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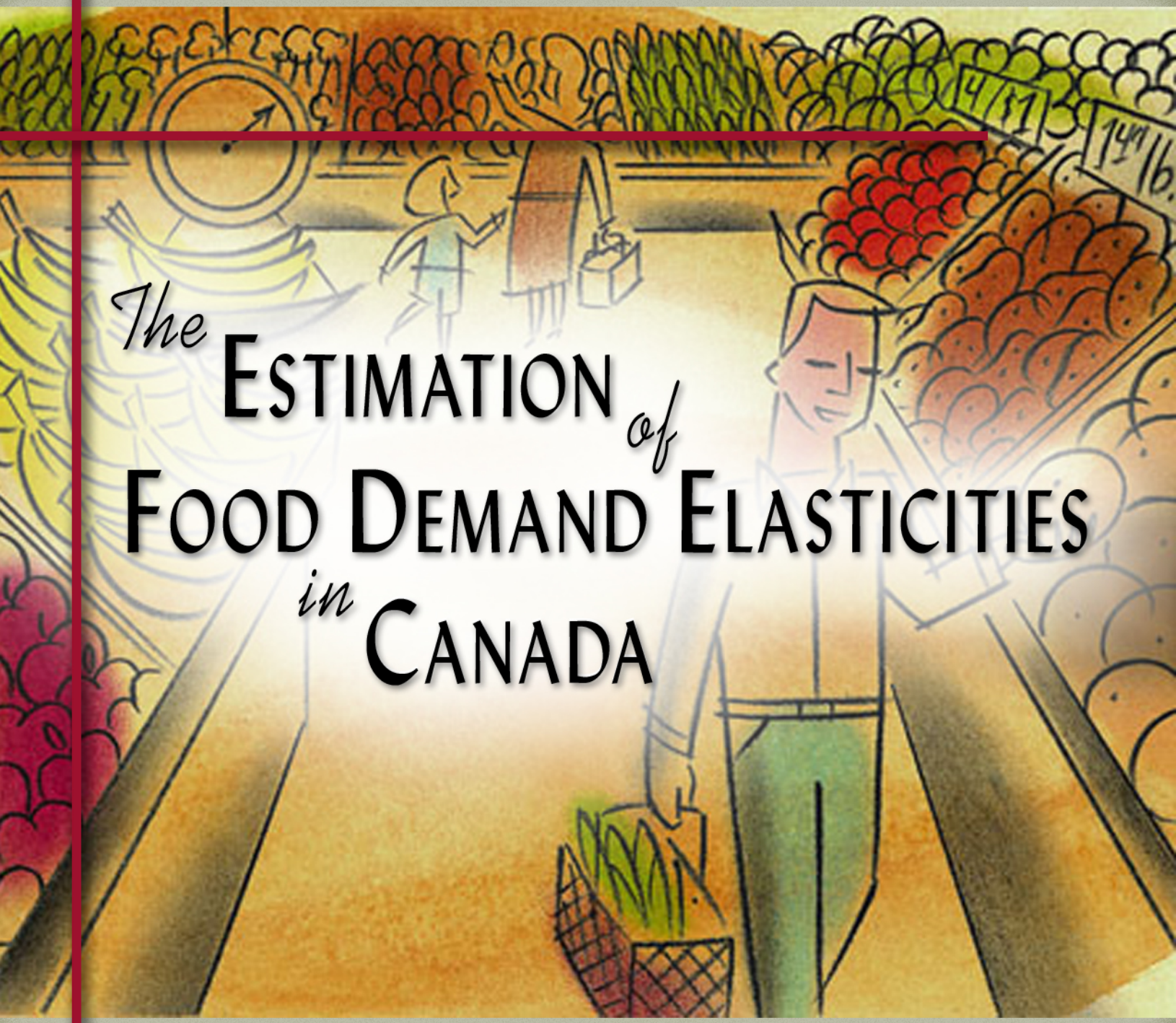

The Estimation of Food Demand Elasticities in Canada

Canada

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Foreword

Changing consumer and market demands have been identified as an important driver behind the challenges and opportunities that are facing the agriculture and agri-food sector in Canada and that will influence the sector's profitability and competitiveness in the future. It is therefore important to understand developments in the consumer demand for agriculture and agri-food products. For example, consumers are increasingly willing to pay for increased convenience in the food items they purchase, such as ready-to-eat meals from grocery stores. They are also interested in the health benefits of food items as they become more concerned about their health and wellness. For both industry, which is concerned about maintaining its competitiveness, and government, which is trying to promote the competitiveness of the industry as it develops policies for the sector, it is key to understand consumer behaviour relative to the demand for food.

