
**Consumer Risk Perceptions
and Attitudes
about Beef Food Safety:
*Implications for Improving
Supply Chain Management***

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Executive Summary

Recent concerns about food safety have been the most disruptive and costly events the Canadian beef industry has ever experienced. At best, food safety scares reduce consumer confidence in beef products. At worst, complete loss of beef market access occurs because of a food safety event. Either scenario, reduced consumer confidence in beef safety or loss of market access, adds considerable stress to the Canadian beef industry as reduced consumer demand causes lower beef and cattle prices. Prosperity of the Canadian beef industry rests heavily on export markets as farm value of beef exports represent nearly 50 percent of farm cash receipts for cattle. Therefore, losing access to export markets devastates the Canadian cattle and beef industry. Furthermore, vigorous global competition from other major beef export countries as well as stiff competition from competing protein sources make it critical that Canadian beef have a positive food safety image among potential customers. Developing and ensuring a reputation for safe beef products requires a supply chain in which all participants are held accountable for and benefit from ensuring the product is safe.

Understanding consumer preferences and demands is an integral part of developing an effective beef production and marketing supply chain that addresses consumer concerns. Understanding consumer attitudes and perceptions about food safety of Canadian beef is particularly important when dealing with food safety concerns to build and ensure consumer confidence. This project was designed to assess consumer perceptions and attitudes about Canadian beef food safety and to propose supply chain management strategies to enhance beef demand. We conducted extensive surveys focusing on beef food safety during February and March 2006 with approximately 1,000 consumers in each of four primary markets for Canadian beef; Canada, the United States, Japan, and Mexico.

- Consumers make beef purchase decisions based on an array of bundled product attributes. Respondents in all four countries most often cited product freshness as one of the most important purchase deter-

minants. This was followed by leanness, price, and color in Canada and the United States; by country of origin, price, and food safety assurances by consumers in Japan; and by color, price, and flavor by Mexican consumers. Clearly, product price is also a very important beef purchase determinant that must be considered in supply chain strategies.

- About 80 percent or more of consumers in Canada and the United States consider beef a safe product whereas only 48 percent of Japanese and 60 percent of Mexican respondents feel beef is safe to consume. Beef food safety concerns in Mexico and, especially, Japan are significant demand drivers.
- Relative to 4 years ago, approximately 20 percent of Canadian and U.S., 30 percent of Mexican, and 55 percent of Japanese consumers have reduced their beef consumption because of food safety concerns. This very sobering finding reveals a substantial loss in consumer demand related to food safety perceptions about beef in recent years. Particularly challenging about this finding is that lost consumer confidence in beef can occur regardless of what the Canadian beef industry alone does to ensure food safety. That is, beef food safety is a global issue. This indicates that striving for sound, but strict international beef trade standards may be in the best interest of the entire beef industry for helping to ensure food safety of beef around the world regardless of beef origin.
- North American respondents have greater food safety concerns about beef prepared away from home than when they prepare the food themselves. Consumers recognize that having more food handlers can increase food safety risks. Japanese consumers are equally concerned about beef safety whether the beef is prepared at home or away from home. In addition, consumers reported having greater food safety concerns associated with highly processed beef such as microwavable products.

Demand for food service and easy-to-prepare products is increasing, yet consumers indicate concern about these products' safety. The beef industry must be diligent in ensuring food safety for products that are going into these expanding markets.

- Consumers in each of the four countries indicated preferences for domestically produced beef. Country-of-origin can be a cue for a lot of different product characteristics including food safety, meat quality, freshness, production practices, environmental impact of production, and other credence product attributes that one may not be able to discern even by consuming the product. Further, purchasing locally produced products may make people feel good about supporting local producers or economies. Important for the Canadian beef industry to understand is that to expand market share in other countries, the industry will have to overcome skepticism among consumers of foreign-produced beef products. The more Canada can ensure and promote that Canadian beef is produced meeting the highest standards of quality, freshness, food safety, and whatever else might be embedded in country-of-origin labeling (e.g., environmental stewardship, animal welfare, and so forth), the more likely Canadian beef will be well accepted and even preferred by international consumers.
- Canadian beef enjoys a relatively strong reputation for food safety among consumers in the four countries surveyed. In particular, consumers have a more favorable view of Canadian beef safety compared to other major exporters such as the United States, Australia, and Brazil. Still, more than 70 percent of Canadian, U.S., and Japanese consumers indicated willingness to pay premiums for beef having enhanced food safety. Maintaining and improving Canadian beef's reputation will require ongoing efforts directed toward developing new technology, production practices, and vertical supply chain strategies that enhance food safety. Addressing these issues will require careful attention to consumers in each country regarding their attitudes and specific concerns about beef food safety.
- Consumers know little about the probable impact and prevalence of most beef food safety contaminants. For example, nearly 20 percent of consumers in Canada, the United States, and Japan and about 60 percent in Mexico consider *E. coli* 0157:H7 contamination as a high or very high risk in beef. However, *E. coli* 0157:H7 bacteria are rarely present in beef products and with proper cooking and handling by the food preparer can be virtually eliminated. Furthermore, more than 50 percent of consumers in Japan and Mexico indicate BSE in beef products is a high or very high food safety risk; a perception sensationalized by the media and widely misunderstood by consumers. These examples demonstrate that education about beef food safety risk and proper handling must remain a priority. Only by providing accurate and trustworthy information will consumers better understand the safety of beef products and their role in ensuring product safety.
- Respondents in all four countries hold everyone in the beef supply chain responsible for helping to ensure food safety. This includes producers, processors, grocers and retailers, food service establishments, government regulators, and consumers themselves. Beef food-safety management requires an integrated effort involving everyone from industry regulators, beef production input suppliers, producers, processors, food preparers, and consumers. Ensuring food safety requires having the ability to rapidly trace food safety problems if they occur. Industry management strategies that include rapid and comprehensive animal and meat product traceability are critical to gaining and maintaining consumer trust. Thus, starting at the producer level, having individual animal traceability is important in helping manage food safety up and down the supply chain. Furthermore, having a reliable trace-back system will increase access to global markets.
- Respondents generally indicated high levels of trust in food safety information obtained from family physicians and dietitians, especially relative to retailers, food industry sources, and consumer groups.

Food safety information will be most effective if targeted toward educating information providers who already have high levels of consumer trust.

- Canadian and U.S. consumers largely consider beef as safe and have low levels of risk aversion with respect to beef consumption. Maintaining safe beef products and helping these consumers understand the low levels of risk present should be sufficient to maintain consumer trust. However, consumers who have reduced beef consumption in recent years because of food safety concerns have done so more because of attitudes about beef food safety than because of perceptions. That is, they choose not to consume beef because they are unwilling to take on food safety risks they believe are associated with beef consumption. Bringing these consumers back to beef will require eliminating beef food safety risk and helping these consumers understand that the risk has been eliminated, not just reduced. Whether this approach will be feasible or economically viable for the Canadian beef industry is yet to be determined, but potential benefits of regaining beef customers are apparent.
- Japanese and Mexican consumers are more risk averse about consuming beef and have more negative perceptions about beef food safety in general than do Canadian and U.S. respondents. Negative perceptions about beef food safety among these consumers must be addressed first to attract these consumers to beef products.

That is, perceptions about beef safety are more easily dealt with through industry strategies to enhance beef food safety and educate consumers. Attitudes about food safety are more difficult to change and may require more aggressive industry strategies in dealing with food safety incidents.

- Females, older adults, and more educated people tend to be more risk averse about consuming beef and they revealed stronger perceptions about beef not being safe to consume. This result was consistent across respondents from all four countries. Developing educational and informational programs about beef food safety targeted toward these specific demographic segments will be most effective at increasing beef demand.
- Canadian beef enjoys brand equity. That is, the Canadian beef country-of-origin has value in that many consumers have positive perceptions about Canadian beef. This is especially true in Canada, but it is also true in a relative sense in the United States, Japan, and Mexico. Building on this positive perception and partnering with downstream beef market outlets may be an effective strategy (e.g., food service featuring Canadian beef). New Zealand lamb and Australian wine have both pursued this strategy successfully with North American consumers in recent years. Further examination of these brand establishment strategies may be warranted to identify ways to enhance Canadian beef brand equity.

Supply Chain Management Strategy Recommendations

The research conducted for this study revealed numerous strategies that the Canadian beef industry could pursue to enhance product demand. Most noteworthy is that consumers in each of the four countries surveyed (Canada, United States, Japan, and Mexico) vary greatly in their stated preferences and attitudes about beef and beef food safety. Considerable heterogeneity in preferences is apparent across consumers, both within and across countries. This makes implementing broad supply chain management strategies challenging as no single strategy will effectively hit the target for all consumers in a particular country, let alone across countries.

Fundamental to successfully designing a supply chain management strategy to attract and maintain loyal consumers will be determining Canada's comparative advantage. Specifically, it is essential to determine which consumer segments the country's beef system is best positioned to supply. However, in the process of consumer targeting of a supply chain it is critical that the focus be on maximizing the value of the entire beef carcass, not just components of the carcass. This is important because there are differences in product preferences across countries and cultures, and strategy development must consider the impact on the entire carcass' value. Also, as the Canadian beef industry develops a strategy to produce and market beef, the industry should keep in mind that there are things the industry can do to enhance the product (i.e., give the consumer what they want) or things the industry can do to educate and inform the consumer (i.e., convince consumers that what you have is what they want). Both strategies are probably warranted. Cognizant of these issues and based on our knowledge of the Canadian beef industry, global protein competitors, and results revealed from our intensive consumer surveys in this study, we offer several ideas regarding what we believe could be a part of an overall successful supply chain management strategy for the Canadian beef industry.

1. Under any supply chain management strategy, efficiency must be a significant driver. Consumers indicate that (relative)

product price is a very important purchase determinant. Furthermore, with intense global competition from alternative protein suppliers (e.g., beef from Brazil, Australia, and the United States; pork; and poultry), whatever the Canadian beef production and marketing system does to enhance beef product demand, economic efficiency will be critical. This suggests new technology (production, processing, quality enhancing, food safety assurance, etc.) will be an important dimension of a supply chain management strategy.

A segment of consumers in each of the four countries analyzed in this research are willing to pay significant premiums for products possessing relatively rare combinations of attributes. While traditional, mass production at a national level is not recommended (as the consumer market for some products may be small), encouraging progressive entities of the Canadian beef industry to develop niche products to capture these premiums is one strategy worth considering. An example might be producing Canadian branded beef, assured to be tender, and produced and processed in an environment consumers see as particularly conscientious of food safety. As worldwide incomes continue to increase and food expenditures as a percentage of income decline, demand for this type of product will grow. Given the diverse preferences that exists across consumers, clearly multiple strategies can be employed to successfully attract different consumers. Additional information (not available from our consumer analysis) is needed to more completely assess the added expense likely to be incurred in producing beef for targeted markets.

2. Beef products are highly perishable. The vast majority of consumers in all four countries indicate product freshness is the single most important trait when considering beef product purchases. Supply chain strategies that reduce the time required to get beef products on store shelves and safely enhance beef shelflife is important to

consumers. Product freshness is certainly an important component of food safety. Distributing fresh product becomes even more important when targeting distant markets like Japan because of physical shipping time required. Canadian and U.S. consumers indicate product color is an important trait they consider when purchasing beef, so shelf life enhancement must be developed with product color in mind.

3. Product leanness is an important product trait to Canadian and U.S. consumers. This characteristic is particularly relevant for ground beef where consumers indicate strong preferences for lean product. When targeting whole muscle cuts for domestic and U.S. consumers, close product fat trimming will present a lean product consumers are more likely to be attracted to than a product with visible fat. Further, product labels that indicate product lean percentage are important to these consumers. However, consumers in Canada and the United States also indicated willingness to pay sizable premiums for steak products that are guaranteed tender. The implication is that product development work must be multidimensional, pursuing leanness while also being mindful of other quality attributes, such as tenderness.

4. Japanese consumers demand food safety assurances. Japanese, and to some extent Mexican, consumers are skeptical about the safety of beef products. Additionally, U.S. and Canadian consumers revealed willingness to pay premiums for safety assured beef. Consumers desire assurance that products are safe, which implies they have undergone a rigorous procedure to ensure food safety and a validation process.

The combination of strong risk attitudes, risk perceptions, and revealed demand mean that food safety concerns will constrain future Canadian beef market share growth in the Japanese and, perhaps, Mexican markets. It is possible that expenditures needed to appease the typical Japanese consumer with respect to food safety are cost prohibitive. If that is the case, it may be more appropriate to develop

management strategies that target subsets of Japanese consumers. Serious evaluation of the expenditures needed to meet such demands needs to be further assessed prior to undertaking such efforts.

5. Consumers want beef products that fit modern lifestyles of households whose members have limited time for food preparation. This has resulted in large increases in consumption of food prepared away from home as well as increases in meal packages that are highly processed and microwaveable. However, our surveys indicate that consumers have less confidence in the safety of food that is prepared or highly processed by others. Consumers perceive that the more hands that touch a product and/or the more processing lines it passes through, the greater the chance for introduction of food-borne pathogens. The beef industry is somewhat at the mercy of the rest of the food-processing and food-service sectors to make sure they have systems in place that ensure beef food safety. However, the beef industry can develop programs that help prevent downstream handlers from introducing food-borne pathogens in beef products. Education of downstream handlers and working with them so they better understand beef food safety assurance protocols is central to accomplishing this goal. Every animal and food handler needs to have incentives, as well as accountability, to assure food safety vertically in the meat supply chain. Product traceability is one way to accomplish better accountability and enhance food safety assurance levels to consumers, but traceability alone is insufficient.
6. Canadian beef enjoys a very favorable perception among Canadian consumers. The industry can certainly make the most of this by labeling beef products as Canadian in the domestic market. Domestic support of Canadian beef should also be a signal for domestic food service entities to feature Canadian beef. Our surveys indicate this will enhance domestic beef product demand.

7. Canadian beef generally enjoys a solid reputation among consumers in the United States. This suggests that Canada might be able to successfully produce a branded beef product line with penetration in the U.S. market. That would be especially true if the branded product line features fresh, lean, safety enhanced, assured tender, competitively priced beef products.
8. Consumers across all countries have little knowledge of beef food-borne pathogens, except for BSE and *E. coli* 0157:H7, although BSE is misunderstood by Japanese and Mexican consumers. Similarly, few consumers know how consumption of products tainted with a pathogen can affect human health. This area of supply chain management presents a particularly interesting challenge. Education is undoubtedly key to dealing with misperceptions and lack of understanding. However, raising issues of sizeable magnitude for food-borne pathogens that are quite rare can have unintended consequences of being misleading by drawing unwarranted attention to food safety issues with very low or even infinitesimal levels of presence. Japanese consumers further reveal very high levels of risk aversion and rather than respond to education, our results indicate that they want greater assurances of safe food, regardless of how rare pathogens might be. These perceptions, together with markedly different levels of risk attitudes across consumers, suggest a multifaceted approach to food safety is necessary. First, educating consumers about the steps taken by the Canadian beef supply chain, especially relative to major competitors, to ensure beef safety is also important. Consumers hold all parties in the beef supply chain as largely responsible for ensuring safe food. Therefore, the entire system from producer through final food handler has responsibility and opportunity to promote what they are doing to ensure safe food products. Finally, educating consumers about safe food handling practices and the implications of food safety incidents could be helpful in some markets, such as Mexico.

The country that most effectively integrates its beef industry, either through new ownership structures or contractually, will likely be in the best position to provide enhanced traceability systems, and hence most effectively assure consumers of beef safety. In turn, these results suggest that the country that does the best job of assuring consumers of beef safety is most likely to gain market share by capitalizing on current attitudes and beliefs of consumers concerned about food safety. Furthermore, these integration efforts would likely lead to increased efficiency in providing these desired beef traits.

9. Reassuring and informing consumers about the food safety attributes and other desirable characteristics of Canadian beef is a strategy we believe will be successful. Our survey results indicate most consumers in each surveyed country are willing to pay for products with greater food safety assurances (or will discount those without food safety assurances). But to be successful in a food safety enhancement strategy, the Canadian beef industry must also proactively assure production of consistent, high-quality beef (e.g., guaranteed tender steak products) with high levels of food safety assurance, that is price competitive with alternative protein sources. If the industry can accomplish this, getting the message to more than just consumers will be critical to success. For example, Canadian, U.S., and Mexican consumers indicate they have high levels of trust in information about food safety from family physicians, dieticians, and government food agencies. These are excellent targets for information announcing new supply chain enhancement strategies that accomplish various goals. However, Japanese consumers have less trust in these food safety information sources so getting the news out about new initiatives is more challenging in Japan.

Comments about price competitiveness warrant further elaboration. It is obvious that beef products possessing enhanced characteristics such as guaranteed tenderness and additional food safety assurances will be produced at higher expense than

typical beef products. This fact alone does not make the product “price uncompetitive.” Rather, the final price can be higher than that of competing products (such as typical beef, poultry, etc.) as long as the targeted consumer views the higher price of this more expensive beef to be warranted relative to cheaper alternatives lacking these desirable traits. We make this point to further emphasize that price competitiveness involves more than just comparing the sticker price of two protein alternatives. Some consumers will assess the complete bundle of attributes (price, tenderness and other quality attributes, food safety certifications, etc.) of the two alternatives and, based on their valuation of the attributes, decide to purchase the higher priced product because it is a better value.

10. Females generally tend to have poorer perceptions of beef’s safety. Women also want greater assurances of food safety than males. This is particularly important because females also represent a majority of grocery shoppers and meal planners. This means that messages regarding food-product quality and safety need to be targeted toward female consumers.
11. Every player in food production, processing, merchandising, and preparation plays an important role in food safety. Each segment of the food chain depends on the prior segments for delivery of product meeting necessary food safety standards. Further, each segment that supplies product to customers for further processing relies heavily on downstream players to maintain the level of food safety the product possessed as it entered their system. Therefore, food safety assurance requires an integrated effort from all chain participants.

Events that have been at least perceived to adversely affect food safety have resulted in complete loss of access to key markets by North American beef producers.

Introduction

Food safety concerns have had dramatic impacts on cattle and beef markets in recent years. Events that have been perceived to adversely affect food safety have resulted in complete loss of access to key markets by North American beef producers. Discovery of cattle infected with bovine spongiform encephalopathy (BSE) in North America in 2003 resulted in immediate and long-lasting bans on animal and beef trade. The economic consequences of lost market access have been substantial. For example, in 2002 Canada exported \$CN 3.6 billion¹ (farm value) of cattle and beef, representing about 48 percent of farm cash receipts for cattle (Poulan and Boame 2003). Discovery of BSE in an Alberta cow in May 2003 caused an immediate halt to all Canadian cattle and beef exports causing substantial declines in fed-cattle and cull-cow prices. By early 2004, the aggregate economic loss to the Canadian livestock sector associated with the BSE discovery was estimated at \$6.3 billion (Serecon Management Consulting Inc. 2003). The impact of the BSE discovery on Canadian cattle markets is ongoing. More than 3 years after the discovery, major importers still ban imports of some Canadian cattle and beef.

In addition to BSE, numerous other food safety concerns are also of considerable importance to the beef industry. For example, periodic detection of *E. coli* 0157:H7, *Salmonella*, *Campylobacter*, *Listeria*, and similar foodborne pathogens have been particularly noteworthy beef food safety concerns. The U.S. Centers for Disease Control estimates that approximately 4 million foodborne bacterial illnesses occur annually in the United States with 37 percent of those from *E. coli* 0157:H7, *Salmonella*, *Campylobacter*, or *Listeria* (Meade, et al. 1999). Furthermore, they estimate that annually more than 1200 deaths are associated with foodborne outbreaks from these four bacteria in the United States. Food safety events, at worst, cause complete loss of market access. At best, discovery of foodborne pathogens in beef erode consumer confidence about beef food safety, which reduces demand for beef and cattle and causes lower prices (Marsh, Schroeder, and Mintert 2004).

¹ All dollar values in this report are expressed in Canadian dollars, unless otherwise noted.

Food-safety assurances are costly endeavors and food safety can never be fully guaranteed. However, the beef industry can potentially adopt a host of alternative production, processing, product handling and preparation, and product testing and surveillance activities that influence food-product safety and/or consumer perceptions about beef food safety. Further, the industry can develop programs to inform consumers about food safety and the consumer's role in assuring beef products are safe. Determining the optimal industry strategy for managing beef, food safety requires in-depth knowledge about consumer perceptions and attitudes regarding beef food safety. For example, some consumers understand that there is some food safety risk inherent in all food products and they accurately assess the low level of risk present in Canadian beef. As such, they are very willing to consume the product despite known low risk levels. Evidence of this is that beef demand in Canada increased in 2004 following discovery of the BSE infected cow in Canada in May 2003 (Agriculture and Agri-Food Canada 2006). Overall, Canadian consumers have not perceived a food safety threat from Canadian beef despite the BSE discovery (Beef Information Centre 2005). In fact, the 2004 increase in demand suggests that typical Canadian consumers are more sensitive to price effects than BSE (and possibly food safety in general) risks.

In contrast, some consumers react much differently to a food safety event and simply quit consuming the product if an actual or perceived food safety breach occurs (Pennings et al. 2002). The dramatic beef demand decline that took place in Japan following the September 2001 discovery of a domestic dairy cow infected with BSE is an example of this phenomenon. Following the discovery, per capita Japanese beef consumption declined by more than 50 percent in just 2 months and about 1 in 4 Japanese consumers indicated that they eliminated beef from their diets (Peterson and Chen 2005). This ultimately led to Japan enacting mandatory BSE testing for all bovines intended for human consumption. Although these examples refer to consumers by country of residence, reactions to food safety events vary across consumers within a country. Some consumers may stop eating beef in reaction to

a BSE discovery (e.g., 1 in 4 Japanese consumers), whereas, other consumers' demand for beef may not change at all. Therefore, developing an effective food safety supply chain management strategy requires that the beef industry understand consumer perceptions and attitudes about beef food safety.

This research project was undertaken to increase understanding of consumer attitudes and perceptions about beef in Canada, the United States, Japan, and Mexico. These countries were the four largest markets for Canadian beef, prior to 2003. The Canadian beef industry relies heavily upon export markets with the United States historically being by far the largest market representing about 75 percent of total beef and related product exports followed by Mexico and Japan. Since the 2003 BSE discovery, the United States and Mexico are once again the two primary market outlets for Canadian beef exports and the Japanese market maintains considerable future market potential. The ultimate purpose of the project is to use information gained from this research to guide future supply chain management strategies for the Canadian beef industry.

Objectives

The overall objective of this project is to determine consumer risk attitudes and perceptions about beef food safety in major importing and exporting countries and design supply chain management strategies to address these concerns. Particular objectives include:

1. Determine how risk perceptions and risk attitudes differ among representative consumers in Canada and leading export markets for Canadian beef, particularly the United States, Japan, and Mexico.
2. Identify the primary drivers of consumer responses to food safety (risk attitudes vs. risk perceptions) in the four countries and how that influences optimal responses from the beef industry (e.g., designing an optimal response model based on the underlying drivers of consumer reactions to food safety issues).
3. Determine the degree of heterogeneity, both within and across countries, of risk perceptions and attitudes regarding beef

food safety among consumers in Canada, the United States, Japan, and Mexico.

4. Determine actual and perceived knowledge about the safety of consuming beef in major beef importing and exporting countries of Canada, the United States, Japan, and Mexico.
5. Design beef supply chain management strategies for the Canadian beef industry to optimize domestic and international consumer acceptance of beef products across these different cultures.

