(\beta_2 \text{Enhance} + \beta_3 \text{Contain} + \beta_4 \text{GM} + \beta_5 \text{NonGM}$

$$+\beta_6 \text{Canada}+\beta_7 \text{Price}+\beta_8 \text{VCan}+\beta_9 \text{VFort}+\beta_{10} \text{VGM}+\beta_{11} \text{VPrice1} \quad (4)$$
$$+\beta_{12} \text{VPrice2}+\beta_{13} \text{VPrice3})+e_{ni}, \quad i \neq \text{“no purchase”}$$

where “Nopurchase” takes the value of 1 for the “no purchase” option, otherwise “Nopurchase” equals 0; “Enhance” takes the value of 1 if a canola oil is labeled “enhanced omega-3” and is 0 otherwise; “Contain” equals 1 if a canola oil is labeled “contains omega-3” and otherwise equals 0. The attribute of GM derivation is coded into two separate dummy variables, GM and NonGM, indicating the presence and absence of GM ingredients respectively; “no label” is the omitted level for this attribute. “Canada” equals 1 if a canola oil is produced in Canada, otherwise “Canada” equals 0; “U.S.” is the omitted level of this attribute. Price denotes the price of a canola oil product; VCan is a dummy variable with a value of 1 if a violation of the cutoff of only purchasing Canadian oils occurs (a U.S. product is considered a violation of this cutoff), otherwise VCan equals 0. VFort and VGM are defined in a similar manner, with VFort indicating a violation of the fortification cutoff; based on the definitions and information given to respondents we define a canola oil with enhanced omega-3 as a violation of this cutoff. VGM denotes a violation of the GM cutoff; a canola oil containing GM ingredients violates this cutoff. VPrice1, VPrice2 and VPrice3 are three dummy variables indicating violations of three different price cutoffs, with VPrice1 corresponding to a violation of the price cutoff at $2.49/litre, VPrice2 at $4.99/litre, and VPrice3 at $7.49/litre; βs are parameters to be estimated; and e_{ni} represents an error term.

In this study, survey respondents were asked to choose among different canola oils in a series of choice tasks. Each choice task contains three alternatives: two canola oil products and a “no purchase” option. Let U_{ni} denote the level of utility individual n obtains from choosing oil i. By assuming the error term has a type I extreme value distribution, the logit choice probability of individual n choosing oil i (P_{ni}) takes the form:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_k e^{V_{nk}}} \qquad (5)$$

where V_{ni} represents the deterministic component of U_{ni} (equation (4)).

Table 3.3 compares the results of a standard conditional logit (CL) model (equation (5)) with that of a CL model which allows for cutoff violations (we label this "CL model with penalties"). These models were estimated with maximum likelihood methods using NLOGIT Version 4 (Greene, 2007). As can be seen in table 3.3, the analytic findings from these models are similar. A negative coefficient on "Nopurchase" suggests that consumers are averse to not purchasing a canola oil product. Omega-3 content in a canola oil is valued by consumers since the coefficients on both "enhanced omega-3" and "contains omega-3" are positive and significant. Findings related to the GM attribute are as expected: in general, consumers do not like a canola oil with GM ingredients and are willing to pay a premium for a canola oil labeled "NonGM" relative to one that is not labeled. We also find that Canadian consumers prefer canola oils produced in Canada to those produced in the U.S.

The results from the CL model that includes utility penalties when cutoffs are violated, given in table 3.3, are based on the assumption that some respondents may be willing to sacrifice a utility loss rather than eliminate an alternative when there is a cutoff violation associated with that alternative[11]. Consequently we expected the coefficients for the variables representing cutoff violations to be negative. As expected, the results of the CL model incorporating utility penalties suggest that violations of the cutoffs did result in utility losses to decision makers. All the coefficients for the cutoff violation variables are negative and significant except for that on the variable of VPrice3, which denotes a violation of the price

[11] A total of 6,054 choices are made. Of these, 1,644 choices involve violating at least one attribute cutoff (171 choices involve multiple violations). The cutoff of only purchasing Canadian oil was violated 416 times; the fortification cutoff was violated 96 times; the no-GM cutoff was violated 143 times; the price cutoff at $2.49 was violated 467 times; the price cutoff at $4.99 was violated 638 times; the price cutoff at $7.49 was violated 58 times.

cutoff at $7.49. It seems likely that this may arise from the feature that the maximum price employed in the choice experiment is $7.50, which is very close to $7.49 and thus is unlikely to be considered a real violation of this particular price cutoff. We observe that the coefficient on VGM has the largest absolute value, which indicates that the utility penalty associated with violating the GM cutoff is larger than that associated with violating any other cutoff.

A comparison between the two CL models in table 3.3 suggests that incorporating the cutoffs into the CL model does affect the model estimates. For example, the results from the CL model without penalties indicate that the presence of GM ingredients in a canola oil reduces utility by 0.829 units compared with a canola oil without an explicit "GM/NonGM" label. However, the results from the CL model with penalties find that a "GM" label only reduces utility by 0.282 units, while violating the no-GM cutoff results in a utility penalty of 1.9321 units. Table 3.3 also shows that incorporating attribute cutoffs into the utility function significantly increased the model fit. The log likelihood statistic increased from -5145.132 to -4804.135, while the pseudo R^2 increased from 0.2139 to 0.2656. A likelihood ratio (LR) test of inclusion of the cutoff violation variables in the model clearly favors inclusion: the LR statistic is -2[-5145.132-(-4804.135)] = 681.994. This is much greater than the one percent critical value of 16.81(the number of degrees of freedom is 6), suggesting that the utility function without the cutoff violation variables be rejected.

There is a possibility that overestimation of cutoff effects on decision making may arise from not accounting for taste variation among the respondents (Swait, 2001). To assess this, we further test the model with compensatory attribute cutoffs by controlling for unobservable preference heterogeneity among the survey respondents. We conduct this test by estimating a random parameters logit (RPL) / mixed logit (ML) model, which allows for preference heterogeneity across individuals (Hensher and Greene, 2003; Train, 2003). The mixed logit probability of individual n choosing alternative i is:

$$P_{ni} = \int \left(\frac{e^{V_{ni}(\beta)}}{\sum_k e^{V_{nk}(\beta)}} \right) f(\beta) d\beta \qquad (6)$$

where $V_{ni}(\beta)$ is the deterministic component of U_{ni}; β is a vector of parameters; and $f(\beta)$ denotes a density function of parameters (Train, 2003).

Table 3.4 presents the results from estimating the RPL model, as described by equation (6). We allow for heterogeneous consumer preferences for all the attributes when estimating the RPL model. The coefficients for the attributes are assumed to have a normal distribution. Since economic theory suggests that price has a negative impact on utility, we assume that negative prices exhibit a lognormal distribution. The statistics on the model fit suggest that the RPL model reported in table 3.4 is superior to the CL models presented in table 3.3. Both the log likelihood and pseudo R^2 increase when taste variations are considered in the model. However, comparison of the results reported in tables 3.3 and 3.4 suggests that in general the findings are not highly sensitive to the model specification in that we identify the same pattern of consumer preference for all the attributes. Specifically, from the results in both tables, consumers value omega-3 content in a canola oil product. Overall, they dislike GM food and prefer a canola oil that contains no GM ingredients. These Canadian consumers also prefer canola oils produced in Canada to those produced in the U.S.

Regarding the attribute cutoffs, we find that consumers suffer a utility loss when they violate their self-reported attribute cutoffs and that this holds even after we consider unobservable preference heterogeneity across individuals in the model. As suggested by the estimates of the CL model with utility penalties in table 3.3, the results of the RPL model also indicate that a violation of the no-GM cutoff results in the largest utility penalty. A possible explanation for this is that individuals consider the GM attribute to be a more important factor than the other attributes in their decision making, so they suffer more from violating the cutoff associated with this attribute. However, whether a utility penalty increases with

the level of importance of an attribute remains an interesting topic to be further investigated in future studies. The findings on the price cutoffs changed slightly when unobservable preference heterogeneity was considered. The estimates of the CL model suggest that there is a utility penalty associated with violating the price cutoff at $2.49, whereas the RPL model shows that the violation of that price cutoff variable (VPrice1) had no impact on utility. Both the CL model and the RPL model indicated no evidence that a violation of the highest price cutoff ($7.49), affects an individual's utility level. However, as noted above, the highest price level that appeared in the choice experiment is $7.50, very close to the price cutoff at $7.49, suggesting that inclusion in the model of a price cutoff at $7.49 is redundant. Since both the CL model and the RPL model suggest that violation of the price cutoff at $7.49 has no impact on utility, we consider only two price cutoffs in the following analyses, one at the level of $2.49 and the other at the level of $4.99.

3.6. Modeling consumer behavior under predicted cutoffs

Endogeneity associated with attribute cutoffs has been discussed in several studies (Klein and Bither, 1987; Huber and Klein, 1991; Swait, 2001). It has been found that cutoffs are influenced by numbers of factors, such as an individual's knowledge of the attributes (Huber and Klein, 1991) and the choice context (Swait, 2001). In this section, we examine potential endogeneity of respondents' self-reported cutoffs. A common approach to testing endogeneity is to use instrumental variables (IV) in model estimation and then compare model estimates with and without IVs. We create instruments for respondents' self-reported cutoffs by predicting cutoffs based on respondents' demographic characteristics. In modeling, we then replace the self-reported cutoffs with predicted cutoffs.

3.6.1. Linking cutoffs to demographic characteristics using a binary logit model

Respondents' demographic characteristics are exogenous variables. One possibility to examine the problem of endogeneity of the self-reported cutoffs is to

predict cutoffs based on individuals' demographic characteristics. However, the feasibility of this approach depends on how much explanatory power an individual's demographic characteristics have on his/ her self-stated cutoffs. In section 3.4, we identified that there are some linkages between respondents' preferences for food attributes and their demographic characteristics (see tables 3.2a-d). In this section we formally test the relationships between respondents' self-reported cutoffs and their demographic characteristics.

Four types of cutoffs are identified from respondents in the survey, corresponding to each of the four attributes employed in the choice tasks (see table 3.1). About one third of the respondents indicated that they would only purchase canola oils produced in Canada; 8% of the respondents indicated that they would not purchase food with fortified ingredients; almost 40% of the respondents identified that they were not willing to purchase a canola oil with GM ingredients; and the majority of the respondents indicate that they would pay no more than one of the specified prices for a bottle of canola oil. Since these are all discrete cutoffs, respondents' answers to each of the cutoff questions can be grouped into two categories, having a cutoff and not having a cutoff. Therefore, it is appropriate to use a binary indicator to show whether an individual has a cutoff for a particular attribute or not. This indicator has two values, 0 and 1, with 1 indicating that an individual has a cutoff and 0 indicating that an individual has no cutoff. The creation of a binary indicator for each of the attribute cutoffs allows us to link individuals' self-reported cutoffs to their demographic characteristics using a binary logit model.

In a binary logit model, the dependent variable (Y) is a binary variable, taking a value of either 1 or 0. Let y* be an unobservable variable and $y^* = X'\alpha + \varepsilon$, where X represents the factors influencing y* and α is a vector of parameters. We cannot observe y* directly, what we see is Y=1 if y*>0; otherwise Y=0. Assuming that ε has a logistic distribution,

$$\text{Prob}\left(Y=1\middle|X\right)=\frac{e^{X'\alpha}}{1+e^{X'\alpha}} \qquad (7)$$

We define Y=1 if a respondent reports having a cutoff and Y=0 if a respondent has no cutoff. We then examine how the respondents' demographic characteristics affect their answers to each of the cutoff questions respectively based on equation (7). The definitions of the variables used in the binary logit models are presented in Appendix 3.1 and the results are presented in tables 3.5a and 3.5b.

Table 3.5a reports the results from estimating three binary logit models. Model (1) examines how demographic variables affect the probability that an individual only purchases canola oils produced in Canada. In this context we are not particularly interested in the magnitude of the influence that a demographic variable has on the probability of only purchasing Canadian oils and consequently do not present the marginal effects of the demographic variables in the table. According to the results of Model (1), the older people are, the more likely they are only to purchase Canadian oils. Compared with respondents from other regions in Canada, respondents that reside in Quebec are less likely to have a cutoff only to purchase Canadian oils, while respondents that reside in the Prairie provinces are more likely not to consider purchase of canola oils produced outside of Canada. We also find that urban residents are less likely only to purchase Canadian oils.

The results of Model (2) suggest that male respondents are more likely to have a cutoff for fortified ingredients in a food product; respondents with higher levels of education (a university degree and above) tend to dislike fortified ingredients in a food product; and urban respondents are less likely to have a cutoff for fortified ingredients. Model (3) examines how demographic characteristics influence the probability that a respondent has a cutoff for GM ingredients in a food product. We find that male respondents and urban residents are less likely to have a cutoff for GM food while residents of Quebec and those

with more education (a university degree or above) are more likely to have a cutoff for GM food.

The maximum prices indicated by respondents to be acceptable for the purchase of a bottle of canola oil vary from $2.49/litre to $7.49/litre. In the choice experiment, the attribute of price has three levels, $2.5/litre, $5.0/litre and $7.50/litre. As discussed above, only two price cutoffs, at the levels of $2.49 and $4.99, have impacts on utility. The price cutoff at $7.49 is evidently redundant, being very close to $7.50, the maximum level of price employed in the choice experiment. Therefore, we created two binary variables representing the two relevant levels of price cutoffs at $2.49 and $4.99. The results for Models (4)-(5) presented in table 3.5 b investigate how demographic variables influence the probability that a respondent has a price cutoff at $2.49/litre and $4.99/litre respectively. In general, we find that, except for income levels, socio-economic and demographic variables tend to have limited impacts on the price cutoffs. As can be seen in table 3.5 b, the coefficients on income in Models (4) and (5) are negative and significant, suggesting that the respondents with more income are less likely to specify price cutoffs at $2.49/litre or $4.99/litre.

3.6.2. Incorporating predicted cutoffs into the utility function

The results in tables 3.5a and 3.5b suggest that demographic characteristics do influence the probability that an individual has a cutoff for an attribute. Thus it should be possible to examine endogeneity of self-reported cutoffs by predicting cutoffs based on respondents' demographic characteristics and using the predicted cutoffs as the instruments for the self-reported cutoffs. In this section, we construct two sets of instruments for the self-reported attribute cutoffs based on the respondents' demographic characteristics and the estimated binary logit models, and compare the results for different models estimated under self-reported cutoffs and predicted cutoffs.

The first set of instruments consist of the predicted probabilities of having a cutoff. The predicted probabilities of having a cutoff can be used as instruments for the self-reported cutoffs if we assume that the respondents who are more likely to have a cutoff for an attribute suffer a larger utility penalty when a violation of a cutoff occurs. Given a respondent's demographic information and the estimated binary logit models, we can calculate the probability that a respondent has a cutoff for a particular attribute. For example, the probability that a respondent has a cutoff for the GM attribute can be calculated by substituting the respondent's demographic information and the parameters in Model (3) (table 3.5a) into equation (7), where X represents the demographic variables and α represents the parameters. We then incorporate the predicted probabilities of having a cutoff into equation (5) and estimate a CL model. The results for the CL model are presented in table 3.6 (see Model (2)). Model (1) in table 3.6 is a CL model in which the attribute cutoffs were reported by the respondents themselves. We present the results for Model (1) in table 3.6 for purposes of comparison of results with Model (2). Model (2) differs from Model (1) (table 3.6) in incorporating cutoff effects based on their predicted probabilities, instead of the respondents' self-reported cutoffs. The cutoff violation variables in Model (2) are labeled as VCana, VForta, VGMa, VPrice1a and VPrice2a, with VCana denoting the violation associated with the cutoff of only purchasing Canadian oils, VForta denoting the violation of the fortification cutoff, VGMa indicating the violation of the GM cutoff, and VPrice1a and VPrice2a indicating the violations of the price cutoffs at $2.49 and $4.99 respectively. For purposes of comparison, two RPL models were also estimated, with one (Model (4) in table 3.7) employing the respondents' self-reported cutoffs and the other (Model (5) in table 3.7) employing the predicted probabilities of having a cutoff as instruments for the self-reported cutoffs. These results for the RPL models are reported in table 3.7.

The results of Model (2) in table 3.6 and Model (5) in table 3.7 show that consumers are averse to not purchasing a canola oil product. They value omega-3 content in canola oils and prefer canola oils produced in Canada to those

produced in the U.S. These findings are consistent with those from the models which employed self-reported cutoffs, i.e. Model (1) in table 3.6 and Model (4) in table 3.7. However, the findings on the cutoff violation variables have changed as a result of using the predicted probabilities as instruments for the self-reported cutoffs. Both Model (2) and Model (5) suggest that consumers' utility is penalized for violating the cutoff of only purchasing Canadian oils and the no-GM cutoff. However, violations of the fortification cutoff were found to have no impact on utility. This finding contradicts those from Model (1) and Model (4), which show that there are utility penalties associated with violating the fortification cutoff. This discrepancy suggests that the results from a model which assumes the cutoffs to be exogenous may be misleading. A possible reason for this is that respondents' self-reported cutoffs may be endogenous.

Regarding the impacts of violating the price cutoffs, Model (2) (table 3.6) indicates that consumers were penalized on utility for violating the price cutoff at $2.49 but there was no utility penalty associated with violating the price cutoff at $4.99. Model (5) in table 3.7, however, indicates no penalty for violating the price cutoff at $2.49 but suggests that violating the price cutoff at $4.99 has a significant and positive effect on utility. Thus, in general, the results on the price cutoffs are not stable across models. These unexpected findings from Model (5) may be caused by the instruments used for the self-reported price cutoffs at $2.49 and $4.99. The instruments for these two price cutoffs could be correlated since these were predicted based on respondents' demographic and socioeconomic information and income has a significant negative impact on having a price cutoff at both $2.49 and $4.99. Considering that the predicted probabilities of having price cutoffs at $2.49 and $4.99 might be correlated, we dropped the cutoff violation variable associated with the price cutoff at $4.99 (VPrice2a) and re-estimated the CL model and the RPL model. These results are presented in tables 3.8 and 3.9. The CL model presented in table 3.8 suggests that there is a penalty associated with violating the price cutoff at $2.49 while the RPL model (table 3.9) found no evidence of penalizing the violations of a price cutoff.

An interesting feature of the results from Models (2) and (5) is that the coefficient on GM is not significant, but the coefficient on VGMa, which denotes a violation of the no-GM cutoff, has a large negative value and is statistically significant. These results suggest that the presence of GM ingredients in a canola oil product has no impact on their utility for those who are not concerned about GM food. However, violating the no-GM cutoff results in a large utility loss for those who are concerned about GM food. The finding that the presence of GM ingredients in a food product has no impact on utility is unexpected and contradictory to the results from Models (1) and (4). This may be due to the estimation method. When we instrument the self-reported cutoff for the GM attribute with the predicted probabilities of having a no-GM cutoff, we change the cutoff variable from a binary variable to a continuous variable. The self-reported cutoff is described as having a cutoff for GM ingredients or not having a cutoff, while the predicted probabilities are the probabilities that the respondents have a cutoff for the GM attribute. Employing the self-reported cutoffs, the model only punishes those who reported having a cutoff for the GM attribute when a violation occurs. However, using predicted probabilities as instruments, all the respondents for whom predicted probabilities are greater than 0 suffer a utility loss when a violation occurs. It is likely that the negative impact of the GM attribute on utility is also captured by the utility penalty variable (VGMa).