In this context, this paper was developed in an attempt to make use of up-to-date information, i.e. data from the 2001 Family Food Expenditure Survey, to update demand elasticities for food in Canada. Demand elasticities, in the economic literature, quantify the responsiveness of consumers and consumer demand to changes in prices and income and other variables of a given food commodity. They are therefore useful for conducting analysis of the changing structure of the agriculture and agri-food sector and can help quantify the impacts that changes in economic variables and policies that impact those economic variables might have. The last time empirical estimates of elasticities were developed at AAFC was in 1993. This paper is a welcome addition to the consumer demand for food literature in Canada.

The report begins with a description of changing trends in many of the demographic and economic variables that impact the consumer demand for food and food products in Canada, including disposable income, household size, type and age of household head. A literature review provides some background as to the type of research that has been conducted in the past and the results of this research. Then the report presents a description of the data that is used in the empirical analysis, from the Family Food Expenditure Survey. It goes on to describe a modified version of an Almost Ideal Demand System (AIDS) model that is used to estimate demand elasticities. The paper concludes with the empirical results and a comparison with other results that have been estimated at AAFC and elsewhere. It is clear from the results that there are differences across commodities in terms of the responsiveness of consumers to changes in prices and income. In addition, there have been changes over time in this responsiveness. For example,

according to the study, the demand for beef is less responsive to changes in own prices than for chicken, and this has fallen over time. Pork and fish have also shown a decline in price responsiveness. Knowing the price responsiveness allows us to anticipate the impact of market developments and policy changes on both the welfare and performance of the agriculture and agri-food sector and on Canadian consumers.