Research Design

To collect information about consumer perceptions and attitudes regarding beef food safety, we conducted an on-line computer survey of consumers from households located in Canada, the United States, and Japan. The same survey was conducted via in-person interviews in Mexico. The Mexican surveys were completed in person because of limited computer access and/or use among the general population in Mexico. A copy of the survey instrument (in English) is provided in Appendix A. The survey was translated into French (primarily for use in Quebec), Spanish (for Mexico), and Japanese to accommodate different respondent languages across countries. Initial drafts of the surveys were formally reviewed by the Canadian Beef Information Centre and the Canadian Beef Export Federation with revisions made based on their suggestions.

The survey instrument was designed to gain an understanding of consumer perceptions and attitudes about beef food safety in general. In addition, socio-demographic information about each respondent, meat consumption habits, questions regarding the amount of trust in various sources of information, food safety knowledge, and product attribute and labeling preferences were collected. Each respondent also completed a choice experiment designed to determine the amount consumers would be willing to pay for various beef steak production, food safety, and product quality attributes. Combined, this information provides a comprehensive assessment of views and preferences of consumers from four different countries about beef products. The survey questions were designed to solicit information that would

Table 1. Summary Statistics of Selected Demographic Variables of Survey Respondents

Biographical Data	Respondent Country			
	Canada	United States	Japan	Mexico
Total Respondents	1,002	1,009	1,001	993
Gender				
Male	48%	17%	51%	20%
Female	52%	83%	49%	80%
Age				
Under 25 years	3%	2%	9%	38%
25-34	15%	13%	20%	29%
35-44	22%	20%	25%	18%
45-54	23%	28%	30%	10%
55-64	27%	21%	16%	4%
Over 64	10%	16%	0%	2%
Average age (years)	47.7	48.9	41.8	31.1
Education Level				
Less than High School Graduate	2%	2%	3%	17%
High School Graduate	30%	19%	33%	17%
Some College or Technical (No Bachelor's)	40%	39%	25%	18%
College Bachelor's Graduate	17%	25%	34%	26%
Post-College Graduate	7%	14%	3%	8%
No Response	3%	0%	3%	0%
Household Income Category^a				
I lower	10%	18%	33%	36%
II lower-middle	23%	18%	21%	39%
III middle	26%	15%	21%	14%
IV middle-upper	19%	22%	12%	11%
V upper	22%	27%	13%	

^aCanada, I is less than \$15,000; II \$15,000-\$34,999; III \$35,000-\$59,999; IV \$60,000-\$79,999; V \$80,000 or more (\$CN)

United States, I is less than \$22,500; II \$22,500-\$39,999; III \$40,000-\$59,999; IV \$60,000-\$89,999; V \$90,000 or more (\$U.S.)

Japan, I is less than 2,000,000; II 2,000,000-3,999,999; III 4,000,000-5,999,999, IV 6,000,000-7,999,999; V 8,000,000 or more (Japanese Yen)

Mexico, I is 4,000-6,000; II is 7,000-21,000; III 22,000-54,000; and IV is 55,000+ (Mexican pesos)

guide Canadian beef industry supply chain management strategies for targeted consumers in these major markets.

The surveys were conducted through a subcontract between Kansas State University and TNS NFO, a global market research company. TNS NFO has a vast consumer panel worldwide with more than 5 million individuals in their data bank. For our surveys, TNS NFO targeted one adult per household who was familiar with shopping habits. Target respondents were older than 18 years of age and overall came from a representative distribution of household income levels. We sought approximately 1,000 completed survey responses from each country. TNS NFO estimated the surveys would take approximately 20 minutes for each respondent to complete. All questions were designed with a list of options for respondents to select from or requested rankings of information, including choice experiments (discussed later). Questions were presented in randomized order across respondents to reduce question ordering biases. All surveys were completed between late February and early March 2006. Respondents were assured their answers would be anonymous and we were supplied with no information beyond demographics about specific respondent identities.

Survey Respondents and Demographic Information

A total of 4,005 respondents completed the survey across all four countries (Canada 1,002; the United States 1,009; Japan 1,001; and Mexico 993). Summary data of selected demographic attributes of survey respondents are provided in Table 1. In Canada and Japan, male and female respondents were about equal, whereas, in the U.S. and Mexico females represent about 80 percent of respondents. Most respondents are 35 to 64 years of age in Canada, the United States, and Japan, with an average age ranging from 42 to 49 years old. The Mexican survey responses are more heavily skewed toward a younger population, with 65 percent of respondents being younger than 35 years old and an average age of 31. Although respondents in Mexico are younger than the other countries, this is consistent with census data on age distributions across these

four countries. Roughly one-quarter of the adult population over 18 years of age is less than 35 years old in Canada, the United States, and Japan. In contrast, 43 percent of the adult population in Mexico is less than 35 years of age (U.S. Census Bureau 2006).

Respondent education levels (Table 1) vary from less than high school to post-bachelor's graduate level. The majority of respondents in each country have at least some college education. Mexican respondents tend to have lower education levels than respondents from the other three countries, consistent with their younger age distribution. Income levels of respondents are also quite variable ranging from lower income levels (e.g., \$15,000 or less to upper income levels (e.g., more than \$80,000). More than 20 percent of Canadian and U.S. respondents are categorized in the upper income level, whereas about 12 percent of Japanese and 11 percent of Mexican respondents are from their respective highest income categories.

Survey respondent geographic distributions within each country are summarized in Table 2. A broad geographic representation of respondents is apparent in Canada, the United States, and Japan, whereas Mexican respondents are from the three largest metropolitan areas in Mexico because Mexican surveys were conducted in person.

Beef Consumption Habits

The vast majority of survey respondents are beef consumers with more than 95 percent in each country indicating they eat beef at least occasionally (Table 3). More than 60 percent of respondents in Canada, the United States, and Mexico consume beef at least 2 to 3 times per week, compared to only 30 percent of Japanese respondents consuming beef this often. Overall, a considerable amount of variability is present in beef consumption frequency across respondents in each country. To the extent frequency of consumption is an indicator of market penetration and/or saturation, beef has not enjoyed the level of penetration in Japan relative to the other three countries. Based on just this factor alone, there may be more opportunity for beef market growth in Japan than the other countries, but this conclusion

Table 2. *Geographic Locations of Survey Respondents*

Country/Region	Respondent Percentage	Country/Region	Respondent Percentage
Canada		Mexico	
Atlantic	8%	Mexico City	50%
Quebec	26%	Guadalajar	25%
Ontario	38%	Monterrey	25%
Prairie Provinces	15%		
British Columbia	14%		
United States		Japan	
New England	5%	Hokkaido	5%
Middle Atlantic	13%	Tohoku	6%
East North Central	15%	Kanto	39%
West North Central	8%	Chubu	16%
South Atlantic	19%	Kinki	19%
East South Central	6%	Chugoku	5%
West South Central	11%	Shikoku	3%
Mountain	7%	Kyushu	8%
Pacific	15%	Okinawa	1%

Table 3. *Survey Respondent Beef Consumption Habits and Frequency of Ordering Food Prepared Away from Home*

Beef Consumption Habit	Respondent Country			
	Canada	United States	Japan	Mexico
Beef Consumption Frequency				
Never	4.4%	2.5%	2.2%	1.2%
Once per month or less	7.0%	5.4%	16.1%	2.4%
2-3 times per month	10.0%	8.7%	22.3%	7.5%
Once per week	18.5%	20.3%	29.4%	21.8%
2-3 times per week	47.8%	45.4%	27.0%	45.6%
4 or more times per week	12.4%	17.7%	3.1%	21.6%
Frequency of Eating Out, Take Out, or Carry Out for Breakfast				
Never	69.9%	68.7%	86.3%	41.4%
1 Time	20.5%	21.4%	8.8%	24.3%
2 Times	6.0%	6.1%	2.0%	18.9%
3 or more Times	3.7%	3.8%	2.9%	15.4%
Frequency of Eating Out, Take Out, or Carry Out for Lunch				
Never	37.9%	31.0%	26.6%	18.0%
1 Time	31.2%	29.1%	29.9%	24.4%
2 Times	14.9%	18.3%	14.1%	21.3%
3 Times	7.5%	9.0%	9.5%	14.1%
4 Times	3.6%	4.9%	4.2%	6.1%
5 Times	4.2%	6.5%	11.7%	9.9%
6 or more Times	0.7%	1.1%	4.1%	6.2%
Frequency of Eating Out, Take Out, or Carry Out for Dinner				
Never	27.2%	17.0%	30.1%	38.4%
1 Time	45.0%	40.6%	43.4%	24.8%
2 Times	18.3%	24.7%	13.7%	18.6%
3 Times	5.6%	11.2%	7.6%	8.8%
4 Times	2.4%	3.9%	2.2%	4.2%
5 or more Times	1.6%	2.6%	3.1%	5.2%

Table 4. *Distributions of Individual Beef Product Consumption over the Past Year*

	Respondent Country			
	Canada	United States	Japan	Mexico
% Consumed as ground or minced beef (e.g., hamburger)				
Less than 20%	14.0%	11.1%	26.6%	33.9%
20% - 39%	35.2%	32.1%	48.2%	54.2%
40% - 59%	29.7%	31.8%	17.5%	10.2%
60% - 79%	14.9%	17.7%	6.0%	0.8%
80% or more	6.3%	7.3%	1.7%	0.8%
% Consumed as roasts				
Less than 20%	51.2%	60.6%	26.5%	54.8%
20% - 39%	41.2%	35.0%	51.2%	40.2%
40% - 59%	6.3%	4.1%	18.0%	4.5%
60% - 79%	0.8%	0.3%	3.4%	0.3%
80% or more	0.5%	0.1%	1.0%	0.2%
% Consumed as steaks				
Less than 20%	41.0%	43.5%	70.9%	13.6%
20% - 39%	41.6%	37.8%	24.7%	48.3%
40% - 59%	12.6%	13.5%	3.4%	31.4%
60% - 79%	3.2%	3.3%	0.5%	5.0%
80% or more	1.6%	1.9%	0.5%	1.7%
% Consumed as sausage, brats, hotdogs, beef luncheon meats, deli meats				
Less than 20%	63.7%	60.0%	41.3%	49.3%
20% - 39%	31.3%	33.3%	42.7%	44.3%
40% - 59%	4.1%	5.5%	12.7%	5.6%
60% - 79%	0.6%	0.9%	2.2%	0.6%
80% or more	0.3%	0.3%	1.1%	0.1%
% Consumed as organ meats (e.g., liver, tongue, tripe, etc.)				
Less than 20%	98.0%	98.9%	93.3%	87.7%
20% - 39%	1.9%	1.1%	6.0%	11.3%
40% - 59%	0.1%	0.0%	0.6%	0.9%
60% - 79%	0.0%	0.0%	0.1%	0.1%
80% or more	0.0%	0.0%	0.0%	0.0%

Consumers are highly sensitive to, and aware of, product freshness information when they make beef purchase decisions.

must be tempered with additional information summarized later.

Many meals consumed by the respondents are prepared outside the home, especially lunch and dinner (Table 3). More than 30 percent of respondents in each country consume lunch prepared away from home at least two times per week and more than 25 percent in each country consume dinner prepared away from home at least two times per week. This illustrates the importance of the away-from-home-food market, which will have particular relevance regarding food safety concerns discussed later.

In addition to the frequency of beef consumption and frequency of respondents consuming food prepared away-from-home, we also surveyed the types of beef products typically consumed when someone consumed beef over the past year (Table 4). As expected, ground beef tends to be the most common beef product form, especially in Canada and the United States with about 50 percent of respondents in these two countries indicating at least 40 percent of beef they consume is ground. This compares to less than 25 percent of respondents in each Japan and Mexico indicating that 40 percent or more of their beef is consumed in ground form. Japanese and Mexican respondents tend to consumer a greater variety of beef products. Japanese consume roasts and processed products (e.g., sausages, brats, luncheon meats, etc.) more often than others and Mexicans consume steak and processed products more often. Again, considerable heterogeneity in beef product consumption patterns is present across consumers in each country.

Beef Purchase Decision Determinants

Survey respondents were presented with a list of 15 items (presented in randomized order across individual surveys) that could influence their beef purchase decision and were asked to identify the five most important factors. The 15 items included price; visual and labeling product characteristics; product assurances and eating experience attributes; preparation convenience characteristics; and beef production practice traits associated with the product. Results provided in Tables 5 and 6 reveal simi-

larities as well as stark differences regarding the relative importance of what consumers think about in each country when they purchase beef products.

Given the perishability of beef, it is not surprising that *product freshness* is the most frequently cited factor affecting beef purchases among the top five items in all four countries. More than three-fourths of Canadian, U.S., and Japanese respondents and 60 percent of Mexican respondents listed product freshness as an important purchase determinant. This demonstrates that consumers are highly sensitive to, and aware of, product freshness information when they make beef purchase decisions. Consumers use the *purchase by date* on the package label to judge product freshness, not the slaughter date, which is usually not known. This is important because processes that slow down product movement, but enhance beef quality (such as aging) may still be valuable industry product management strategies as long as consumers do not perceive it as reducing freshness.

The next two most often cited important attributes in Canada and the United States are *product price* and *leanness* with roughly 70 percent of respondents citing these. Given that Canadian and U.S. respondents consume ground beef more often than respondents in the other two countries, Canadian and U.S. consumers would be expected to be more aware of percentage lean than the other respondents as leanness is a widely used measure of ground beef quality. *Price* was selected as having major importance by 75 percent of Japanese respondents. Therefore, product price is a significant economic driver of consumer beef purchase decisions by respondents in three of the countries. However, in Mexico only 45 percent of respondents listed price as a major (top five) purchase determinant. This is difficult to understand since Mexican consumers tend to have lower incomes than consumers in the other countries surveyed and we would generally expect lower income households to be more price responsive. However, beef prices in Mexico tend to be lower than in the other countries and it is possible consumers take the lower prices for granted and focus their attention on other product attributes. Overall, it is apparent that Mexican respondents focus on

Table 5. Importance of Selected Traits in Beef Product Purchase Decisions

	Respondent Country			
	Canada	United States	Japan	Mexico
Price				
% Choosing Product Price as 1 of 5 most important traits				
No	30.8%	27.0%	25.1%	55.3%
Yes	69.2%	73.0%	74.9%	44.8%
Product Visual and Labeling				
% Choosing Product Freshness as 1 of 5 most important traits				
No	16.4%	18.7%	23.7%	40.4%
Yes	83.6%	81.3%	76.3%	59.6%
% Choosing Product Nutritional Information as 1 of 5 most important traits				
No	83.0%	83.7%	96.3%	77.3%
Yes	17.0%	16.3%	3.7%	22.7%
% Choosing Product Color as 1 of 5 most important traits				
No	48.4%	39.0%	56.2%	52.6%
Yes	51.6%	61.0%	43.8%	47.4%
% Choosing Product Leanness as 1 of 5 most important traits				
No	27.6%	29.4%	78.4%	68.6%
Yes	72.4%	70.6%	21.6%	31.4%
Product Assurances				
% Choosing Product Labeled Natural as 1 of 5 most important traits				
No	93.0%	93.4%	95.2%	80.9%
Yes	7.0%	6.6%	4.8%	19.1%
% Choosing Product Labeled Organic as 1 of 5 most important traits				
No	93.0%	94.0%	94.0%	88.4%
Yes	7.0%	6.0%	6.0%	11.6%
% Choosing Product Food Safety Assurance as 1 of 5 most important traits				
No	68.2%	74.3%	42.6%	64.0%
Yes	31.8%	25.7%	57.4%	36.0%
% Choosing Traceability of Product to Farm as 1 of 5 most important traits				
No	95.7%	97.0%	75.4%	91.4%
Yes	4.3%	3.0%	24.6%	8.6%
% Choosing Country of Origin of Product as 1 of 5 most important traits				
No	75.2%	85.9%	23.8%	82.0%
Yes	24.8%	14.1%	76.2%	18.0%
Product Eating Experience and Preparation Attributes				
% Choosing Product Flavor as 1 of 5 most important traits				
No	66.5%	63.7%	66.7%	61.9%
Yes	33.5%	36.3%	33.3%	38.1%
% Choosing Product Tenderness as 1 of 5 most important traits				
No	59.5%	61.6%	83.5%	69.5%
Yes	40.5%	38.4%	16.5%	30.5%
% Choosing Product Juiciness as 1 of 5 most important traits				
No	90.3%	88.0%	93.9%	67.5%
Yes	9.7%	12.0%	6.1%	32.5%
% Choosing Product Preparation Ease as 1 of 5 most important traits				
No	82.9%	82.9%	90.9%	82.7%
Yes	17.1%	17.1%	9.1%	17.3%
% Choosing Product Preparation Time as 1 of 5 most important traits				
No	87.7%	88.8%	97.9%	85.6%
Yes	12.3%	11.2%	2.1%	14.4%

Table 6. Ranked Frequency of Product Attributes that are a Top Five Purchase Determinant by Respondent Country

Respondent Country							
Canada		United States		Japan		Mexico	
Beef Attribute	% Listed as Top 5	Beef Attribute	% Listed as Top 5	Beef Attribute	% Listed as Top 5	Beef Attribute	% Listed as Top 5
Freshness	84%	Freshness	81%	Freshness	76%	Freshness	60%
Leanness	72%	Price	73%	Country of Origin	76%	Color	47%
Price	69%	Leanness	71%	Price	75%	Price	45%
Color	52%	Color	61%	Safety Assurance	57%	Flavor	38%
Tenderness	41%	Tenderness	38%	Color	44%	Safety Assurance	36%
Flavor	34%	Flavor	36%	Flavor	33%	Juiciness	33%
Safety Assurance	32%	Safety Assurance	26%	Traceability	25%	Leanness	31%
Country of Origin	25%	Preparation Ease	17%	Leanness	22%	Tenderness	30%
Preparation Ease	17%	Nutrition	16%	Tenderness	16%	Nutrition	23%
Nutrition	17%	Country of Origin	14%	Preparation Ease	9%	Natural	19%
Preparation Time	12%	Juiciness	12%	Juiciness	6%	Country of Origin	18%
Juiciness	10%	Preparation Time	11%	Organic	6%	Preparation Ease	17%
Natural	7%	Natural	7%	Natural	5%	Preparation Time	14%
Organic	7%	Organic	6%	Nutrition	4%	Organic	12%
Traceability	4%	Traceability	3%	Preparation Time	2%	Traceability	9%

A majority of Japanese respondents collectively rated beef as neither safe or unsafe, somewhat unsafe, or not safe at all.

a much broader set of attributes when making purchase decisions than respondents in the other three countries. For example, the only trait affecting beef purchase decisions selected by more than half of Mexican respondents was *product freshness*.

Japanese respondents are highly concerned about beef products' *country of origin* with 76 percent citing this as one of the five most important attributes affecting purchase decisions. In contrast, only 14 percent of U.S. consumers cite *country of origin* as a top purchase determinant. This suggests that country of origin labeling on beef products tends to be a significant concern to Japanese consumers, but it is not a leading concern of most U.S. consumers. Country of origin labeling has been a significant policy issue in the United States, but it does not appear to be a major determinant of U.S. beef consumer purchase decisions. More than half of Japanese consumers also listed *beef food safety* as a top priority, whereas 25 percent to 36 percent of consumers in the other countries listed this as one of the top determinants they use when they make beef purchase decisions. This reveals that beef food safety is on the minds of most Japanese as well as many Canadian, U.S., and Mexican consumers when making purchase decisions.

Product traits such as *natural* or *organic* labels, *nutritional information*, *product juiciness*,

product preparation time and *ease*, and *product traceability* are infrequently (generally less than 20 percent with a few exceptions) cited by respondents as one of the top-five beef purchase decision determinants. However, this does not necessarily mean that these product attributes are unimportant for enhancing beef demand. For example, even though product traceability back to the farm is not ranked as highly important by many respondents, food safety is rated much higher and product traceability is an integral part of beef food-safety management. Since ensuring food safety requires product traceability in production and processing, it follows that consumers are indirectly concerned about product traceability.

Beef Food Safety Concerns and Reactions

A significant goal of this study was to assess consumer views about beef food safety and learn what they know about beef food safety risks. In this light, one of the perceptions we were interested in gaining insights about was how consumers view beef's safety relative to competing meats. Table 7 summarizes consumer responses to a general question about respondent perceptions about beef and competing meat food safety. For beef in particular, we queried food safety perceptions by more detailed products, which will be discussed

below. Results for beef in Table 7 use the average response across beef steak, roast, and ground beef to represent an overall beef food safety perception. Generally, most respondents consider all meat species at least *somewhat safe*, with some noted exceptions. About 80 percent or more of consumers in Canada and the United States consider beef, pork, poultry, and fish/seafood as *somewhat* or *very safe* whereas more than 70 percent of consumers in these two countries had the same sentiment about lamb. Japanese respondents, on the other hand, are more skeptical about food safety levels across all species than consumers in Canada and the United States. In particular, a majority (52 percent) of Japanese respondents collectively rated beef as *neither safe or unsafe*, *somewhat unsafe*, or *not safe at all*.

Figure 1 summarizes the weighted-average food-safety risk perception of respondents for each meat species by country from the responses provided in Table 7. In this figure, if all consumers in a country rated a product as *very safe*, the index would have a value of 2, the maximum possible value. A value of zero indicates that the average response is that the product is neither safe nor unsafe (i.e., indifference). Beef enjoys a strong food safety perception in Canada and the United States, but not nearly as strong in Japan. Looking ahead, these results suggest future supply chain development will require special attention to beef safety to address consumer concerns in Japan and Mexico.