As mentioned earlier in this section, in using the predicted cutoff probabilities as the instruments for the self-reported cutoffs, we assume that respondents who are more likely to have a cutoff for an attribute suffer a larger utility penalty when a violation of a cutoff occurs. However, it could be the case that a utility penalty may not occur until the probability of having a cutoff surpasses a threshold. In other words, a violation of a cutoff may have no impact on the respondents who have a predicted probability of having a cutoff under a threshold, say 50%, but may cause a large utility loss for those respondents with a predicted probability even slightly above the threshold. To assess this, we constructed a second set of instruments for the self-reported cutoffs which allow a

utility penalty to take effect only when the predicted probability surpasses a threshold.

Given information on the socioeconomic and demographic characteristics of respondents and the estimated functions between the respondents' self-reported cutoffs and these characteristics, we can predict whether a respondent has a cutoff for an attribute. These predicted cutoffs can be used as the alternative instruments for the self-reported cutoffs. We initially adopted the threshold value of probability of 0.5 in predicting cutoffs. If a respondent has a predicted probability greater than 0.5 of having a cutoff for an attribute, the model predicts that this respondent has a cutoff for that attribute. Otherwise, the model predicts that this respondent does not have a cutoff for an attribute. However, a probability level of 0.5 may not be an appropriate threshold value if the dependent variable in a binary logit model consists of either too many 0s or too many 1s. In this study, we identified that only 8.33% of the survey respondents have a self-reported cutoff for fortified ingredients in food and only 11.6% have a price cutoff at $2.49 (see table 3.1). As a result, it is not possible for the model to predict any respondent to have a fortification cutoff or a price cutoff at $2.49 if we set the threshold value at 0.5. Consequently, we adjusted the threshold value to 0.2 in predicting whether a respondent has a cutoff for fortified ingredients or for a price over $2.49.

We estimate a CL model (Model (3) in table 3.6) based on the predictions of whether a respondent has a cutoff for an attribute instead of using respondents' self-reported cutoffs[12]. The variables indicating the cutoff violations in Model (3) were adjusted accordingly and were labeled as VCanb, VFortb, VGMb, VPrice1b and VPrice2b. VCanb has a value of 1 if a respondent violates his/her predicted (not self-reported) cutoff of only purchasing Canadian oils; otherwise VCanb has a value of 0; VFortb, VGMb, VPrice1b and VPrice2b were defined in a similar manner, taking the value of 1 if a violation occurs based on the predicted cutoffs;

[12] A corresponding RPL model was also estimated, but the model did not converge and therefore are not reported.

otherwise these variables equal 0. As is the general case from the previous estimations, the results of Model (3) suggest that respondents do not like GM food and are willing to pay more for canola oils labeled as “contains omega-3” and “enhanced omega-3” and for canola oils produced in Canada. Regarding the cutoff violation variables, from Model (3), violating the cutoff of only purchasing Canadian oils and the no-GM cutoff results in utility penalties. Moreover, the magnitude of the utility penalties suggested by Model (3) are much smaller than is suggested by Models (1) (table 3.6) and (4) (table 3.7), which are based on the respondents’ self-reported cutoffs. We find no evidence that violating the fortification cutoff and the price cutoffs resulted in utility losses based on the results of Model (3).

3.7. Conclusions

In this study, we incorporate attribute cutoffs into the modeling of consumers’ choices for functional canola oil which may be associated with genetic modification. We find empirical evidence that consumers tend to use attribute cutoffs in their decision making regarding stated purchases of a food product. However, our results show that some respondents do not adhere to their self-stated cutoffs and take a utility penalty rather than eliminate an alternative when a violation occurs. The results of both CL models and RPL models suggest that incorporating attribute cutoffs into the compensatory utility function significantly improved the model fit; differences in behavior are also implied.

By linking respondents’ self-stated cutoffs to their demographic characteristics, we find evidence that respondents’ demographic characteristics explain some of the cutoff level selected for some attributes. In general, we find that demographic variables have less impact on price cutoffs than on cutoffs associated with the other attributes. We examine endogeneity of respondents’ self-reported cutoffs by predicting cutoffs based on the respondents’ demographic characteristics and employing predicted cutoffs in model estimation. Our results suggest that using predicted cutoffs as the instruments for the self-reported cutoffs

affected some of the parameter estimates, relative to the model without instruments. In general, our results for cutoffs relating to the purchase of Canadian oils only and the no-GM cutoff are stable across the different models estimated. Model estimates that incorporate self-reported cutoffs and those that incorporate predicted cutoffs all suggest that violations of the cutoff of purchasing Canadian oil only and the no-GM cutoff result in utility penalties to consumers. However, the magnitude of the utility penalty associated with violating these two cutoffs is influenced by whether the self-reported cutoffs or the predicted cutoffs are employed in the model. Findings related to the fortification cutoff and the price cutoffs are not consistent between models under the self-reported cutoffs and those under the predicted cutoffs. Although the models incorporating self-reported cutoffs suggest that there is a utility loss associated with violating the fortification cutoff, we found no evidence of utility penalty associated with violating the fortification cutoff when we estimated the model under the predicted cutoffs. In this context we note that relatively few respondents actually indicated a fortification cutoff. Findings on the violations of the price cutoffs also vary among models. One interesting feature of these findings is that results from CL models under both self-reported cutoffs and predicted cutoffs seem to suggest that violations of the lower price cutoff led to more consistent evidence of utility loss. This may be due to the fact that respondents who reported a lower price cutoff are more concerned about price. Consequently, violating a price cutoff is more likely to result in utility loss for these respondents.

Individual's demographic characteristics are exogenous variables. Predicting cutoffs based on respondents' demographic characteristics can provide a way to examine potential endogeneity of cutoffs. However, we must acknowledge that there are some drawbacks in pursuing this approach to estimation. First, there may be an identification problem since respondents' demographic characteristics may affect not only cutoffs but also their choices, predicting cutoffs based on demographic characteristics may cause a problem of identification between the cutoffs and demographics. Furthermore, our work suggests that demographic

characteristics have limited predictive power on the cutoffs. Thus the instruments based on demographic characteristics could be weak. Good instruments are necessary for identifying and addressing the potential endogeneity of self-reported cutoffs. However, finding good instruments to predict cutoffs remain a challenge. Nevertheless, this study provides some support for the contention that self reported cutoffs may be endogenous and that researchers should consider using approaches that recognize this.

In this study we examine the potential endogeneity associated with self-reported attribute cutoffs by predicting cutoffs based on respondents' demographic characteristics. However, it is possible that the use and violation of attribute cutoffs by respondents are also affected by choice contexts, such as the specific choice questions that respondents encounter. Future study may extend the current model by incorporating information on the specific choice questions encountered by individual respondents. Moreover, in this study we assume that cutoffs are fixed over time. Previous literature suggests that decision makers learn from their decision making and tend to adjust their cutoffs when they have more information about their choice tasks (Klein and Bither, 1987; Huber and Klein, 1991). Future studies may consider extensions to the current model by allowing for heterogeneity in cutoffs and for adjustments in these over time.

Table 3.1 Numbers and percentages of respondents with cutoffs (sample size: 1,009)

Cutoff Statements	Numbers of respondents with cutoffs	%
I only purchase canola oil produced in Canada	336	33.3
I am not willing to purchase any food with fortified ingredients	84	8.33
I am not willing to purchase any food with genetically modified ingredients	387	38.35
My maximum price for 1 litre bottle of canola oil is $2.49 or less	117	11.6
My maximum price for 1 litre bottle of canola oil is $2.5~$4.99	393	38.95
My maximum price for 1 litre bottle of canola oil is $5~$7.49	78	7.73

Table 3.2a Influences of demographic characteristics on consumers' preferences for the country of origin of canola oil

	Respondents	Gender		Age		Income		Education		
		Male	Female	Mean	Std.dev	Mean	Std.dev	High school or below	Post secondary degree	University or above
My decision depends on the specific canola oil.	20.10%	41.90%	58.10%	47.90	*14.91*	73716.57	*39893.8*	29.60%	47.70%	22.70%
I only purchase canola oil produced in Canada.	33.30%	42.60%	57.40%	**53.46**	*13.90*	68633.06	*38394.2*	33.90%	49.70%	**16.40%**
I do not care.	46.60%	40.90%	59.10%	45.57	*14.67*	66911.06	*38240.3*	35.70%	43.90%	20.40%

Table 3.2b Influences of demographic characteristics on consumers' preferences for fortified ingredients in food

	Respondents	Gender		Age		Income		Education		
		Male	Female	Mean	Std.dev	Mean	Std.dev	High school or below	Post secondary degree	University or above
My decision depends on the specific food with fortified ingredients.	52.70%	38.30%	61.70%	50.14	*14.67*	71449.85	*39857.39*	33.50%	48.60%	17.90%
I am not willing to purchase any food with fortified ingredients.	8.30%	**59.50%**	40.50%	51.14	*13.54*	67057.21	*34683.12*	22.60%	36.90%	**40.50%**
I am indifferent towards foods with/without fortified ingredients.	38.90%	42.20%	57.80%	46.15	*15.08*	65723.27	*37682.60*	36.90%	45.80%	17.30%

Table 3.2c Influences of demographic characteristics on consumers' preferences for GM/GE ingredients in food

	Respondents	Gender		Age		Income		Education		
		Male	Female	Mean	Std.dev	Mean	Std.dev	High school or below	Post secondary degree	University or above
My decision depends on the specific food with GM/GE ingredients.	30.10%	39.10%	60.90%	49.40	*15.85*	69946.49	*40278.38*	35.20%	46.10%	18.70%
I am not willing to purchase any food with GM/GE ingredients.	38.40%	37.50%	**62.50%**	49.74	*13.98*	65876.86	*34590.78*	31.50%	46.50%	**22.00%**
I am indifferent towards foods with/without GM/GE ingredients.	31.50%	49.10%	50.90%	46.65	*14.80*	71431.74	*41592.87*	35.50%	47.20%	17.30%

Table 3.2d Influences of demographic characteristics on consumers' maximum price for canola oil

	Respondents	Gender		Age		Income		Education		
		Male	Female	Mean	Std.dev	Mean	Std.dev	High school or below	Post secondary degree	University or above
I have a maximum price for a 1 litre bottle of canola oil.	59.10%	40.90%	59.10%	47.97	*14.60*	**63811.80**	*35217.69*	33.60%	48.60%	**17.80%**
I do not have a maximum price for a 1 litre bottle of canola oil.	40.90%	42.60%	57.40%	49.67	*15.21*	76129.63	*42172.49*	34.40%	43.60%	22.00%

Table 3.3 Results of conditional logit (CL) models with/without utility penalties

	CL model without penalties		CL model with penalties	
Attribute	Coefficient	Standard error	Coefficient	Standard error
Nopurchase	-2.0037***	0.069	-2.414***	0.0787
Enhance	0.3922***	0.0492	0.4732***	0.0525
Contain	0.43***	0.0513	0.4706***	0.0537
GM	-0.829***	0.0513	-0.282***	0.0588
NonGM	0.2709***	0.0479	0.3039***	0.0496
Canada	0.6574***	0.0385	0.3967***	0.0451
Price	-0.4548***	0.0115	-0.4367***	0.0134
VCan			-1.0224***	0.0759
VFort			-0.5797***	0.1473
VGM			-1.9321***	0.1083
VPrice1			-0.735***	0.0935
VPrice2			-0.5641***	0.0683
VPrice3			0.0864	0.1654
Log likelihood	-5145.132		-4804.135	
Pseudo R^2	0.2139		0.2656	

*** denotes a significance level of 1%.

Table 3.4 Results of a random parameters logit (RPL) model with attribute cutoffs

Attribute	Coefficient	Standard error
Random parameter in utility functions		
Nopurchase	-4.0262***	0.131
Enhance	0.701***	0.0816
Contain	0.6588***	0.0748
GM	-0.6368***	0.1357
NonGM	0.4479***	0.0726
Canada	0.6003***	0.0791
Nsprice [a]	0.6967***	0.0376
Nonrandom parameters in utility functions		
VCan	-1.5961***	0.1118
VFort	-0.7175***	0.23
VGM	-3.2318***	0.2511
VPrice1	-0.324	0.2736
VPrice2	-0.5093***	0.1074
VPrice3	0.0007	0.2468
Derived standard deviation of parameter distributions		
Sd-Nopurchase	1.3413***	0.1329
Sd-Enhance	0.9841***	0.1126
Sd-Contain	0.7106***	0.1372
Sd-GM	2.046***	0.1529
Sd-NonGM	0.5452***	0.1612
Sd-Canada	1.1753***	0.0904
Sd-Nsprice	0.4373***	0.0275
Log likelihood	-4369.062	
Pseudo R^2	0.329	

***indicates a significance level of 1%.

[a] : Nsprice denotes negative normalized prices.

Table 3.5a Impacts of demographic variables on respondents' answers to different cutoff questions

	Model (1)-Canadian oils only		Model (2)-No fortified ingredients		Model (3)-No GM ingredients	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Constant	-2.3506***	0.3394	-2.9627***	0.553	-0.38	0.3076
Male	0.1984	0.145	0.763***	0.2455	-0.3627***	0.1392
Age	0.0365***	0.005	0.0096	0.0083	0.0049	0.0046
QC	-0.4213**	0.1784	0.2338	0.2803	0.5574***	0.1601
Pra	0.4851***	0.1768	-0.1616	0.3408	-0.2927	0.1804
Univ	-0.0388	0.1611	0.8468***	0.2533	0.3218**	0.1494
Incm [a]	0.0004	0.0026	-0.0028	0.0044	-0.0021	0.0025
Urban	-0.328**	0.1645	-0.6683**	0.2632	-0.343**	0.1591
Log likelihood	-602.7724		-271.2302		-650.672	
Pseudo R^2	0.06		0.06		0.03	

***,** represents significance levels of 1% and 5% respectively.

[a] The coefficients and standard errors presented in this row are 1000 times the estimated coefficients and standard errors.

Table 3.5b Impacts of demographic variables on respondents' price cutoffs

	Model (4)-Price cutoff at $2.49		Model (5)-Price cutoff at $4.99	
	Coefficient	Standard error	Coefficient	Standard error
Constant	-1.3294***	0.445	0.1844	0.3016
Male	0.4703**	0.2033	-0.1219	0.1351
Age	0.0025	0.0068	-0.007	0.0045
QC	-0.2196	0.2561	0.3252**	0.1602
Pra	0.056	0.2563	0.0311	0.1719
Univ	0.0182	0.2324	-0.1362	0.1492
Incm [a]	-0.0131***	0.0038	-0.0048**	0.0025
Urban	-0.2984	0.2295	-0.0079	0.1585
Log likelihood	-352.6311		-668.8105	
Pseudo R^2	0.03		0.01	

***,** represent significance levels of 1% and 5% respectively.

[a] The estimated coefficient and standard error on income are very small due to the scale effect (the values of income are very large relative to the values of other variables). The presented coefficient and standard error on income are 1000 times the estimated coefficient and standard error.

Table 3.6 Results of conditional logit (CL) models incorporating self-reported and predicted cutoffs

	Model (1)		Model (2)		Model (3)	
Attribute	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Nopurchase	-2.409***	0.0781	-2.5287***	0.1373	-2.057***	0.0708
Enhance	0.473***	0.0525	0.3373***	0.0746	0.3945***	0.0498
Contain	0.4705***	0.0537	0.4347***	0.0516	0.4284***	0.0514
GM	-0.2823***	0.0588	0.2311	0.1713	-0.7655***	0.0533
NonGM	0.3044***	0.0496	0.2687***	0.0481	0.2679***	0.048
Canada	0.3969***	0.0451	0.2978***	0.0927	0.6149***	0.0404
Price	-0.4349***	0.013	-0.4344***	0.0216	-0.4556***	0.0116
VCan	-1.0222***	0.0759				
VFort	-0.5798***	0.1473				
VGM	-1.9321***	0.1083				
VPrice1	-0.7381***	0.0933				
VPrice2	-0.5699***	0.0674				
VCana			-1.113***	0.2564		
VForta			0.6393	0.6733		
VGMa			-2.8117***	0.4385		
VPrice1a			-1.6464**	0.6996		
VPrice2a			-0.2565	0.2036		
VCanb					-0.3765***	0.1018
VFortb					-0.1615	0.2027
VGMb					-0.6111***	0.1393
VPrice1b					0.0002	0.1422
VPrice2b					-0.0546	0.2307
Log likelihood	-4804.27		-5110.538		-5127.355	
Pseudo R^2	0.2657		0.2189		0.2163	

***,** represent significance levels of 1% and 5% respectively.

Table 3.7 Results of random parameters logit (RPL) models under self-reported and predicted cutoffs

	Model (4)		Model (5)	
Attribute	Coefficient	Std. error	Coefficient	Std. error
Random parameter in utility functions				
Nopurchase	-4.0637***	0.1306	-4.6777***	0.2957
Enhance	0.7041***	0.0833	0.5373***	0.1251
Contain	0.6759***	0.0749	0.6421***	0.0749
GM	-0.6349***	0.1345	0.2288	0.4391
NonGM	0.4414***	0.0741	0.4647***	0.0757
Canada	0.5603***	0.0778	0.4255***	0.1555
Nsprice [a]	0.7072***	0.0364	0.8658***	0.0526
Nonrandom parameters in utility functions				
VCan	-1.6573***	0.1126		
VFort	-0.7421***	0.2401		
VGM	-3.2705***	0.2536		
VPrice1	-0.2523	0.2779		
VPrice2	-0.5176***	0.1062		
VCana			-2.1755***	0.4213
VForta			0.7793	1.185
VGMa			-5.3391***	1.109
VPrice1a			-0.6277	2.0683
VPrice2a			0.7321**	0.339
Derived standard deviations of parameter distributions				
Sd-Nopurchase	1.382***	0.1355	1.61***	0.143
Sd-Enhance	1.0526***	0.1127	1.0035***	0.1282
Sd-Contain	0.6454***	0.1285	0.618***	0.1355
Sd-GM	2.0105***	0.1468	2.4183***	0.1785
Sd-NonGM	0.6021***	0.1497	0.6131***	0.1608
Sd-Canada	1.211***	0.0909	1.3424***	0.1007
Sd-Nsprice	0.4422***	0.0269	0.4148***	0.0255
Log likelihood	-4367.073		-4536.515	
Pseudo R^2	0.329		0.3386	

*** and ** indicate significance levels of 1% and 5% respectively.

[a] : Nsprice denotes negative normalized prices.