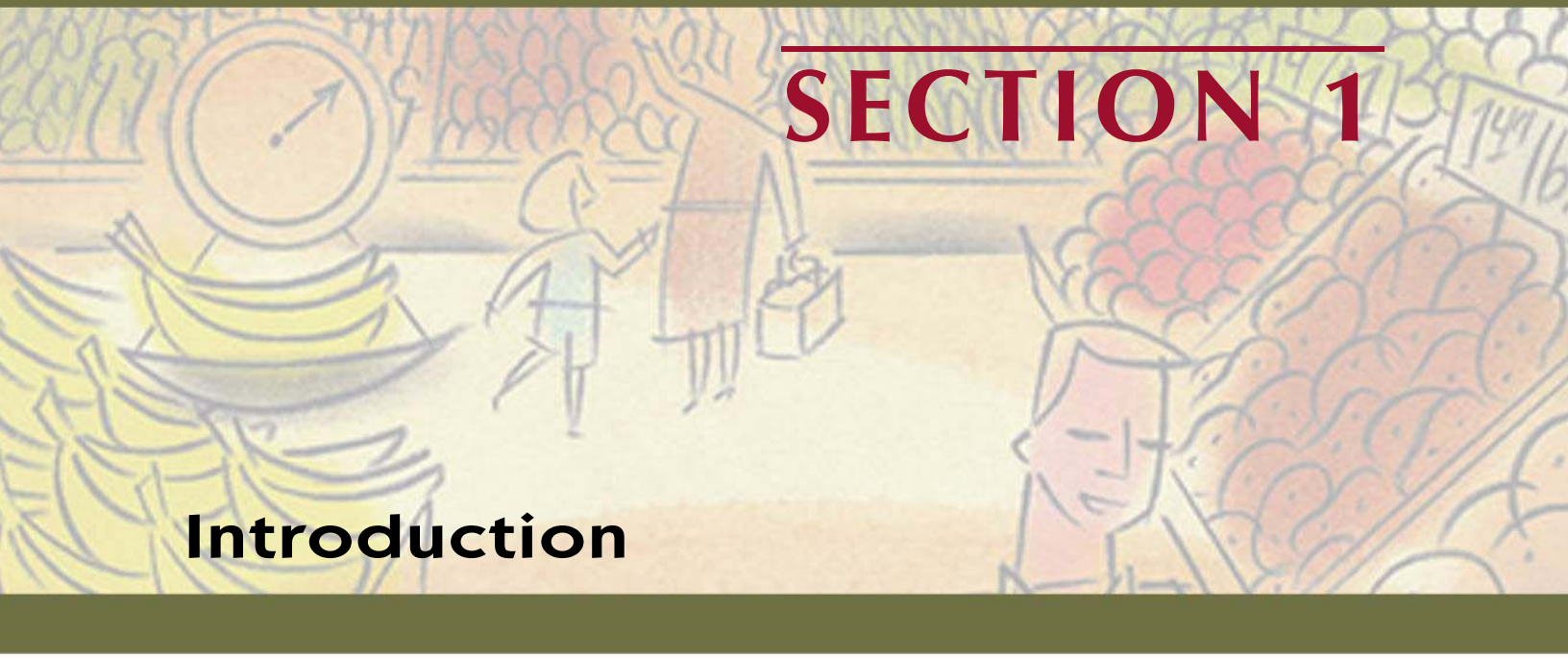
Executive summary

The objective of this paper is to estimate demand elasticities for food in Canada using the Food Expenditure Survey (FOODEX) data. To enrich the analysis, recent trends in food consumption and expenditure in Canada are identified and incorporated in the modeling of consumer demand.

For the purpose of this study we aggregated the 246 food categories in the FOODEX into 14 food groups that include: beef, pork, poultry, other meat, fish, dairy, eggs, bakery, cereal and pasta products, fruit, vegetables, fats and oils, other food, and non-alcoholic beverages.

In the FOODEX data commodity prices were not recorded, we instead used unit values (defined as the ratio of expenditure to quantity) in place of market prices. Since unit values reflect both market prices and consumer choices of food quality, we adjusted the elasticity estimates, as in Deaton (1988) and Huang and Lin (2001), to exclude the food quality effects. With this adjustment we obtained a complete set of demand information that include own and cross price elasticities, as well as, expenditure elasticities.

Results appear to be consistent with economic theory. Own price elasticities are negative and less than 1 with the exception of other foods. The demand for poultry, other meat, dairy, fruit, non-alcoholic beverages and other food were more price elastic than the rest of the food groups, with elasticities ranging from -0.81 to -1.14 and all are significant at a 5 percent confidence level. Cross price elasticities are also within the acceptable range. Expenditure elasticities (both unadjusted and adjusted for food quality effects) are positive and less than 1 with the exception of fruit and vegetables.



SECTION 1

Introduction

Analysis of policy decisions related to agricultural food markets requires information about the response of consumers' demand for food commodities as prices and income change. For instance, the incentive to establish a traceability program for beef production may require the adoption of new technologies or procedures that may imply increasing costs and hence prices. By knowing demand elasticities for beef, policy makers may be able to infer the impact that the government policy on traceability would have on the demand for beef.

There are two objectives for this project. The first objective is to estimate food demand elasticities for major food groups in Canada. This includes own and cross price elasticities and income elasticities. The second objective is to identify the quality effects and the factors that influence changes in food expenditure patterns in Canada.

The rest of the paper is organized as follows: the second section summarizes recent trends in food consumption and expenditure in Canada. This is followed by a brief review of the literature on food demand modeling and estimation related to Canada. The fourth section discusses the data, data sources and data limitations. The fifth section gives a brief description of the model used in this study. The sixth section presents the empirical results, while the last section provides a summary of the analysis as well as some policy implications. Tables and bibliographies are appended at the end of the document.

SECTION 2

Demographics and the trends in food consumption and expenditure in Canada

We are interested in looking at the various demographic variables that may explain the observed changes in consumers' demand. As a result, in this section, we look at: changes in income, meals away from home, food quality, household size and type, degree of urbanization and regional factors and how they relate to food consumption in Canada. These factors will be important inputs in the modeling of consumer demand.