To better understand respondent food safety perceptions across species, we inquired about the respondent's personal family experience with food-borne illness. Table 8 reports the frequency of suspected food-borne illness and the food that was the suspected cause as well as the location of food preparation. Just fewer than 40 percent of Canadian, U.S., and Mexican consumers (just under half this amount by Japanese respondents) indicate a family member experienced illness from spoiled, tainted, or improperly handled food. Of those that had experienced food-borne

Table 7. Respondent Food Safety Perceptions Across Meat Species

Meat Species	Food Safety Perception	Respondent Country			
		Canada	United States	Japan	Mexico
Beef					
	Very Safe	41.0%	42.2%	3.5%	15.1%
	Somewhat Safe	45.1%	43.2%	44.8%	46.2%
	Neither Safe nor Unsafe	9.8%	9.8%	36.8%	24.8%
	Somewhat Unsafe	2.7%	3.3%	12.3%	11.4%
	Not at all Safe	1.4%	1.5%	2.7%	2.5%
Pork					
	Very Safe	43.5%	43.0%	11.7%	12.2%
	Somewhat Safe	43.2%	40.2%	68.4%	29.3%
	Neither Safe nor Unsafe	7.6%	9.0%	16.6%	23.9%
	Somewhat Unsafe	2.2%	4.9%	2.8%	22.2%
	Not at all Safe	3.5%	2.9%	0.5%	12.5%
Poultry					
	Very Safe	39.8%	39.3%	7.3%	17.0%
	Somewhat Safe	47.2%	47.1%	60.4%	47.4%
	Neither Safe nor Unsafe	9.5%	9.3%	26.1%	24.2%
	Somewhat Unsafe	2.4%	3.4%	5.5%	9.2%
	Not at all Safe	1.1%	0.9%	0.7%	2.2%
Lamb/Mutton					
	Very Safe	35.8%	31.4%	8.0%	13.3%
	Somewhat Safe	41.6%	39.7%	51.9%	42.0%
	Neither Safe nor Unsafe	19.0%	23.8%	34.2%	30.0%
	Somewhat Unsafe	2.1%	3.3%	5.0%	10.8%
	Not at all Safe	1.5%	1.8%	1.0%	3.9%
Fish/Seafood					
	Very Safe	35.0%	29.4%	9.0%	14.3%
	Somewhat Safe	46.8%	49.9%	59.8%	41.2%
	Neither Safe nor Unsafe	14.1%	14.0%	24.7%	22.9%
	Somewhat Unsafe	2.8%	5.6%	5.9%	17.8%
	Not at all Safe	1.3%	1.1%	0.6%	3.8%

Figure 1. Respondent Perception Food Safety Weighted Index by Meat Species

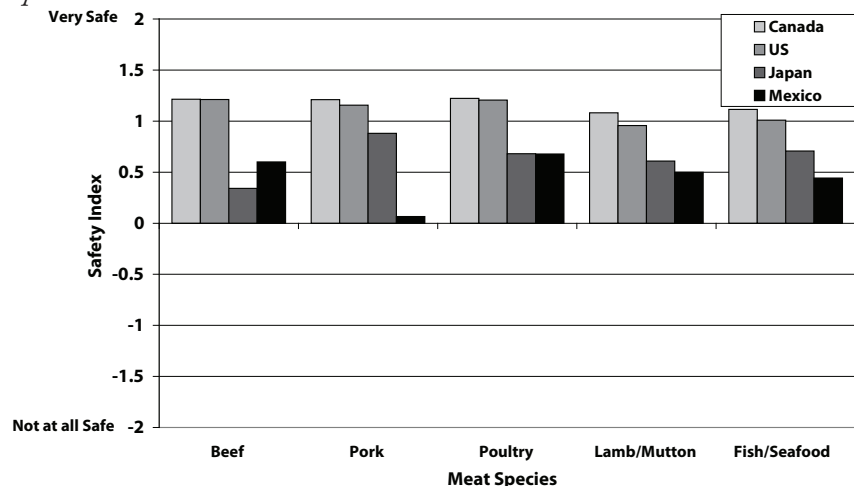
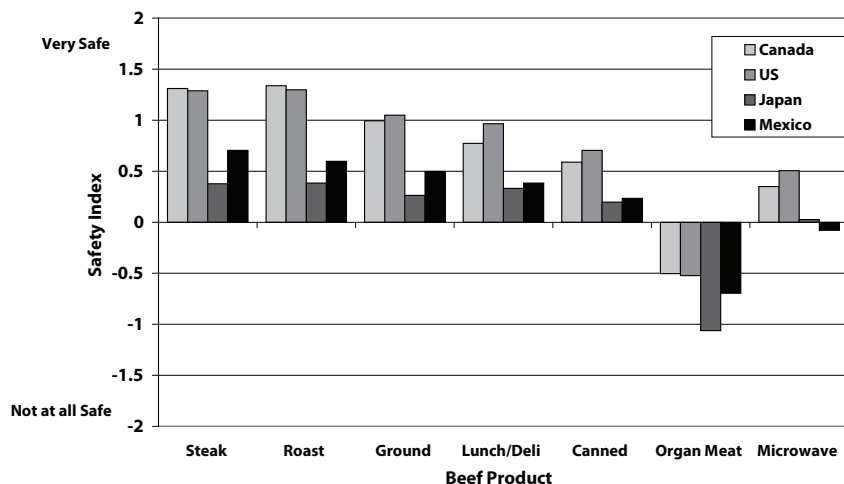


Table 8. Illnesses Suspected Caused by Spoiled, Tainted, or Improperly Cooked Food

	Respondent Country			
	Canada	United States	Japan	Mexico
Family Experienced Illness Caused by Spoiled, Tainted, or Improperly Handled Food				
Yes	37.1%	35.8%	18.4%	39.7%
No	62.9%	64.2%	81.6%	60.3%
Of those that answered Yes to having experienced food-borne illness:				
Was Pork Suspected of Causing the Illness?				
No	87.6%	87.3%	89.7%	32.7%
Yes	12.4%	12.7%	10.3%	67.3%
Was Poultry Suspected of Causing the Illness?				
No	62.6%	70.9%	90.2%	86.0%
Yes	37.4%	29.1%	9.8%	14.0%
Was Beef Suspected of Causing the Illness?				
No	78.0%	74.8%	87.5%	76.4%
Yes	22.0%	25.2%	12.5%	23.6%
Was Lamb/Mutton Suspected of Causing the Illness?				
No	98.1%	99.7%	98.9%	92.9%
Yes	1.9%	0.3%	1.1%	7.1%
Was Fish/Seafood Suspected of Causing the Illness?				
No	72.9%	72.0%	43.5%	59.4%
Yes	27.2%	28.0%	56.5%	40.6%
Were Fruits Suspected of Causing the Illness?				
No	98.7%	97.8%	97.3%	94.7%
Yes	1.3%	2.2%	2.7%	5.3%
Were Vegetables Suspected of Causing the Illness?				
No	96.0%	92.0%	96.2%	90.6%
Yes	4.0%	8.0%	3.8%	9.4%
Suspected Food Preparation Location				
Home	12.1%	8.0%	44.6%	18.3%
Away from Home	76.9%	82.3%	42.4%	67.8%
Some at home & some away from home	11.0%	9.7%	13.0%	14.0%

Figure 2. Respondent Perception Food Safety Weighted Index by Beef Product



illness, poultry was identified as the most likely culprit in Canada and the United States followed by fish/seafood with beef coming in third. In contrast, Japanese respondents were far more likely to blame food-related illness on fish/seafood, indicating that it was believed responsible 57 percent of the time. Beef was the second most likely cause of food-related illness according to Japanese participants, but only 13 percent of respondents said it caused the illness, just slightly more than the 10 percent responding that pork likely caused the illness. Mexican survey participants pointed toward pork as the most likely source of food-related illness (67 percent), with fish/seafood ranked second (41 percent). Nearly a quarter (24 percent) of Mexican survey participants indicated beef caused a food-based illness, making it the third most likely cause of illness. These results were similar to those obtained from the rest of North America as 22 percent of Canadian consumers and 25 percent of U.S. consumers said beef was suspected of causing a food-related illness.

Food prepared away from home was a bigger food safety concern than food prepared at home by a wide margin for consumers in Canada, the United States, and Mexico. Japanese consumers responding to the survey had a different perspective. They thought the likelihood of a food safety problem with food prepared at home (45 percent) and away from home (42 percent) were nearly equal. This indicates that North American consumers tend to have greater concern about food safety when the product is prepared away from home. This is not surprising because consumers rely upon other people, who, during food preparation, can actually introduce a food safety hazard, to prepare their food. The rising frequency of away-from-home food consumption means increasing food safety diligence at food service establishments is a critical element of ensuring beef food safety. This is especially challenging given the chances of cross contamination and human-introduced food contaminants in food service operations.

In addition to comparing food safety perceptions across meat species, we also inquired about respondent views about food safety of different beef products. Table 9 summarizes respondent views about particular beef product

food safety across consumers in the four countries. In addition, a weighted-average food safety index of respondents by beef product is provided in Figure 2. Some results are not unexpected, but others are somewhat surprising. For example, as expected, respondents generally consider *steak, roast*, and, to a lesser extent, *ground beef* and *deli beef* as safe foods. Not unexpectedly, respondents are less confident about the safety of *canned beef* and *organ meats*. Somewhat surprising, however, is that consumers are even more skeptical about the safety of microwavable beef products. In three of the four countries, most consumers (except in the United States where about half of respondents feel this way) indicated they feel such beef products are less than *somewhat safe*. These results indicate that consumers' opinions about food safety vary by beef product. From a supply chain management perspective, this means that mechanisms to ensure food safety will be of considerable importance to many potential customers, particularly when marketing certain beef products such as *canned* and *microwavable products*. Furthermore, consumers in Japan and Mexico are more skeptical about beef food safety in general, indicating that they need more reassurance about food safety attributes than do most Canadian and U.S. consumers.

The rising frequency of away-from-home food consumption means increasing food safety diligence at food service establishments is a critical element of ensuring beef food safety.

Table 9. Respondent Food Safety Concerns by Beef Product

Beef Product	Food Safety Perception	Respondent Country			
		Canada	United States	Japan	Mexico
Beef Steak					
	Very Safe	45.6%	45.8%	3.6%	16.3%
	Somewhat Safe	44.2%	42.0%	46.4%	50.5%
	Neither Safe nor Unsafe	7.1%	8.6%	36.9%	22.9%
	Somewhat Unsafe	1.8%	2.4%	10.6%	8.2%
	Not at all Safe	1.3%	1.2%	2.6%	2.2%
Beef Roast					
	Very Safe	47.1%	46.7%	3.8%	16.3%
	Somewhat Safe	43.7%	41.2%	47.0%	44.4%
	Neither Safe nor Unsafe	6.3%	8.5%	35.8%	25.0%
	Somewhat Unsafe	1.6%	2.4%	10.9%	11.3%
	Not at all Safe	1.3%	1.2%	2.6%	3.0%
Ground Beef / Minced Beef (e.g., hamburger)					
	Very Safe	30.1%	34.0%	3.2%	12.8%
	Somewhat Safe	47.3%	46.3%	41.0%	43.6%
	Neither Safe nor Unsafe	16.1%	12.4%	37.7%	26.6%
	Somewhat Unsafe	4.8%	5.3%	15.3%	14.7%
	Not at all Safe	1.7%	2.1%	2.9%	2.3%
Luncheon / Deli Cooked Beef					
	Very Safe	20.5%	30.1%	4.9%	12.6%
	Somewhat Safe	47.7%	44.7%	44.0%	39.8%
	Neither Safe nor Unsafe	22.7%	18.3%	34.5%	26.7%
	Somewhat Unsafe	7.1%	5.3%	12.8%	15.4%
	Not at all Safe	2.1%	1.6%	3.9%	5.5%
Canned Beef					
	Very Safe	19.8%	24.0%	4.7%	10.8%
	Somewhat Safe	38.6%	35.8%	35.5%	35.9%
	Neither Safe nor Unsafe	26.9%	29.9%	39.5%	26.4%
	Somewhat Unsafe	10.3%	7.3%	15.7%	20.0%
	Not at all Safe	4.5%	3.0%	4.7%	7.0%
Beef Organ Meats (e.g., liver, tripe)					
	Very Safe	12.9%	13.0%	1.0%	8.0%
	Somewhat Safe	33.1%	27.4%	15.6%	25.6%
	Neither Safe nor Unsafe	29.7%	34.4%	35.5%	26.4%
	Somewhat Unsafe	16.8%	15.5%	35.9%	25.6%
	Not at all Safe	7.5%	9.8%	12.1%	14.5%
Microwavable Packaged Beef					
	Very Safe	13.9%	18.9%	3.0%	8.4%
	Somewhat Safe	33.3%	33.8%	27.4%	29.2%
	Neither Safe nor Unsafe	33.6%	30.8%	43.9%	23.1%
	Somewhat Unsafe	12.2%	11.8%	20.9%	25.0%
	Not at all Safe	7.0%	4.7%	4.9%	14.4%

Table 10. Respondent Perceptions About Beef Food Safety by Country of Origin

Country of Origin	Food Safety Perception	Respondent Country			
		Canada	United States	Japan	Mexico
Unknown Country of Origin					
	Very Safe	1.7%	0.9%	0.4%	5.9%
	Somewhat Safe	12.3%	9.7%	2.1%	11.7%
	Neither Safe nor Unsafe	38.8%	35.5%	14.2%	16.2%
	Somewhat Unsafe	22.8%	25.4%	30.7%	26.2%
	Not at all Safe	24.5%	28.5%	52.7%	40.0%
Australia					
	Very Safe	18.8%	14.8%	10.4%	6.2%
	Somewhat Safe	38.9%	31.3%	59.2%	24.9%
	Neither Safe nor Unsafe	35.1%	40.2%	22.4%	32.7%
	Somewhat Unsafe	3.6%	8.4%	6.5%	22.5%
	Not at all Safe	3.6%	5.3%	1.5%	13.7%
Brazil					
	Very Safe	6.0%	5.6%	1.0%	3.9%
	Somewhat Safe	29.3%	23.0%	16.8%	22.4%
	Neither Safe nor Unsafe	44.5%	47.4%	58.0%	35.6%
	Somewhat Unsafe	13.7%	16.0%	19.8%	25.1%
	Not at all Safe	6.5%	8.0%	4.4%	13.1%
Canada					
	Very Safe	58.1%	17.6%	2.0%	9.2%
	Somewhat Safe	33.7%	34.7%	28.9%	33.3%
	Neither Safe nor Unsafe	6.5%	32.8%	46.8%	30.3%
	Somewhat Unsafe	0.9%	10.6%	18.1%	16.6%
	Not at all Safe	0.8%	4.3%	4.3%	10.6%
Japan					
	Very Safe	14.9%	11.8%	26.8%	6.1%
	Somewhat Safe	28.5%	24.5%	58.0%	24.1%
	Neither Safe nor Unsafe	41.7%	42.6%	11.9%	30.0%
	Somewhat Unsafe	8.9%	14.1%	2.7%	25.2%
	Not at all Safe	6.0%	7.0%	0.6%	14.6%
Mexico					
	Very Safe	2.9%	2.4%	0.8%	19.9%
	Somewhat Safe	18.2%	14.4%	12.1%	46.2%
	Neither Safe nor Unsafe	44.9%	38.1%	56.5%	22.8%
	Somewhat Unsafe	24.6%	29.5%	24.2%	9.1%
	Not at all Safe	9.5%	15.7%	6.4%	2.0%
United States					
	Very Safe	24.6%	38.3%	0.2%	12.4%
	Somewhat Safe	45.7%	43.7%	7.4%	33.3%
	Neither Safe nor Unsafe	21.2%	14.8%	24.4%	27.5%
	Somewhat Unsafe	5.5%	2.4%	34.1%	16.5%
	Not at all Safe	3.1%	0.9%	34.0%	10.3%

Concerns by Beef Product

To delve further into consumer perceptions about beef food safety, we explored how beef's country-of-origin is related to food safety perceptions. Table 10 summarizes survey respondent perceptions about beef from six selected origins and of unknown origin. Important to note in interpretation of these findings is that this question did not ask about product labeling per se, but simply about product origin (i.e., this question did not indicate who in the marketing chain did or did not know the origin of the beef). Interpretation of these results must be made with that caveat in mind. Still, it is evident in these results that country-of-origin affects consumer perceptions about beef food safety. Products of unknown origin have low levels of consumer confidence, especially among Japanese and Mexican respondents. Consumers in every country have the most confidence in the safety of beef from their own country with at least 80 percent of respondents in Canada, the United States, and Japan (and 66 percent in Mexico), indicating beef from their own country was safe. This reaffirms that what consumers are most familiar with is what they fear least, with respect to food safety. Also noteworthy is that, on average, the country with the highest perceived level of safe beef among these selected countries (Australia, Brazil, Canada, Japan, Mexico, the United States) is Canada. Fifty-four percent of respondents across all countries indicate Canadian origin beef is safe (*somewhat* or *very*). This is followed closely by U.S. origin beef with 51 percent indicating they believe it to be safe. On the other end of the spectrum, the two countries with the worst overall safety perception among respondents are Brazil (only 27 percent viewing the product as safe) and Mexico (just 29 percent indicating the product is safe).

When considering these results, it's important to recall that three of these countries (Canada, the United States, and Japan) are not considered BSE free while the other three (Australia, Brazil, and Mexico) are considered BSE free. Respondents rated beef from these three countries that are not

Table 11. Survey Respondent Trends in Beef Consumption Related to Food Safety Concerns

Beef Consumption Habit	Respondent Country			
	Canada	United States	Japan	Mexico
Have Lowered Beef Consumption Relative to Four Years Ago Because of Food Safety Concerns				
Yes	19.6%	20.6%	55.0%	31.2%
No	80.4%	79.4%	45.1%	68.8%
Approximate % of Beef Consumption Reduction (of those that responded “yes” to above question)				
Less than 20%	7.7%	10.1%	6.0%	11.6%
20% - 39%	24.0%	26.9%	25.1%	30.7%
40% - 59%	27.0%	22.6%	31.1%	28.7%
60% - 79%	16.8%	18.3%	14.7%	13.2%
80% or more	24.5%	22.1%	23.1%	15.8%

BSE free as being relatively safer than beef from the identified BSE-free countries. These results suggest that many consumers accurately perceive that BSE risk is very low and that other pathogens are far more likely to cause human health problems than BSE. This means supply chain management strategies need to focus on other areas of concern to consumers, not simply BSE.

Given concerns raised by at least some respondents about beef food safety and recent global beef food safety issues such as heavily publicized BSE events, we wanted to determine to what extent consumption habits might have changed because of food safety concerns. Table 11 summarizes respondent changes in beef consumption in response to changing food safety concerns. In Canada and the United States, about 20 percent of consumers indicated that they have reduced beef con-

sumption because of food safety concerns in the past 4 years. This is in sharp contrast to Japan and Mexico where 55 percent and 31 percent of respondents, respectively, indicated they have reduced beef consumption because of food safety concerns. Among consumers that reduced their beef consumption, the typical reduction was quite substantial, ranging from 20 percent to 60 percent. Importantly, roughly one-quarter of Canadian, U.S., and Japanese respondents virtually eliminated beef from their diet (80 percent or more reduction). This demonstrates that the beef industry has lost an important segment of its customer base because of food safety concerns. This is additional evidence that addressing food safety concerns within a supply chain management system are crucial to maintaining and expanding beef’s market share.

In Canada and the United States, about 20 percent of consumers indicated that they have reduced beef consumption because of food safety concerns in the past 4 years. This is in sharp contrast to Japan and Mexico where 55 percent and 31 percent of respondents, respectively, indicated they have reduced beef consumption because of food safety concerns.

Table 12. Respondent Perception of Various Food Safety Risks in Beef

Food Safety Risk Perception	Respondent Country			
	Canada	United States	Japan	Mexico
E-Coli (O157:H7 bacteria)				
Very High Risk	5.8%	5.9%	7.2%	35.7%
High Risk	11.3%	12.8%	13.0%	23.5%
Moderate Risk	29.9%	33.2%	23.5%	20.0%
Low Risk	27.4%	25.8%	26.2%	4.3%
Very Low Risk	17.0%	12.9%	13.3%	3.4%
Don't Know	8.7%	9.4%	16.8%	13.1%
BSE ("Mad Cow") related diseases				
Very High Risk	5.0%	4.0%	28.1%	38.8%
High Risk	5.0%	8.1%	24.9%	26.1%
Moderate Risk	17.6%	18.3%	18.6%	16.9%
Low Risk	25.3%	24.1%	12.4%	7.7%
Very Low Risk	41.0%	36.2%	8.2%	5.4%
Don't Know	6.2%	9.3%	7.9%	5.1%
Salmonella				
Very High Risk	2.5%	4.2%	5.4%	35.3%
High Risk	7.2%	7.8%	12.4%	24.5%
Moderate Risk	23.1%	25.2%	20.8%	19.1%
Low Risk	27.3%	29.0%	27.4%	7.1%
Very Low Risk	28.8%	21.5%	12.9%	4.2%
Don't Know	11.2%	12.3%	21.2%	9.9%
Listeria				
Very High Risk	1.2%	2.6%	3.7%	28.7%
High Risk	2.5%	5.6%	7.7%	22.2%
Moderate Risk	13.3%	16.6%	14.4%	19.1%
Low Risk	18.4%	22.4%	20.1%	7.7%
Very Low Risk	15.4%	16.0%	8.9%	4.3%
Don't Know	49.3%	36.9%	45.3%	18.0%
Campylobacter				
Very High Risk	1.1%	2.2%	3.7%	27.3%
High Risk	2.4%	4.6%	7.1%	20.4%
Moderate Risk	11.8%	13.2%	15.3%	17.8%
Low Risk	17.0%	19.7%	20.5%	7.2%
Very Low Risk	15.3%	13.5%	9.2%	4.4%
Don't Know	52.5%	46.9%	44.3%	22.9%
Staphylococcus aureus				
Very High Risk	1.7%	2.7%	5.4%	31.0%
High Risk	3.5%	5.6%	9.1%	19.8%
Moderate Risk	14.4%	16.3%	18.4%	18.2%
Low Risk	18.2%	21.1%	23.7%	6.3%
Very Low Risk	17.8%	15.6%	13.0%	4.4%
Don't Know	44.5%	38.9%	30.5%	20.1%

Consumer Food Safety Knowledge and Information Sources

Developing effective supply chain management strategies that deal with food safety requires understanding what consumers know about food safety and what sources of information they use to gain additional knowledge. Therefore, we asked a set of questions to inquire about the level of understanding of the presence, probable impacts of, and sources of information that consumers use as they assess beef food safety concerns. Table 12 summarizes responses to questions ascertaining the level of risk consumers perceive is associated with various food safety concerns (*E. coli* O157:H7, BSE, *Salmonella*, *Listeria*, *Campylobacter*) sometimes associated with beef products. Canadian and U.S. respondents generally believe beef products are quite safe, though they overall rank *E. coli* O157:H7 as the highest at a *moderate risk* to *low risk* level. Respondents in Canada and the United States rated BSE as *very low risk* (36 percent to 41 percent). Japanese respondents also generally perceived low risk levels, except for BSE which 28 percent of respondents rated *very high risk*. Overall, Mexican respondents have considerably more concerns about beef food safety than consumers in the other three countries. The high risk perceptions recorded by Mexican respondents for food safety risks that clearly have very low incidence rates (some infinitesimal) suggests Mexican consumers have a markedly higher concern about food safety than consumers in the three other countries. Finally, it should be noted that there is, not unexpectedly, a lack of knowledge among consumers about some beef food safety concerns. In particular, the largest group of respondents in Canada, the United States, and Japan indicated that they *don't know* the risk levels associated with *Listeria*, *Campylobacter*, and *Staphylococcus aureus*. In turn, this could be because the incidence level of these foodborne pathogens is so low and they receive much less media attention so that consumers are simply unfamiliar with them.

In addition to levels of concern about beef food safety, we inquired about the probable health impact if a particular food safety issue occurred. Table 13 summarizes respondent expectations about the probable impact of a food safety occurrence for selected problems.