Table 3.8 Results of a conditional logit (CL) model including only one price cutoff

	CL model with penalties	
Attribute	Coefficient	Standard error
Nopurchase	-2.5751***	0.1323
Enhance	0.3364***	0.0746
Contain	0.4337***	0.0515
GM	0.2335	0.1712
NonGM	0.2689***	0.0481
Canada	0.3017***	0.0925
Price	-0.4575***	0.0115
VCana	-1.104***	0.256
VForta	0.6517	0.6734
VGMa	-2.88223***	0.438
VPrice1a	-1.689**	0.6983
Log likelihood	-5111.332	
Pseudo R^2	0.2188	

***,** represent significance levels of 1% and 5% respectively.

Table 3.9 Results of a random parameters logit (RPL) model including only one price cutoff

Attribute	Coefficient	Standard error
Random parameter in utility functions		
Nopurchase	-4.4886***	0.2813
Enhance	0.5518***	0.1235
Contain	0.6436***	0.0743
GM	0.0793	0.4517
NonGM	0.4552***	0.0755
Canada	0.4147***	0.1579
Nsprice [a]	0.7801***	0.0325
Nonrandom parameters in utility functions		
VCana	-2.1714***	0.4246
VForta	0.7461	1.1782
VGMa	-5.1094***	1.1364
VPrice1a	-0.7103	1.999
Derived standard deviation of parameter distributions		
Sd-Nopurchase	1.6177***	0.141
Sd-Enhance	0.9661***	0.1245
Sd-Contain	0.5878***	0.1472
Sd-GM	2.4664***	0.1794
Sd-NonGM	0.6325***	0.131
Sd-Canada	1.382***	0.0931
Sd-Nsprice	0.4205***	0.0267
Log likelihood	-4532.448	
Pseudo R^2	0.3431	

*** indicates a significance level of 1%.

[a] : Nsprice denotes negative normalized prices.

Appendix 3.1 Definitions of the variables presented in the binary logit models

Variables [a]	Definitions
Y1	Y1=1 if a respondent is only willing to purchase Canadian oils; otherwise Y1=0
Y2	Y2=1 if a respondent is not willing to purchase food with fortified ingredients; otherwise Y2=0
Y3	Y3=1 if a respondent is not willing to purchase food with GM ingredients; otherwise Y3=0
Y4	Y4=1 if a respondent has a maximum price for a bottle of canola oil at $2.49; otherwise Y4=0
Y5	Y5=1 if a respondent has a maximum price for a bottle of canola oil at $4.99; otherwise Y5=0
Gender	Male=1; female=0
Age	the actual age of a respondent
Region of residency	QC=1 if Quebec, Pra=1 if the Prairie provinces; 0 if other regions
Education	Univ=1 if a university degree and above; 0 otherwise
Income	Incm=the actual annual income of a household
Urban	Urban=1 if a respondent resides in an urban area; otherwise urban=0

[a] Y1-Y5 denote the dependent variables of Models (1)-(5) in Tables 3.5a and 3.5b respectively.

References

Bettman, J.R., E.J. Johnson, and J.W. Payne. 1991. Consumer decision making. In *Handbook of consumer behavior,* edited by T.S. Robertson and H.H. Kassarjian, pp. 50-84. Prentice-Hall, Englewood Cliffs, N.J.

Billings, R.S. and S.A. Marcus. 1983. Measures of compensatory and noncompensatory models of decision behavior: Process tracing versus policy capturing. *Organizational Behavior and Human Performance* 31(3): 331-352.

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.

Christoph, I.B., J. Roosen, and M. Bruhn. 2006. Willingness to pay for genetically modified food and non-food products. Selected paper for presentation at the American Agriultural Economics Association Annual Meeting, Long Beach, California.

De Palma, A., G.M. Myers, and Y.Y. Papageorgiou. 1994. Rational choice under an imperfect ability to choose. *The American Economic Review* 84(3): 419-440.

Elrod, T., R.D. Johnson, and J. White. 2004. A new integrated model of noncompensatory and compensatory decision strategies. *Organizational Behavior and Human Decision Processes* 95(1): 1-19.

Ford, J.K., N. Schmitt, S.L. Schechtman, B.M. Hults, and M.L. Doherty. 1989. Process tracing methods: Contributions, problems, and neglected research questions. *Organizational Behavior and Human Decision Processes* 43(1): 75-117.

Gilbride, T.J. and G.M. Allenby. 2004. A choice model with conjunctive, disjunctive, and compensatory screening rules. *Marketing Science* 23(3): 391-406.

Green, P.E., A.M. Krieger, and P. Bansal. 1988. Completely unacceptable levels in conjoint analysis: A cautionary note. *Journal of Marketing Research* 25(3): 293-300.

Greene, W.H. 2007. *NLOGIT version 4.0: reference guide*. Econometric Software, Inc.

Grether, D. and L. Wilde. 1984. An analysis of conjunctive choice: Theory and experiments. *Journal of Consumer Research* 10(4): 373-385.

Heiner, R.A. 1983. The origin of predictable behavior. *The American Economic Review* 73(4): 560-595.

Hensher, D. and W. Greene. 2003. The mixed logit model: The state of practice. *Transportation* 30(2): 133-176.

Hu, W., A. Hunnemeyer, M. Veeman, W. Adamowicz, and L. Srivastava. 2004. Trading off health, environmental and genetic modification attributes in food. *European Review of Agricultural Economics* 31(3): 389-408.

Huber, J. and N.M. Klein. 1991. Adapting cutoffs to the choice environment: The effects of attribute correlation and reliability. *The Journal of Consumer Research* 18(3): 346-357.

Huffman, W.E., J.F. Shogren, M. Rousu, and A. Tegene. 2003. Consumer willingness to pay for genetically modified food labels in a market with diverse information: Evidence from experimental auctions. *Journal of Agricultural and Resource Economics* 28(3): 481-502.

Lancaster, K.J. 1966. A new approach to consumer theory. *The Journal of Political Economy* 74(2): 132-157.

Lusk, J.L., J. Roosen, and J.A. Fox. 2003. Demand for beef from cattle administered growth hormones or fed genetically modified corn: A comparison of consumers in France, Germany, the United Kingdom, and the United States. *American Journal of Agricultural Economics* 85(1): 16-29.

Johnson, E.J. and R.J. Meyer. 1984. Compensatory choice models of noncompensatory processes: The effect of varying context. *Journal of Consumer Research* 11(1): 528-541.

Klein, N.M. and S.W. Bither. 1987. An investigation of utility-directed cutoff selection. *The Journal of Consumer Research* 14(2): 240-256.

McFadden, D. 1974. Conditional logit analysis of qualitative choice behavior. In *Frontiers in econometrics*, edited by P. Zarembka, pp. 105-142. Academic Press, New York.

Onyango, B., R.M. Nayga, and R. Govindasamy. 2006. U.S. consumers' willingness to pay for food labeled 'genetically modified'. *Agricultural and Resource Economics Review* 35(2): 299-310.

Payne, J., J. Bettman and E. Johnson. 1993. *The adaptive decision maker*. Cambridge University Press, New York.

Payne, J.W. 1982. Contingent decision behavior. *Psychological Bulletin* 92(2): 382-402.

Payne, J.W., J.R. Bettman, and E.J. Johnson. 1988. Adaptive strategy selection in decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14(3): 534-552.

Payne, J.W. 1976. Task complexity and contingent processing in decision making: An information search and protocol analysis. *Organizational Behavior and Human Performance* 16(2): 366-387.

Roberts, J.H. and J.M. Lattin. 1991. Development and testing of a model of consideration set composition. *Journal of Marketing Research* 28(4): 429-440.

Russo, J.E. and B.A. Dosher. 1983. Strategies for multiattribute binary choice. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 9(4): 676-696.

Shugan, S.M. 1980. The cost of thinking. *Journal of Consumer Research* 7(2): 99-111.

Siegrist, M., H. Gutscher, and T.C. Earle. 2005. Perception of risk: The influence of general trust and general confidence. *Journal of Risk Research* 8(2): 145-156.

Simon, H.A. 1955. A behavioral model of rational choice. *The Quarterly Journal of Economics* 69(1): 99-118.

Swait, J. 2001. A non-compensatory choice model incorporating attribute cutoffs. *Transportation Research Part B: Methodological* 35(10): 903-928.

Swait, J. and W. Adamowicz. 2001. The influence of task complexity on consumer choice: A latent class model of decision strategy switching. *The Journal of Consumer Research* 28(1): 135-148.

Swait, J. and M. Ben-Akiva. 1987. Incorporating random constraints in discrete models of choice set generation. *Transportation Research Part B: Methodological* 21(2): 91-102.

Train, K. 2003. *Discrete choice models with simulation*. Cambridge University Press, Cambridge.

Tversky, A. 1972. Elimination by aspects: A theory of choice. *Psychological Review* 79(4): 281-299.

Tversky, A. and D. Kahneman. 1974. Judgment under uncertainty: Heuristics and biases. *Science* 185(4157): 1124-1131.

Tversky, A. and E. Shafir. 1992. Choice under conflict: The dynamics of deferred decision. *Psychological Science* 3(6): 358-361.

Wright, P. 1975. Consumer choice strategies: Simplifying vs. optimizing. *Journal of Marketing Research* 12(1): 60-67.

Wright, P. 1974. The harassed decision maker: Time pressure, distractions, and the use of evidence. *Journal of Applied Psychology* 59(5): 555-561.

CHAPTER 4. BSE and the dynamics of beef consumption: Influences of habit and trust

4.1. Introduction

Canada's first detected case of bovine spongiform encephalopathy (BSE) in a domestically raised bovine animal was announced on May 20, 2003[13]. International borders to Canada's bovine exports were closed immediately following the BSE announcement. The Canadian beef industry suffered major financial costs due to the consequent declines in cattle prices (Roy and Klein, 2005). More than a year later two more BSE events were confirmed in Alberta. One of these was announced on January 2, 2005; the second on January 11, 2005. From 2003 until 2009, 16 cases in which a cow was affected by BSE were reported in Canada (CFIA, 2009).

Consumers' responses to domestic BSE outbreaks have been explored in many nations where this animal disease has occurred. International evidence suggests that beef consumption fell dramatically after the discovery of BSE in most of these instances. For example, Japanese beef sales fell by 70 percent in response to the first of numbers of cases of BSE in Japan (Zielenziger, 2001). The decline in beef purchases by European populations after widespread and numerous incidents of BSE (and associated human deaths) had occurred in Western Europe has also been documented, for example, in Great Britain (Burton and Young, 1996) and Italy (Mazzocchi and Lobb, 2005). Studies of beef consumption by U.S. consumers found negative, but short-lived, impacts of North American BSE (e.g., Kuchler and Tegene, 2006). Unlike experience in other countries, statistics on aggregate Canadian beef disappearance suggest that Canadian beef consumption increased in both 2003 and 2005. According to Statistics Canada (2004), per capita beef consumption in Canada increased from

[13] One earlier incident in which BSE was detected, in December 1993, involved a cow imported from Britain; this caused little concern and received little publicity.

13.5 kilograms (kg) in 2002 to 14.2 kg in 2003, a 5 percent gain. Meanwhile, consumer price indices show that retail beef prices fell by 14 percent from May through September 2003 and then rebounded in September 2003 (Boame et al., 2004). In 2005, a 3.6 percent increase in Canadian beef consumption was reported (Statistics Canada, 2006) when price indexes for beef declined slightly relative to 2004 (Agriculture and Agri-Food Canada, 2007).

Empirical studies on Canadian consumers' responses to domestic BSE incidents have mainly focused on the 2003 BSE incident. Using aggregate provincial data, Peng et al. (2004) identified a significantly negative but small impact of Canada's first domestic BSE incident on the consumption of beef products other than ground beef in Alberta. Maynard et al. (2008) examined BSE impacts on the retail sales of beef entrees in both Alberta and Ontario and concluded that while the 2003 BSE incident stopped some Ontario consumers from purchasing beef entrees in the short-term, there was no evidence that Alberta consumers responded to the BSE event by reducing consumption. So far, to our knowledge, no published work has focused on the dynamics of consumer responses to recurring BSE cases in Canada.

Recurring food safety incidents are not new phenomena. Other familiar examples include multiple outbreaks of Listeria, Salmonella, Avian Influenza, and E.coli. Surprisingly, empirical studies on the recurrence of food safety incidents are rare. Even so, habit persistence in food consumption has been recognized to exist. It is plausible to postulate that recurring food safety events may lead to changes in purchasing patterns for certain food products, including changes in habits. There is empirical evidence that consumers adjust their meat consumption habits during food safety shocks and gradually return to past consumption patterns as their concerns diminish (Saghaian and Reed, 2007; Mazzocchi and Lobb, 2005). However, previous literature has paid little attention to how those adjustments were made, the specific role of consumption habits in shaping individuals' responses to food risks or how previous habits might be modified by

food risks. Furthermore, trust has been suggested by some recent literature as an important factor in analyzing consumer behavior towards food risks (Lobb, 2005). The current study relates recurring food safety incidents to both habit persistence and trust in the context of the series of the first three incidents in Canada in which a domestic cow was found to have BSE. To do this, we examine a sample of Canadian households' meat purchases and responses to the initial and two subsequent BSE incidents in Canada, with particular emphasis on the roles of habit persistence and trust on consumers' reactions.

4.2. Literature review

A comprehensive literature review on trust has been presented in Chapter 2. Therefore, this is not further discussed here. Rather, focus is placed on reviewing studies on BSE and habit. In the context of varying national occurrence and as a major food risk concern for consumers, BSE events have attracted much attention worldwide. Previous studies mainly focused on consumer valuation of food risk reduction (e.g., Dickinson and Bailey, 2002), the impacts of BSE events on meat demand (e.g., Burton and Young, 1996), and consumers' responses to media reports on BSE (e.g., Piggott and Marsh, 2004). Negative impacts of BSE occurrence on beef demand and price have been confirmed by empirical studies in Japan (Peterson and Chen, 2005), Europe (Burton and Young, 1996) and the U.S. (Schlenker and Villas-Boas, 2009). Burton and Young (1996) showed that the BSE outbreak in Great Britain reduced beef consumption in that region in both the short- and long-run. Jin and Koo (2003) identified a structural change in Japanese meat consumption associated with the BSE outbreak in that nation. A recent study by Schlenker and Villas-Boas (2009) found that the announcement of the first infected cow in the U.S. had negative impacts on both beef sales and cattle futures prices.

A common approach has been to estimate the effect of a food scare on consumer preferences by use of a single constant shifter on the intercept of an estimated demand function. However, in many circumstances it appears more

plausible to postulate that impacts on demand of food safety events occur over time. Thus there is growing interest in investigating the time period and extent during which consumers have reacted to a BSE outbreak. Some studies have accounted for gradual changes in preferences by incorporating a continuous shift variable, such as a media index, into a demand function (e.g., Piggott and Marsh, 2004). Others have used a time transition function to allow for gradual changes between particular time periods (e.g., Peterson and Chen, 2005). Using such methods, Mangen and Burrell (2001) concluded that consumers in the Netherlands exhibited a 21-month preference shift illustrated by reductions in beef purchases subsequent to a series of BSE-linked media stories in Europe in March 1996. Peterson and Chen (2005) similarly identified a transition period of two months for changes in meat consumption in Japan. Kuchler and Tegene (2006) examined U.S. consumers' retail purchases of beef products from 1998 through 2004 using Nielsen Homescan® data and concluded that most variance in purchases could be explained by trend and seasonality influences. These authors also concluded that the duration of BSE impacts on U.S. consumers was limited to no more than two weeks (Kuchler and Tegene, 2006).

Recent literature that pays attention to the dynamics of consumer preferences in response to food safety concerns includes Adda (2007) who used the BSE scare in France as a natural experiment to study how previous consumption affected consumer responses to this food risk. His study suggests that French consumers with low and high levels of consumption of beef products were less affected than those with intermediate-level consumption (Adda, 2007). Mazzocchi and Lobb (2005) applied a stochastic approach to aggregate data on Italian household meat demand to measure time-varying impacts of two major BSE outbreaks (1996 and 2000) in Europe. These authors concluded that the influences of the second wave of BSE incidents on meat demand were much stronger than the impacts on demand generated by the first wave of BSE outbreaks (Mazzocchi and Lobb, 2005). Recovery in beef consumption from the first BSE incidents took only a few months while the second wave of BSE outbreaks caused an upward shift in

chicken demand for 14 months (Mazzocchi and Lobb, 2005). In general, however, recurrence associated with food safety incidents has received relatively little attention in the literature on the impacts of food safety events on demand. There has been very little, if any, focus on habits in this context.

Habit formation has been examined in studies of consumer behavior (e.g., Pollak, 1970; Browning and Collado, 2007). The tendency for habit persistence to be exhibited in consumption of at least some goods and services suggests non-separability in preferences across time periods. It has been argued that scholars hold two different views regarding the theoretical explanations of consumer habits (Zhen and Wohlgenant, 2006). One group view habits as subsistence consumption (e.g., Ryder and Heal, 1973; Pollak, 1970). Scholars in this group argue that taste is endogenous and an individual's past consumption is an important factor determining current consumption patterns (Pollak, 1970). Past consumption affects an individual's subsistence consumption which in turn affects his current utility level (Zhen and Wohlgenant, 2006). The other group, however, consider habits as learning-by-doing processes (e.g., Stigler and Becker, 1977; Boyer, 1978). These authors postulate that it is consumption capital, rather than taste, that changes over time (e.g., Stigler and Becker, 1977). Consumers appreciate current consumption based on the knowledge they acquired from past consumption (Zhen and Wohlgenant, 2006).

Regarding the modeling of habits, there are two issues. One relates to consumer rationality. Some studies model habits as "myopic" (e.g., Pollak, 1970). These models assume that consumers do not consider the future effects of their current consumption when making decisions. Others, however, favor rational habitual consumption models (e.g., Zhen and Wohlgenant, 2006). Zhen and Wohlgenant (2006) developed a theoretical model with rational habit formation to examine consumers' responses to food safety incidents. They found significant differences in the reaction patterns between myopic consumers and rational consumers and concluded that consumers' adjustments to a food safety incident

depend not only on the degree of their habit persistence but also on whether they perceive the health impacts of a food safety incident to be transitory or permanent (Zhen and Wohlgenant, 2006). The other issue concerns time aggregation. Heaton (1993) studied the interaction between time-nonseparable preferences and time aggregation based on aggregate consumption data on durables, nondurables and services. He concluded that it was important to account for time non-separabilities in preferences over short periods of time, while for longer periods of time, preferences were observed to be more consistent with a time-separable structure of preferences (Heaton, 1993). Heaton (1993) also suggested that habit effects tend to dominate substitution effects in data aggregated over longer periods of time; his explanation of this is that it takes time to develop a habit, so that evidence for habit formation is more likely to be found as the time period increases.

Perhaps due to data availability limitations, most empirical studies on consumption which allow for time non-separable preferences are based on aggregate data. However, it has been argued that aggregation can distort estimates of preferences due to a number of factors unrelated to preferences (Dynan, 2000). Microeconomic-level household data are less affected by time averaging than aggregate data (Dynan, 2000). There is growing interest in testing time non-separabilities in preferences using microeconomic level data (e.g., Meghir and Weber, 1996; Naik and Moore, 1996). Studies which examined habit formation in the context of food consumption have had mixed findings. Naik and Moore (1996) found evidence of habit formation in households' food expenditure, while research by Dynan (2000) does not support this conclusion.