Changes in income

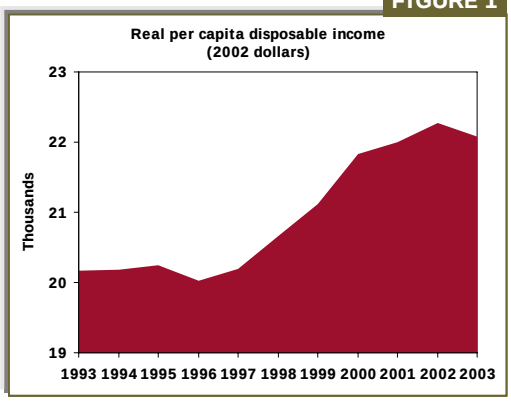
Income growth and subsequent changes in food consumption are key elements of shifts in food demand. As presented in Figure 1, per capita disposable income grew from $20,172 in 1993 to $22,082 in 2003, which represents an increase of 9.5 percent over 10 years.

As real per capita disposable income has increased, the share of personal disposable income spent on food[1] by Canadians has declined (Figure 2). In 2003 the share of disposable income spent on food reached 10.6 percent, slightly less than the 1993 level of 12.9 percent.

Over the same period of time, food prices increased by 20.4 percent, at about the same rate as the CPI for all items excluding food (Figure 3).

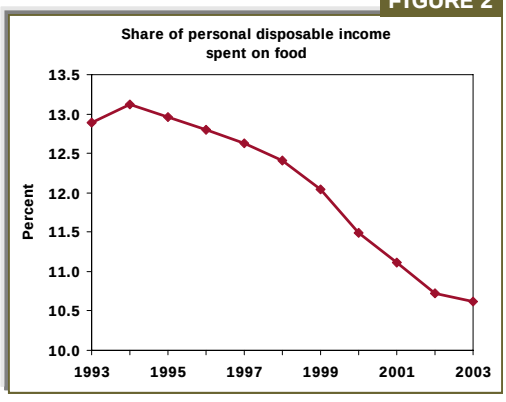
As real per capita disposable income has increased and the share of personal disposable income spent on food by Canadians has decreased, food spending patterns seem to have changed as well.

FIGURE 1



Source: Statistics Canada, CANSIM, Table No. 384-0013. Base year changed to 2002=100.

FIGURE 2



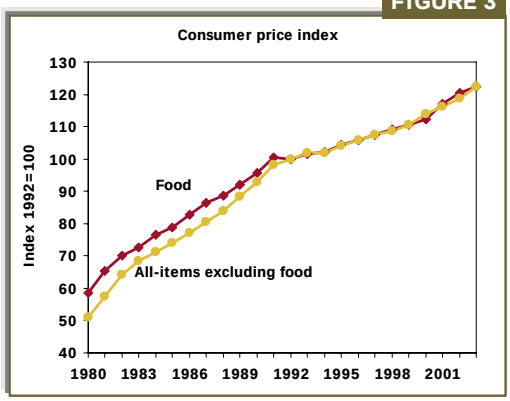
Source: Statistics Canada, Canada Food Stats 2004.

Meals away from home

Canadian food spending patterns are changing towards more convenient types of food. Canadian households are increasingly spending more on meals away from home. In 2001 for example, the share of meals away from home in the total family food expenditure reached 30.3 percent, up from 27.6 percent in 1996. Overall, from 1982 to 2001 meals away from home shows an increasing trend with a single spike in 1992[2], Figure 4.

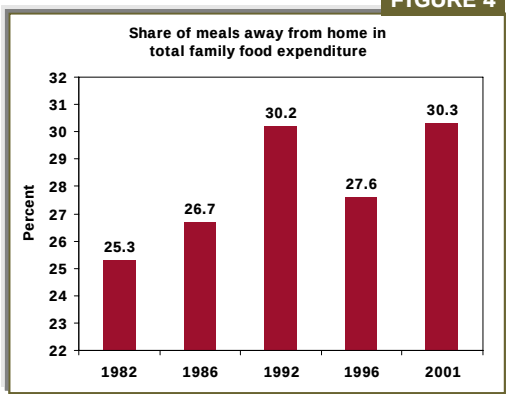
The shift in household food spending towards ready-to-eat food shows that consumers are buying food that is easy and fast to prepare. Annual growth in sales ranging from 31 to 81 percent for refrigerated entrées, frozen and refrigerated pizza, diet meat and energy bars and drinks have been recorded[3]. This seems to suggest that Canadian consumers are now increasingly looking for convenient food products.