Table 13. Expected Health Impact of Various Beef Food Safety Occurrences

Food Safety Occurrence	Respondent Country			
	Canada	United States	Japan	Mexico
E-Coli (O157:H7 bacteria)				
Serious Illness (requires hospital care)	40.9%	38.5%	30.0%	40.3%
Major Illness (requires physician care)	31.1%	29.1%	40.8%	26.4%
Moderate Illness (vomit, in bed, no physician care)	14.9%	20.7%	13.0%	13.3%
Minor Illness (stomach ache, no physician care)	4.2%	2.9%	5.2%	3.5%
No adverse impact on health	1.0%	0.2%	1.8%	1.4%
Don't Know	7.9%	8.6%	9.3%	15.1%
BSE ("Mad Cow") related diseases				
Serious Illness (requires hospital care)	61.8%	68.7%	61.6%	52.5%
Major Illness (requires physician care)	18.9%	17.3%	17.7%	24.8%
Moderate Illness (vomit, in bed, no physician care)	4.0%	2.5%	3.2%	9.4%
Minor Illness (stomach ache, no physician care)	1.5%	0.9%	0.9%	3.9%
No adverse impact on health	2.1%	0.7%	3.6%	1.7%
Don't Know	11.8%	9.9%	13.0%	7.8%
Salmonella				
Serious Illness (requires hospital care)	18.0%	16.5%	15.7%	37.6%
Major Illness (requires physician care)	35.3%	38.6%	44.3%	30.4%
Moderate Illness (vomit, in bed, no physician care)	29.8%	30.8%	20.1%	14.2%
Minor Illness (stomach ache, no physician care)	4.8%	4.8%	5.6%	5.1%
No adverse impact on health	0.9%	0.6%	1.5%	1.3%
Don't Know	11.2%	8.8%	12.9%	11.4%
Listeria				
Serious Illness (requires hospital care)	7.1%	10.0%	6.7%	29.4%
Major Illness (requires physician care)	16.5%	23.9%	24.6%	28.7%
Moderate Illness (vomit, in bed, no physician care)	10.3%	14.4%	15.4%	12.9%
Minor Illness (stomach ache, no physician care)	3.4%	2.9%	4.9%	6.8%
No adverse impact on health	1.0%	0.2%	1.6%	1.8%
Don't Know	61.8%	48.7%	46.9%	20.4%
Campylobacter				
Serious Illness (requires hospital care)	6.7%	8.6%	7.0%	27.9%
Major Illness (requires physician care)	14.7%	18.1%	25.9%	25.3%
Moderate Illness (vomit, in bed, no physician care)	10.5%	12.0%	15.9%	11.6%
Minor Illness (stomach ache, no physician care)	3.7%	2.6%	5.2%	6.0%
No adverse impact on health	1.0%	0.5%	1.7%	2.7%
Don't Know	63.5%	58.2%	44.4%	26.5%
Staphylococcus aureus				
Serious Illness (requires hospital care)	12.3%	14.1%	12.8%	30.8%
Major Illness (requires physician care)	20.4%	25.6%	35.7%	24.4%
Moderate Illness (vomit, in bed, no physician care)	10.1%	14.1%	19.8%	12.2%
Minor Illness (stomach ache, no physician care)	4.6%	2.9%	4.9%	5.9%
No adverse impact on health	1.1%	0.7%	2.2%	2.5%
Don't Know	51.6%	42.7%	24.7%	24.2%

Table 14. *Reliability of Various Food Preparers Regarding Beef Food Safety*

Food Preparer / Reliability	Respondent Country			
	Canada	United States	Japan	Mexico
Home Prepared By Individual Completing Survey				
Extremely Reliable	53.6%	56.1%	19.1%	68.6%
Very Reliable	36.4%	36.8%	35.0%	23.9%
Somewhat Reliable	8.3%	6.8%	37.0%	4.6%
Not Very Reliable	1.3%	0.2%	7.9%	1.6%
Not at all Reliable	0.4%	0.1%	1.1%	1.3%
Cooked by Grocer (e.g., deli)				
Extremely Reliable	4.5%	7.1%	2.5%	8.5%
Very Reliable	35.1%	33.0%	15.9%	22.8%
Somewhat Reliable	51.8%	52.0%	55.4%	30.6%
Not Very Reliable	7.3%	7.1%	23.3%	27.3%
Not at all Reliable	1.3%	0.7%	2.9%	10.9%
Expensive Dine-In Restaurant				
Extremely Reliable	12.1%	15.7%	11.3%	9.2%
Very Reliable	46.0%	45.7%	38.6%	30.5%
Somewhat Reliable	37.7%	35.1%	40.7%	43.6%
Not Very Reliable	3.3%	3.3%	8.2%	13.5%
Not at all Reliable	0.9%	0.3%	1.3%	3.2%
Medium-Cost Dine-In Café				
Extremely Reliable	4.7%	7.8%	1.1%	5.5%
Very Reliable	26.3%	33.3%	14.9%	23.2%
Somewhat Reliable	56.1%	52.3%	54.6%	47.0%
Not Very Reliable	11.5%	5.6%	25.2%	21.3%
Not at all Reliable	1.5%	1.0%	4.3%	3.0%
Low-Cost Dine-In Café				
Extremely Reliable	3.2%	5.6%	1.2%	5.5%
Very Reliable	13.3%	17.6%	6.7%	14.2%
Somewhat Reliable	48.7%	52.3%	39.8%	30.5%
Not Very Reliable	28.5%	19.9%	39.7%	30.2%
Not at all Reliable	6.3%	4.6%	12.7%	19.5%

High-end, expensive dine-in restaurants obtain high levels of food safety confidence in Canada and the United States with about 60 percent of respondents rating them at least very reliable for beef food safety. This declined to about 40 percent very reliable for medium-cost restaurants, and declined further to about 20 percent for low-cost food service establishments.

Most respondents, generally 70 percent or more in each country, felt *E. coli* 0157:H7 and BSE would cause *Major* or *Serious* illness whereas a somewhat smaller, but still quite large, group (50 percent or more) felt the same way about *Salmonella*. Consistent with perceptions about risk levels of these food safety issues, respondents in Canada, the United States, and Japan generally did not know the likely impact of illness associated with *Listeria*, *Campylobacter*, or *Staphylococcus aureus*. Once again, Mexican consumers revealed that they have a higher level of concern about food safety issues in general, indicating they believe the likelihood of serious illness requiring hospital care for all of the specified food safety issues is substantially higher than did consumers in the other three countries.

Addressing food safety from a supply chain management perspective requires gaining a sense of how consumers' food-safety perspective changes, depending on where the product is prepared. We asked respondents to indicate the level of confidence they have in food prepared at different preparation points. Table 14 summarizes responses to consumers' food safety concerns, sorted by food preparer. Respondents (with the exception of Japan) had high levels of confidence in food safety when they prepared the meal themselves with roughly 90 percent indicating *very* or *extremely* reliable food safety assurance when they prepared the food themselves relative to other preparers. Japanese respondents displayed markedly less confidence in food safety reliability for food prepared at home than respondents from the other three coun-

tries. The difference in perceptions between Japanese respondents and consumers from Canada and the United States could be related to Japanese consumers concern about BSE risk, which is unaffected by food preparation. Restaurant price class affected consumers' food safety perceptions. High-end, expensive dine-in restaurants obtain high levels of food safety confidence in Canada and the United States with about 60 percent of respondents rating them at least *very reliable* for beef food safety. This declined to about 40 percent *very reliable* for medium-cost restaurants (with similar sentiments for meat from delis), and declined further to about 20 percent for low-cost food service establishments. Japanese and Mexican respondents felt food service establishments of all types had lower food safety reliability than did Canadian and U.S. respondents.

Where the responsibility lies with assuring food safety is also an important dimension of supply chain management strategies. Many argue that all segments of the supply chain have some ability to influence food safety. Generally respondents agree with this sentiment as more than 70 percent of respondents tend to believe all participants in the supply chain from grower through food preparer are *somewhat* or *completely* able to influence beef food safety assurances (Table 15). Respondents tend to rate producers, processors, and government regulators as having the greatest impact on food safety with grocers, restaurants, and food preparers having somewhat less influence. This demonstrates that respondents place a lot of responsibility upon several segments of the supply chain as well as government inspectors to assure food safety.

Table 15. *Ability of Various Parties to Influence and Assure Beef Food Safety*

Supply Chain Participant / Ability	Respondent Country			
	Canada	United States	Japan	Mexico
Farm Producer/Grower				
Completely Able	42.8%	40.1%	38.8%	65.7%
Somewhat Able	36.5%	39.0%	30.2%	25.2%
Might or Might Not Be Able	16.7%	16.1%	21.0%	5.9%
Somewhat Unable	2.8%	3.4%	6.2%	1.9%
Not at all Able	1.2%	1.4%	3.9%	1.3%
Beef Processor				
Completely Able	50.8%	52.3%	34.2%	50.9%
Somewhat Able	35.5%	34.2%	33.7%	39.0%
Might or Might Not Be Able	11.4%	11.6%	18.6%	6.5%
Somewhat Unable	1.3%	0.5%	9.1%	2.7%
Not at all Able	1.0%	1.4%	4.5%	1.0%
Retail Grocer				
Completely Able	28.8%	27.6%	12.1%	34.4%
Somewhat Able	45.2%	45.4%	34.7%	44.2%
Might or Might Not Be Able	19.0%	21.9%	32.4%	15.0%
Somewhat Unable	5.3%	3.7%	14.2%	5.0%
Not at all Able	1.7%	1.5%	6.7%	1.3%
Food Service Restaurant				
Completely Able	31.4%	32.5%	11.6%	38.1%
Somewhat Able	39.7%	40.3%	31.9%	42.8%
Might or Might Not Be Able	21.4%	21.2%	31.1%	12.3%
Somewhat Unable	5.4%	4.5%	16.3%	5.6%
Not at all Able	2.1%	1.5%	9.2%	1.2%
Consumer - Home Food Preparer				
Completely Able	29.2%	28.0%	3.6%	39.4%
Somewhat Able	42.0%	43.0%	20.8%	35.1%
Might or Might Not Be Able	21.5%	23.0%	34.0%	12.8%
Somewhat Unable	5.3%	4.5%	23.3%	7.6%
Not at all Able	2.0%	1.5%	18.4%	5.2%
Government Inspectors/Regulators				
Completely Able	55.0%	50.0%	38.3%	47.7%
Somewhat Able	31.0%	32.1%	28.5%	29.8%
Might or Might Not Be Able	10.1%	13.8%	18.8%	10.6%
Somewhat Unable	2.4%	2.7%	7.5%	5.7%
Not at all Able	1.5%	1.4%	7.0%	6.1%

Table 16. Amount of Reliance on Product Attributes in Assessing Food Safety

Product Attribute / Reliance Level	Respondent Country			
	Canada	United States	Japan	Mexico
Price Level				
Extremely Reliant	13.9%	15.5%	13.9%	20.1%
Very Reliant	34.9%	29.3%	36.8%	36.9%
Somewhat Reliant	33.9%	36.8%	37.6%	30.8%
Not Very Reliant	12.1%	10.8%	9.2%	9.6%
Not at all Reliant	5.2%	7.6%	2.6%	2.7%
Brand Name				
Extremely Reliant	14.7%	12.9%	10.4%	19.8%
Very Reliant	32.9%	29.9%	31.7%	41.4%
Somewhat Reliant	39.5%	41.1%	39.8%	28.3%
Not Very Reliant	8.1%	9.5%	14.4%	7.9%
Not at all Reliant	4.8%	6.7%	3.7%	2.7%
Purchased from Reputable Store				
Extremely Reliant	33.4%	37.8%	14.0%	23.6%
Very Reliant	46.7%	42.7%	37.6%	40.1%
Somewhat Reliant	16.1%	17.4%	37.0%	28.0%
Not Very Reliant	3.2%	1.2%	9.2%	6.9%
Not at all Reliant	0.9%	0.9%	2.3%	1.4%
Country of Origin				
Extremely Reliant	22.6%	18.6%	35.8%	19.7%
Very Reliant	28.8%	24.1%	35.9%	38.0%
Somewhat Reliant	32.8%	32.9%	23.1%	30.3%
Not Very Reliant	10.9%	14.8%	4.5%	9.1%
Not at all Reliant	5.0%	9.6%	0.8%	3.0%
Package / Product Date (e.g., “Sell by Date” in U.S.; “Packaged on Date” in Canada and Mexico; “Best Before” Date in Japan)				
Extremely Reliant	52.1%	48.9%	34.2%	40.9%
Very Reliant	32.6%	34.2%	38.9%	37.0%
Somewhat Reliant	14.0%	14.4%	21.4%	15.8%
Not Very Reliant	0.8%	1.5%	4.0%	5.5%
Not at all Reliant	0.5%	0.9%	1.5%	0.8%
Government Inspected				
Extremely Reliant	40.9%	34.8%	18.5%	27.4%
Very Reliant	36.4%	34.0%	34.7%	37.4%
Somewhat Reliant	18.1%	25.3%	32.8%	23.9%
Not Very Reliant	2.9%	4.4%	11.0%	8.3%
Not at all Reliant	1.7%	1.5%	3.0%	3.1%

Table 16 continued on page 25

Part of the effort of managing beef food safety is developing an understanding of the signals consumers rely upon for food safety assurances. Table 16 summarizes how much reliance in assessing food safety consumers place on a variety of food-product attributes. One of the noticeable things about these

results is that few product attributes stand out as being relied upon to the same extent by large numbers of respondents. *Reputation* of the store where the product was purchased; *product freshness date*; *product color*, *smell*, and *texture*; and *government inspection* are the most relied upon food safety indicators. *Brand name*,

Table 16 continued from page 24

Product Attribute / Reliance Level	Respondent Country			
	Canada	United States	Japan	Mexico
Labeled Organic				
Extremely Reliant	9.2%	7.2%	7.3%	18.4%
Very Reliant	20.9%	15.8%	24.7%	33.7%
Somewhat Reliant	36.2%	35.0%	43.3%	31.5%
Not Very Reliant	19.4%	22.9%	19.9%	13.0%
Not at all Reliant	14.3%	19.2%	4.8%	3.5%
Labeled Natural				
Extremely Reliant	9.7%	7.8%	6.4%	22.3%
Very Reliant	24.2%	19.2%	23.3%	35.4%
Somewhat Reliant	38.1%	38.5%	43.5%	30.2%
Not Very Reliant	16.5%	18.9%	20.9%	10.0%
Not at all Reliant	11.5%	15.5%	5.8%	2.1%
Product Color				
Extremely Reliant	38.0%	43.1%	25.6%	35.3%
Very Reliant	38.4%	38.1%	40.3%	40.6%
Somewhat Reliant	20.5%	16.4%	27.9%	18.7%
Not Very Reliant	2.4%	1.6%	4.5%	4.3%
Not at all Reliant	0.7%	0.8%	1.7%	1.2%
Product Smell				
Extremely Reliant	49.6%	53.9%	28.6%	41.5%
Very Reliant	31.2%	27.8%	31.7%	36.7%
Somewhat Reliant	14.9%	14.3%	25.6%	16.4%
Not Very Reliant	2.9%	2.4%	11.2%	4.0%
Not at all Reliant	1.4%	1.5%	2.9%	1.4%
Product Texture				
Extremely Reliant	24.5%	19.7%	16.1%	31.3%
Very Reliant	41.7%	38.6%	41.8%	44.2%
Somewhat Reliant	27.7%	32.6%	32.6%	19.2%
Not Very Reliant	4.6%	6.8%	7.6%	4.0%
Not at all Reliant	1.6%	2.2%	1.9%	1.3%
Labeled Traceable to Farm				
Extremely Reliant	13.3%	11.4%	14.0%	20.1%
Very Reliant	23.7%	20.2%	34.3%	39.3%
Somewhat Reliant	32.9%	34.2%	36.9%	28.3%
Not Very Reliant	19.2%	19.2%	11.9%	8.9%
Not at all Reliant	11.0%	14.9%	3.0%	3.5%

organic and *natural labels*, *price*, and *traceable product* tend to be relied upon less for food safety information by respondents. But enough variability was present across respondents that an argument could be made that a significant number of consumers rely on nearly every product attribute presented to them, although

the extent to which they rely upon them varies across respondents.

Consumers potentially obtain information about food safety from a variety of sources. To effectively inform consumers about beef food safety, we need to understand the level of trust they place in different sources of food safety information. Table 17 reports the level of

Table 17. Respondent Trustworthiness in Various Sources of Food Safety Information

Information Source / Trustworthiness	Respondent Country			
	Canada	United States	Japan	Mexico
Family Physician				
Extremely Trustworthy	26.3%	23.2%	4.5%	28.6%
Very Trustworthy	46.2%	51.8%	30.1%	49.2%
Somewhat Trustworthy	23.5%	21.7%	55.6%	17.5%
Not Very Trustworthy	3.5%	2.6%	9.2%	3.5%
Not at all Trustworthy	0.6%	0.7%	0.6%	1.1%
Dietician				
Extremely Trustworthy	22.8%	17.9%	6.6%	28.9%
Very Trustworthy	48.4%	50.9%	38.3%	46.9%
Somewhat Trustworthy	26.2%	27.3%	48.8%	19.5%
Not Very Trustworthy	2.1%	2.7%	5.7%	3.7%
Not at all Trustworthy	0.6%	1.2%	0.7%	0.9%
Government Food Agencies				
Extremely Trustworthy	13.6%	7.1%	4.4%	22.9%
Very Trustworthy	39.6%	40.0%	19.5%	33.2%
Somewhat Trustworthy	36.8%	40.2%	45.8%	32.1%
Not Very Trustworthy	8.0%	9.3%	24.0%	9.3%
Not at all Trustworthy	2.0%	3.3%	6.4%	2.5%
University Scientists / Educators				
Extremely Trustworthy	12.6%	12.1%	6.8%	30.2%
Very Trustworthy	43.3%	45.0%	29.3%	42.1%
Somewhat Trustworthy	37.8%	36.2%	51.2%	21.8%
Not Very Trustworthy	4.9%	4.9%	11.3%	5.3%
Not at all Trustworthy	1.4%	1.9%	1.5%	0.6%
Private Researchers / Consultants				
Extremely Trustworthy	4.3%	4.5%	2.6%	18.2%
Very Trustworthy	31.2%	29.4%	18.3%	39.0%
Somewhat Trustworthy	51.4%	53.3%	55.5%	25.3%
Not Very Trustworthy	11.0%	10.0%	21.6%	13.2%
Not at all Trustworthy	2.1%	2.8%	2.0%	4.3%
Retail Grocer or Butcher				
Extremely Trustworthy	4.4%	3.6%	2.0%	9.9%
Very Trustworthy	27.5%	29.7%	8.5%	29.0%
Somewhat Trustworthy	54.5%	55.2%	46.6%	34.6%
Not Very Trustworthy	12.7%	9.4%	39.6%	21.9%
Not at all Trustworthy	1.0%	2.1%	3.4%	4.6%
Food Industry Sources				
Extremely Trustworthy	3.1%	3.3%	2.4%	20.6%
Very Trustworthy	24.1%	25.4%	14.4%	38.9%
Somewhat Trustworthy	52.0%	51.0%	48.5%	29.4%
Not Very Trustworthy	18.8%	15.4%	31.1%	9.9%
Not at all Trustworthy	2.1%	5.0%	3.7%	1.2%
Consumer Groups				
Extremely Trustworthy	6.0%	6.2%	10.6%	11.8%
Very Trustworthy	36.5%	37.1%	35.3%	33.4%
Somewhat Trustworthy	48.5%	46.8%	45.3%	36.1%
Not Very Trustworthy	7.7%	7.4%	7.9%	16.0%
Not at all Trustworthy	1.3%	2.5%	1.0%	2.7%

trust respondents place in various food safety information sources. The highest levels of trust are associated with *family physicians, dieticians, and university researchers/educators*, although Japanese respondents tend not to place high levels of trust in any of the sources presented. More than 60 percent of Canadian, U.S., and Mexican consumers rate *family physicians* and *dieticians* as *very* or *extremely trustworthy*. Government food agencies, private researchers, retail grocers, food industry sources, and consumer groups tend to be perceived as *somewhat trustworthy* sources of food safety information.

Risk Perceptions and Attitudes

A primary goal of this project was to evaluate and compare risk perceptions and attitudes of consumers in Canada, the United States, Japan, and Mexico. The approach builds on previous work by Pennings, Wansink, and Meulenberg and investigates how consumers vary in the way they perceive food safety risk and how they react to food safety risks that might exist (i.e., what are their attitudes toward food safety risk).

Risk perceptions represent a person's views about risk inherent in, or *riskiness* of, a particular situation. Perceptions about food safety risk are what the individual believes would be the amount of health risk, if any, they would face from consuming a food product. In this part of the study, we examine survey respondent risk perceptions about consuming beef.

Risk attitudes describe a person's overriding tendency toward risk in a consistent way across different risky situations. Risk attitudes refer to how willing a person is to accept risk. Risk-averse people place a high premium on assured safe, relative to risky, ventures. Risk-neutral people are indifferent among choices with different levels of risk, and risk-seeking individuals (e.g., gamblers) pursue risky situations. We are particularly interested in consumer risk attitudes regarding beef food safety.

In order to formulate an effective supply chain management strategy and public policy dealing with beef food safety, the beef industry needs to understand consumer reactions in times of crisis. Two dimensions play a crucial part in consumer reactions to crises like food contamination: 1) the risk content and 2) the likelihood of exposure to that risk content.

The first dimension refers to the content of the crisis, the impact of an event. The second dimension reflects the likelihood that the content of the risk actually becomes manifest. The likelihood of the risk content occurring can be either known or unknown, with the latter case often referred to as “uncertainty” (Knight, Hirshleifer and Riley). These two dimensions, risk content and the likelihood of exposure, are directly related to the two fundamental drivers of decision behavior under uncertainty: risk attitude and risk perception.

Risk attitude and risk perception are two different concepts (Pennings, Wansink and Meulenberg). Risk attitudes range from extremely risk averse (i.e., refusing any risk under any condition) to extremely risk seeking (i.e., always preferring a risk-carrying outcome), while risk perceptions range from high to none at all. It is the interaction between both concepts that drives decision behavior, as it reflects consumers’ predispositions to deal with the risks inherent in the risk content and the risks that their reactions to this risk content generate (Arrow, Pratt, Pennings and Wansink).

For example, certain consumers might be highly risk averse toward food contamination. Yet, whether or not they will actually take precautions depends on their risk perception: if these consumers estimate the likelihood of food contamination at zero, they will not take any precautions. Only when the consumers are both risk-averse and perceive risk at the same time, will they adopt preventive behavior (toward food contamination). Thus, the entire behavioral outcome space, which contains all possible consumer behaviors, is driven by consumer risk attitudes, risk perceptions and the interaction between them. This conceptualization has often been used successfully in economic literature to describe and explain behavior (Holthausen). In that context, however, the risk content is often well understood (e.g., price fluctuations), while the likelihood of exposure to that risk content can often be formulated as concrete probabilities: commodity prices, for example, follow a random walk, as prices can go up or down with equal probability (Cargill and Rausser). However, in the case of the food risks the risk is not exactly known or estimable in the types of crises that

policy makers increasingly face. Consumers, in other words, are unable to form a risk attitude, since they do not know the exact content of the risk, while they cannot form a risk perception either, as they are incapable of judging the likelihood (i.e., probability) of exposure to the risk content.

Since risk attitudes and risk perceptions span the entire behavioral outcome space, this space will increase in such a situation, theoretically even to infinity. This increases the chances of what might be called extreme, unpredictable, and undesirable behavior within the behavioral outcome space. Extreme, unpredictable, and undesirable behavior may become manifest as individual behavior, such as reluctance to buy the product, or as collective behavior, banning beef consumption all together. It is of eminent importance to the Canadian beef industry to keep the behavioral outcome space as small as possible, as this minimizes the chances of extreme, unpredictable, and undesirable behavior. The beef industry may be able to minimize the behavioral outcome space by clarifying the risk content and by concretely defining the likelihood of exposure as much as possible (i.e. probabilities or degrees of risk: high, medium, or low) (Anand). Doing so will stimulate the formation of uniform risk attitudes and risk perceptions among consumers, leading to a smaller behavioral outcome space and a reduced chance of extreme, unpredictable, and undesirable behavior.

Understanding how risk perceptions and risk attitudes about food safety influence consumer purchase decisions is critical if the industry is going to produce and market beef products to heterogeneous consumers from diverse backgrounds. In particular, we are interested in whether risk perceptions or risk attitudes dominate consumer purchase decisions for beef products. Consumers whose consumption behavior is driven primarily by risk perception are more likely to be influenced by educational efforts that communicate “true probabilities” of adverse events. Consumers in this category form their perceptions and make decisions based on relative probabilities associated with various outcomes. Conversely, consumer behavior motivated primarily by risk attitudes is less likely to be influenced by educational endeavors that might reveal low

Understanding how risk perceptions and risk attitudes about food safety influence consumer purchase decisions is critical if the industry is going to produce and market beef products to heterogeneous consumers from diverse backgrounds.