Although the empirical literature on habit formation has often rejected models without habit formation, it has been argued that it is important to distinguish between state dependence and heterogeneity to avoid overstatement of habit effects (Naik and Moore, 1996; Keane, 1997). However, to distinguish between state dependence and heterogeneity, panel data with several periods of

observations for each micro unit are required. Using Spanish panel data on family expenditure, Browning and Collado (2007) concluded that both state dependence and heterogeneity should be considered in the analysis of demand behavior to avoid seriously biased estimates. The current study adds to the literature by examining habit persistence in the context of a series of food safety incidents using microeconomic-level household panel data.

4.3. Data

The study uses data from the Nielsen Homescan® panel which consists of a national sample of Canadian households. The available panel data set follows the purchases of meat by these households before and after the first BSE incident in Canada, covering the period from January 1, 2002 to December 31, 2007, during which 11 cases of BSE were confirmed in Canada. The data set contains detailed information on household purchase expenditures on a variety of food products categorized by universal product codes (UPCs) for processed packaged food items which include meat, and for other items without UPCs, which is the case for fresh meat purchases. This information includes detailed descriptions of the different meat products purchased by the household for home consumption, the household's expenditures to purchase the different specified meat products, and the dates on which these household purchases were made. The data set also reports information on household characteristics, including the region of residence, household income, age and education level of the household head and the composition of the household. A second data set used for this study was collected through a survey (see Appendix B) conducted by the Department of Rural Economy at the University of Alberta with the assistance of the Nielsen Company in early 2007. This survey was applied to those households that had been members of the Nielsen Homescan® consumer panel since 2002. The survey provides information on these respondents' risk perceptions regarding BSE and responses to questions on trust expressed by the household member responsible for grocery purchases.

We investigate household expenditures on different meat purchases for the time period from January 2002 to December 2005, based on individual household's total monthly expenditures on fresh meat purchased at retail grocery stores (meat without UPCs). This time period is selected because it encompasses the first three cases of BSE in Canada and is sufficiently long to assess the impacts of habit persistence, allowing examination of how Canadian consumers responded to the initial BSE event and enabling comparison of reactions to the series of two further BSE incidents. The size of the panel has varied, from a low of 8,849 households in 2003 to a high of 9,635 households in 2004. To avoid the problem of missing values and reduce the volume of data to a more manageable size, we selected from the complete data base those households that stayed in the panel over the time period from 2002 to 2005 and that purchased at least one meat product (not necessarily a beef product) in each of the 48 consecutive months from January 2002 to December 2005. The final sample consists of 644 households[14].

Tables 4.1a and 4.1b give descriptive statistics of the household characteristics for the selected sample, the full Nielsen Homescan® panel, and the Canadian population; t-statistics suggest there are some relatively small but significant differences between the selected sample and the full Nielsen Homescan® panel. The mean of the household size in the selected sample (2.63) is slightly larger than the average household size in the full panel (2.51). According to the Census of Population of Statistics Canada, in 2006 the average household size in Canada was 2.5 persons (Statistics Canada, 2006 Census (a)). The average age of the household head in the selected sample is 56.14, while for the full Nielsen Homescan® panel this is 51.12. Counterpart statistics on the average age of household heads of the Canadian population are not available. We also compare the distribution of the levels of education of household heads in the

[14] The panel consists of 14,176 households. Among these households, only 6,012 stayed in the panel from January 2002 till December 2005. 644 out of these 6,012 households purchased meat products (not necessarily beef products) in each of the 48 consecutive months from January 2002 till December 2005.

selected sample to that in the full Nielsen Homescan® panel and the Canadian population aged 20 years and over (there is a lack of statistics on the education levels of household heads for the population). It appears that the selected sample has a slightly lower level of education than either the full panel or the adult Canadian population (table 4.1b). The average household income of the selected sample has a value of $59,310.95. This is slightly higher than the average household income of the whole panel ($57,486.77). The 2006 Census by Statistics Canada indicates an average household income in 2005 of $69,548, appreciably higher than the selected sample mean of $59,310.95 (Statistics Canada, 2006 Census (b)). However, the methods to measure the sample household income are imprecise and likely to be downward biased. The 2006 Census recorded exact values of reported household income, while the Nielsen Homescan® panel data recorded income in categories. Households that selected $70,000 and above are assigned the value of $100,000, which is likely to underestimate the average household income of the selected sample. Despite their differences, we judge that the selected sample matches observable characteristics of the Canadian population reasonably well. Nevertheless differences in unobservable characteristics may remain. Basing the analyses on the selected sample has the advantages of making full use of the data from those households for which there are purchase records in every month during the time period considered and avoiding the problem of missing values in the dataset.

4.4. Descriptive analyses

In this study, we apply Engel curve analysis since this enables assessment of the dynamics of beef expenditure shares following the food safety shocks associated with the first three Canadian BSE incidents, which is facilitated by the data available. Expenditures on meat products were grouped into four categories: beef, pork, poultry and other. In figure 4.1, monthly price indices[15] for the different

[15] The price indices are monthly Consumer Price Indices (CPI) for fresh or frozen meat products in Canada. These price data are published by Statistics Canada, CANSIM table 3260020-Consumer Price Index (CPI), 2005 basket, monthly (2002=100). This CPI compares, in percentage terms, prices in any given time period to prices in the official base period, which is 2002=100.

meat groups, available from Statistics Canada, are graphed. These show that beef prices fell after the 2003 announcement of the first BSE event, which led to the immediate closure of export markets for bovine animals and meat. A trough in beef prices occurred in September 2003. The Nielsen Homescan® dataset contains no information on meat prices. To take into account the impacts of price variation over time, the reported household meat expenditures were deflated by monthly regional price indices. These price indices are aggregated monthly regional consumer price indices for meat products in broad categories (i.e., beef, pork, etc) published in the Statistics Canada CANSIM database[16] . The regions for which these are reported are the Maritimes, Quebec, Ontario, Manitoba/Saskatchewan, Alberta and British Columbia. Monthly shares of the individual household's deflated expenditures on each of the identified four meat categories were constructed for each household. Aggregated monthly deflated expenditure shares for each of the four meat categories averaged over the selected households are shown in figure 4.2.

Figure 4.2 shows the pattern of seasonality in household's beef and poultry purchases. Poultry consumption peaks during the Christmas season, while beef consumption peaks during the summer months. A slight downward trend in the share of the expenditure on beef is seen in figure 4.2 over the period examined. However, figure 4.2 also suggests an increase in beef expenditure shares, which reached a peak in August 2003, following the first BSE incident in May 2003. This may be due to the combined effect of both declining beef price and seasonality, as the 2003 BSE discovery occurred just prior to the peak season of beef consumption. Both the second and third BSE cases occurred in the month of January 2005, making it impossible to separate the impacts of these two cases using monthly data. For the purposes of this study, we group the second two cases together and refer to these as the "second BSE events". Figures 4.1 and 4.2 do not reveal patterns that might suggest how the second BSE events may have

[16] These monthly regional price indices are also retrieved from CANSIM table 3260020.

affected prices and purchases of meat products. Formal tests of the influence of these BSE incidents on beef demand, controlling for trend and seasonality, are discussed in the next section.

One attractive feature of panel data is that it allows researchers to investigate heterogeneity in micro units. Figure 4.3 indicates the distributions of changes in the values of monthly beef expenditure shares from April to May in 2002 and 2003, recognizing that these two months are of interest because the first BSE case occurred in May 2003. One interesting feature displayed in figure 4.3 is that most households were relatively consistent in their beef consumption, since for the majority of the selected households, the month to month changes in beef expenditure shares were less than 20% of their meat expenditure. Figure 4.4 depicts the distributions of changes in the values of beef expenditure shares from December 2002 to January 2003, and the changes from December 2004 to January 2005. From figure 4.4, comparison can be made of these distributions of changes for the year preceding the second BSE events with those for the year in which the second BSE events occurred. These figures suggest generally similar patterns of behavioral changes for the first and second BSE events. We had expected negative impacts of BSE on beef consumption that would shift the distribution of changes in beef expenditure shares at least somewhat towards the left after the BSE announcements. This pattern is not, however, evident in figures 4.3 or 4.4.

A possible explanation for the feature that most of the sampled households tended to be relatively consistent in the pattern of their beef consumption expenditures in the period following the three food safety events is that beef consumption is habit forming. If this is the case, habit persistence may affect a household's ability or incentives to adjust to the BSE events. We postulate that habit persistence resulted in some households not changing their patterns of consumption.

4.5. Model specification and estimation methods

Formal tests of the impacts of the first two BSE events in Canada on household's meat expenditures are reported in this section. The Almost Ideal Demand System (AIDS) approach has been widely used to investigate the impacts of food safety incidents on consumer demand (e.g., Piggott and Marsh, 2004; Burton and Young, 1996). However, this study uses Engel curve analysis to assess how multiple and recurring BSE incidents shaped the patterns of Canadian households' beef consumption over time. Thus we focus on expenditures associated with beef consumption over time, by analyzing the dynamics of the sampled Canadian households' beef expenditure shares.

There is a long history of use of Engel curves to analyze consumer demand. Early studies include those by Working (1943) and Leser (1963). One Engel curve specification which underlines popular demand models, such as the AIDS, is the Price-Independent Generalized Logarithmic (PIGLOG) or Working-Leser Engel Curve. The PIGLOG specification relates budget shares linearly to the logarithm of total expenditure. The consistency of this Engel curve specification with utility theory has been demonstrated by Muellbauer (1976). Some empirical studies have rejected the PIGLOG specification for some commodities and favored quadratic Engel curves (Blundell and Duncan, 1998). Nonetheless, both parametric and nonparametric estimations of Engel curves for food support the PIGLOG specification (Blundell and Duncan, 1998; Banks et al., 1997).

The structure of the PIGLOG expenditure specification is as following:

$$\omega_{ih} = \alpha_i + \beta_i \ln x_h \qquad (1)$$

where ω_{ih} denotes budget share of the i th good for household h, $\ln x_h$ is the logarithm of the total expenditure for household h, and α_i and β_i are parameters. Following Pollak and Wales (1981), a translating approach is adopted to incorporate non-price and non-income variables into the model. Parameter α_i is augmented to be a function of demographics, dummy variables associated with

BSE occurrences, time trend and seasonal dummy variables. We include demographic variables to capture some of the household heterogeneities. Since the impacts of BSE are the focus of this analysis, two sets of dummy variables associated with the first and second BSE events are also included in the model. As demonstrated in figure 4.1, Canadian household beef expenditure shares exhibit seasonality and follow a declining trend during the time period examined. Thus it is plausible to consider the seasonality effects and trend effect in the analyses. We introduce dynamics into the model by allowing the current beef expenditure shares to depend on beef expenditure shares in the previous period. This enables the habit formation hypothesis to be tested based on the significance of the lagged beef share in the budget share equations.

The extended model takes the form:

$$\omega_{ht} = \beta_0 + \beta_1 \ln x_{ht} + \beta_2 \omega_{ht-1} + \beta_3 t + \sum_{k=2}^{12} \gamma_k D_{kt} + \sum \delta_l z_{lht} + \sum_{i=1}^{2}\sum_{j=1}^{4} \alpha_{ij} BSE_{ij} + \mu_h + \varepsilon_{ht} \quad (2)$$

where ω_{ht} denotes beef expenditure share for household h at time t; $\ln x_{ht}$ is the logarithm of total meat expenditure for household h at time t; ω_{ht-1} is the lagged beef expenditure share; t denotes the time trend; D_{kt} are 11 monthly seasonal dummy variables with January as the base; z_{lht} are demographic variables including education of the household head, number of children in a household and a regional dummy variable; BSE_{ij} are two sets of dummy variables indicating the specific month that followed the first BSE incident and second pair of BSE events respectively; μ_h captures unobservable individual characteristics; ε_{ht} is a random error term; and $\beta_0, \beta_1, \beta_2, \beta_3, \gamma_k, \delta_l, \alpha_{ij}$ are parameters to be estimated.

Models tested on panel data have been used in the literature to examine many dynamic relationships (e.g., Arellano and Bond, 1991; Browning and Collada, 2007; Keane, 1997). One common feature of these models is the presence of a lagged dependent variable on the right hand side, which complicates their estimation. The fixed effects and random effects approaches are not appropriate in

this setting because the lagged dependent variable is correlated with the disturbance. For this reason, the approach that takes the first difference of the equations and then estimates the differenced equations has been widely used in empirical analysis on dynamic panel data (Browning and Collado, 2007). Although taking first differences removes heterogeneity from the model, the differenced equations still have the problem of endogeneity due to the lagged dependent variable (Greene, 2003). The idea of using lagged values of dependent variables as instruments for the differenced equations was first suggested by Anderson and Hsiao (1981). Based on this concept, Arellano and Bond (1991) developed a generalized method of moments (GMM) procedure which improves estimation efficiency by making use of all available moment conditions. Arellano and Bover (1995) unify the literature and develop a general framework for efficient IV estimators. Although using instruments in levels for equations expressed in first differences is a typical approach to estimate dynamic panel data models, Arellano and Bover (1995) argue that there are potential gains to estimating equations in levels using instruments in first differences.

Panel data have the advantage of enabling better analysis of dynamic effects (Kennedy, 2003). However, the estimation of a model that is based on dynamic panel data is complicated. Since the objective of this study is to examine how multiple BSE incidents affect sampled Canadian households' beef consumption patterns over time, we adopted the GMM approach developed by Arellano and Bond (1991) and Arellano and Bover (1995). Two sets of models were estimated: Engel curves in differences with instruments in levels and Engel curves in levels with instruments in differences. The results are presented and discussed in the following section.

4.6. Results and discussion

4.6.1 Impacts of BSE on beef purchases

We initially transformed equation (2) by taking first differences between equations in levels (each level represents a specific month). Taking first

differences removed the unobservable household characteristics (μ_h) from the error term. Under the assumption that the errors are not serially correlated, lagged values of endogenous variables are valid instruments for the equations in first differences associated with later periods (Arellano and Bond, 1991). Thus, we instrumented the two endogenous terms in the differenced equations (the differenced lagged beef share ($(\omega_{ht-1} - \omega_{ht-2})$and the differenced logarithm of total meat expenditure $(\ln \chi_{ht} - \ln \chi_{ht-1})$) with the values of beef share and logarithm of total meat expenditure, lagged two periods and more, respectively. Other explanatory variables in equation (2) are assumed to be exogenous. Demographic variables are time-invariant and drop out in taking the first differences of the equations. The estimation results of this model version are presented in table 4. 2 (see equations in differences). The coding of the variables is described in Appendix 4.1.

In the Arellano-Bond approach, the validity of the instruments is conditional on the assumption of lack of serial correlation in errors (Arellano and Bond, 1991). Lagged values are used as instruments for endogenous variables in our estimation based on the assumption that the errors are not serially correlated. Therefore, testing for autocorrelation between the errors is necessary to justify the validity of these instrumental variables. We tested for serial correlation in the errors based on equations in levels. Durbin-Watson statistics suggest no evidence of autocorrelated errors in these equations in levels[17].

Table 4.2 (equations in differences) shows that the lagged beef expenditure share has a positive effect on current beef share, which provides evidence of habit persistence. There are also significant seasonal effects on beef purchases. Beef expenditure share increases during the summer, indicated by the significant positive coefficients for the monthly dummy variables of May, June, August and

[17] We have 46 Durbin-Watson (DW) statistics for each of the differenced equations. Each of the 46 DW statistics tests the autocorrelation between two consecutive levels. None of the DW statistics is significant. DW statistics for each of the equations are available upon request.

September. Beef expenditure share drops in winter, particularly over the Christmas season. The time trend has a significant negative influence on beef expenditure share, indicating that these shares decline over the time period considered in this study, which is consistent with the trend of declining consumption of beef in Canada since the late 1990s (Statistics Canada, 2007).

The impact of BSE on beef expenditures is the focus of this model. It is possible that BSE had both contemporaneous and lagged effects on beef demand. However, the length of the impacts is an empirical question. Piggott and Marsh (2004) tested for length of impact up to three quarters after food safety events, but only found evidence of contemporaneous effects. Following their procedure, we locate the BSE impacts on expenditure shares by searching over the time period and iteratively estimating the model. We started estimation by including only one BSE dummy variable (which represents the month of the BSE occurrence) for each of the two BSE events. We then iteratively estimated the model by successively adding a further BSE dummy variable for the two BSE incidents considered (i.e., we extended the time period by one more month every time we re-estimated the model). The impacts on beef expenditure shares vanished three months after the BSE announcements. This pattern was found for both the first and second BSE events. Consequently, four BSE event dummy variables for each of the first two BSE events indicating the specific months following the BSE announcements are included in the final model estimations.

From table 4.2 it is seen that following the announcement of the first BSE case, made on May 20, 2003, there was an immediate negative impact on beef expenditure shares. The results show that the BSE dummy representing May 2003 (BSE11) has a significant and negative effect on beef expenditure shares. One month later, the BSE impact is still negative but no longer significant. In the following two months, beef purchase expenditures increased. It appears that at the time of the announcement of the first BSE case, risk concerns may have been dominant for many consumers, leading to an immediate reduction in beef

expenditures after the announcement of evidence of the initial Canadian BSE case. However, it seems that concern about risk impacts diminished gradually and consumers resumed their previous consumption patterns as time passed.

Since the Homescan® data set contains no information on prices, we controlled for the effects of price on beef expenditures by deflating expenditures by monthly regional price indices for the specific types of meats in question (beef, pork, poultry and other). These provincial-level price indices, which are aggregated across different meat cuts, do reveal the trend of price changes (see figure 4.1), but are likely to contain less information than would actual prices associated with specific purchases. Consequently, it is possible that increases in the households' beef purchase expenditures in the second and third months after the initial BSE announcement may be due to price effects that are not captured by the price indices used in deflation. However, it is also possible that the initial BSE event caused some households to switch to higher priced beef cuts in order to obtain higher quality products than previously. This type of behavior could have led to the increase in household beef expenditure shares indicated by our data in the second and third months following the first BSE event. It is also possible that the actions taken by the Canadian government in responding to the BSE cases, and media information about these actions (which included an initial focus by the media on precautionary actions taken and subsequent emphasis on the adverse financial effects of the BSE incidents on the beef industry) persuaded Canadian consumers that eating beef was both low risk and likely to support the beleaguered beef industry.

Following the announcements of the second and third BSE cases in January 2005, a negative impact on beef expenditures was not evident until two months after this second pair of BSE events and this reaction lasted only for a very short period of time. Expenditures on beef purchases increased in April 2005, the third month after the discovery of the second and third BSE cases (table 4.2: equations in differences). The second two BSE events follow a similar pattern to the 2003

case: consumers initially decreased beef purchases, but then resumed their earlier consumption patterns, even temporarily reaching a higher level of expenditure. These findings are generally consistent with the literature on consumers' responses to a single food safety incident, which suggests that consumers initially reduce purchases and then gradually return to their past consumption patterns (Saghaian and Reed, 2007; Mazzocchi and Lobb, 2005). However, the specific patterns of consumer responses that we observed relative to the first and the second Canadian BSE cases are different. The negative impact on sampled household expenditures was slower to take effect following the second BSE events, suggesting that consumers did not respond to the news of the second BSE events as quickly as they had responded to the first BSE case. Even so, the magnitudes of the negative impacts on beef expenditure shares are similar. A possible reason for the slower response in reduction of beef expenditure shares following the second BSE events might be that the second events were seen as less of a shock, compared to the first instance of a domestic case of BSE. As well fewer media reports followed the second and third BSE incidents in Canada than occurred following the initial event (Boyd, 2008).

The alternative approach to avoid estimation problems in estimating dynamic Engel curves proposed by Arellano and Bover (1995) estimates equations in levels using lagged first differences of the endogenous variables as instruments. Use of this estimation method allowed us to examine the effects of household demographics on expenditures and to compare the findings with the results from estimating equations in first differences. Lagged first differences of beef expenditure shares and the logarithms of total meat expenditures were used as instruments for the beef expenditure share and the logarithm of total meat expenditure respectively to estimate the equations in levels. These results are also presented in table 4.2 (equations in levels).

The findings from the two estimation methods are consistent. The results from estimating equations in levels (table 4.2) suggest that beef expenditure is

habit forming. Again, beef expenditure shares increased during the summer months and decreased in winter. We also observe a declining trend in the beef expenditure share over the entire period (i.e., from January 2002 to December 2005). In each case, the same cycle is identified: the sampled households reduced their relative expenditures on beef after both BSE events but this decline was subsequently reversed. Again, the first BSE case was followed by an immediate negative reaction in beef expenditure shares by the sampled households, while the reduction in beef expenditure shares following the second BSE events did not occur until two months after the BSE announcements. From testing the model (equation 2) in levels and assessing the impacts of household demographics, it is seen that these evidently play a role in determining beef expenditure shares. It seems that beef consumption is affected by the education level of households. Households with lower levels of education have higher beef shares. Households located in Quebec have higher beef expenditure shares than households in other regions.

4.6.2 Impacts of habits on households' responses to BSE events

The following analyses examine the dynamic relationship between consumption habits and BSE shocks. We tested two hypotheses in this regard. The first hypothesis is that households with higher beef expenditure shares reacted less to the BSE events. There is evidence in table 4.2 that beef consumption is habit forming, in that higher past beef expenditure shares lead to higher current beef expenditure shares. Consequently we expect that a household's response to a food risk event depends not only on views of risk per se but also on the household's desire, expressed through its habit, to adjust to that risk event. We also hypothesize that habit persistence in beef consumption, expressed through expenditures on beef purchases, tends to offset some of the negative impacts of the BSE events. The second hypothesis relates to the recurrence involved in the first three Canadian BSE events and is based on the expectation that effects of habit persistence diminish following more than one risky event. The rationale for this hypothesis is that consumers may gradually alter their beef consumption

habits over time following successive BSE cases. That is, habit is expected to have less impact on adjustments in purchasing patterns following successive BSE cases. To test these hypotheses, we interacted the lagged dependent variable with those BSE dummy variables which are significant in equation (2) (i.e., BSE11, BSE13, BSE14, BSE23 and BSE24), and introduced these interaction terms into equation (2). The modified model is:

$$\omega_{ht} = \beta_0 + \beta_1 \ln x_{ht} + \beta_2 \omega_{ht-1} + \beta_3 t + \sum_{k=2}^{12} \gamma_k D_{kt} + \sum_l \delta_l z_{lht} + \sum_{i=1}^{2}\sum_{j=1}^{4} \alpha_{ij} BSE_{ij} + \sum_{i=1}^{2}\sum_{j=1}^{4} \eta_{ij} BSE_{ij}\omega_{ht-1} + \mu_h + \varepsilon_{ht} \quad (3)$$

Table 4.3 presents the results from estimating this equation in differences and in levels. Two interaction terms are found to be significant, including the interaction between the BSE dummy variable indicating May 2003 (i.e., BSE11) and lagged beef shares, and the interaction between the BSE dummy variable representing March 2005 (i.e., BSE23) and lagged beef shares. Those terms which are not significant are excluded from the model. In general, the model estimates are not sensitive to the inclusion of the interaction terms between lagged beef share and the BSE dummy variables. The same general cycle of behavior is identified for both the first and second BSE events: households reduced their beef expenditure shares following the BSE announcements but these recovered subsequently. However, again, the patterns of reaction and the impacts of habit persistence, are different for the first and the two subsequent BSE incidents. Following the first BSE incident, households' beef expenditure shares shifted downward. A second feature seen in this case is the joint effect of BSE and habit persistence. The positive coefficient on the interaction between the lagged beef expenditure share and BSE11 suggests that habit persistence offset the negative BSE effect and that households with higher beef expenditures reduced expenditures relatively less following the first case of BSE than was the case for households with lower beef expenditures. However, relative to the second cases of BSE, the coefficient for the interaction between the lagged beef expenditure share and BSE23 is significant and negative, suggesting that households with

higher beef expenditure shares reduced their expenditures more than did households with lower beef expenditure shares. We expected that habit persistence would tend to offset part of the negative impacts of the BSE announcements and while this is evidently the case for the first BSE event, the evidence from households' adjustments to the second BSE events indicates the opposite. This change in habit for households that had previously habitually purchased beef may reflect households' reactions to the cumulative effects of more than one BSE incident. Following a series of BSE cases, households that consumed more beef might perceive a higher level of risk, and revise their habits, leading them to be more sensitive to subsequent BSE incidents than households that consumed less beef. We also observe that the absolute value of the coefficient for the interaction between the lagged beef share and BSE11 is slightly greater than the absolute value of the coefficient for the interaction between the lagged beef share and BSE23, which suggests diminished impacts of habit persistence following successive risk events. As reported in table 4.3, the findings from estimating equations in differences and in levels are consistent.

An interesting feature of the results in table 4.3 is that the magnitude of the estimated parameters on the interaction between the lagged beef share and BSE11 is much larger than that of the estimated parameters on the lagged beef share. For example, the results from estimating equations in differences show that the coefficient on the lagged beef share is about 0.03, whereas the coefficient on the interaction between the lagged beef share and BSE11 is 0.08. Several factors may contribute to the large positive effects of habits on beef expenditures following the first BSE announcement. It is possible that households with higher beef expenditures stocked more beef when beef prices dropped after the first BSE incident. It is also possible that the initial BSE incident caused households who consume more beef products to switch to more expensive beef cuts to ensure beef quality. These factors are related to changes in actual beef prices associated with specific purchases and have positive effects on beef expenditure shares. However,

we must acknowledge that the lack of price data makes it very difficult to interpret the results on habit persistence precisely.

4.6.3 Impacts of trust on households' responses to BSE events

Several studies have investigated how trust affects consumers' perceptions and acceptance of food with risk attributes (e.g., Sjöberg, 2001; Siegrist, 2000). However, there is relatively little research that relates trust to consumers' reactions to recurring food safety incidents. In this section, we examine the role of trust in shaping Canadian consumers' reactions to recurring BSE incidents in Canada.

Despite growing interest in understanding the role of trust, measuring trust is challenging. The attitudinal question "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" has been widely used to measure trust in the economic literature (e.g., Glaeser et al., 2000). In the 2007 survey of Nielsen Homescan® panel participants, this question was applied and respondents were asked to choose a response to this question from the statements: "People can be trusted", or "Can't be too careful in dealing with people", or "Don't know". Households were also asked to respond to questions on the extent to which they trusted institutions (including government, manufacturers, farmers and retailers).

Previous literature suggests that trust is negatively related to perceived risk (e.g., Sjöberg, 2001; Siegrist and Cvetkovich, 2000). Therefore, we expect households that do not exhibit trust to be more sensitive to the risks that might be associated with the identified BSE incidents. In order to test this hypothesis, we matched the 644 households selected from the Homescan data set with those in the survey data set, and selected only those households that had also participated in the 2007 survey. As a result, the study sample for this component of the analyses consists of 437 households.

We choose to apply the attitudinal trust measure that questions people's view of whether most people can be trusted, rather than the institutional trust measure. One reason for this is because literature on trust suggests that people's responses to the attitudinal question "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" remain stable over time (Uslaner, 2001). As mentioned above, the information on trust was collected in 2007, four years after the first BSE incident in a Canadian cow which was discovered in 2003. Consumers' trust in food safety has recently been found to be declining in a number of countries, as a result of numerous food safety incidents (e.g., Houghton et al., 2008). It is possible that people's trust in food institutions may be changing over time. Therefore, we choose to measure trust based on respondents' responses to the available standardized trust question "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?". Moreover, we see the attitudinal trust measure to be exogenous to households' expenditure decisions, whereas this may not be the case for the institutional trust measure.

We examine how trust affects households' reactions to BSE by incorporating trust into equation (3). The extended model takes this form:

$$\omega_{ht} = \beta_0 + \beta_1 \ln x_{ht} + \beta_2 \omega_{ht-1} + \beta_3 t + \sum_{k=2}^{12} \gamma_k D_{kt} + \sum_l \delta_l z_{lht} + \sum_{i=1}^{2}\sum_{j=1}^{4} \alpha_{ij} BSE_{ij} + \sum_{i=1}^{2}\sum_{j=1}^{4} \eta_{ij} BSE_{ij}\omega_{ht-1} + \sum_{i=1}^{2}\sum_{j=1}^{4} \phi_{ij} BSE_{ij} trust_h + \mu_h + \varepsilon_{ht} \quad (4)$$

where $trust_h$ is a dummy variable, taking the value of 1 if the respondent in household h selected " most people can be trusted" and the value of 0 if the respondent chose " can't be too careful in dealing with people". Among the 437 selected households, 201 responding households answered that "People can be trusted"; 210 households answered "Can't be too careful in dealing with people"; and 26 households chose "Don't know". We dropped those households that chose "Don't know" from this test. Table 4.4 shows the results from estimating equation (4) in differences and in levels.

Analyzing the smaller sample, we identified the same cycle of BSE impacts. However, the impacts of habit persistence on households' reactions to BSE incidents are not identical between this smaller sample and the larger sample used in the previous sections. Results from the smaller sample show that only the interaction between the lagged beef share and BSE11 is significant. The positive coefficient on this interaction term suggests that habit persistence offset the negative impact of the first BSE case. However, regarding the second BSE events, analyses based on the smaller sample find no evidence that habit persistence influenced households' responses to the second BSE events.

We expect that trust tends to offset the negative impacts of BSE. In order to test this hypothesis, we interact the trust variable with the two significant BSE dummy variables which have negative impacts on beef expenditure shares, i.e., BSE11 and BSE23. The coefficient on the interaction between trust and BSE23 is positive and significant, suggesting that trust limited households' reduction in beef expenditure shares following the second BSE events. Moreover, the magnitude of the negative impact of the second BSE events on expenditure shares for beef purchases (0.066) almost equals the magnitude of the positive effect of trust (0.067) on these expenditure shares, suggesting that households that are trusting barely reacted to the second BSE events. However, the coefficient on the interaction between trust and BSE11 is not significant; thus the results show no evidence that trust influenced households' responses to the first BSE event. A possible explanation for this pattern of results is that at the time of the first BSE announcement, risk concerns dominated consumers. However, the experience of the first BSE incident, as reflected in associated press reports, indicated the health risk of eating Canadian beef to be extremely low. Consequently, it seems that consumers who are trusting did not react to the second BSE events while consumers who are less trusting reduced their beef consumption after the discovery of the second and third BSE cases.

The results from estimating equations in levels are also presented in table 4.4. In general, these results are consistent with the findings from estimating equations in differences. The pattern of households' reactions to BSE incidents is the same. Again, we find evidence that habit persistence and trust offset the negative impacts of BSE. Moreover, the results from estimating equations in levels show that demographic characteristics also influence households' beef expenditure shares. The number of children in the household has a negative impact on households' beef expenditure shares. Consumers in Quebec tend to consume more beef relative to consumers in other regions of Canada.

4.7. Conclusions

There have been several analyses of the impacts of BSE and other food safety cases on consumption. However, few of these analyses considered the interactions between habits, trust and recurrent food safety incidents. Using Engel function analyses, we examine the impact of the Canadian BSE outbreak on beef consumption and assess the roles of consumption habits and trust in shaping consumers' reactions following the first three BSE incidents.

Our analyses focus on the dynamics of monthly beef expenditure shares of selected Canadian households. The results suggest that the dynamics of beef expenditure shares were influenced by a number of factors, including habit, trust, seasonality, time trend, food risk shocks and household characteristics. Households' reactions to both the initial and two subsequent BSE cases followed the same general pattern. Households reduced their beef purchase expenditures following the announcement of the BSE occurrence; then, evidently as concern diminished, their expenditures on beef consumption recovered. Regarding the role of consumption habits, we found evidence that habit persistence limited households' reductions of beef purchases following the first BSE event. In the case of the second BSE events, results from the larger sample (644 households) suggest that households with higher beef expenditure shares modified their beef consumption habits following recurring BSE incidents, whereas analyses based on

the smaller sample (437 households) find no evidence that habit influenced households' reactions to the second BSE events. The assessment of the impacts of trust on consumers' reaction patterns show that trust had no apparent impact on households' reactions to the first BSE event, but offset the negative impact of the second pair of BSE cases.

Food scares seem to be proliferating in number, as well as in media attention, contributing to the need to improve current understanding of consumer responses to food safety incidents. The question of how consumption patterns evolve over time in the presence of a series of food scares is expected to be of interest for both policy makers and the food industry. Analyzing beef expenditure shares of selected Canadian households, we find evidence of only temporary impacts of the first three BSE incidents on beef consumption in Canada. Households in the selected samples reduced their beef expenditure shares following the BSE announcements. However, their beef consumption increased again fairly soon. Examining the larger sample, we also observed evidence of cumulative effects of more than one BSE incident, with households modifying their beef consumption habits as the number of BSE events increased. The reaction patterns exhibited by these households in the larger sample suggest that the long-term impacts of recurrent food safety events can differ from the short-run effects. The finding that trusting households did not react to the second set of Canadian BSE cases suggests that maintaining trust may aid societal management of food risks.

The data set used in this study contains detailed information on household meat purchases before and after the first BSE case in Canada, which enables us to give consideration to several important factors that influence consumer responses to food safety events, including habit persistence, trust, household heterogeneities and the recurrence of food safety incidents. However, we must acknowledge that the lack of price data that correspond to individual's specific meat purchases in the Homescan® data may have limited our analysis. For example, there may have been differences in the price changes for different beef products following the

BSE announcements. The use of provincial price indices for beef, aggregated across all cuts, in our models considers the general impact of prices but could not consider variations in store-level price changes for different beef cuts. We also must acknowledge the possibility that there might be behavioral differences between the analysis samples and the general population. The meat consumption patterns exhibited by these selected households could differ from that of the Canadian population. Future studies may give further insight on consumers' responses to recurrent food safety incidents and indicate the robustness of our conclusions.

Table 4.1a Summary statistics of household characteristics: selected sample, Nielsen Homescan® panel, and Canadian population

	Definition	Mean (Standard Deviation)		
		Selected Sample	Nielsen Homescan® Panel	Population
Household Size	1=Single member 2=Two members 3=Three members 4=Four members 5=Five-Nine Plus members	2.63 (1.14)	2.51 (1.22)	2.5
Household Head Age	26=18-34 40=35-44 50=45-54 60=55-64 70=65+	56.14 (11.72)	51.12 (13.07)	—
Income	15,000=<$20,000 25,000=$20,000-$29,999 35,000=$30,000-$39,999 45,000=$40,000-$49,999 65,000=$50,000-$69,999 100,000=$70,000+	59310.95 (29884.91)	57486.77 (29578.55)	69,548
Household Number	—	644	14176	—

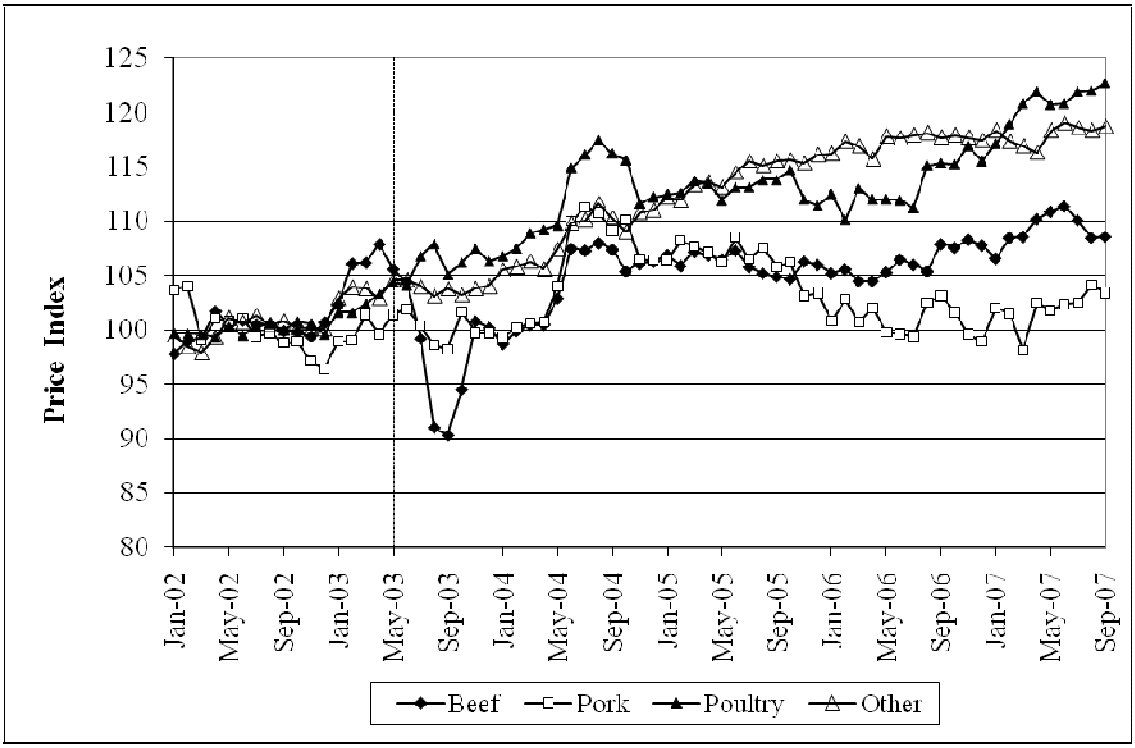
Source: Nielsen Homescan® Panel; Statistics Canada, 2006 Census (a) and (b).

Table 4.1b Household head education: the selected sample, Nielsen Homescan® panel, and Canadian population 20 years and over

Household Head Education	Percent (%)		
	Selected Sample	Nielsen Homescan® Panel	Population (20+)
Not High School Graduate	18.2	15.1	15.7
High School Graduate	19.0	18.4	22.7
Some College or Tech.	16.1	13.8	13.3
College or Tech. Graduate	18.4	21.6	20.3
Some University	9.7	9.7	5.4
University Graduate	18.6	21.5	22.7

Source: Nielsen Homescan® Panel data; Statistics Canada, 2006 Census (c).

Figure 4.1 Monthly consumer price indices for meat products in Canada, 2002-2007



Source: Statistics Canada, CANSIM table 3260020.