Table 18. Risk Perception Assessment

Risk Perception Statement	Respondent Country			
	Canada	United States	Japan	Mexico
I consider eating beef ...				
1 = Not at all Risky	22.6%	18.2%	1.8%	4.6%
2 =	23.5%	22.5%	5.7%	7.7%
3 =	18.7%	17.6%	15.6%	11.4%
4 =	9.1%	8.1%	10.4%	7.5%
5 =	7.3%	11.9%	18.9%	17.6%
6 =	5.8%	6.6%	15.8%	15.3%
7 =	6.3%	5.4%	16.2%	16.3%
8 =	2.9%	5.9%	9.6%	13.2%
9 =	1.8%	2.2%	3.1%	3.5%
10 = Highly Risky	2.2%	1.6%	3.0%	2.9%
When eating beef I am exposed to ...				
1 = No Risk at all	18.6%	15.1%	2.1%	5.6%
2 =	27.6%	23.9%	7.8%	9.3%
3 =	18.8%	20.1%	15.2%	11.8%
4 =	10.3%	9.2%	10.1%	8.7%
5 =	9.6%	11.8%	19.6%	22.2%
6 =	5.0%	7.4%	15.3%	17.0%
7 =	4.6%	5.0%	15.1%	11.7%
8 =	2.4%	4.4%	9.0%	8.9%
9 =	1.4%	1.3%	2.7%	2.3%
10 = Very High Risk	1.8%	1.9%	3.2%	2.6%
Eating beef is risky				
1 = Strongly Disagree	23.1%	18.5%	6.4%	7.7%
2 =	24.7%	22.1%	7.5%	6.2%
3 =	16.7%	16.9%	17.4%	6.7%
4 =	10.1%	8.3%	10.3%	6.1%
5 =	8.7%	11.1%	18.8%	10.0%
6 =	4.7%	8.3%	16.0%	9.4%
7 =	5.0%	5.7%	12.0%	11.3%
8 =	2.8%	4.9%	6.0%	12.5%
9 =	1.8%	1.4%	3.0%	13.3%
10 = Strongly Agree	2.6%	2.9%	2.7%	16.9%

probability of risk associated with an event. Rather, individuals exhibiting a very risk averse attitude might require the risk be eliminated before consuming a product or only consume the product if it is severely discounted.

Given fundamental differences in risk perceptions and risk attitudes and how this corresponds to effective food supply chain management; we sought to ascertain and then measure underlying drivers of risk perceptions and attitudes of consumers in Canada, the United States, Japan, and Mexico. This was accomplished by asking consumers a series of questions to build a set of risk attitude and risk perception indexes.

Summary statistics of the individual questions asked to ascertain risk perceptions are provided in Table 18. At least some consumers in each of the four countries surveyed perceive eating beef to be risky and at least some consumers in each country consider eating beef to not be risky at all. However, there are stark differences in beef food safety risk perceptions by country. For example, on a scale of 1 (strongly disagree) to 10 (strongly agree) that eating beef is risky, 75 percent of Canadian consumers responded with a score of 4 or lower indicating they disagree rather strongly that eating beef is risky. In contrast, only 42 percent of Japanese and 27 percent of Mexican respondents provided a ranking of 4 or lower for this question. Consumers in Canada and the United States tend to have much stronger positive perceptions about beef food safety than Japanese and Mexican consumers do.

Respondent responses to individual questions used to construct risk attitude questions are provided in Table 19. Canadian and U.S. consumers indicate that they feel like eating beef is worth the food safety risk (only about 25 to 30 percent indicating they disagreed that eating beef was worth the risk), whereas, a larger percentage of Japanese consumers have stronger held risk attitudes that eating beef is not worth the risk (e.g., 63 percent disagreed that eating beef was worth the risk). Although Mexican respondents indicated beef was risky to eat, Mexican respondents tended to have risk attitudes about beef food safety similar to that of Canadian and U.S. consumers. Results in Table 19 show that Japanese consumers have high levels of concern about BSE in their beef

despite compulsory BSE testing of bovine destined for consumption.

To condense the set of risk perception and attitude questions into single indexes of each, we calculated an average response to each of the series of questions. Table 20 presents summary statistics of corresponding risk attitude and risk perception indexes built from these individual questions. Larger risk attitude (RA) and risk perception (RP) indexes (Table 20) reflect higher levels of overall risk aversion and perception, respectively. Table 20 suggests that Japanese consumers have notably stronger risk aversion attitudes (higher RA index average) toward beef food safety than Canadian, American, or Mexican consumers. Japanese consumers have an average risk aversion score on a 1 to 10 scale of 6.4 compared to a range of 4.7 to 4.9 for Canadian, U.S., and Mexican respondents. Food safety risk perceptions also differ across countries. Japanese and Mexican consumers perceive beef to have higher food safety risk (Risk Perception index of 5.2 and 5.6, respectively) than Canadian and U.S. consumers (Risk Perception index of 3.3 and 3.7, respectively).

Even more information can be gleaned from observing distributions of risk perception and attitude. Figures 3 and 4, respectively, display the distribution of risk attitude and risk perception index values for respondents by country. In Figure 3, the peak of the risk aversion index distribution for Japanese consumers lies higher and to the right of corresponding points of the other three country groups. This further demonstrates that risk attitudes are stronger among Japanese consumers than Canadian, U.S., and Mexican consumers. Likewise, in Figure 4 substantially more Japanese and Mexican consumers perceive beef as risky from a food safety perspective than do consumers in Canada and the United States.

To further appreciate the importance of understanding differences across countries, we evaluated how risk attitude and perceptions are related to changes in beef consumption in recent years. Given all of the press about food safety and BSE in beef in particular, it is probable that highly risk-averse people would reduce beef consumption. Likewise, those who perceive beef consumption to be a food safety threat would also reduce beef consumption.

Table 19. Risk Attitude Assessment

Risk Attitude Statement	Respondent Country			
	Canada	United States	Japan	Mexico
My willingness to accept food safety risk when eating beef, I am ...				
1 = Very Willing	16.2%	13.3%	1.8%	3.7%
2 =	13.6%	14.2%	2.5%	5.7%
3 =	15.7%	17.0%	9.8%	8.0%
4 =	10.5%	11.0%	13.3%	14.5%
5 =	10.0%	10.9%	22.4%	20.6%
6 =	11.9%	13.2%	19.9%	15.3%
7 =	4.7%	4.9%	10.0%	8.0%
8 =	5.0%	5.6%	9.7%	10.0%
9 =	4.5%	4.3%	5.2%	5.4%
10 = Not at all Willing	8.1%	5.9%	5.5%	8.8%
I rarely think about food safety when eating beef				
1 = Strongly Agree	14.5%	14.1%	1.7%	9.8%
2 =	14.3%	14.8%	3.3%	21.9%
3 =	12.4%	12.3%	5.2%	16.6%
4 =	6.3%	5.8%	6.9%	11.1%
5 =	8.5%	9.0%	10.6%	11.3%
6 =	10.9%	10.9%	16.8%	10.3%
7 =	6.4%	8.2%	15.7%	4.6%
8 =	7.1%	8.1%	14.9%	4.9%
9 =	6.9%	7.1%	9.1%	3.2%
10 =Strongly Disagree	12.9%	9.7%	15.9%	6.3%
For me, eating beef is worth the risk				
1 = Strongly Agree	11.5%	11.9%	1.0%	6.3%
2 =	11.0%	10.8%	1.1%	14.4%
3 =	10.1%	11.8%	3.4%	18.4%
4 =	9.0%	8.4%	4.5%	11.3%
5 =	12.8%	14.9%	11.8%	11.8%
6 =	13.5%	16.9%	15.8%	9.9%
7 =	6.3%	5.1%	13.0%	4.2%
8 =	6.0%	5.7%	13.3%	5.0%
9 =	6.9%	4.9%	10.3%	4.2%
10 =Strongly Disagree	13.1%	9.8%	25.9%	14.4%
I believe that current levels of government testing ensure that beef cattle that might be infected with BSE (“Mad Cow”) are identified and kept out of the food chain				
1 = Strongly Agree	19.5%	12.1%	5.0%	9.3%
2 =	19.9%	18.4%	6.1%	15.5%
3 =	18.5%	17.1%	9.7%	16.3%
4 =	10.2%	10.5%	10.2%	13.3%
5 =	8.6%	11.0%	11.6%	15.3%
6 =	8.5%	12.0%	13.8%	10.2%
7 =	2.9%	4.6%	11.0%	4.1%
8 =	4.2%	4.7%	12.0%	4.7%
9 =	2.7%	4.4%	7.7%	4.0%
10 =Strongly Disagree	5.2%	5.4%	13.0%	7.3%

Table 20. Risk Attitude and Risk Perception Index Distributions

Risk Measure	Respondent Country			
	Canada	United States	Japan	Mexico
Risk Attitude				
1 = Under 2.5 (Low Risk Aversion)	18.5%	17.5%	0.7%	8.1%
2 = 2.51 - 5.0	40.8%	41.2%	17.8%	53.3%
3 = 5.01 - 7.5	32.4%	32.9%	60.3%	28.7%
4 = Over 7.50 (High Risk Aversion)	8.3%	8.3%	21.2%	10.0%
Average Risk Attitude Index Value	4.7	4.7	6.4	4.9
Risk Perception				
1 = Under 2.5 (Perceive Beef as Safe)	45.3%	38.9%	9.0%	10.5%
2 = 2.51 - 5.0	37.1%	37.9%	42.1%	27.9%
3 = 5.01 - 7.5	13.1%	16.6%	36.7%	43.2%
4 = Over 7.50 (Perceive Beef as Unsafe)	4.5%	6.7%	12.3%	18.4%
Average Risk Perception Index Value	3.3	3.7	5.2	5.6

Figure 3. Risk Attitude Frequency Distribution

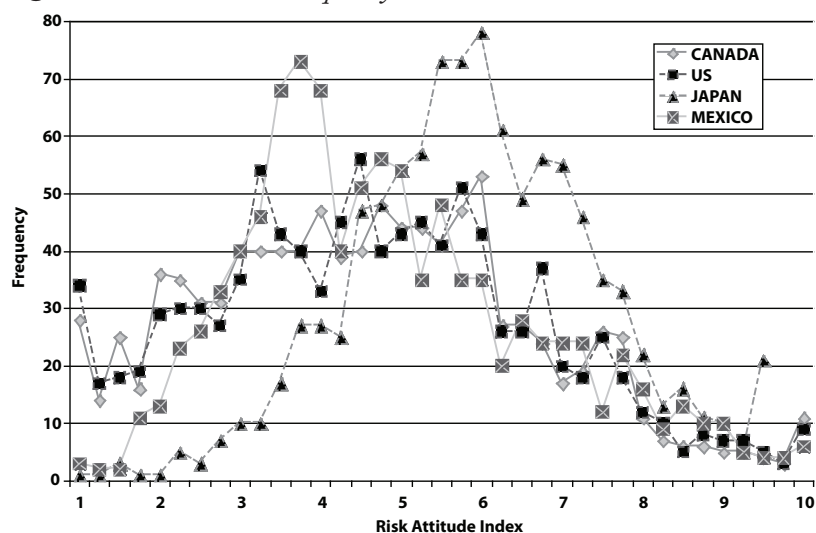
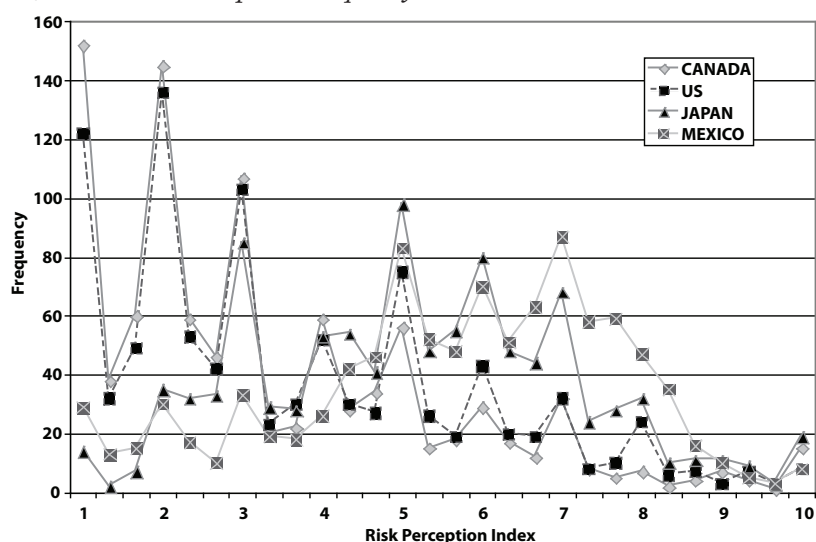


Figure 4. Risk Perception Frequency Distribution



Respondents were asked if they had lowered their consumption of beef over the last 4 years (survey question 4). We used a logit model to examine the impact risk attitudes and risk perceptions had on the decision to reduce beef consumption. The model has a binary dependent variable equal to 1 if the consumer lowered their consumption of beef over the last 4 years and 0 if they did not. Recall from Table 10, that about 20 percent of each Canadian and U.S.; 30 percent of Mexican; and 55 percent of Japanese respondents indicated they

had reduced beef consumption over the past 4 years because of food safety concerns.

The model was estimated with risk attitude index, risk perception index, and their interaction term as explanatory variables. Results of these models (Table 21) indicate that both risk perceptions and risk attitudes significantly influence consumers' beef consumption behavior in each of the four countries.² As risk aversion and/or risk perception increases (higher RA or RP index values), the likelihood a respondent reduced beef consumption in recent years increases. That is, respondents who indicated that they reduced beef consumption, tended to be more risk averse and/or they perceived beef as a more risky product to consume.

Direct interpretation of estimated coefficients in logit models is not informative. Rather, it is more common and enlightening to consider marginal effects implied by the model. The estimated marginal effects (Table 21) reveal interesting differences in the effect of risk attitudes and perceptions on the different consumer groups. One particularly interesting finding is that for Canadian, U.S., and Japanese consumers, changes in risk attitudes have nearly twice the effect as equal changes in risk perceptions on the likelihood of reducing

² The model estimates the probability that a consumer reduced beef consumption. Thus, positive signs on risk aversion and risk attitude parameter estimates indicate that as these measures increase, the probability of reducing beef consumption increases.

beef consumption. For example, the marginal effects suggest that a one unit increase in risk attitude index values for Canadian consumers corresponds with a 7.8 percent increase in the probability of reducing beef consumption, compared with a corresponding 4.5 percent probability change from a one unit adjustment in risk perception index value. In contrast to respondents in the other three countries, the marginal effects of risk attitudes and perceptions are about equal for Mexican consumers. Overall, results of this analysis indicate that variation in risk attitudes among Canadian, U.S., and Japanese consumers had notably more influence on the likelihood they reduced beef consumption in recent years than did risk perceptions. Conversely, risk perceptions and attitudes had similar impacts with respect to reducing beef consumption among Mexican consumers.

The bottom line of these results is that educating consumers about beef food safety to alter their perceptions, especially about food safety events with very low probabilities, will have a positive impact on consumer demand. However, attitudes about beef food safety tend to be more deeply held and have an even larger impact on consumer demand. For consumers with strong risk aversion, education is not going to be as effective at increasing demand as is eliminating, to the extent possible, the inherent food-product safety risk.

Given the importance of risk attitudes and perceptions, we wanted to gain an understanding of what factors might be related to these attributes. Risk attitudes and perceptions of individual consumers are typically unobservable; hence, we wanted to determine whether demographic factors (beyond just country of residence) were related to respondent attitudes and perceptions.

We evaluated the relationship among demographic factors including gender, age, education, and income and each of the risk attitude and perception indexes. We used Tobit models to examine the impact of these factors on risk attitudes and risk perceptions. The Tobit models have dependent variables ranging from 1 to 10 reflecting the possible range in index values individuals have.

Results of the Tobit analysis are reported in tables 22 and 23. Canadian and U.S. con-

Table 21. *Risk Attitudes and Perceptions Impact on Beef Consumption Reduction*

Respondent Country	RA Index	RP Index	RA Index* RP Index
Canada	0.503* (0.078)	0.290* (0.045)	-0.114* (-0.018)
United States	0.624* (0.090)	0.343* (0.050)	-0.145* (-0.021)
Japan	0.393* (0.077)	0.156* (0.031)	-0.108* (-0.021)
Mexico	0.337* (0.068)	0.330* (0.067)	-0.103* (-0.021)

For each model, the two rows present a) estimated coefficients and b) marginal effects (in parentheses). A * indicates the estimated coefficient is statistically significant with at least 95% confidence. The presented marginal effects are calculated as the average across individuals and represent the effect of a one-unit change in the independent variable on the probability of reducing beef consumption.

Table 22. *Factors Related to Risk Attitude Index*

Respondent Country	Female	Age	Education	Income
Canada	1.105* (1.010)	0.041* (0.037)	0.505* (0.461)	0.144* (0.131)
United States	1.833* (1.681)	0.037* (0.034)	0.343* (0.315)	0.025 (0.023)
Japan	1.213* (1.312)	0.070* (0.066)	0.770* (0.719)	0.100* (0.094)
Mexico	1.529* (1.399)	0.049* (0.044)	0.360* (0.330)	0.440* (0.403)

For each model, the two rows present a) estimated coefficients and b) marginal effects (in parentheses), respectively. The presented marginal effects are calculated as the average across individuals and represent the effect of a one-unit change in the independent variable on the risk attitude index. Demographic variables defined consistent with their presentation in Table 1 (e.g., Education =2 denotes a High School Graduate). A * indicates the estimated coefficient is statistically significant with at least 95% confidence.

Table 23. *Factors Related to Risk Perception Index*

Respondent Country	Female	Age	Education	Income
Canada	0.953* (0.739)	0.030* (0.023)	0.411* (0.319)	-0.034 (-0.023)
United States	1.513* (1.238)	0.025* (0.020)	0.380* (0.309)	-0.096 (-0.078)
Japan	1.001* (0.928)	0.060* (0.056)	0.624* (0.579)	0.014 (0.013)
Mexico	2.238* (2.018)	0.072* (0.065)	0.287* (0.259)	0.267* (0.241)

For each model, the three rows present a) estimated coefficients and b) marginal effects (in parentheses), respectively. The presented marginal effects are calculated as the average across individuals and represent the effect of a one-unit change in the independent variable on the risk perception index. Demographic variables defined consistent with their presentation in Table 1 (e.g., Education =2 denotes a High School Graduate). A * indicates the estimated coefficient is statistically significant with at least 95% confidence

Table 24. *Steak Product Attributes and Attribute Levels Evaluated in Choice Experiments.*

Product Attribute	Attribute Label
Country of Origin	Canada
	U.S.
	Japan
	Mexico
Production Practice	Approved Standards
	Natural
Tenderness	Uncertain
	Assured Tender
Food Safety Assurance	Typical
	Enhanced 40%
	Enhanced 80%
Price (\$ CN / lb.) ^a	\$5.50
	\$9.00
	\$12.50
	\$16.00

^a Prices differed by country with price options in U.S. surveys (U.S. \$/lb) \$5.00, \$8.00, \$11.00, and \$14.00; in Mexico surveys (Mexican Pesos/kg) 120, 190, 260, 330; in Japan surveys (Japanese yen/ 100 grams) 300, 600, 900, 1,200.

sumer risk attitudes (Table 22) and perceptions (Table 23) are related to similar factors. Females, older individuals, and those with more education have higher risk attitudes and perceptions. All other things constant, females tend to be more risk averse by nearly an increment of 1 (on the scale of 1 to 10) than males in three of the four countries, with an increment of 2 in Mexico. This is important because in many households the female is the primary food shopper and this indicates that females tend to view the safety of beef in a worse light and have more risk-averse attitudes about beef food safety than males. Implications for the Canadian beef industry are clear. The industry must target education and information programs about beef food safety toward women.

Food safety risk aversion and adverse perceptions also tend to increase with respondent age. An additional 10 years of age is associated with an increase in these indexes ranging from 0.2 to 0.7 across the four different countries. This indicates that assuring older consumers of food safety will be important as supply chain management strategies are adopted. Respondent education level is also related to risk aversion and risk perceptions. More highly educated respondents tend to have worse perceptions about beef food safety and are more risk averse. This result is a little perplexing as more educated people would be expected to better understand the low levels of food safety risk associated with beef products. These results suggest there is a need to more broadly disseminate information conveying actual food safety risk to correct some consumers' misperceptions.

Household income level is not consistently related to beef food safety perception or attitude across the four countries. For Canadian, Japanese, and Mexican consumers, higher incomes are associated with more risk-averse consumers regarding beef food safety. Income is only statistically related to beef risk perceptions for Mexican consumers where higher income respondents tend to have more skepticism about beef food safety.

Choice Experiments – Willingness to Pay for Beef Product Attributes

In addition to using standard survey questions (e.g., ranking options, multiple choice, etc.) consumers participated in a choice experiment. Choice experiments are commonly used by researchers to evaluate the value of products or tradeoffs between product attributes in situations where market data are nonexistent or unreliable. In the context of this project, insight was sought on consumer preferences for attributes and attribute bundles not commonly found in beef markets. As such, a choice experiment was used to elicit this information.

In the choice experiment, consumers were presented with a set of 21 different purchasing scenarios (all 21 are presented in the Appendix). Each scenario involved consumers selecting between two differentiated strip steak alternatives or indicating they would select neither of the two steak options. Consumers were informed of the importance of answering each scenario as if they were actually making a retail purchasing decision. An example of a choice scenario is:

Choice Set 2

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$14.00	\$11.00	
Country of Origin	USA	Canada	
Production Practice	Natural	Natural	Neither A nor B is preferred
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 80%	Enhanced 40%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The respondent was asked to select which steak (including neither) that they would purchase given the steak attributes associated with that particular scenario. For example, in the steak choices above a respondent could select between two different steaks, having different prices, from two different countries of origin, different production practices, having different tenderness assurances, and with varying food safety enhancement levels.

Levels for each of the steak product attributes are presented in Table 24. The percentage of participants who chose each steak, in

each of the 21 shopping scenarios, and a copy of the choice experiment questions and associated attribute descriptions are included in the Appendix. These choice experiments, together with statistical analysis, enable us to determine how much respondents are willing to pay for individual attributes and bundles of attributes.

Interpretation of each individual choice scenario is difficult as each involves the trade-off of multiple product attributes. Furthermore, across choice scenarios, the bundling of these attributes varies. To determine consumer preferences for each of the individual steak attributes, we estimated a series of statistical models. Our approach facilitates a more enhanced level of understanding regarding the heterogeneity in consumer preferences that exist within and across countries. The technical aspects of the modeling technique are described in Appendix C.

The initial sets of models estimated typically are referred to as conditional logit models. We estimated a conditional logit model for each individual survey respondent. The second step conducted was a disjoint cluster analysis using the individual consumer-specific coefficients of the conditional logit. In short, cluster analysis provides a method of identifying marketing segments. The process groups consumers with relatively homogeneous preferences based on similarities in their utility, as revealed by parameter estimates from the conditional logit models.

Summary statistics of this segmentation in each country-group appears in Table 25. The cluster analysis suggested that three clusters adequately segmented the consumers in each country-based group. The largest cluster among Canadian, U.S., Japanese, and Mexican consumers contained at least 60 percent of all consumers. Further comparison of select demographic variables across clusters is included in the Appendix in tables C1a-C1d. Gender, age, education, and income tend to not vary significantly in a systematic way across clusters. This suggests that other factors such as risk attitudes, risk perceptions, and product perceptions may have more impact on segmenting consumers into clusters of similar steak preferences.

The final model estimation step was to estimate a set of random parameters logit

Table 25. Summary Statistics of Clustering Consumer Segments

Respondent Country	Cluster 1	Cluster 2	Cluster 3
Canada	100 10%	616 61%	286 29%
United States	109 11%	756 75%	144 14%
Japan	41 4%	158 16%	802 80%
Mexico	80 8%	93 9%	820 83%

For each country, the two rows present a) the number of consumers in each segment and b) the percentage of all respondents belonging to each segment, respectively.

(RPL) models for each cluster group and for each aggregate, country-of-residence based group. Results of each RPL model are provided in the Appendix in tables C2a-C2d.

Estimates obtained from the statistical logit analysis allow us to estimate the value that consumers place on various steak attributes as revealed by their selections in the choice experiments. We adjust price until the utility of consuming steaks with and without the evaluated attribute is equal and then interpret the price change as the average consumer willingness to pay (WTP) to obtain, if positive, or to avoid, if negative, the steak attribute at hand relative to a base steak. The calculated willingness to pay estimates by country of respondent for models of each aggregated consumer group and each cluster group are presented in the Appendix in Table C3.