Figure 4.2 Average monthly expenditure shares for meat products from sampled Canadian households in the Nielsen Homescan® panel, 2002-2005

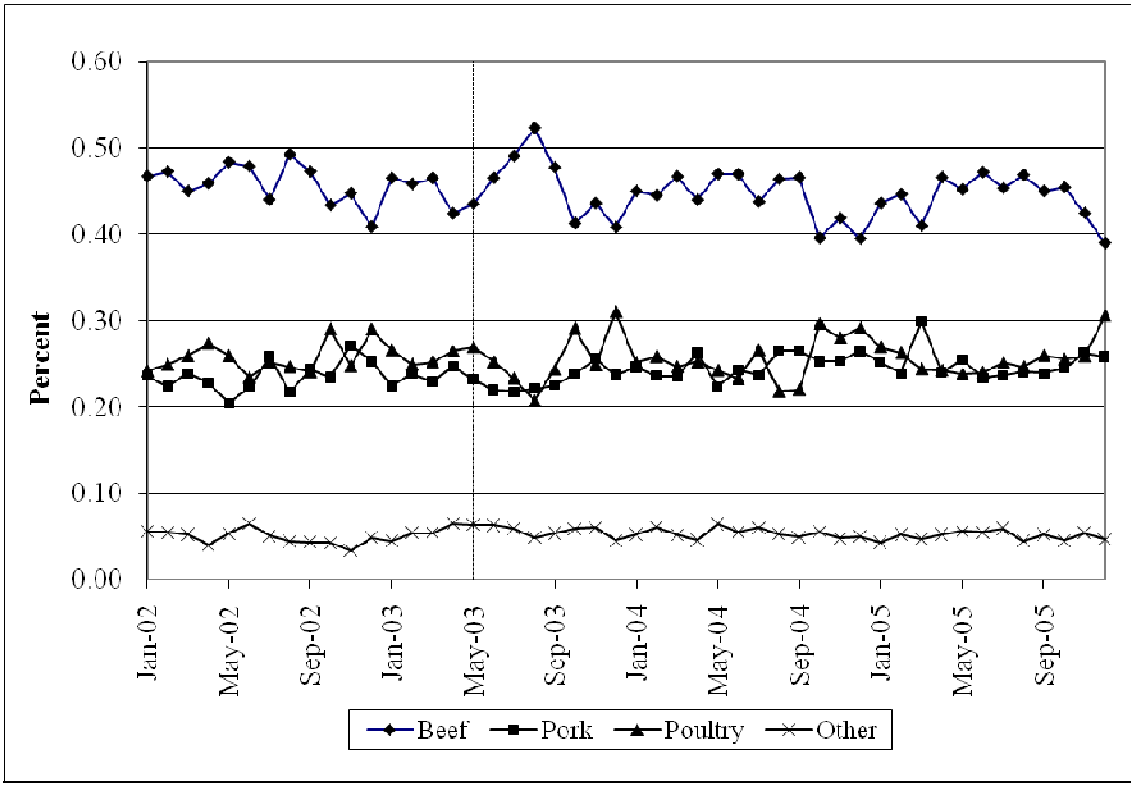
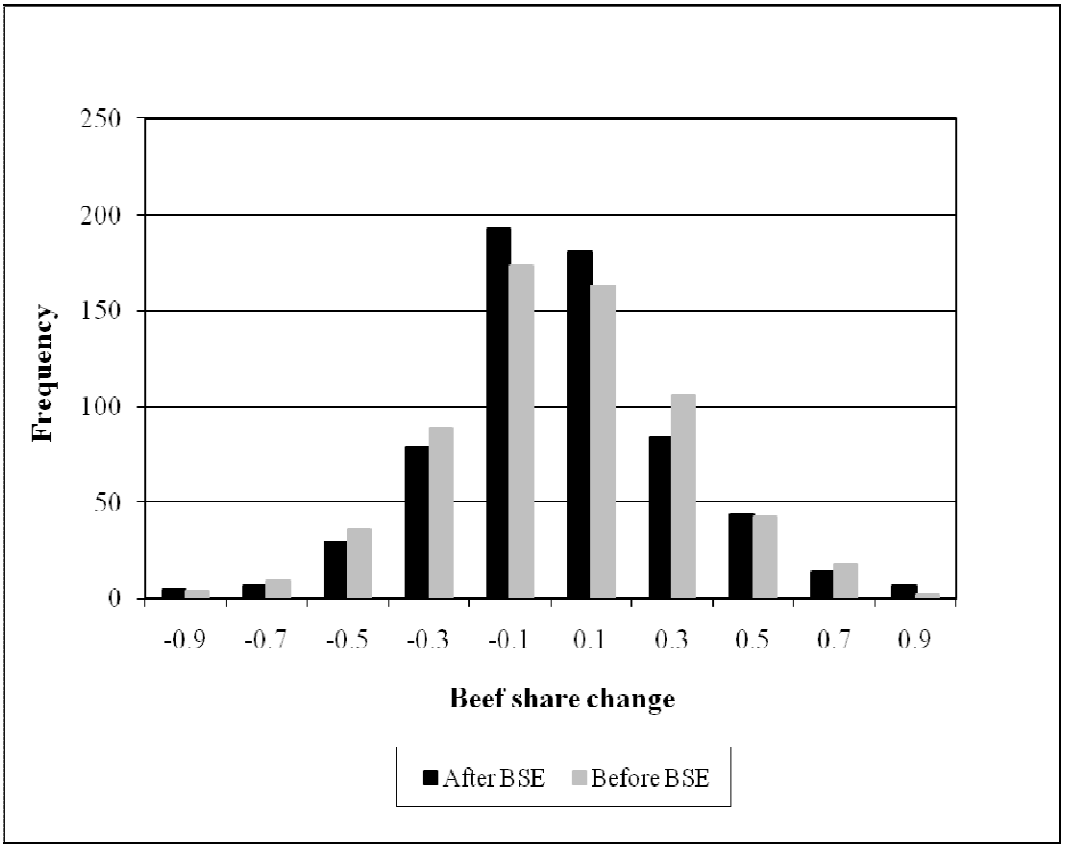
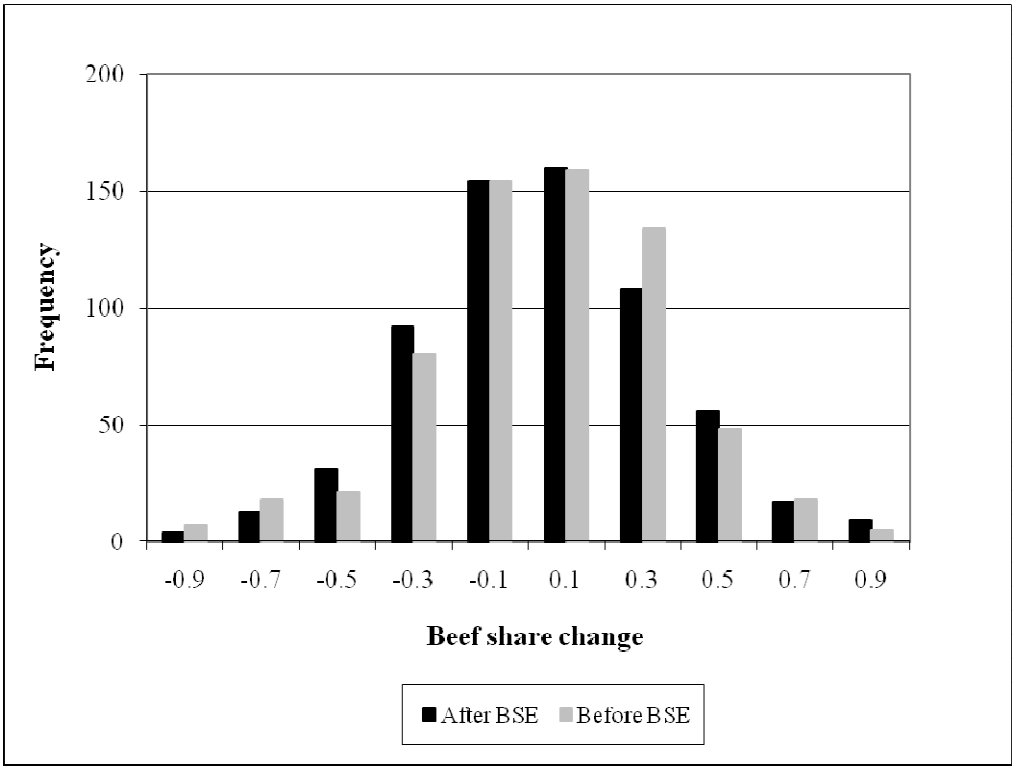


Figure 4.3 Adjustments of beef expenditure shares following the 1st BSE incident for sampled Canadian households in the Nielsen Homescan® panel



Note: Beef share change before the 1st BSE incident=beef share in May 2002-beef share in April 2002.
Beef share change after the 1st BSE incident=beef share in May 2003-beef share in April 2003.

Figure 4.4 Adjustments of beef expenditure shares to the 2nd BSE incidents for sampled Canadian households in the Nielsen Homescan® panel



Note: Beef share change before the 2nd BSE events=beef share in January 2003-beef share in December 2002.
Beef share change after the 2nd BSE events=beef share in January 2005-beef share in December 2004.

Table 4.2 Beef consumption Engel curve parameter estimates: equations in differences and equations in levels

	Equations in differences	Equations in levels
ω_{ht-1}	0.02997***	0.02941***
	(0.00620)	(0.00621)
$\ln x_{ht}$	0.00263	0.00643
	(0.00654)	(0.00613)
FEB	-0.00105	-0.00376
	(0.00754)	(0.00819)
MAR	-0.00196	-0.00166
	(0.00728)	(0.00728)
APR	-0.00935	-0.00878
	(0.00758)	(0.00758)
MAY	0.01654**	0.01710**
	(0.00759)	(0.00760)
JUN	0.02469***	0.02521***
	(0.00818)	(0.00818)
JUL	-0.00412	-0.00333
	(0.00790)	(0.00789)
AUG	0.02470***	0.02508***
	(0.00805)	(0.00805)
SEP	0.01803**	0.01873**
	(0.00752)	(0.00752)
OCT	-0.02472***	-0.02403***
	(0.00742)	(0.00743)
NOV	-0.01685**	-0.01645**
	(0.00735)	(0.00737)
DEC	-0.04857***	-0.04801***
	(0.00761)	(0.00764)
BSE11	-0.01972**	-0.02005**
	(0.00928)	(0.00931)
BSE12	-0.01045	-0.00996
	(0.00969)	(0.00970)
BSE13	0.04276***	0.04254***
	(0.01045)	(0.01044)
BSE14	0.05770***	0.05869***
	(0.01007)	(0.01008)
BSE21	-0.00797	-0.00791
	(0.01048)	(0.01051)
BSE22	0.00627	0.00986
	(0.00986)	(0.01034)
BSE23	-0.02040**	-0.02058**
	(0.01009)	(0.01011)
BSE24	0.02319**	0.02303**
	(0.00967)	(0.00969)
T	-0.00045***	-0.00048***
	(0.00014)	(0.00015)
NKID	–	-0.01998
		(0.01495)
EDU	–	0.01578*
		(0.00922)
QC	–	0.08444***
		(0.00969)
CONSTANT	–	0.38673***
		(0.025502)

Note: See Appendix 4.1 for the definitions of the variables.
*,**,*** signify, 10%, 5% and 1% levels of significance respectively.

Table 4.3 Impacts of habit persistence on sampled households' responses to two BSE events: equations in differences and equations in levels

	Equations in differences	Equations in levels
ω_{ht-1}	0.029034***	0.02887***
	(0.00630)	(0.00635)
$\ln x_{ht}$	0.00189	0.00625
	(0.00655)	(0.00613)
FEB	-0.00110	-0.00376
	(0.00754)	(0.00819)
MAR	-0.00197	-0.00164
	(0.00728)	(0.00728)
APR	-0.00938	-0.00878
	(0.00758)	(0.00758)
MAY	0.01654**	0.01711**
	(0.00759)	(0.00760)
JUN	0.02464***	0.02522***
	(0.00818)	(0.00818)
JUL	-0.00416	-0.00331
	(0.00790)	(0.00789)
AUG	0.02463***	0.02508***
	(0.00805)	(0.00805)
SEP	0.01802**	0.01877**
	(0.00752)	(0.00752)
OCT	-0.02468***	-0.02399***
	(0.00742)	(0.00743)
NOV	-0.01686**	-0.01643**
	(0.00735)	(0.00737)
DEC	-0.04859***	-0.04799***
	(0.00761)	(0.00764)
BSE11	-0.05516***	-0.05165**
	(0.01607)	(0.01797)
BSE12	-0.01043	-0.00993
	(0.00970)	(0.00970)
BSE13	0.04285***	0.04257***
	(0.01045)	(0.01044)
BSE14	0.05778***	0.05874***
	(0.01007)	(0.01008)
BSE21	-0.00809	-0.00794
	(0.01048)	(0.01051)
BSE22	0.00625	0.00986
	(0.00986)	(0.01034)
BSE23	0.01201	0.00894
	(0.01857)	(0.02048)
BSE24	0.02317**	0.02301**
	(0.00967)	(0.00969)
T	-0.00045***	-0.00048***
	(0.00014)	(0.00015)
$\omega_{ht-1} * BSE11$	0.08110**	0.07231**
	(0.03129)	(0.03664)
$\omega_{ht-1} * BSE23$	-0.072847**	-0.0663*
	(0.03531)	(0.04033)
NKID		-0.02074
	–	(0.01498)
EDU		0.01547*
	–	(0.00924)
QC		0.08525***
	–	(0.00971)
CONSTANT		0.38774***
	–	(0.02551)

Table 4.4 Impacts of trust on households' responses to two BSE events: Equations in differences versus equations in levels

	Equations in differences	Equations in levels
ω_{ht-1}	0.02407***	0.02284***
	(0.00770)	(0.00773)
$\ln x_{ht}$	0.01472**	0.02070***
	(0.00676)	(0.00646)
FEB	-0.00384	-0.00790
	(0.00891)	(0.00986)
MAR	-0.00129	-0.00078
	(0.00913)	(0.00915)
APR	-0.01074	-0.01050
	(0.00912)	(0.00913)
MAY	0.01170	0.01251
	(0.00900)	(0.00898)
JUN	0.01973*	0.02018**
	(0.01010)	(0.01013)
JUL	-0.01263	-0.01169
	(0.00952)	(0.00953)
AUG	0.02385**	0.02445**
	(0.00967)	(0.00968)
SEP	0.01436	0.01529
	(0.00938)	(0.00939)
OCT	-0.03217***	-0.03120***
	(0.00899)	(0.00900)
NOV	-0.01760*	-0.01659*
	(0.00906)	(0.00908)
DEC	-0.05127***	-0.05049***
	(0.00947)	(0.00952)
BSE11	-0.07537***	-0.08465***
	(0.02239)	(0.02387)
BSE12	-0.01088	-0.01005
	(0.01204)	(0.01204)
BSE13	0.04548***	0.04621***
	(0.01321)	(0.01320)
BSE14	0.04666***	0.04868***
	(0.01218)	(0.01219)
BSE21	-0.01295	-0.01260
	(0.01313)	(0.01315)
BSE22	0.00624	0.01117
	(0.01220)	(0.01277)

Table 5.2 Continued

	Equations in differences	Equations in levels
BSE23	-0.06643***	-0.05344**
	(0.01712)	(0.01656)
BSE24	0.02917**	0.02953**
	(0.01166)	(0.01169)
T	-0.00045**	-0.00054***
	(0.00018)	(0.00019)
$\omega_{ht-1} * BSE11$	0.11624***	0.13291***
	(0.03625)	(0.04211)
TRUST*BSE11	-0.02094	-0.01608
	(0.02360)	(0.02243)
TRUST*BSE23	0.06704***	0.03916*
	(0.02484)	(0.02314)
NKID		-0.03970**
		(0.01600)
QC		0.09184***
		(0.01212)
CONSTANT		0.35379***
		(0.02690)

*,**,*** signify, 10%, 5% and 1% levels of significance respectively.

Appendix 4.1 Definition of the variables

Variables	Definition
ω_{ht-1}	Monthly beef expenditure share for household h at time t-1
$\ln x_{ht}$	The logarithm of total meat expenditure for household h at time t
FEB-DEC	Monthly seasonal dummy variables
BSE11	A dummy variable indicating the month when the 1st BSE incident occurred (1=May 2003; 0=otherwise).
BSE12	A dummy variable indicating one month after the 1st BSE occurrence (1=June 2003; 0=otherwise).
BSE13	A dummy variable indicating two months after the 1st BSE occurrence (1=July 2003; 0=otherwise).
BSE14	A dummy variable indicating three months after the 1st BSE occurrence (1=August 2003; 0=otherwise).
BSE21	A dummy variable indicating the month when the 2nd BSE incident occurred (1=January 2005; 0=otherwise).
BSE22	A dummy variable indicating one month after the 2nd BSE occurrence (1=February 2005; 0=otherwise).
BSE23	A dummy variable indicating two months after the 2nd BSE occurrence (1=March 2005; 0=otherwise).
BSE24	A dummy variable indicating three months after the 2nd BSE occurrence (1=April 2005; 0=otherwise).
T	Time trend
NKID	Number of children in a household
EDU	The education level of the household head (1=high school and below; 0=otherwise).
QC	Regional dummy variable (1=Quebec; 0=otherwise).

References

Adda, J. 2007. Behavior towards health risks: An empirical study using the 'mad cow' crisis as an experiment. *Journal of Risk & Uncertainty* 35(3): 285-305.

Agriculture and Agri-Food Canada. 2007. Beef Demand in Canada. http://www4.agr.gc.ca/AAFC-AAC/display afficher.do?id=1184247072557&lang=eng. Accessed 12 Feb 2009.

Anderson, T.W. and C. Hsiao. 1981. Estimation of dynamic models with error components. *Journal of the American Statistical Association* 76(375): 598-606.

Arellano, M. and S. Bond. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies* 58(2): 277-297.

Arellano, M. and O. Bover. 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* 68(1): 29-51.

Banks, J., R. Blundell and A. Lewbel. 1997. Quadratic Engel curves and consumer demand. *The Review of Economics and Statistics* 79(4): 527-539.

Blundell, R. and A. Duncan. 1998. Semiparametric estimation and consumer demand. *Journal of Applied Econometrics* 13(5): 435-461.

Boame, A., W. Parsons, and M. Trant. 2004. Mad cow disease and beef trade: An update. Statistics Canada, Ottowa, ON., Catalogue No. 11-621-MIE2004010, February.

Boyd, A. D. 2008. Effects of media representations around mad cow disease on public perspectives of risk. M.Sc. thesis. University of Alberta, Edmonton.

Boyer, M. 1978. A habit forming optimal growth model. *International Economic Review* 19(3): 585-609.

Browning, M. and M.D. Collado. 2007. Habits and heterogeneity in demands: A panel data analysis. *Journal of Applied Econometrics* 22(3): 625-640.

Burton, M. and T. Young. 1996. The impact of BSE on the demand for beef and other meats in Great Britain. *Applied Economics* 28(6): 687-693.

Canadian Food Inspection Agency (CFIA). 2009. BSE enhanced surveillance program.http://www.inspection.gc.ca/english/anima/heasan/disemala/bseesb/surv/surve.shtml. Accessed 10 Jan 2010.

Dickinson, D. and D. Bailey. 2002. Meat traceability: Are U.S. consumers willing to pay for it? *Journal of Agricultural and Resource Economics* 27(2): 348-364.

Dynan, K.E. 2000. Habit formation in consumer preferences: Evidence from panel data. *The American Economic Review* 90(3): 391-406.

Glaeser, E.L., D.I. Laibson, J.A. Scheinkman, and C.L. Soutter. 2000. Measuring trust. *Quarterly Journal of Economics,* 115(3): 811-846.

Greene, W.H. 2003. *Econometric Analysis*. Prentice Hall, Upper Saddle River, N.J.

Heaton, J. 1993. The interaction between time-nonseparable preferences and time aggregation. *Econometrica* 61(2): 353-385.

Houghton, J.R., G. Rowe, L.J. Frewer, E. van Kleef, G. Chryssochoidis, O. Kehagia, S. Korzen-Bohr, J. Lassen, U. Pfenning, and A. Strada. 2008. The quality of food risk management in Europe: Perspectives and priorities. *Food Policy* 33(1): 13-26.

Jin, H.J. and W.W. Koo. 2003. The effect of the BSE outbreak in Japan on consumers' preferences. *European Review of Agricultural Economics* 30(2): 173-192.

Keane, M.P. 1997. Modeling heterogeneity and state dependence in consumer choice behavior. *Journal of Business & Economic Statistics* 15(3): 310-327.

Kennedy, P. 2003. *A Guide to Econometrics*. The MIT Press, Cambridge, MA.

Kuchler, F. and A. Tegene. 2006. Did BSE announcements reduce beef purchases? Washington DC: U.S. Department of Agriculture. Agricultural Economics Report 34, December.

Leser, C.E.V. 1963. Forms of Engel functions. *Econometrica* 31(4):694-703.

Lobb, A.E., 2005. Consumer trust, risk and food safety: A review. *Food Economics* 2(1): 3-12.

Mangen, M.J. and A.M. Burrell. 2001. Decomposing preference shifts for meat and fish in the Netherlands. *Journal of Agricultural Economics* 52(2): 16-28.

Maynard, L.J., E. Goddard and J. Conley. 2008. Impact of BSE on beef purchases in Alberta and Ontario quick-serve restaurants. *Canadian Journal of Agricultural Economics* 56(3): 337-351.

Mazzocchi, M. and A.E. Lobb. 2005. A latent-variable approach to modelling multiple and resurgent meat scares in Italy. Paper prepared for presentation at the 11th International Congress of the EAAE, Copenhagen, DK, 24-27 August.

Meghir, C. and G. Weber. 1996. Intertemporal nonseparability or borrowing restrictions? A disaggregate analysis using a U.S. consumption panel. *Econometrica* 64(5): 1151-1181.

Muellbauer, J. 1976. Community preferences and the representative consumer. *Econometrica* 44(5): 979-999.

Naik, N.Y. and M.J. Moore. 1996. Habit formation and intertemporal substitution in individual food consumption. *Review of Economics & Statistics* 78(2): 321-328.

Peng, Y., D. McCann-Hiltz, and E. Goddard. 2004. Consumer demand for meat in Alberta, Canada: Impact of BSE. Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Denver, Colorado, 1-4 August.

Peterson, H.H. and Y. Chen. 2005. The impact of BSE on Japanese retail meat demand. *Agribusiness* 21(3): 313-327.

Piggott, N.E. and T.L. Marsh. 2004. Does food safety information impact U.S. meat demand? *American Journal of Agricultural Economics* 86(1): 154-174.

Pollak, R.A. and T.J. Wales. 1981. Demographic variables in demand analysis. *Econometrica* 49(6):1533-1551.

Pollak, R.A. 1970. Habit formation and dynamic demand function. *The Journal of Political Economy* 78(4): 745-763.

Roy, D.G.L. and K.K. Klein. 2005. Mad cow chaos in Canada: Was it just bad luck or did government policies play a role?" *Canadian Public Policy / Analyse De Politiques* 31(4): 381-399.

Ryder, H.E. and G.M. Heal. 1973. Optimal growth with intertemporally dependent preferences. *The Review of Economic Studies* 40(1): 1-31.

Saghaian, S.H. and M.R. Reed. 2007. Consumer reactions to beef safety scares. *International Food and Agribusiness Management Review* 10(1): 18-35.

Schlenker, W. and S.B. Villas-Boas. 2009. Consumer and market responses to mad cow disease. *American Journal of Agricultural Economics* 91(4): 1140-1152.

Siegrist, M. 2000. The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis* 20(2): 195-204.

Siegrist, M. and G. Cvetkovich. 2000. Perception of hazards: The role of social trust and knowledge. *Risk Analysis* 20(5): 713-720.

Sjöberg, L. 2001. Limits of knowledge and the limited importance of trust. *Risk Analysis* 21(1): 189-198.

Statistics Canada. 2007. Food statistics. No. 21-020-X. http://www.statcan.gc.ca/pub/21-020-x/21-020-x2007001-eng.pdf. Accessed 20 Nov 2008,

———. 2006. The Daily. 1 June. http://www.statcan.gc.ca/daily-quotidien/060601/dq060601c-eng.htm. Accessed 5 Dec 2008.

———. 2006 Census (a). Average Household Size for Canada, Provinces and Territories, 2006, 2001 and 1996 Censuses. http://www12.statcan.ca/english/census06/data/trends/table_2.cfm?T=PR&LINE_ID=407&TOPIC_ID=400. Accessed 8 Nov 2008.

———. 2006 Census (b). Statistics Canada catalogue no. 97-563-XCB2006045. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837928&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=94592&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=81&VID=0&VNAMEE=&VNAMEF=. Accessed 8 Nov 2008.

———. 2006 Census (c). Highest Certificate, Diploma or Degree (14), Age Groups (10A) and Sex (3) for the Population 15 Years and Over of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations. http://www12.statcan.gc.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=97-560 XCB2006007&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=&GC=99&GK=NA&GRP=0&IPS=97-560-XCB2006007&METH=0&ORDER=&PID=93609&PTYPE=88971&RL=0&S=1&ShowAll=&StartRow=&SUB=&Temporal=2006&Theme=75&VID=&VNAMEE=&VNAMEF=. Accessed 8 Nov 2008.

———. 2004. The daily. 26 May. http://www.statcan.ca/Daily/English/040526/d040526e.htm. Accessed 15 Nov 2008.

Stigler, G.J. and G.S. Becker. 1977. De gustibus non est disputandum. *American Economic Review* 67 (2): 76-90.

Uslaner, E.M. 2001. Trust as a moral value. Prepared for the conference, "Social Capital: Interdisciplinary Perspectives", University of Exeter, United Kingdom. http://huss.exeter.ac.uk/politics/research/socialcapital/papers/uslaner.pdf. Accessed 14 September 2009.

Working, H. 1943. Statistical laws of family expenditure. *Journal of the American Statistics Association* 38 (221): 43-56.

Zhen, C. and M.K. Wohlgenant. 2006. Meat demand under rational habit persistence. *Canadian Journal of Agricultural Economics* 54 (4): 477-495.

Zielenziger, M. 2001. 2nd mad cow discovery cripples beef sales in Japan. The Honolulu Advertiser 22 November (1).

CHAPTER 5. Conclusions and potential extensions

5.1. Conclusions and discussions

There is a high level of public interest in food safety and the linkages between food and health. Understanding the behavioral determinants of consumers' reactions to food safety incidents, their decision-making regarding food purchases, and how trade-offs may be made between risky and healthy components of food, is important to the design of several important aspects of food policy, including risk management and risk communication associated with health and food safety. It is the general objective of this thesis to advance current knowledge of consumer behavior in the context of food risks. This is accomplished in three related analyses, two of which examine different aspects of consumers' stated preferences for food with health benefits from omega-3 content which may be associated with GM/nonGM food ingredients. In the third paper, the demand impacts of the initial series of three BSE incidents in Canada are analyzed, based on revealed preferences data on household food expenditures during these incidents.

The first paper, presented in Chapter 2, focuses on examining the roles of trust on consumers' choices for a GM/nonGM food that may include health-related attributes of omega-3 content. This paper contributes to the literature by incorporating generalized trust into the studies of consumers' choices for a selected food item. In this paper, we examine correlations between measures of generalized trust and trust in the food system, as well as the predictive power of different measures of trust on consumers' stated choices for GM/nonGM canola oil products that may contain high levels of omega-3 content. The different measures of generalized trust that are considered include attitudinal questions adopted from the General Social Survey (GSS) and behavioral questions from previous literature. Respondents' trust in four institutions involved in the food system (government, farmers, manufacturers and retailers) in the context of food

safety is also considered. Trust in each of the four institutions is measured on the three dimensions of competency, honesty and public interest. Data on these various measures were obtained from the nation-wide survey "Linking Diet and Health: Consumers' Decisions on Functional Food" which is presented in Appendix A.

The analyses show that generalized trust and trust in the food system are correlated; respondents who are less trusting in others also exhibit lower levels of trust in food institutions. Integrating different measurements of trust into models of consumers' food choices, we find that consumers' choices for GM/nonGM oil are influenced by both generalized trust and trust in food institutions. In general, trusting people are less likely to be in the group of respondents that can be characterized as being anti-GM; trusting people also tend to place a lower discount on the presence of a GM attribute. Moreover, we find that although generalized trust, measured by trust in strangers and past trusting behavior, explains consumers' choices well, there is no evidence that generalized trust, as measured by the widely used attitudinal question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?", has predictive power on consumers' stated choices in the context of GM food. However, we acknowledge that the lack of predictive power of this measure of generalized trust on consumers' stated choices of GM oils may be due to generalized trust having little impact on consumer behavior in the context of GM food.

In the second paper, Chapter 3, attention is focused on the modeling of consumers' choices for foods with potential health and risk attributes. In the analysis the assumption that consumers evaluate all the attributes of alternatives and trade off between the attributes when they choose among alternatives is relaxed by incorporating attribute cutoffs into the modeling of consumers' decision making. We identified that a significant proportion of respondents indicated having cutoffs for the GM attribute and the country of origin attribute.

Incorporating these into analysis of the data from a stated choice experiment on functional GM/nonGM canola oil provides empirical evidence that respondents tend to violate their self-reported cutoffs and take a utility penalty, rather than eliminate an alternative, when a cutoff violation occurs. Our results suggest that incorporating attribute cutoffs into the linear compensatory utility function significantly improves the fit of the models tested. In this analysis, we also examine the potential endogeneity of attribute cutoffs by linking respondents' self-reported cutoffs to their demographic characteristics. Instruments for the self-reported cutoffs are created by predicting attribute cutoffs based on respondents' demographic characteristics. The predicted attribute cutoffs are then incorporated into the modeling of respondents' food choices. We find that model estimates based on self-reported cutoffs differ substantially from those based on predicted cutoffs. A possible reason for this is that self-reported cutoffs may be endogenous. Endogeneity of self-reported cutoffs has been hypothesized by a number of scholars (e.g., Swait, 2001; Klein and Bither, 1987; Huber and Klein, 1991). However, it is a challenge to test and address the endogeneity of cutoff due to the difficulty in finding good instruments. The second paper adds to the literature by assessing the influence of cutoffs on consumers' choices of a specific food with functional food characteristics that may be associated with genetic modification. We examine the problem of potential endogeneity of attribute cutoffs by using respondents' demographic characteristics as instruments in IV estimation. However, demographic characteristics only have limited explanatory power on having/not having cutoffs. Weakness in the instruments based on demographic characteristic may contribute to some component of the large difference between model estimates based on self-reported cutoffs and those based on predicted cutoffs.

In Paper 3, we examine consumers' responses to multiple and recurring food safety incidents in the context of a series of three BSE cases in Canada, with particular emphasis on the roles of habit and trust in shaping consumers' reactions Unlike in Papers 1 and 2, which use respondents' stated choice data, in Paper 3

consumers' revealed preferences are studied using information on household's expenditures from a data set which followed meat expenditures by a panel of Canadian households before and after the first three incidents in which a cow was found to have BSE. Examining the dynamics of monthly beef expenditure shares of selected Canadian households for the time period from January 2002 until December 2005, we find that households' responses to the first three BSE incidents in Canada followed a similar general pattern: households reduced their beef expenditures following the BSE announcements but these expenditures subsequently recovered. In the case of the first BSE incident, we find that habit persistence limited households' reductions of beef expenditure shares. However, relative to the second BSE events, analysis of the relatively larger data set of 644 Canadian households indicates that households modified their meat consumption habits following recurring BSE incidents, while analysis of a smaller data set of 437 households finds no evidence that habit influenced households' reactions to the second BSE events. The impacts of trust on consumers' reactions to BSE are also assessed in Chapter 4, based on the smaller set of households' expenditure data. The results show that trust had no impact on households' reactions to the first BSE incident but offset the negative impacts of the second BSE events. In Paper 3, we focus on meat-consuming households to avoid missing values. However, the behavioral patterns exhibited by the selected households may differ from that of the Canadian population. Moreover, the lack of price data limits our ability to precisely interpret the results. Nevertheless, the third study contributes to advancing current understanding of how consumption patterns evolve over time in the presence of multiple and recurring food safety incidents, an interesting but largely unexplored research topic.

Food consumption patterns have been changing over time. Food safety and quality are believed to have become increasingly important in consumers' food choices. The analyses reported in Papers 1 and 2, which focus on consumers' stated choices for functional GM/nonGM canola oil products, find that consumers value health benefits associated with omega-3 content in a functional food

product. However, they tend to discount this value of a functional food product if GM ingredients are present. These findings suggest that health benefits may offset negative perceptions associated with GM food, which in turn suggests the promise for the potential market for functional GM food. However, in Paper 2 (Chapter 3), we identify that some 40% of respondents reported having a cutoff for the GM attribute. Violating the no-GM cutoff tends to result in large utility penalties for these consumers, even when the GM food provides potential health benefits. This suggests difficulties in the marketing of functional foods with GM ingredients to those consumers who strongly desire avoidance of GM food.

Although food scientists maintain that today, food is safer than it has ever been (Verbeke et al., 2007), consumer trust in food safety seems to be declining globally (Kjærnes et al., 2007). Examining trust and consumer behavior in the contexts of GM food and BSE, we find that trust offset the negative effects of food risks in both contexts. In the study of trust and consumers' choices of GM food, we find that consumers who are less trusting in general also exhibit lower levels of trust in the food system. Moreover, both generalized trust and trust in food institutions affect consumers' stated choices for GM food. Assessment of the role of trust on consumers' reactions to recurring BSE incidents shows that trust had an impact: following the second BSE incidents, households that are trusting did not reduce their beef expenditure shares by as much as did less trusting households. These findings indicate that social and institutional factors play an important role in consumers' decision making on food that may involve uncertainty or risk, and deserve more attention in future studies on reactions to food risks.

We also test the predictive power of generalized trust on consumers' food purchasing behavior in the contexts of both GM food and BSE. Generalized trust measured by the standardized trust question, "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?", is found to have explanatory power on consumers' reactions to the

occurrence of the first three Canadian BSE cases, but this measure did not have a significant explanatory impact on consumers' choices of the identified GM food. Given the wide use of this trust measure in the economic literature, it is of interest to test the predictive power of this measure on consumers' behaviors. However, our findings in this context, for the two different cases of GM food and BSE are not consistent. It is possible that this discrepancy could be related to the nature of the data employed in the studies. We employed stated preference data in the context of the GM food but revealed preference data for BSE. Another possibility is that the discrepancy exists because GM food and BSE may be viewed as two different types of food risks. Future studies linking trust and behavior may add insights to the interrelationship that may exist between different measures of trust and different types of food risks.

The dynamics of food consumption patterns have undoubtedly been shaped both by economic factors (such as prices and income) and non-economic factors (including food safety and quality). This thesis study includes assessments of the impacts of some non-economic factors, including health benefits and food risks, on consumers' food choices. Papers 1 and 2 shed light on how health and risk factors affect consumers' food choices in the context of functional GM/nonGM canola oil products. Our results show that both health benefits from omega-3 content and potential risks associated with GM food have impacts on consumers' decision making. For some consumers, food can be seen as a powerful tool to improve health. Health and risk components of food products appear to be of growing importance in consumers' food choices. Meanwhile, food safety incidents also affect consumers' food consumption patterns. Our study of consumers' reactions to recurring BSE incidents in Canada shows that although consumers' beef consumption exhibits habit persistence, habitual beef consumption patterns did change in response to recurring BSE incidents. Recurring food safety incidents may have longstanding impacts on consumption of particular foods.

5.2. Potential extensions

Given the nature of the credence features of food risks and benefits and consumers' dependence on various food institutions to assess and maintain the safety and quality of food, it is of increasing interest to study interrelationships between trust, food risk and consumer behavior (Lobb, 2005). However, trust is an abstract and multi-dimensional concept which makes studying consumer trust in the food system challenging. From Paper 1, we find evidence that both generalized trust and trust in food institutions affect consumers' choice for functional GM/nonGM canola oil products. Although economic literature has investigated factors influencing generalized trust (e.g., Bjørnskov, 2006), the determinants of consumer trust in food institutions remain to be explored. Based on micro-level data, we find that individuals differ in their trust in the food system. Further, macro-level studies suggest that consumer trust in the food system varies among countries. For example, Kjærnes et. al (2007) document substantial variations in consumer trust in food across European countries. Future studies examining the determinants of consumer trust in the food system, including both micro-level determinants and macro-level determinants, should add insights to differences in trust between individuals and populations.

An obvious potential extension of the current analyses is to assess the impacts of respondents' health status and health attitudes on their choices for functional GM/nonGM canola oil products. Another natural extension of the current study is to test further the robustness of our findings, by applying these in different contexts. Many major food scares have differed in terms of the nature and type of risk. Some are caused by contamination and inadequate sanitation during food production and transportation. Examples are E. coli and salmonella outbreaks. Others are due to uncertainties associated with technology innovation, such as some controversies over GM food or food irradiation. Consideration of different types of food risks can highlight different dimensions of the societal management of food risks. This thesis study focuses only on GM food and BSE. It is unclear whether the findings based on these two types of food risks apply in

other contexts. Future studies comparing consumers' responses to food risks with different features should add to knowledge of the nature of individuals' decision making in the context of food risks.

This thesis study applies data on consumers' stated preference and revealed preferences in two different contexts of food risks, GM food and BSE. Both stated preference data and revealed preference data have their own advantages and limitations. It is possible that the findings from this thesis are influenced by not only the feature of the data sets but also the risk contexts. Future studies may also consider research approaches that combine stated preference and revealed preference data for particular food risk behaviors.

References

Bjørnskov, C. 2006. Determinants of generalized trust: A cross-country comparison. *Public Choice* 130: 1-21.

Houghton, J.R., G. Rowe, L.J. Frewer, E. van Kleef, G. Chryssochoidis, O. Kehagia, S. Korzen-Bohr, J. Lassen, U. Pfenning, and A. Strada. 2008. The quality of food risk management in Europe: perspectives and priorities. *Food Policy* 33(1): 13-26.

Huber, J. and N.M. Klein. 1991. Adapting cutoffs to the choice environment: The effects of attribute correlation and reliability. *The Journal of Consumer Research* 18(3): 346-357.

Kjærnes, U., M. Harvery., and A. Warde. 2007. *Trust in Food: A Comparative and Institutional Analysis*. Palgrave Macmillan, New York.