Prior to discussing the WTP estimates, note that the cluster analysis allows us to better isolate individuals with extreme preferences. Such preferences may correspond to survey participants failing to completely understand the choice experiment, the existence of hypothetical bias, or other factors. As such, our WTP discussion will center on models believed to best account for these extreme preferences. Additional discussion of this point is provided in Appendix C.

Table 26 presents the calculated willingness to pay estimates for each preferred model in each country. In addition, the proportion of consumers estimated to have a positive WTP

for each attribute is provided. One must be careful in interpretation of these willingness-to-pay estimates as they can be interpreted in a number of different ways. For example, the Canadian WTP for a Canadian origin beef steak is estimated to be \$18 per pound. The base is Mexico origin beef which means one can also interpret this as the Canadian WTP for a Mexican origin steak is an \$18 per pound discount relative to a Canadian origin steak. The key here is that the WTP numbers do not imply one can expect to sell a Canadian origin steak in Canada for \$18 per pound only that relative to a Mexican origin steak, the Canadian origin is strongly preferred and would certainly garner a premium in the market relative to a steak labeled as of Mexican origin. The result in this example does indicate that given typical market prices for a strip steak in Canada are less than \$18 per pound, one would have to give away a Mexican origin labeled steak to the typical Canadian consumer as they would not purchase it otherwise.

The results of the WTP analysis suggest some very important implications. Canadian consumers exhibited more loyalty (larger WTP) to domestically produced steak than consumers did from any other country, though U.S., Japanese, and Mexican consumers also revealed strong preferences for domestically produced steaks. In fact, at least 84 percent of the consumers in each of the four countries placed a premium on domestically produced beef. Japanese consumers revealed considerable distrust in U.S. steak and, relative to U.S. and Mexican steak, placed greater value on Canadian origin steaks. Essential to remember in interpretation of the WTP estimates related to country of origin is that country of origin labels are signals representing a host of bundled product attributes all embedded in the origin label. For example, origin can influence consumer perceptions about product food safety, production practices, product quality, product freshness, and other value components. These results suggest the Canadian beef industry enjoys brand equity. This concept is discussed further below.

The production method tended not to be a very important WTP consideration for consumers from any country. However, at least 56 percent of each consumer group dislikes

Canadian consumers exhibited more loyalty to domestically produced steak than consumers did from any other country, though U.S., Japanese, and Mexican consumers also revealed strong preferences for domestically produced steaks.

Table 26. Marginal Willingness-to-Pay Estimates

	Respondent Country							
	Canada		United States		Japan		Mexico	
	WTP Estimate	Percent with Positive WTP	WTP Estimate	Percent with Positive WTP	WTP Estimate	Percent with Positive WTP	WTP Estimate	Percent with Positive WTP
Country of Origin								
Canada	18.00	84%	0.13	62%	0.68	67%	-4.51	7%
U.S.	10.00	82%	5.42	84%	-4.19	22%	-7.07	8%
Japan	-0.58	38%	-2.58	29%	4.52	94%	-12.75	9%
Mexico	Base	Base	Base	Base	Base	Base	Base	Base
Production Method								
Natural	-0.84	39%	-0.70	38%	-1.46	14%	-0.36	44%
Typical Production	Base	Base	Base	Base	Base	Base	Base	Base
Food Safety Assurance								
40% Food Safety Enhancement	2.16	75%	3.57	88%	0.17	53%	-0.68	24%
80% Food Safety Enhancement	4.55	71%	5.59	91%	1.49	70%	-0.32	65%
Typical Food Safety	Base	Base	Base	Base	Base	Base	Base	Base
Tenderness Level Assurance								
Assured Tender	1.58	69%	5.93	89%	0.67	78%	0.73	51%
No Tenderness Assurance	Base	Base	Base	Base	Base	Base	Base	Base

The WTP values are estimates of average WTP for each individual attribute. They are derived from preferred models most likely reflecting consumer preferences (see tables C2a-C2d and C3). Each estimate is presented in \$/CN/lb. The *Percent with Positive WTP* value is the proportion of consumers estimated to have a positive WTP for the given attribute.

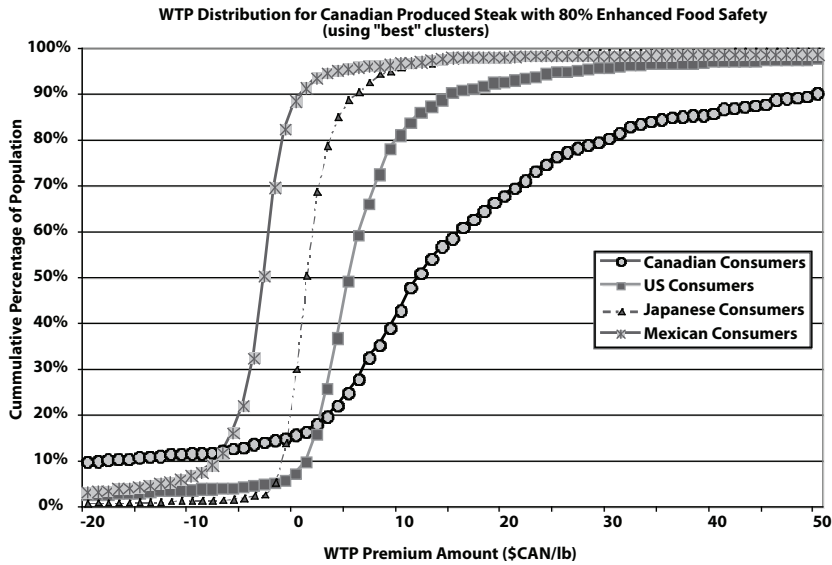
steak labeled as Natural. This finding may correspond to differences consumers perceive in freshness, or eating quality of steaks labeled as Natural as compared to typical steaks.

Enhancing food safety of beef was important to consumers in Canada, the United States, and Japan. Enhancing food safety by 80 percent was especially valuable to respondents relative to typical food safety protocols. U.S. consumers revealed the highest WTP for food safety enhancement relative to typical food safety protocols valuing food safety enhancements of 80 percent by more than \$5 per pound. It is interesting to note that most Mexican consumers were not willing to pay for food safety enhancements, despite the fact that Mexican consumers expressed some skepticism about beef food safety. The implication is that other issues, such as eating experience characteristics, are of more importance to the typical Mexican consumer. Finally, steak tenderness

assurances were notably valued differently by the four consumer groups. U.S. consumers demonstrated the strongest preferences with WTP premiums of nearly \$6 per pound. Conversely, only about one-half of the Mexican consumers placed a positive value on tenderness assurances.

As previously noted, the estimated logit models reveal significant heterogeneity of preferences across consumers even within the same country. To further evaluate this heterogeneity we present a selected figure demonstrating the distribution of preferences for possible steak bundles. The bundle considered is a steak labeled as being produced in Canada, under normal production practices, of uncertain tenderness, with an 80 percent enhancement in food safety assurances. Figure 5 shows the distribution of preferences for this product as suggested by the preferred RPL models (Table 26). In particular, this graph depicts the

Figure 5. *Distribution of WTP for steak originating from Canada, produced under Approved Standards, with an 80 percent enhancement in food safety assurances*



cumulative percentage of consumers willing to pay a given value for this steak. More than 88 percent and 30 percent of Mexican and Japanese consumers, respectively, have a WTP of \$0 or less for this steak. Conversely, nearly 20 percent of Canadian consumers have a WTP of at least \$30 and about 9 percent of U.S. consumers have a WTP of at least \$20 for the steak.

In addition to the above discussion on consumer WTP for each of the steak attributes, the estimated RPL models provide additional information regarding the impact of demographic factors and beef consumption frequency on consumer behavior. Tables C2a-C2d reveal that these factors have mixed effects across the four consumer groups. Analyzing the preferred models (see Table C3), reveals that demographic factors tend to influence the probability of Canadian and U.S. consumers not selecting either of the two alternative steaks. However, this is not true for Japanese and Mexican consumers. Further, as expected, Canadian and U.S. consumers with higher beef consumption frequencies are more likely to select steak. Surprisingly, the opposite finding persists among Mexican consumers.

Brand Equity

Results of our surveys and choice experiments indicate Canadian beef enjoys some “brand” equity where the “brand” here refers

to beef having *Canadian country-of-origin*. Future supply chain development should consider more completely identifying this brand equity and developing strategies designed to capture some of the value associated with the Canadian beef “brand.” Doing so requires consideration of exactly what is brand equity. A wide variety of definitions and methods have been employed in the marketing literature to measure brand equity. Table 27 provides an overview of some of the brand equity definitions employed by various researchers.

The broad range of definitions arise in part because some researchers focus specifically on placing a financial value on a brand, whereas other researchers emphasize measuring brand value from the consumer’s perspective. Most marketing researchers examining the value of brands recognize the fact that if a brand has no meaning to the consumer, it offers no meaning to investors, manufacturers, or retailers (Cobb-Walgren, Ruble, Donthu 1995). With the knowledge of what goes into the purchase decision process, one can determine what value consumers place on a particular brand (Keller 1998, Lassar, Mittal, Sharma 1995). By examining the components of brand equity, insights into the value provided by a brand name can be obtained. In the marketing literature, numerous components of the customer-based approach to brand equity can be found. Table 28 gives a brief overview of a selection of these components.

Table 27. Definitions of Brand Equity

Reference	Definition
Farquhar, 1989	The added value with which a given brand endows a product. A product offers a functional benefit and the brand of a product a name, symbol, design, or mark that enhances the value of a product beyond its functional purpose.
Aaker, 1991	A set of brand assets and liabilities linked to a brand, its name and symbol, that add to or subtract from the value provided by a product or service to a firm and/or to that firm's customers.
Keller, 1993	The differential effect of brand knowledge on consumer response to the marketing of the brand" - customer-based brand equity.
Bonner & Nelson, 1985	The goodwill adhering to a brand.
Crimmins, 1992	The amount of value added by a brand name is the ratio of its price to its competitor's price when both products are equally desirable to consumers, minus one.
Swait et al., 1993	Equalization Price (EP); a measure of the implicit value to the individual consumer of the brand in a market in which some degree of differentiation exists vis-à-vis its implicit value in a market characterized by no brand differentiation". This is the value that can not be subscribed to physical product attributes.
Kamakurra & Russell, 1993	The intrinsic utility that remains after the tangible utility based on perception and preferences of the physical attributes is withdrawn from the total utility.
Rangaswamy, 1993	The residual value in the form of favorable impressions, attitudinal dispositions, and behavioral predilections among all those who are exposed to the marketing activities related to the brand, including present consumers, potential consumers, as well as channel members and other influencers in the buying process.
Srinivasan, 1979	The component of overall preference not explained by objectively measured attributes.
Leuthesser et al., 1995	Brand equity represents the value (to a consumer) of a product, above that which would result for an otherwise identical product without the brand's name.
Marketing Science Institute 1988	The set of associations and behaviors on the part of the brand's customer, channel members, and parent corporations that permit the brand to earn greater volume or greater margins than it could without the brand name and that gives the brand strong, sustainable, and differentiated advantage over competitors.

Table 28. Components of Brand Equity

Component	Description
Brand Awareness	Brand recognition, Aided Recall, Spontaneous Recall.
Brand Image	Consumer's associations with the brand.
Perceived Quality	Consumers' perception of the quality of the brand.
Other proprietary assets	Market share of the brand, among others.
Brand Loyalty	Consistent repurchase of the brand.
Price Premium	The premium consumers are willing to pay for brand.
Customer Satisfaction	Perceived satisfaction related to the brand.

Table 29. *Methods for Measuring Customer-Based Brand Equity*

Method/Measure	Description
Indirect Methods:	
Awareness	<ul style="list-style-type: none"> • Brand recognition (percentage recognizing the brand name). • Aided recall (percentage aided recall the brand). • Unaided recall (percentage recall the brand). • Familiarity (6-point scale).
Perceptions and Attitudes (Krishnan 1996)	<ul style="list-style-type: none"> • A composite multiattribute weighted score (sum of x attributes times importances). • Seven-point quality of brand name. • The favorability, strength, and uniqueness of consumers' associations with the brand
Direct Methods:	
Choice Intention	<ul style="list-style-type: none"> • Single-item measure, likelihood of buying each brand (0 to 100-point scale)
Actual Choice	<ul style="list-style-type: none"> • Discrete-choice methodology (factorial design, 32 choice sets with 13 brands) • Self-reported past-purchase rate.
Brand Loyalty	<ul style="list-style-type: none"> • Consistent repurchase of the brand
Equalization price (Swait et al. 1993)	<ul style="list-style-type: none"> • Designed choice experiments that account for brand name, product attributes, brand image, and consumer heterogeneity. EP is a measure of the implicit value to the individual consumer of the brand in a market in which some degree of differentiation exists vis-à-vis its implicit value in a market characterized by no differentiation.
Price Premium (Park and Srinivasan 1994)	<ul style="list-style-type: none"> • Price premium for switching between brands (dollar metric scaling method) • 2 Single-item scales, a six-point value for money. • They propose a method that measures brand equity as the difference between an individual consumer's overall brand preference and his or her brand preference based on objectively measured product attribute levels. To understand the sources of brand equity, the approach divides brand equity into attribute-based and nonattribute-based components. The method provides the market share premium and the price premium attributable brand equity.
Indiferential Method (Crimmins 1992)	<ul style="list-style-type: none"> • Brand equity is measured by estimating the price at which the test brand and each competitor are equally likely to be chosen.
Brand price trade off (Blackston 1990)	<ul style="list-style-type: none"> • Brand equity is measured using conjoint analysis. Respondents choose their preferred brand at different price levels. By pooling all respondents' decision processes, one can simulate market outcomes at any set of prices
Actual purchase behavior (Kamakura & Russell 1993)	<ul style="list-style-type: none"> • Actual purchase behavior is observed under regular market conditions. Next, accounting for differences in net price and brand salience due to short term advertising exposures, brand value is calculated and decomposed in tangible and intangible components

A Customer-Based Approach to Measuring Brand Equity

A number of researchers have attempted to measure brand equity. Depending on how brand equity is defined, it is measured directly or indirectly, by measuring its determinants. With *direct* measuring methods one tries to determine the actual added value of a brand according to the definition of the brand equity of Farquhar (1989) and Keller (1993). Possible methods are "blind" tests, conjoint analyses, or trade-off analyses. The *indirect* approach tries to identify the potential sources of brand equity. An understanding of these sources for a firm's own and competitive brands is critical for the brand manager (Keller 1993, Parker and Srinivasan 1994). The indirect approach does not actually focus on the determination of the brand equity, but tries to detect possible sources of brand equity. Different methods might be used to determine these potential sources of brand equity. Aaker (1991) for example suggests using switching costs, repurchase rates, levels of satisfaction, preference for brand, and perceived quality on various product dimensions as possible measures. Keller (1993) suggests that to test for brand recall and recognition, brand associations, ratings of evaluations, and beliefs of associations be employed as potential indirect measuring methods. Table 29, based in part on Agarwal and Rao (1996), gives an overview of the different approaches for measuring brand equity as identified in the marketing literature.

Taking advantage of the Canadian beef brand equity identified in our study will require additional research. Although this research could explore a number of different avenues, focusing on the *Canadian beef* brand value from the consumer's perspective might be particularly useful since it could be used to help identify ways to exploit brand value among both domestic and export customers.

References

- Aaker, D. "Managing the Most Important Asset: Brand Equity." *Planning Review*, 20 (5, 1992):56-58.
- _____, 1996. "Measuring Brand Equity Across Products and Markets." *California Management Review*, 38(3, 1996):102-120.
- _____, and Keller, K. "Consumer Evaluations of Brand Extensions." *Journal of Marketing*, 54(1990):27-41.
- _____, 1995. "The Qualitative Dimension of Brand Equity." *Journal of Advertising Research*, 35 (4, 1995): RC2- RC7.
- Agarwal, Manoj K., Rao, Vithala R. "An Empirical Comparison of Consumer-Based Measures of Brand Equity." *Marketing Letters*, 7(3, 1996):237-247
- Agriculture and Agrifood-Canada. *Beef Demand in Canada* accessed June 5, 2006 <http://www.agr.gc.ca/redmeat/beefdem.pdf>
- Anand, P. "Decision-making When Science is Ambiguous." *Science* 259(2002):1839.
- Arrow, K.J. *Essays in the Theory of Risk Bearing*. Chicago, IL: Markham Publishing Company, 1971.
- Baldinger, A. "Defining and Applying the Brand Equity Concept: Why the Researcher Should Care." *Journal of Advertising*, 30(3, 1990):RC2-RC5.
- Barwise, P. "Brand Equity: Snark or Boojum?" *International Journal of Research Marketing*, 10(1992):93-104.
- Barwise, P., Higson, C., Likierman, A., Marsh, P. *Brands as 'Separable Assets'*, London: Institute of Chartered Accountants in England and Wales., 10(1989):43-59.
- Beef Information Centre. *Consumer Reactions and Expectations: Canadian Perspective*. Presentation available at <http://www.meatami.com/BSE/Consumer%20reactions.pdf>
- Blackston, M. (1990) "Price Trade-Offs as a Measure of Brand Value." *Journal of Advertising Research*, 30, 4, p. 3-6.
- Blackston, M., 1995. "Copy-Testing and Brand Equity: What's the Connection?" *Journal of Advertising Research*, 35 (1), RC2-RC7.
- _____, 1995. "The Qualitative Dimension of Brand Equity." *Journal of Advertising Research*, 35 (4) RC2- RC7.
- Blattberg, R.C. and Wisniewski, K.J., (1989) "Price-Induced Patterns of Competition." *Marketing Science*, 8 (Fall), 291-309.
- Brasco, T.C., (1988) "How Brand Names are Valued for Acquisition." In: L. Leuthesser (ed.), *Defining, Measuring and Managing Brand Equity: A Conference Summary*, Marketing Science Institute Report, 88-104.
- Cargill, T.F. and G.C. Rausser. "Temporal Price Behavior in Commodity Futures Markets." *Journal of Finance* 30(1975):1043-1053.
- Chaudhuri, A. (1995) "Brand Equity or Double Jeopardy?" *Journal of Product and Brand Management*, 4 (1), 26-32.
- Cobb-Walgreen, C., Ruble, C., and Donthu, N. (1995) "Brand Equity, Brand Preference, and Purchase Intent." *Journal of Advertising*, 24 (3), 25-40.
- Crimmins, J.C. (1992) "Better Measurement and Management of Brand Value." *Journal of Advertising Research*, 32, 4, p. 11-19.
- Davis, S., and Douglass, D. (1995). "Holistic Approach to Brand Equity Management." *Marketing News*, 29 (2) 4-5.
- Dyson, P., Farr, A., and Hollis, N. (1996). "Understanding, Measuring, and Using Brand Equity." *Journal of Advertising Research*, 36 (6), 9-21.
- Farquhar, P. (1990) "Managing Brand Equity." *Journal of Advertising Research*, 30(4), RC7-RC12.
- Feldwick, P. (1996) "What is Brand Equity Anyway, and How do You Measure it?" *Journal of Market Research Society*, 38 (2), 85-104.
- Fishbein, M. and A. Icek. (1975), *Beliefs, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley Publishing, Reading, MA.
- Green, P.E., V. Srinivasan (1990) "Conjoint Analyses in Marketing Research: New Developments and Directions." *Journal of Marketing*, Vol. 54, no. 4 (October), 3-19.
- Hayakawa, S., *Language and Thought in Action*, 1941, p 171. Harcourt, Brace and company, New York, New York.
- Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Beverly Hills, CA: Sage Publications. 1980.
- Hofstede G. "The Cultural Relativity of Organizational Practices and Theories." *Journal of International Business Studies*, 14(1983):75-89.
- Kamakura, W.A., R.J. Gary (1993) "Measuring Brand Value with Scanner Data." *International Journal of Research in Marketing*, 10 (March), 9-22
- Keller, K., (1993). "Conceptualizing, Measuring, and Managing Customer-Based Brand Equity." *Journal of Marketing*, 57 (1), 1-22.
- Knight, F.H. *Risk, Uncertainty and Profit*. Boston, Mass: Houghton Mifflin, 1933.
- Krishnan, H. (1996). "Characteristics of Memory Associations: A Consumer-Based Brand Equity Perspective." *International Journal of Research in Marketing*, 13, 389-405.

- Lassar, W., B. Mittal, and B.A., Sharma (1995). "Measuring Customer-Based Brand Equity." *Journal of Consumer Marketing*, 12 (4), 11-19.
- Leuthesser, L., Kohli, C., and Harich, K., (1995). "Brand Equity: The Halo Effect Measure." *European Journal of Marketing*, 29 (40), 57-66.
- Lobb, A.E., M. Mazzocchi, and W.B. Traill. "Risk Perception and Chicken Consumption in the Avian Flu Age – A Consumer Behaviour Study on Food Safety Information." Selected paper presented at the American Agricultural Economics Annual Meeting, Long Beach, California, July 23-26, 2006.
- Louviere, J. and R. Johnson (1988) "Measuring Brand Image with Conjoint Analysis and Choice Models" In: L. Leuthesser (ed.), *Defining, Measuring and Managing Brand Equity: A Conference Summary*, Marketing Science Institute Report, 88-104.
- Mahajan, V., V. Rao, and R. Srivastava (1994). "An Approach to Assess the Importance of Brand Equity in Acquisition Decisions." *Journal of Product Innovation Management*, 11, 221-235.
- Marsh, T.L., T.C. Schroeder, and J. Mintert. "Impacts of Meat Product Recalls on Consumer Demand in the U.S." *Applied Economics* 36(9, 2004):897-909.
- Mead, P.S., L. Slutsker, V. Dietz, L.F. McCaig, J.S. Bresee, C. Shapiro, P.M. Griffin, and R.V. Tauxe. "Food-Related Illness and Death in the United States." Centers for Disease Control and Prevention, Atlanta, Georgia, USA. *Emerging Infectious Diseases*, 5, 5(September-October 1999): 607-25.
- Oakenfull, G., and Gelb, B., (1996). "Research-Based Advertising to Preserve Brand Equity but Avoid 'Genericide.'" *Journal of Advertising Research*, 36 (5), 65-72.
- Oliver R.L. (1999) "Whence Consumer Loyalty?" *Journal of Marketing*, 63, 33-44.
- Park, Chan Su, Srinivasan, V. (1994) "A Survey-Based Method for Measuring and Understanding Brand Equity and its Extendibility." *Journal of Marketing Research*, (May) pp. 271-288.
- Pennings, J.M.E., B. Wansink, and M.T.G. Meulenber. "A Note on Modeling Consumer Reactions to a Crisis: The Case of the Mad Cow Disease." *International Journal of Research in Marketing* 19(2002):91-100.
- Pennings, J.M.E. and van Ittersum, K. "Understanding & Managing Consumer Risk Behavior." Paper presented at the American Agricultural Economics Association Annual Meeting, August 1-4, 2004, Denver, Colorado.
- Pennings, J.M.E. and B. Wansink. "Channel Contract Behavior: the Role of Risk Attitude, Risk Perceptions, and Channel Members' Market Structures." *Journal of Business* 77(2004):697-724.
- Penrose, N., (1989), Valuation of Trade Names and Trademarks. In: J. Murphy (ed.), *Brand Valuation: Establishing a True and Fair View*. London: The Interbrand Group.
- Peterson, H.H. and Y.-J. Chen. "The Impact of BSE on Japanese Retail Meat Demand." *Agribusiness* 21, 3(2005):313-327.
- Pitta, D., and Katsanis, L., (1995). "Understanding Brand Equity for Successful Extension." *Journal of Consumer Marketing*, 12 (4), 51-64.
- Pokorny, G., (1995). "Building Brand Equity and Customer Loyalty." *Electric Perspectives*, 20(3), 54-66.
- Poulin, D. and A.K. Baome. *Mad Cow Disease and Beef Trade*. Statistics Canada, November 2003. <http://www.statcan.ca/english/research/11-621-MIE/2003005/11-621-MIE2003005.pdf>
- Pratt, J.W. "Risk Aversion in the Small and in the Large." *Econometrica* 32(1964):122-136.
- Riezebos, H.J., (1994), *Brand-Added Value: theory and empirical research about the value of brand to consumers*, Dissertation Rotterdam School of Management, Erasmus University Rotterdam. Eburon Publishers, Delft
- Serecon Management Consulting Inc. 2003. Economic implications of BSE in Canada. Final report prepared for the Canadian Animal Health Coalition. November 2003. Edmonton. <http://www.animalhealth.ca>.
- Simon, C.J., M.W. Sullivan (1993) "The Measurement and Determinants of Brand Equity: A Financial Approach." *Marketing Science*, Vol. 12, No. 1, 28-52.
- Stobart, P., (1989), Alternative Methods for Brand Valuation: In: J. Murphy (ed.), *Brand Valuation: Establishing a True and Fair View*. London: The Interbrand Group.
- Swait, J., T. Erdem, J. Louviere, and C. Dubelaar (1993), "The Equalization Price: A Measure of Consumer-Perceived Brand Equity." *International Journal of Research in Marketing*, 10 (March), 23-45
- Wansink B., Gilmore J.M. (1999), "New Uses that Revitalize Old Brands." *Journal of Advertising Research*, 39 (2): 90-98.
- Woods, R.J. (1998), "Can there be a Common Definition for Brand Equity?" *Journal of Modern Business*, [online] <http://www.dcpres.com/jmb/1998.htm>.
- Yovovich, B.G., (1988), "What is Your Brand Really Worth?" *Adweeks Marketing Week*, (August 8), 18-20
- Sharkey, B., (1989), "The People's Choice." *Adweeks Marketing Week*, (November 27), 6-10
- U.S. Census Bureau. International Database Summary Demographic Data. Available at: <http://www.census.gov/ipc/www/idbsum.html> Accessed June 2006.