Klein, N.M. and S.W. Bither. 1987. An investigation of utility-directed cutoff selection. *The Journal of Consumer Research* 14(2): 240-256.

Lobb, A. 2005. Consumer trust, risk and food safety: A review. *Food Economics-Acta Agriculturae Scandinavica Section C* 2(1): 3-12.

Swait, J. 2001. A non-compensatory choice model incorporating attribute cutoffs. *Transportation Research Part B: Methodological* 35(10): 903-928.

Verbeke, W., L.J. Frewer, J. Scholderer, and H.F. De Brabander. 2007. Why consumers behave as they do with respect to food safety and risk information. *Analytica Chimica Acta* 586: 2-7.

APPENDIX A. Linking Diet and Health: Consumers' Decisions on Functional Food

SCREENING

S1. Do you or anyone in your immediate household work for any of the following types of companies? **Please check all that apply**

An advertising agency or public relations firm
A marketing research company
The media (TV, newspaper or radio)
Retailer, wholesaler, processor or distributor of cooking oil
None of the above

[IF 'NONE OF THE ABOVE', CONTINUE; OTHERS THANK AND TERMINATE]

S2. How much of the grocery shopping would you say that you do for your household? **(Select one)**

All of it
More than half of it
About half of it
Less than half of it
None of it

[IF CODES 1 TO 3, "ALL OF IT", "MORE THAN HALF OF IT" OR "ABOUT HALF OF IT" CONTINUE; OTHERS THANK AND TERMINATE]

S3. Which, if any, of the following types of cooking oil do you purchase either regularly or occasionally?
(Select All That Apply)

Canola oil
Corn oil
Grape seed oil
Olive oil
Palm oil
Peanut oil
Safflower oil
Sesame oil
Sunflower oil

None of the above

[IF CODE 1, 'CANOLA OIL', CONTINUE; OTHERS THANK AND TERMINATE]

We start the survey with questions about general issues in society today and your personal views of these.

Q1. We would like your opinions about spending on public services. For each of the publicly-provided services listed below, please indicate if you personally think funding for these services should be reduced substantially, reduced somewhat, not changed, increased somewhat, or increased substantially. *Select one response for each row*

	Reduced substantially	Reduced somewhat	Not changed	Increased somewhat	Increased substantially
Education services					
Police and security services					
Health care services					
Improving and maintaining the natural environment					
Providing for safe food and water					
Providing roads and highways					

Q2. Some people say that people can get ahead by their own hard work; others say that lucky breaks or help from people are most important. Which do you think is most important to getting ahead? *Select one response*

Hard work is most important
Hard work, luck equally important
Luck or help from other people most important
Don't know

Q3. Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? *Select one response*

Most people can be trusted
Cannot be too careful in dealing with people
Don't know

Q4. Do you think most people would try to take advantage of you if they got a chance, or would they try to be fair? *Select one response*

Would take advantage of you
Would try to be fair
Don't know

Q5. Would you say that most of the time people try to be helpful, or that they are mostly just looking out for themselves? *Select one response*

Try to be helpful
Just look out for themselves
Don't know

Q6. Please indicate your level of agreement or disagreement with the statement: *"You can't trust strangers anymore". Select one response*

Strongly disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Strongly agree

Q7. How often, if ever, do you lend money to friends when they ask? *Select one response*

Always
Most of the time
Sometimes
Rarely
Never

Q8. How often, if ever, do you lend personal possessions to friends when they ask? *Select one response*

1. Always
2. Most of the time
3. Sometimes
4. Rarely
5. Never

CANOLA OIL PURCHASING

In the next few questions, we are interested in your preferences regarding canola oil purchases.

Q9. When purchasing canola oil, which of the following statements best represents how the country of origin influences your purchase decision? *Select one response*

My decision depends on the specific canola oil.
I only purchase canola oils produced in Canada.

I only purchase canola oils produced in the U.S.
I do not care

Q10. Which of the following statements best describes your attitudes toward buying foods with fortified ingredients? *Select one response*

Food fortification refers to the addition of one or more nutrients to a food product, e.g., adding calcium to fruit juice or adding flax/fish oils to milk or to vegetable oil.

My decision depends on the specific food with fortified ingredients.
I am not willing to purchase any food with fortified ingredients.
I am indifferent towards foods with/without fortified ingredients.

Q11. Which of the following behaviour when it comes to buying foods that have ingredients that are genetically modified (GM) or genetically engineered (GE)? *Select one response*

Genetic modification/engineering (GM/GE) is a modern agricultural biotechnology which involves the transfer of genetic material from one organism to another. Through GM/GE, it is easier to introduce new traits without changing other traits in the plant or animal. GM/GE also makes it possible to introduce traits from other species, something not possible with traditional breeding methods.

My decision depends on the specific food with GM/GE ingredients.
I am not willing to purchase any food with GM/GE ingredients.
I am indifferent towards foods with/without GM/GE ingredients.

Q12. Thinking about the canola oil that you normally buy, does it have genetically modified ingredients? *Select one response*

Yes
No
Don't know

Q13a. When you purchase a bottle of canola oil, say 1 litre in size, is there always a maximum price you will pay? *Select one response*

Yes
No

[IF YES, CONTINUE. OTHERS SKIP TO NEXT SECTION]
Q13b. Which of the following represents the <u>maximum</u> price you will pay for one litre bottle of canola oil? *Select one response*

$2.49 per litre or less
$2.50~ $4.99 per litre
$5.00/litre ~ $7.49 per litre
$7.50 per litre or more

Awareness of links between diet and health, together with new scientific discoveries, is leading to markets for functional foods. Functional foods are novel foods with enhanced health benefits. Functional foods can be developed by different methods. In the following purchase simulation questions, we are interested in your choices of different canola oils with functional health benefits.

Please also keep in mind these definitions when answering the next questions

Omega-3 fatty acids: Omega-3 fatty acids are essential nutrients for health. The human body cannot produce these on its own so they must come from one's diet or through supplements (e.g., pills). Medical research has linked omega-3 with numerous health benefits, such as reducing cardiovascular disease and lowering the danger of heart disease and stroke.

Canola oil that contains omega-3 fatty acids: Any regular canola oil has some level of omega-3 fatty acids. Manufacturers may choose to state this on the label as: "contains omega-3."

Canola oil with enhanced omega-3 fatty acids: While ordinary canola oil has a certain level of omega-3 fatty acids, the type and level of omega-3 fatty acids in canola oil can be increased and enhanced through genetically modifying/engineering (**GM/GE)** canola plants. Enhanced omega-3 fatty acids can also be achieved without the use of GM/GE by **fortification.**

Product of Canada: This means that the canola oil is Canadian grown and processed.

Product of US: This means that the canola oil is imported from the US where it was grown and processed.

[PURCHASE SIMULATION]

PLEASE TAKE TIME TO CAREFULLY READ THE FOLLOWING INSTRUCTIONS BEFORE PROCEEDING

In this section you are presented with a series of scenarios with different purchase decision options for canola oils. Each option includes a description of its different features. For each decision simulation, you are asked to indicate your own preference. Specifically, you are asked which oil you would CHOOSE to purchase compared to other oils in the choice set. Alternatively, you may choose NOT TO PURCHASE either oil in any purchase scenario.

IMPORTANT

- **CHOOSE** one of the options on each page. Or you may choose NOT TO PURCHASE either oil.
- Assume that the options on each page are the only ones available
- Do not compare options on different pages

You may see a few options that seem counter-intuitive (e.g., a lower price but a higher quality in your personal opinion). Be assured that this is not an error but part of the design of the survey. Simply choose the option that you most prefer, based on its characteristics.

Now suppose you are shopping for canola oil. Examine the options in each scenario below. Please CHOOSE one---OR NONE---of the available oil options. Keep in mind that, in a real-life situation, you would be paying for the product that you choose. Make the decision that most closely reflects what you would do in an actual shopping situation.

EXAMPLE

Oil A	Oil B
	
Enhanced Omega-3 Contains GM/GE Product of U.S. $3.50/litre	Contains Omega-3 No GM/GE Product of Canada $7.50/litre
☐ Choose Oil A ☐ Choose Oil B ☐ No purchase	

PLEASE TAKE TIME TO CAREFULLY READ THE FOLLOWING INSTRUCTIONS BEFORE PROCEEDING.

In this section you are presented with a series of scenarios with different purchase decision options for canola oils. Each option includes a description of its different features. For each decision simulation, you are asked to indicate your own preference. Specifically, you are asked which oil you would DISCARD (i.e. remove from consideration for purchase) compared to other oils in the choice set. Alternatively, you may choose to DISCARD BOTH oils in any purchase scenario.

IMPORTANT

- **DISCARD** one of the options on each page. Or you may choose to DISCARD BOTH oils.
- Assume that the options on each page are the only ones available
- Do not compare options on different pages

You may see a few options that seem counter-intuitive (e.g., a lower price but a higher quality in your personal opinion). Be assured that this is not an error but part of the design of the survey. Simply discard the option that you least prefer, based on its characteristics.

Now suppose you are shopping for canola oil. Examine the options in each scenario below. Please DISCARD one---OR BOTH---of the available oil options. Make the decision that most closely reflects what you would do in an actual shopping situation.

EXAMPLE

Oil A	Oil B
	
Enhanced Omega-3 Contains GM/GE Product of U.S. $3.50/litre	Contains Omega-3 No GM/GE Product of Canada $7.50/litre

☐ Discard Oil A
☐ Discard Oil B
☐ Discard both oils

Q14a. Regarding the safety of foods in Canada, we would like to know whether you trust individuals and organizations involved in the food system. Please indicate to what extent you agree or disagree with each of the following statements. *Select one response for each row*

(a) Government

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't Know
The government has the competence to control the safety of food.						
The government has sufficient knowledge to guarantee the safety of food.						
The government is honest about the safety of food.						
The government is sufficiently open about the safety of food.						
The government takes good care of the safety of food.						
The government gives special attention to the safety of food.						

(b) Farmers

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't Know
Farmers have the competence to control the safety of food.						
Farmers have sufficient knowledge to guarantee the safety of food.						
Farmers are honest about the safety of food.						
Farmers are sufficiently open about the safety of food.						
Farmers take good care of the safety of food.						
Farmers give special attention to the safety of food.						

(c) Manufacturers of food

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't Know
Manufacturers have the competence to control the safety of food.						
Manufacturers have sufficient knowledge to guarantee the safety of food.						
Manufacturers are honest about the safety of food.						
Manufacturers are sufficiently open about the safety of food.						
Manufacturers take good care of the safety of food.						
Manufacturers give special attention to the safety of food.						

(d) **Food Retailers**

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't Know
Retailers have the competence to control the safety of food.						
Retailers have sufficient knowledge to guarantee the safety of food.						
Retailers are honest about the safety of food.						
Retailers are sufficiently open about the safety of food.						
Retailers take good care of the safety of food.						
Retailers give special attention to the safety of food.						

Q14b. We would also like to know whether you trust the government regarding inspecting and regulating the safety of foods with GM/GE ingredients. Please indicate to what extent you agree or disagree with each of the following statements. *Select one response for each row*

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't Know
The government has the competence to control the safety of GM/GE food.						
The government has sufficient knowledge to guarantee the safety of GM/GE food.						
The government is honest about the safety of GM/GE food.						
The government is sufficiently open about the safety of GM/GE food.						
The government takes good care of the safety of GM/GE food.						
The government gives special attention to the safety of GM/GE food.						

Q14c. Please indicate which of the following you believe are primarily responsible for the safety of foods with GM/GE ingredients. *Select all that apply.*

Government
Farmers
Manufacturers
Retailers
Agricultural biotechnology companies

Q15. Each item below is a belief statement about your health condition with which you may agree or disagree. Beside each statement is a scale which ranges from strongly disagree (1) to strongly agree (6). For each item please select the number that represents the extent to which you agree or disagree with that statement. The more you agree with a statement, the higher will be the number you select. The more you disagree with a statement, the lower will be the number you select. Please make sure that you answer **EVERY ITEM** and that you SELECT **ONLY ONE** number per row. This is a measure of your personal beliefs; obviously, there are no right or wrong answers.

1 = STRONGLY DISAGREE **(SD)** 2 = MODERATELY DISAGREE **(MD)** 3 = SLIGHTLY DISAGREE **(D)**	4 = SLIGHTLY AGREE **(A)** 5 = MODERATELY AGREE **(MA)** 6 = STRONGLY AGREE **(SA)**

		SD 1	**MD 2**	**D 3**	**A 4**	**MA 5**	**SA 6**
1	If I get sick, it is my own behavior which determines how soon I get well again.						
2	No matter what I do, if I am going to get sick, I will get sick.						
3	Having regular contact with my physician is the best way for me to avoid illness.						
4	Most things that affect my health happen to me by accident.						
5	Whenever I don't feel well, I should consult a medically trained professional.						
6	I am in control of my health.						
7	My family has a lot to do with my becoming sick or staying healthy.						
8	When I get sick, I am to blame.						
9	Luck plays a big part in determining how soon I will recover from an illness.						
10	Health professionals control my health.						
11	My good health is largely a matter of good fortune.						
12	The main thing which affects my health is what I myself do.						
13	If I take care of myself, I can avoid illness.						
14	Whenever I recover from an illness, it's usually because other people (for example, doctors, nurses, family, friends) have been taking good care of me.						
15	No matter what I do, I 'm likely to get sick.						
16	If it's meant to be, I will stay healthy.						
17	If I take the right actions, I can stay healthy.						
18	Regarding my health, I can only do what my doctor tells me to do.						

Q16a. How would you describe your health in general? *Select one response*

Very good
Good
Neither good nor bad
Bad
Very bad
Don't Know

Q16b. How important are food choices in preventing chronic illness and supporting health? *Select one response*

Not important at all
Not very important
Somewhat important
Very important
Extremely important
Don't know

Q17a. Are you currently taking omega-3 supplements? *Select one response*

Yes

No

Q17b. Are you currently taking vitamin supplements? *Select one response*

Yes

No

Q17c. Are **you a vegetarian or vegan?** *Select one response*

Yes

No

Q18. Below is a list of **possible food safety issues**. For each, please indicate how much of **a health risk** you feel each of these is to you personally. *Select one response for each row*

	High risk	Moderate risk	Slight risk	Almost no risk	Don't know
Bacteria contamination of food					
Pesticide residuals in foods					
Use of hormones in food production					
Use of antibiotics in food production					
BSE (mad cow disease)					
Use of food additives					
Use of genetic modification / engineering in food production					
Drugs (i.e. medicines) made from plant molecular farming though genetic modification/engineering					
Genetically modified/engineered crops to increase nutritional qualities of food					
Genetically modified/engineered crops to produce industrial products like plastics, fuel or industrial enzymes					
Fat and cholesterol content of food					

Q19a. How well informed would you say you are about genetically modified/engineered foods? Would you say…? *Select one response*

Very well informed
Somewhat informed
Not very informed
Not at all informed
Don’t know

Q19b. How well informed would you say you are about functional foods? Would you say…? *Select one response*

Very well informed
Somewhat informed
Not very informed
Not at all informed
Don’t know

Q20. Has anyone in your immediate family (including all household members, children, parents, grandparents, aunts or uncles) been diagnosed with any of the following diseases? *Select one response for each row*

	Yes	No	Don't know
Cancer			
Heart disease			
Diabetes			

Q21. How often do you buy organic food products? *Select one response*

Regularly
Occasionally
Never

Q22. On average, how often do you exercise? *Select one response*

5 or more times per week
3-4 times per week
1-2 times per week
Less than 1 time per week

Q23. How often, if ever, do you seek health information from sources such as television, newspapers, the internet, etc? *Select one response*

Regularly
Occasionally
Never

Q24. Before buying food products, how often, if ever, do you read the product labels? *Select one response*

Regularly
Occasionally
Never

Q25. How often, if ever, do you smoke? *Select one response*

Regularly
Occasionally
Never

The following questions are designed to tell us a little about you. This information will only be used to report comparisons among groups of people. Your identity will not be linked to your responses in any way.

Q26. How many brothers and sisters do you have? *Please enter one number in the box provided.*

Q27. What is your weight? *Please choose either Pounds or kilos and enter number in chosen box*

_____ Pounds
_____Kilos

Q28. What is your height? *Please select one from the drop down menu*
4ft 6 inches (137 cm)
4ft 7 inches (140 cm)
4 ft 8 inches (142 cm)
4 ft 9 inches (145 cm)
4 ft 10 inches (147 cm)
4 ft 11 inches (150 cm)
5 ft (152 cm)
5 ft 1 inch (155 cm)
5 ft 2 inches (157 cm)
5 ft 3 inches (160 cm)
5 ft 4 inches (162 cm)
5 ft 5 inches (165 cm)
5 ft 6 inches (167 cm)
5 ft 7 inches (170 cm)
5 ft 8 inches (172 cm)
5 ft 9 inches (175 cm)
5 ft 10 inches (177 cm)
5 ft 11 inches (180 cm)
6 ft (183 cm)
6 ft 1 inch (186 cm)
6 ft 2 inches (188 cm)
6 ft 3 inches (191 cm)
6 ft 4 inches (193 cm)
6 ft 5 inches (196 cm)
6 ft 6 inches (199 cm)
6 ft 7 inches (201 cm)

Q29. What is the highest level of education that you have completed?
Select one response only

Never attended school
Grade school (grades 1 to 9)
Some high school
High school graduate
Post secondary trade or technical school certificate/degree

Some university or college
College diploma/degree
University undergraduate degree
Some post graduate university study
Post graduate university degree (e.g., Masters or Ph.D.)
Decline to respond

Q30. For classification purposes, what is your total household income before taxes? *Select one response*

Less than $10,000
$10,000 - $19,999
$20,000 - $29,999
$30,000 - $39,999
$40,000 - $49,999
$50,000 - $59,999
$60,000 - $69,999
$70,000 - $79,999
$80,000 - $89,999
$90,000 - $99,999
More than $100,000
Decline to respond

Q31. Which of the following occupational descriptions suits your current situation the best? *Select one response*

Working in private sector
Working in public/government sector
Working as self-employed (including farmers and fishermen)
Pensioner
Student
Unemployed
Full-time housewife/home worker
None of the above

APPENDIX B. Trust Questions in the 2007 Neilsen Homescan™ Panel Survey[18]

General Trust
A. Generally speaking, would you say that most people can be trusted?

People can be trusted
Can't be too careful in dealing with people
Don't know

B. How much do you trust each of the following groups of people?
(1=Cannot be trusted at all; 2=Somewhat untrustworthy; 3=Slightly untrustworthy; 4=Somewhat trustworthy; 5=Can be trusted a lot; 6=Don't know)

People in your family
People in your neighborhood
People you work or go to school with
Doctors or nurses
Scientists
Consumer organizations
Environmental organizations
Media sources
Strangers

C. How often do you lend money to your friends?

Never
Infrequently
Moderately often
Frequently
Regularly

[18] In early 2007, 5,000 members of the Neilsen Homescan™ panel who had been in the panel since 2002 were provided, by the Neilsen Company, a survey developed by the Department of Rural Economy, University of Alberta. There were 4,090 responses to the survey. We used, in Chapter 4 of this thesis, only the responses to the first question "Generally speaking, would you say that most people can be trusted?".