Appendix A: English Version of Survey (excluding demographic questions)

1. Please indicate on a scale from 1 to 5 how much you trust the following sources for providing accurate information regarding food safety:

	Your level of trust					
	Very Low	Low	Moderate	High	Very High	No opinion
Information Source	1	2	3	4	5	
Family Physician						
Dietician						
Government Food Agencies						
University Scientists / Educators						
Private Researchers / Consultants						
Retail Grocer or Butcher						
Food Industry Sources						
Consumer Groups						

2. How frequently do you typically consume beef at any meal including both home and away from home?
- a. Never
 - b. Once per month or less
 - c. 2-3 times per month
 - d. Once per week
 - e. 2-3 times per week
 - f. 4 or more times per week
3. How frequently do you typically eat out or get take out / carry out at a restaurant or food service establishment for each of the following meals?
- _____ times per week for breakfast
- _____ times per week for lunch
- _____ times per week for dinner
4. Over the past four years, have you lowered your beef consumption because of food safety concerns?
- a. No
 - b. Yes, If yes, reduced by roughly _____% (please give your best estimate)

5. Have you or anyone in your family ever been sick where you suspected the illness was caused by eating spoiled, tainted, or improperly cooked or handled food?

- a. No
- b. Yes

If Yes, check which if any of the following foods you suspected caused the illness(es):

- pork
- poultry
- beef
- lamb/mutton
- fish/seafood
- fruits
- vegetables
- other (please list _____)

If Yes, was the food prepared at:

- home
- away from home (e.g., food service)
- some at home and some away from home

6. Who in your household typically prepares your evening meal:

- Yourself or other adult
- child (age _____ years)

7. Please provide the approximate percentage of your beef consumption over the past year that would include the following beef products (your best guess is fine, they should add to 100%, skip question if you do not consume beef):

- ground or minced (e.g., hamburger)
- roasts
- steaks
- sausage, brats, hotdogs, beef luncheon meats, deli meats
- organ meats (e.g., liver, tongue, tripe, etc.)
- other (please list _____)

100% = sum total

8. Please check the **five** product traits of those listed below that that you consider most important when you purchase a beef product

Product Trait	Check the five most important to you
Price	
Product Food Safety Assurance	
Product Nutritional Information	
Product Leanness (Less Fat)	
Product Flavor	
Product Tenderness	
Product Juiciness	
Product Preparation Ease	
Product Preparation Time	
Product Freshness (i.e., “Sell by Date” in U.S.; “Packaged on Date” in Canada; “Best Before” Date in Japan)	
Product Color	
Product Labeled Natural	
Product Labeled Organic	
Traceability of Product to Farm	
Country of Origin of Product	

9. When you make a purchase decision to buy a particular beef product, you may take several things into consideration such as the trust you place in the store where you are shopping, your past experience with the product, or information contained on the package label. Now think about these factors and please check sources that you use to determine that likely eating experience.

Product Trait THE 5 traits checked from the previous question should only show up here	Rely upon for assessing trait (check all that apply for each trait)						
	Past Experience with Product	Retailer or Butcher Help	Store where Purchased	Brand Name	Visual Inspection of Product	Product Label Information	Quality Grade

10. To what degree is each food safety risk present in beef?

Food Safety Risk	Degree Present in Beef					No opinion
	Very Low	Low	Moderate	High	Very High	
E – Coli O157:H7 bacteria	1	2	3	4	5	
BSE (“mad cow”) related diseases						
Salmonella						
Listeria						
Campylobacter						
Staphylococcus aureus						

11. Suppose you consumed meat that had the following food safety problem. What do you expect would be the likely impact on your health of each of these?

	Likely Impact on your Health					
	No Adverse Impact	Minor illness (stomach ache, no physician care)	Moderated illness (vomit, in bed, no physician care)	Major illness (require physician care)	Serious illness (require hospital care)	
Food Safety Problem	1	2	3	4	5	No opinion
E – Coli O157:H7 bacteria						
BSE (“mad cow”) related diseases						
Salmonella						
Listeria						
Campylobacter						
Staphylococcus aureus						

12. How much ability does each of these parties have to influence and assure beef food safety?

	Ability to Assure Beef Food Safety					
	Very Low	Low	Moderate	High	Very High	
Responsible Party	1	2	3	4	5	No opinion
Farm Producer/Grower						
Beef Processor						
Retail Grocer						
Food Service Restaurant						
Consumer – home food preparer						
Government Inspectors / Regulators						

13. How do you rank the food safety level of beef prepared at different locations?

	Level of Food Safety					
	Very Low	Low	Moderate	High Very	High	
Beef Prepared at:	1	2	3	4	5	No opinion
Home Prepared by you						
Cooked by Grocer (e.g., deli)						
Expensive Dine-In Restaurant						
Medium-Cost Dine-In Café						
Low-Cost Fast Food / Carry Out						

14. Please assess the food safety level of the following meat types and beef products

	Level of Food Safety					No opinion
	Very Low	Low	Moderate	High	Very High	
Meat Type	1	2	3	4	5	
Beef						
Pork						
Poultry						
Lamb/Mutton						
Fish/Seafood						
Particular Beef Product						
Steak						
Roast						
Ground / Minced (hamburger)						
Luncheon / Deli Cooked Beef						
Canned Beef						
Organ Meats (liver, tripe (panza))						
Microwavable Packaged Beef						

15. Whether you have ever knowingly purchased beef produced in another country or not, what is your perception of the level of food safety of beef by country of origin

	Your Perceived Level of Food Safety					No opinion
	Very Low	Low	Moderate	High	Very High	
Country of Origin	1	2	3	4	5	
Unknown Country of Origin						
Australia						
Brazil						
Canada						
Japan						
Mexico						
United States						

16. When you purchase beef to consume how much do you rely on each of the following for assessing food safety information/assurance

	Level Relied on for Food Safety Assurance					No opinion
	Very Low	Low	Moderate	High	Very High	
Product Attribute	1	2	3	4	5	
Price Level						
Brand Name						
Purchased from reputable store						
Country of Origin						
“Sell by Date” In U.S.; “Packaged on Date” in Canada; “Best Before Date” in Japan						
Government Inspected						
Labeled Organic						
Labeled Natural						
Product Color						
Product Smell						
Product Texture						
Labeled Traceable to Farm						

Risk Attitude vs. Risk Perceptions

Beef Risk Perception Assessment:

- I consider eating beef ...
NOT AT ALL RISKY 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 HIGHLY RISKY
- When eating beef, I am exposed to ...
NO RISK AT ALL 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 VERY HIGH RISK
- Eating beef is risky
STRONGLY DISAGREE 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 STRONGLY AGREE

Beef Risk Attitude Assessment:

- I rarely think about food safety when eating beef
STRONGLY AGREE 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 STRONGLY DISAGREE
- My willingness to accept food safety risk when eating beef, I am ...
NOT WILLING 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 VERY WILLING
- For me, eating beef is worth the risk
STRONGLY DISAGREE 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 STRONGLY AGREE
- I believe that current levels of government testing insure that beef cattle that might be infected with BSE (mad cow) are identified and kept out of the food chain:
STRONGLY DISAGREE 1 – 2 – 3 – 4 – 5 – 6 – 8 – 9 STRONGLY AGREE

In this final section of this survey you are provided with 21 different pairs of alternative top loin beef steaks (also known as Kansas City strip and New York steak) that could be available for purchase in the retail grocery store or butcher where you typically shop that possess differing attributes. Steak prices vary from CN \$5.50/lb. to \$16.00/lb. For each pair of steaks, please select the steak that you would purchase, or neither, if you would not purchase either steak. It is important that you make your selections like you would if you were actually facing these choices in your retail purchase decisions.

For your information in interpreting alternative steaks:

- **Country of Origin** refers to the country in which the cow was raised and includes Canada, Japan, Mexico, or USA.
- **Production Practice** is the method used to produce the cow where
 - **Approved Standards** means the cow was raised using scientifically determined safe and government-approved use of synthetic growth hormones and antibiotics (typical of cattle production methods used in USA and Canada)
 - **Natural** is the same as typical except the cow was raised without the use of synthetic growth hormones or antibiotics
- **Tenderness** refers to how tender the steak is to eat and includes
 - **Assured Tender**, which means the steak is guaranteed tender by testing the steak using a tenderness measuring instrument
 - **Uncertain** means there are no guarantees on tenderness level of the steak and the chances of being tender are the same as typical steaks you have purchased in the past
- **Food Safety Assurance** refers the level of food safety assurance with the steak
 - **Typical** food safety means the steak meets current minimum government standards for food safety
 - **Enhanced 40%** means measures have been taken to reduce risks of illness associated with food safety from consuming the product by 40% relative to typical
 - **Enhanced 80%** means measures have been taken to reduce risks of illness associated with food safety from consuming the product by 80% relative to typical

Choice Set 1

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$16.00	\$16.00	
Country of Origin	Mexico	USA	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Enhanced 40%	Enhanced 80%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 2

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$16.00	\$12.50	
Country of Origin	USA	Canada	Neither A nor B is preferred
Production Practice	Natural	Natural	
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 80%	Enhanced 40%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 3

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$16.00	\$12.50	
Country of Origin	Canada	Mexico	Neither A nor B is preferred
Production Practice	Natural	Approved Standards	
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Typical	Enhanced 80%	
I choose ...			

Choice Set 4

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$16.00	\$9.00	
Country of Origin	Japan	Mexico	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Uncertain	Uncertain	
Food Safety Assurance	Enhanced 80%	Typical	
I choose ...			

Choice Set 5

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$16.00	\$5.50	
Country of Origin	USA	Japan	Neither A nor B is preferred
Production Practice	Approved Standards	Approved Standards	
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Enhanced 40%	Enhanced 40%	
I choose ...			

Choice Set 6

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$12.50	\$16.00	
Country of Origin	Japan	Canada	Neither A nor B is preferred
Production Practice	Approved Standards	Approved Standards	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Typical	Enhanced 40%	
I choose ...			

Choice Set 7

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$12.50	\$12.50	
Country of Origin	Mexico	Mexico	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Enhanced 40%	Enhanced 40%	
I choose ...			

Choice Set 8

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$12.50	\$9.00	
Country of Origin	USA	Japan	Neither A nor B is preferred
Production Practice	Natural	Natural	
Tenderness	Uncertain	Uncertain	
Food Safety Assurance	Typical	Enhanced 80%	
I choose ...			

Choice Set 9

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$12.50	\$5.50	
Country of Origin	Japan	USA	Neither A nor B is preferred
Production Practice	Natural	Approved Standards	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Enhanced 80%	Typical	
I choose ...			

Choice Set 10

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$12.50	\$5.50	
Country of Origin	Canada	Canada	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 40%	Typical	
I choose ...			

Choice Set 11

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$9.00	\$16.00	
Country of Origin	USA	Mexico	Neither A nor B is preferred
Production Practice	Natural	Approved Standards	
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 40%	Typical	
I choose ...			

Choice Set 12

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$9.00	\$12.50	
Country of Origin	Mexico	Japan	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Typical	Typical	
I choose ...			

Choice Set 13

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$9.00	\$9.00	
Country of Origin	Canada	USA	
Production Practice	Approved Standards	Approved Standards	Neither A nor B is preferred
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 40%	Enhanced 40%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 14

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$9.00	\$5.50	
Country of Origin	Mexico	Canada	
Production Practice	Approved Standards	Approved Standards	Neither A nor B is preferred
Tenderness	Uncertain	Uncertain	
Food Safety Assurance	Enhanced 80%	Enhanced 80%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 15

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$9.00	\$5.50	
Country of Origin	Japan	Canada	
Production Practice	Natural	Natural	Neither A nor B is preferred
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Enhanced 40%	Enhanced 80%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 16

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$16.00	
Country of Origin	Canada	Japan	
Production Practice	Natural	Natural	Neither A nor B is preferred
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Enhanced 80%	Enhanced 40%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 17

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$12.50	
Country of Origin	Japan	Japan	
Production Practice	Approved Standards	Approved Standards	Neither A nor B is preferred
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Enhanced 40%	Enhanced 80%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 18

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$12.50	
Country of Origin	USA	USA	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Uncertain	Uncertain	
Food Safety Assurance	Typical	Typical	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 19

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$9.00	
Country of Origin	Mexico	Canada	Neither A nor B is preferred
Production Practice	Natural	Approved Standards	
Tenderness	Uncertain	Assured Tender	
Food Safety Assurance	Enhanced 40%	Typical	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 20

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$9.00	
Country of Origin	USA	Mexico	Neither A nor B is preferred
Production Practice	Approved Standards	Natural	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Enhanced 80%	Enhanced 80%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choice Set 21

Steak Attribute	Option A	Option B	Option C
Price (\$/lb.)	\$5.50	\$5.50	
Country of Origin	Mexico	Mexico	Neither A nor B is preferred
Production Practice	Natural	Natural	
Tenderness	Assured Tender	Uncertain	
Food Safety Assurance	Typical	Enhanced 40%	
I choose ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix B. Individual Choice Experiment Summary Results

Table B1. *Choice Experiment Summary Results*

Choice Set	Respondent Country			
	Canada	United States	Japan	Mexico
Choice Set #1				
1 = Choose "Option A"	4.9%	2.4%	10.6%	41.1%
2 = Choose "Option B"	56.2%	64.7%	15.9%	31.2%
3 = Choose "Option C"	38.9%	32.9%	73.5%	27.7%
Choice Set #2				
1 = Choose "Option A"	22.6%	55.8%	13.0%	32.0%
2 = Choose "Option B"	53.0%	10.2%	21.2%	31.9%
3 = Choose "Option C"	24.5%	34.0%	65.8%	36.1%
Choice Set #3				
1 = Choose "Option A"	43.7%	18.0%	10.6%	12.8%
2 = Choose "Option B"	19.7%	21.8%	23.6%	64.7%
3 = Choose "Option C"	36.6%	60.2%	65.8%	22.6%
Choice Set #4				
1 = Choose "Option A"	22.4%	18.5%	53.9%	17.3%
2 = Choose "Option B"	10.6%	11.4%	9.5%	54.9%
3 = Choose "Option C"	67.1%	70.1%	36.7%	27.8%
Choice Set #5				
1 = Choose "Option A"	21.2%	27.4%	1.3%	21.6%
2 = Choose "Option B"	34.2%	34.7%	78.3%	39.1%
3 = Choose "Option C"	44.6%	38.0%	20.4%	39.4%
Choice Set #6				
1 = Choose "Option A"	8.6%	16.7%	69.0%	16.2%
2 = Choose "Option B"	64.3%	29.9%	3.8%	43.6%
3 = Choose "Option C"	27.2%	53.4%	27.2%	40.2%
Choice Set #7				
1 = Choose "Option A"	8.5%	5.6%	8.3%	20.2%
2 = Choose "Option B"	23.1%	23.3%	21.2%	56.3%
3 = Choose "Option C"	68.5%	71.2%	70.5%	23.5%
Choice Set #8				
1 = Choose "Option A"	23.5%	36.1%	0.5%	21.9%
2 = Choose "Option B"	28.8%	27.1%	82.2%	36.3%
3 = Choose "Option C"	47.7%	36.9%	17.3%	41.9%
Choice Set #9				
1 = Choose "Option A"	15.2%	11.7%	68.0%	23.4%
2 = Choose "Option B"	54.3%	72.2%	11.4%	42.1%
3 = Choose "Option C"	30.5%	16.1%	20.6%	34.5%
Choice Set #10				
1 = Choose "Option A"	45.9%	27.3%	23.5%	32.4%
2 = Choose "Option B"	39.4%	27.5%	21.0%	34.3%
3 = Choose "Option C"	14.7%	45.3%	55.5%	33.2%

Table B1 continued on page 53

Table B1 continued from page 52

Choice Set	Respondent Country			
	Canada	United States	Japan	Mexico
Choice Set #11				
1 = Choose "Option A"	63.3%	77.2%	20.6%	30.7%
2 = Choose "Option B"	2.3%	1.8%	7.3%	37.3%
3 = Choose "Option C"	34.4%	21.0%	72.1%	32.0%
Choice Set #12				
1 = Choose "Option A"	18.6%	18.2%	9.7%	57.8%
2 = Choose "Option B"	19.3%	19.7%	66.5%	19.5%
3 = Choose "Option C"	62.2%	62.0%	23.8%	22.7%
Choice Set #13				
1 = Choose "Option A"	82.0%	28.8%	41.9%	41.1%
2 = Choose "Option B"	2.2%	45.8%	2.9%	25.7%
3 = Choose "Option C"	15.8%	25.4%	55.2%	33.2%
Choice Set #14				
1 = Choose "Option A"	0.6%	2.5%	7.5%	44.9%
2 = Choose "Option B"	81.0%	55.4%	41.9%	29.6%
3 = Choose "Option C"	18.4%	42.1%	50.7%	25.5%
Choice Set #15				
1 = Choose "Option A"	0.9%	4.3%	50.4%	12.8%
2 = Choose "Option B"	87.9%	61.9%	28.5%	57.6%
3 = Choose "Option C"	11.2%	33.8%	21.2%	29.6%
Choice Set #16				
1 = Choose "Option A"	76.4%	49.8%	25.6%	43.0%
2 = Choose "Option B"	5.5%	9.5%	44.0%	22.6%
3 = Choose "Option C"	18.2%	40.7%	30.5%	34.4%
Choice Set #17				
1 = Choose "Option A"	31.0%	35.2%	51.2%	28.5%
2 = Choose "Option B"	13.7%	8.6%	36.2%	25.7%
3 = Choose "Option C"	55.3%	56.2%	12.7%	45.8%
Choice Set #18				
1 = Choose "Option A"	47.8%	60.6%	16.6%	32.1%
2 = Choose "Option B"	12.8%	16.4%	5.9%	27.9%
3 = Choose "Option C"	39.4%	23.1%	77.5%	40.0%
Choice Set #19				
1 = Choose "Option A"	10.1%	14.9%	16.5%	51.5%
2 = Choose "Option B"	70.4%	40.7%	28.5%	26.7%
3 = Choose "Option C"	19.6%	44.4%	55.0%	21.9%
Choice Set #20				
1 = Choose "Option A"	65.1%	82.3%	21.9%	21.5%
2 = Choose "Option B"	8.3%	5.8%	19.6%	59.5%
3 = Choose "Option C"	26.7%	11.9%	58.5%	19.0%
Choice Set #21				
1 = Choose "Option A"	17.7%	17.8%	18.0%	39.5%
2 = Choose "Option B"	16.5%	14.7%	17.6%	40.8%
3 = Choose "Option C"	65.9%	67.5%	64.4%	19.7%

Appendix C: Statistical Models used to Analyze Beef Preferences

The initial sets of models estimated typically are referred to as conditional logit models. The conditional logistic models consumer random utility (U). More specifically, the utility of alternative j , in choice situation t , is given by:

$$U_{jt} = \mathbf{B} * \mathbf{V}_{jt} + \varepsilon_{jt} \quad (1)$$

where \mathbf{B} is the vector of coefficients to estimate, \mathbf{V}_{jt} is the systematic, observable portion of the consumer's utility function and ε_{jt} is the stochastic error characteristic of logit models, independently and identically distributed over all alternatives and choice situations.

Assuming the observable portion of utility is linear in parameters, we specify \mathbf{V}_{jt} separately for each of the three available alternatives (two steak alternatives and the none option):

$$\mathbf{V}_{jt} = \mathbf{b}_0 (\mathbf{P}_{jt}) + \mathbf{b}_1 (\mathbf{Canada}_{jt}) + \mathbf{b}_2 (\mathbf{US}_{jt}) + \mathbf{b}_3 (\mathbf{Japan}_{jt}) + \mathbf{b}_4 (\mathbf{Natural}_{jt}) + \mathbf{b}_5 (\mathbf{AssuredTender}_{jt}) + \mathbf{b}_6 (\mathbf{EnhancedFS40}_{jt}) + \mathbf{b}_7 (\mathbf{EnhancedFS80}_{jt}) \quad \forall j = \mathbf{A}, \mathbf{B} \quad (2)$$

$$\mathbf{V}_{jt} = \mathbf{b}_8 \quad j = \mathbf{C} \quad (3)$$

where \mathbf{P}_{jt} is the price of alternative j in choice situation t ; \mathbf{Canada}_{jt} , \mathbf{US}_{jt} , and \mathbf{Japan}_{jt} are dummy variables equal to one if the alternative is labeled to originate from Canada, the United States, or Japan, respectively (0 otherwise); $\mathbf{Natural}_{jt}$, $\mathbf{AssuredTender}_{jt}$, $\mathbf{EnhancedFS40}_{jt}$, and $\mathbf{EnhancedFS80}_{jt}$ denote dummy variables equal to one if the alternative is labeled as being naturally produced, assured to be tender, 40 percent enhanced food safety, and 80 percent enhanced food safety, respectively (0 otherwise); b_k ($k=0, 1, \dots, 8$) are parameters to be estimated.

We estimated a conditional logit model for each individual survey respondent. This results in a coefficient vector specific to each consumer. In our utilization, the conditional logit is being used as an input in building up to our subsequent use of a more complex model to be estimated over sets of consumers.

The second step conducted was a disjoint cluster analysis using the individual consumer-specific coefficients of the conditional logit. Cluster analysis provides a method of identifying marketing segments. Here the cluster analysis uses the estimates obtained from the conditional logit models and groups respondents into segments with similar coefficients. This process groups consumers with relatively homogeneous preferences based on similarities in their utility functions, as revealed by values of each \mathbf{b}_k from the conditional logit models. While the process of determining exactly how many clusters exist and the specific technique to use is somewhat subjective, here we utilized a flexible approach in SAS referred to as PROC FASTCLUS. The PROC FASTCLUS procedure was first used to form up to 25 clusters within each country group, after eliminating outliers defined as clusters with fewer than five consumers. The FASTCLUS procedure starts by forming a set of cluster starting points and assigns each consumer utility valuation observation (set of conditional logit model estimates) to the nearest cluster starting point. Then each cluster is updated such that the reference point of each cluster is its current mean. The process continues until there is sufficiently little change across iterations. The procedure ends by converging to describe a set of clusters. This process assigns each consumer to a particular cluster, hence further segmenting the data from the original aggregated country level.

Summary statistics of size of these clusters and summary statistics of demographic variable of consumers in each cluster are presented in tables G8 and C1a-C1d, respectively.

The final model estimation step was to estimate a set of random parameters logit models both for each cluster group and for each aggregate, country-of-residence based group. The random parameters logit (RPL) model has several similarities to the conditional logit model specification previously noted. The most notable difference is that the preference for each steak attribute is allowed to vary across consumers. This facilitates the ability to directly estimate heterogeneity in consumer preferences. Other benefits include more proper econometric incorporation of the fact that multiple observations are obtained for each individual survey participant.

Specification of the random parameters logit model, given the utility of alternative j , for individual i , in choice situation t , is:

$$\mathbf{U}_{ijt} = \mathbf{B}_i * \mathbf{V}_{ijt} + [\mathbf{N}_{ij} + \varepsilon_{ijt}] \quad (4)$$

where \mathbf{B}_i is the coefficient vector to be estimated, \mathbf{V}_{ijt} is the systematic, observable portion of the consumer's utility function, \mathbf{N}_{ij} is an error term distributed normally over individuals and alternatives and identically distributed over choice situations, and ε_{ijt} is the stochastic error characteristic of logit models and is independently and identically distributed over all individuals, alternatives, and choice situations.

Assuming the observable portion of utility is linear in parameters, we specify \mathbf{V}_{ijt} separately for each of the three available alternatives (two steak alternatives and the none option):

$$\mathbf{V}_{ijt} = \mathbf{b}_{i0} (\mathbf{P}_{it}) + \mathbf{b}_{i1} (\mathbf{Canada}_{jt}) + \mathbf{b}_{i2} (\mathbf{US}_{jt}) + \mathbf{B}_{i3} (\mathbf{Japan}_{jt}) + \mathbf{b}_{i4} (\mathbf{Natural}_{jt}) + \mathbf{b}_{i5} (\mathbf{AssuredTender}_{jt}) + \mathbf{b}_{i6} (\mathbf{EnhancedFS40}_{jt}) + \mathbf{b}_{i7} (\mathbf{EnhancedFS80}_{jt}) \quad \forall j = \mathbf{A}, \mathbf{B} \quad (5)$$

$$\mathbf{V}_{ijt} = \mathbf{b}_{i8} + \mathbf{b}_{i9} (\mathbf{Female}_i) + \mathbf{b}_{i10} (\mathbf{Age}_i) + \mathbf{b}_{i11} (\mathbf{Income}_i) + \mathbf{b}_{i12} (\mathbf{Education}_i) + \mathbf{b}_{i13} (\mathbf{BeefConsFreq}_i) \quad j = \mathbf{C} \quad (6)$$

where the variables in equation (5) are defined as in equation (2); **Female_i**, **Age_i**, **Income_i**, and **Education_i** are demographic variables as defined in table 1; **BeefConsFreq_i** is the frequency of beef consumption as shown in Table 3 (e.g., **BeefConsFreq_i = 1** implies never consuming while **BeefConsFreq_i = 6** reflects at least 4 times per week); and \mathbf{b}_{ik} ($k=0, 1, \dots, 13$) are parameters to be estimated.

In addition, each steak attribute coefficient ($\mathbf{b}_{ik} \quad \forall k = 0, 1, \dots, 7$) is assumed to be normally distributed. This introduces preference heterogeneity across consumers into the model. In particular, the RPL estimates both the mean and standard deviation of the steak attributes being evaluated (see tables C2a-C2d). Conversely, the conditional logit only estimates a mean coefficient across individuals and implicitly assumes this coefficient adequately reflects each individual's preferences. If the standard deviation parameters are significant, evidence is said to exist suggesting notable preference heterogeneity for the evaluated attribute(s). While the conditional logit (described by equations 1-3) was estimated for individual consumers, the random parameters logit is estimated over a set of individuals.

Results of estimating the random parameters logit models for each country-based, aggregated consumer group are provided in tables C2a-C2d. Likelihood ratio tests suggest that each of these presented models was preferred to alternative models not presented here including nested logit models using the same variables as the presented models and traditional conditional logit models as presented in equations (1) – (3).

As noted previously, direct interpretation of logit model coefficients has limited value. However, the set of parameter estimates allows us to estimate the value that consumers place on

various steak attributes. To develop these estimates, we calculate the price change that must occur to an observed, preferable steak in order to make it equally desirable to the originally, less-preferred steak. Or described differently, we adjust price until the utility of consuming steaks with and without the evaluated attribute is equal. Once this price adjustment is derived, we can interpret the price difference as the average consumer's willingness to pay to avoid or obtain the steak attribute at hand.

We should also note that significant terms routinely persist in the Cholesky matrices of the estimated RPL models. This suggests significant correlation across the model parameters. In the context of this study this confirms dependence in the pattern of taste variation over the set of attributes. This suggests that inferences on preferences for individual attributes need to be based upon the joint set of parameters, rather than on individual coefficients. Furthermore, proper evaluation of preferences for bundles of attributes needs to incorporate this correlation information. To accomplish this, we simulate tastes preferences using the mean coefficient estimates of the model, estimates of the Cholesky matrix, and the assumed normal distribution of the random parameters. More specifically, a vector of 9 normally distributed values can be simulated as: $\mathbf{\hat{\beta}} + \mathbf{C}\mathbf{\hat{a}}$, where $\mathbf{\hat{\beta}}$ is the 9 by 1 vector of model coefficients, \mathbf{C} is the estimated 9 by 9 Cholesky matrix, and $\mathbf{\hat{a}}$ is a 9 by 1 vector of standard normal deviates. A large number of vectors can be simulated to approximate the probability of any combination of preferences. All willingness to pay distributions (such as those presented in Figure 3 and underlying the calculation of those with positive WTP presented in Table 25) are derived through simulation of 10,000 taste preference estimates.

Our in-text discussion and presentation of WTP premiums reflect only a subset of the estimated models discussed to here. In particular, for each of the four countries, we identified a *preferred* model that we most believe describes consumers in these countries. More specifically, note that the cluster analysis allows us to better isolate individuals with extreme preferences. Such preferences may correspond to survey participants failing to completely understand the choice experiment, the existence of hypothetical bias, or other factors. As such, our in-text WTP discussion centers on *preferred* models believed to best account for these extreme preferences as opposed to simply using all survey respondents. These models were subjectively chosen from those presented below in tables C2a-C2d and C3. In particular, the WTP estimates in Table C3 suggest that model estimates for Canadian consumers in clusters 1 and 2, U.S. consumers in Cluster 2, Japanese consumers in cluster 3, and Mexican consumers in clusters 1 and 2 are all suspect. For instance, it is likely not reasonable to think that the average consumer in Canadian cluster #3 is willing to pay \$139 more for a Canadian produced steak than for a Mexican produced steak. Furthermore, of the four models (labeled as the *Pooled* models in Table C3), only the U.S. model seems reasonable. While these judgments of reasonability are subjectively made on our part, only the *preferred* models are further discussed in our in-text presentation. We do however include all estimated RPL models and associated WTP values in the appendix for reference.

Table C1a. Demographic Variable Summary Statistics By Cluster: CANADA Clusters

Variable	Cluster 1 (n=100)		Cluster 2 (n=616)		Cluster 3 (n=286)		Chi-Square ^a p-values
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Demographic Variables</i>							
Female	0.60	0.49	0.50	0.50	0.53	0.50	0.18
Age	47.58	11.94	47.27	13.07	48.29	13.05	0.91
Education	3.04	0.94	2.98	0.93	2.95	0.93	0.75
Income	3.43	1.21	3.15	1.29	3.24	1.32	0.86

^a P-values correspond to Chi-squared tests of hypothesis that each demographic factor does not vary across the three clusters.

Table C1b. Demographic Variable Summary Statistics By Cluster: U.S. Clusters

Variable	Cluster 1 (n=109)		Cluster 2 (n=756)		Cluster 3 (n=144)		Chi-Square ^a p-values
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Demographic Variables</i>							
Female	0.83	0.38	0.82	0.38	0.83	0.37	0.97
Age	46.72	12.95	49.65	13.42	46.73	13.41	0.26
Education	3.49	1.05	3.26	0.99	3.28	1.01	0.05
Income	3.43	1.42	3.18	1.47	3.19	1.50	0.39

^a P-values correspond to Chi-squared tests of hypothesis that each demographic factor does not vary across the three clusters.

Table C1c. Demographic Variable Summary Statistics By Cluster: JAPAN Clusters

Variable	Cluster 1 (n=41)		Cluster 2 (n=158)		Cluster 3 (n=802)		Chi-Square ^a p-values
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Demographic Variables</i>							
Female	0.38	0.49	0.49	0.50	0.50	0.50	0.38
Age	42.15	12.45	40.01	12.25	42.33	11.79	0.94
Education	2.92	1.07	3.19	1.01	3.16	1.01	0.41
Income	2.38	1.41	2.47	1.43	2.48	1.35	0.63

Table C1d. Demographic Variable Summary Statistics By Cluster: MEXICO Clusters

Variable	Cluster 1 (n=80)		Cluster 2 (n=93)		Cluster 3 (n=820)		Chi-Square ^a p-values
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Demographic Variables</i>							
Female	0.64	0.48	0.80	0.40	0.82	0.39	0.00
Age	30.60	11.36	35.57	13.16	30.61	11.79	0.02
Education	2.88	1.28	2.95	1.10	2.74	1.25	0.07
Income	2.10	0.98	2.23	0.97	1.98	0.97	0.15

^a P-values correspond to Chi-squared tests of hypothesis that each demographic factor does not vary across the three clusters.

Table C2a. Random Parameters Logit Model Estimation Results: Canadian Consumers

Variable	Pooled (n=1002)		Cluster 1 (n=100)		Cluster 2 (n=616) ^a		Cluster 3 (n=286)	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
<i>Mean Estimate of Variables:</i>								
Price	-0.3166	0.0000	-0.0782	0.0635	-0.3904	0.0000	-0.0663	0.0000
Canada	7.4882	0.0000	6.4994	0.0000	5.9746	0.0000	7.8439	0.0000
United States	4.5352	0.0000	4.3999	0.0000	3.3192	0.0000	4.9682	0.0000
Japan	0.9456	0.0000	1.2021	0.0409	-0.1923	0.1799	1.9426	0.0000
Natural	0.1014	0.0674	1.4934	0.0000	-0.2797	0.0007	-0.1488	0.1904
40% FS Enhancement	0.8180	0.0000	3.0100	0.0000	0.7165	0.0000	-0.4406	0.0008
80% FS Enhancement	1.8655	0.0000	4.0071	0.0000	1.5113	0.0000	0.2532	0.0982
Assured Tender	0.9380	0.0000	1.4370	0.0003	0.5237	0.0000	2.2444	0.0000
None	-0.2602	0.2877	5.2945	0.0130	-0.6937	0.1147	6.3480	0.0000
Female	1.7976	0.0000	0.0287	0.9756	0.9387	0.0000	0.1613	0.4153
Age	0.0745	0.0000	0.0661	0.0145	0.0491	0.0000	-0.0087	0.1765
Income	-0.0835	0.0044	0.1894	0.5018	-1.0118	0.0000	-0.3313	0.0000
Education	-1.0716	0.0000	-1.2665	0.0024	-0.0435	0.5535	-0.1943	0.0534
BeefConsFreq	-1.0544	0.0000	-0.3675	0.1907	-1.0338	0.0000	-0.2428	0.0006

Standard Deviation Estimate of Normally Distributed Random Variables:

Price	0.5139	0.0000	0.2284	0.0000	0.3431	0.0000	0.2045	0.0000
Canada	4.1255	0.0000	4.2492	0.0000	3.3936	0.0000	4.3007	0.0000
United States	2.9966	0.0000	3.5907	0.0000	2.1075	0.0000	3.3672	0.0000
Japan	1.3838	0.0000	3.8147	0.0000	1.2195	0.0000	2.3327	0.0000
Natural	1.1357	0.0000	2.0340	0.0000	0.9556	0.0000	1.2958	0.0000
40% FS Enhancement	1.2542	0.0000	1.4317	0.0030	0.8222	0.0000	0.9323	0.0000
80% FS Enhancement	2.4570	0.0000	2.7360	0.0000	1.9903	0.0000	1.7371	0.0000
Assured Tender	0.7382	0.0000	1.3663	0.0011	0.6690	0.0000	1.4513	0.0000
None	6.2311	0.0000	5.0932	0.0000	6.0592	0.0000	3.5102	0.0000

^a denotes the preferred model.

Table C2b. Random Parameters Logit Model Estimation Results: U.S. Consumers

Variable	Pooled (n=1009)		Cluster 1 (n=109)		Cluster 2 (n=756)		Cluster 3 (n=144) ^a	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
<i>Mean Estimate of Variables:</i>								
Price	-0.2855	0.0000	-0.8672	0.0000	-0.1579	0.0000	-0.6767	0.0000
Canada	0.7580	0.0000	2.5920	0.0000	3.1380	0.0000	0.0769	0.6931
United States	1.8737	0.0000	4.0229	0.0000	5.5935	0.0000	3.1198	0.0000
Japan	0.4663	0.0000	0.6031	0.2015	1.1704	0.0000	-1.4836	0.0000
Natural	-0.6447	0.0000	-1.4592	0.0000	-0.0072	0.9256	-0.4005	0.0772
40% FS Enhancement	1.0092	0.0000	-0.1926	0.4186	0.2597	0.0031	2.0560	0.0000
80% FS Enhancement	1.5164	0.0000	0.9947	0.0087	0.8223	0.0000	3.2129	0.0000
Assured Tender	2.1810	0.0000	0.9324	0.0000	0.8955	0.0000	3.4110	0.0000
None	-2.2757	0.0000	-6.3520	0.0227	2.4368	0.0000	-3.2267	0.0043
Female	0.3647	0.0000	-0.8608	0.4610	0.6950	0.0000	2.0439	0.0002
Age	0.0538	0.0000	0.0439	0.2082	0.0091	0.0000	0.0414	0.0008
Income	-0.1550	0.0000	-0.1914	0.5166	-0.0235	0.0295	0.5191	0.0003
Education	-0.2784	0.0000	-0.5874	0.3393	-0.1875	0.0000	-3.0850	0.0000
BeefConsFreq	-0.4025	0.0000	-0.9597	0.0432	-0.1954	0.0000	-2.3581	0.0000

Standard Deviation Estimate of Normally Distributed Random Variables:

Price	0.0003	0.0000	0.4771	0.0000	0.0001	0.0000	0.4351	0.0000
Canada	1.0538	0.0000	1.5536	0.0001	2.3926	0.0000	0.5998	0.0322
United States	2.1155	0.0000	2.3850	0.0000	3.4594	0.0000	2.7860	0.0000
Japan	1.4962	0.0000	2.0437	0.0001	2.6320	0.0000	2.6062	0.0000
Natural	1.0403	0.0000	1.2708	0.0007	1.2423	0.0000	1.6479	0.0000
40% FS Enhancement	1.1096	0.0000	0.8181	0.0357	0.9211	0.0000	1.4496	0.0000
80% FS Enhancement	1.4865	0.0000	1.0859	0.0039	1.6210	0.0000	2.2761	0.0000
Assured Tender	2.1095	0.0000	0.5476	0.1441	0.6177	0.0000	1.9423	0.0000
None	2.4325	0.0000	4.8661	0.0000	4.1041	0.0000	7.1065	0.0000

^a denotes the preferred model.

Table C2c. Random Parameters Logit Model Estimation Results: Japan Consumers

Variable	Pooled (n=1001)		Cluster 1 (n=41)		Cluster 2 (n=158) ^a		Cluster 3 (n=802)	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
<i>Mean Estimate of Variables:</i>								
Price	-0.1013	0.0000	Not Converged		-0.8578	0.0000	-0.1304	0.0000
Canada	1.3229	0.0000			0.4928	0.0028	1.1378	0.0000
United States	-1.4016	0.0000			-3.0531	0.0000	-1.8938	0.0000
Japan	5.3186	0.0000			3.2978	0.0000	5.7057	0.0000
Natural	-0.2339	0.0000			-1.0640	0.0000	0.1560	0.0298
40% FS Enhancement	0.0848	0.1412			0.1230	0.5635	-0.1875	0.0198
80% FS Enhancement	1.0815	0.0000			1.0900	0.0000	0.8736	0.0000
Assured Tender	0.7529	0.0000			0.4894	0.0129	0.5297	0.0000
None	-1.4777	0.0000			-5.5200	0.0000	-0.0382	0.8489
Female	1.1131	0.0000			-0.5126	0.2570	0.7385	0.0000
Age	0.0092	0.0078			-0.0064	0.7062	0.0257	0.0000
Income	-0.2013	0.0000			0.0313	0.8410	-0.1284	0.0000
Education	-0.0093	0.8125			-0.5200	0.0159	0.1573	0.0000
BeefConsFreq	-0.7441	0.0000			-0.1600	0.3935	-0.3872	0.0000
<i>Standard Deviation Estimate of Normally Distributed Random Variables:</i>								
Price	0.2936	0.0000			0.4291	0.0000	0.0001	0.0000
Canada	1.6842	0.0000			0.9759	0.0000	1.8102	0.0000
United States	3.4014	0.0000			3.9318	0.0000	2.3895	0.0000
Japan	3.5069	0.0000			2.1550	0.0000	2.7112	0.0000
Natural	0.8687	0.0000			1.0017	0.0000	0.7036	0.0000
40% FS Enhancement	0.7352	0.0000			1.1376	0.0000	0.7649	0.0000
80% FS Enhancement	1.1267	0.0000			1.3235	0.0000	0.8322	0.0000
Assured Tender	0.4653	0.0000			0.8579	0.0000	0.3945	0.0000
None	4.5766	0.0000			4.1187	0.0000	3.0812	0.0000

^a denotes the preferred model.

Table C2d. *Random Parameters Logit Model Estimation Results: Mexico Consumers*

Variable	Pooled (n=993)		Cluster 1 (n=80)		Cluster 2 (n=93) ^a		Cluster 3 (n=820)	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
<i>Mean Estimate of Variables:</i>								
Price	-0.0442	0.0000	-0.1304	0.0000	-0.6387	0.0000	-0.0383	0.0000
Canada	-0.8513	0.0000	-2.5951	0.0000	-2.4502	0.0000	-0.8813	0.0000
United States	-1.2007	0.0000	-2.2420	0.0000	-3.8362	0.0000	-1.2005	0.0000
Japan	-1.5254	0.0000	-4.5727	0.0000	-6.9230	0.0000	-1.6808	0.0000
Natural	0.0455	0.2977	-0.3751	0.1671	-0.1975	0.4604	0.2089	0.0000
40% FS Enhancement	-0.0639	0.3044	2.0770	0.0000	-0.3670	0.1433	0.1126	0.0052
80% FS Enhancement	0.1842	0.0027	3.3642	0.0000	-0.1734	0.6969	0.3600	0.0000
Assured Tender	0.1641	0.0004	2.3003	0.0000	0.3965	0.1778	0.3746	0.0000
None	-1.7509	0.0000	-4.1325	0.0228	-5.6095	0.0127	-1.6639	0.0000
Female	0.3691	0.0000	2.6682	0.0000	-2.0777	0.0222	0.3832	0.0736
Age	0.0087	0.0000	0.0864	0.0103	-0.0131	0.6698	0.0009	0.8795
Income	-0.0731	0.0000	-0.9705	0.0400	0.8411	0.1483	-0.0845	0.3231
Education	-0.0434	0.0000	-0.0103	0.9805	-0.3787	0.4210	-0.0217	0.7371
BeefConsFreq	-0.0934	0.0000	0.4702	0.4335	1.2735	0.0497	-0.1767	0.0084

Standard Deviation Estimate of Normally Distributed Random Variables:

Price	0.0001	0.0000	0.0397	0.3528	0.4145	0.0000	0.0082	0.1486
Canada	1.2879	0.0000	3.1343	0.0000	1.4181	0.0001	1.2554	0.0000
United States	1.4206	0.0000	2.5205	0.0000	1.9116	0.0001	1.3347	0.0000
Japan	1.6234	0.0000	4.3796	0.0000	3.7562	0.0000	1.8617	0.0000
Natural	0.6061	0.0000	1.2963	0.0001	0.7835	0.0008	0.3031	0.0000
40% FS Enhancement	0.9107	0.0000	0.8118	0.1493	0.4581	0.2325	0.2916	0.0000
80% FS Enhancement	0.9056	0.0000	1.6377	0.0001	1.6850	0.0032	0.5219	0.0000
Assured Tender	0.7665	0.0000	2.0851	0.0000	1.0780	0.0006	0.6343	0.0000
None	1.6573	0.0000	4.3669	0.0000	3.4179	0.0000	2.2931	0.0000

^a denotes the preferred model.

Table C3. Marginal Willingness-to-Pay (WTP) Estimates by Aggregate and Cluster Groups

	Canadian Consumers				U.S. Consumers			
	Pooled	Cluster1	Cluster2 ^a	Cluster3	Pooled	Cluster1	Cluster2	Cluster3 ^a
Canada	27.82	97.84	18.00	139.15	3.12	3.52	23.38	0.13
United States	16.85	66.24	10.00	88.14	7.72	5.46	41.67	5.42
Japan	3.51	18.10	-0.58	34.46	1.92	0.82	8.72	-2.58
Natural	0.38	22.48	-0.84	-2.64	-2.66	-1.98	-0.05	-0.70
40% FS Enhancement	3.04	45.31	2.16	-7.82	4.16	-0.26	1.93	3.57
80% FS Enhancement	6.93	60.32	4.55	4.49	6.25	1.35	6.13	5.59
Assured Tender	3.49	21.63	1.58	39.81	8.99	1.26	6.67	5.93

	Japanese Consumers				Mexican Consumers			
	Pooled	Cluster1	Cluster2 ^a	Cluster3	Pooled	Cluster1	Cluster2 ^a	Cluster3
Canada	15.36	NC	0.68	10.27	-22.66	-23.42	-4.51	-27.10
United States	-16.27		-4.19	-17.09	-31.97	-20.23	-7.07	-36.92
Japan	61.76		4.52	51.48	-40.61	-41.26	-12.75	-51.69
Natural	-2.72		-1.46	1.41	1.21	-3.38	-0.36	6.42
40% FS Enhancement	0.98		0.17	-1.69	-1.70	18.74	-0.68	3.46
80% FS Enhancement	12.56		1.49	7.88	4.90	30.36	-0.32	11.07
Assured Tender	8.74		0.67	4.78	4.37	20.76	0.73	11.52

- These WTP values are point estimates of average WTP for each individual attribute. They are derived from RPL models using all consumer observations in each country (Pooled) and each cluster (Cluster 1, 2, and 3) (see tables C2a-C2d). Each estimate is presented in \$CAN/lb. NC notes that the underlying RPL model failed to converge. a denotes the preferred model of each country-based consumer group.

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In each case, credit Ted Schroeder et al., *Consumer Risk Perceptions and Attitudes about Beef Food Safety: Implications for Improving Supply Chain Management*, Kansas State University, November 2006.

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