FIGURE 3



Source: Statistics Canada, CANSIM Table No. 326-0002.

FIGURE 4



Source: Statistics Canada, Food Expenditure in Canada, Catalogue No. 62-554.

Food quality

Scientific evidence linking diet choices to health, such as dietary fat with cholesterol and transfats with heart disease among others, along with safety aspects of food consumption such as E-coli and salmonella, have increased consumer awareness and concerns.

Food components and attributes identified as key in influencing consumer perceptions for food include: information on nutrition, labelling, packaging, quality, taste, convenience and food safety in relation to the product itself and the production process. Increased health awareness by consumers has resulted in positive changes in the diets of Canadians.

According to a 2001 research study done by the National Institute of Nutrition[4] Canadians are moving towards food that is lower in fats and high in fibre. Canadians are eating leaner meat, more high fibre foods, whole grains, and fresh vegetables and fruits.

Indeed, for some food commodities, household spending seems to follow this trend. For example, the percentage of total weekly expenditure in meat per household decreased by 6.5 percentage points between 1982 and 2001 (Table 1). The same decreasing trend in food spending was

---

1. *Food, beverages and tobacco.*
2. *In this study, we found this spike unusual. According to Statistics Canada, the spike may be explained due to changes in income from 1989 to 2001. Total income and income after tax increased rapidly until 1989; then it started declining until 1993 and returned to the 1989 levels around 1999. It is believed that households may have taken a couple of years after 1989 to adjust their expenditure patterns to lower income levels.*
3. *AC Nielsen, Marketplace Performance Report/52 Weeks Ending December 29, 2001: Total Grocery, taken from the State of the Industry Report, 2002.*
4. *National Institute of Nutrition, Canadians are moving toward healthier eating. Retreat from the web site at www.nin.ca/public_html/Publications/HealthyBites/hb1_94en.html.*

observed for dairy products and eggs and fats and oils. During the same period spending on cereals and vegetables increased slightly.

Table 1: Percentage of total weekly food expenditure per household in Canada (locally and on day trips)

FOOD GROUP	1982	1986	1992	1996	2001
			Percentage		
Meat	20.5	18.5	16.3	15.7	14.0
Fish and other marine products	2.3	2.3	2.3	2.3	2.3
Dairy products and eggs	13.2	12.9	11.3	11.4	10.2
Bakery and other cereal products	9.3	9.6	10.3	11.2	10.1
Fruit and nuts	7.7	8.0	7.6	8.0	7.9
Vegetables	6.5	6.5	6.5	6.8	7.0
Fats and oils	1.4	1.1	0.9	1.0	0.8
Non-alcoholic beverages	2.4	2.9	3.2	3.3	2.7
Other food*	10.0	10.4	10.5	11.6	12.4

**Includes sugar and sugar preparations; condiments, spices and vinegar; coffee and tea; and other food, materials and food preparations.*

Source: Food Expenditure in Canada 2001, Catalogue No. 62-554-XIE.

Changes in household size and type

The composition of Canadian households has shifted over the last two decades. Food spending patterns also seem to have changed as a result.

Canadian households have become more heterogeneous and smaller, and more female household members are now part of the labour force. The average size of a Canadian household has declined gradually from 2.76 persons in 1982 to 2.57 in 2001[5]. One-fourth of this household population was made up of either one person or a lone parent; the proportion of this type of household has increased since 1992. Similarly, the participation of women aged 15 and over in the labour force continues to increase from 42 percent in 1976 to 57 percent in 2003 while the participation rate for men has stabilized at 67 percent[6].

Canadian households also seem to prefer the convenience of eating out and take out food. For instance, couples with and without children and lone parent families headed by a woman now spend more than 27 percent of every dollar spent on food in restaurants, cafeterias or take out food. This is an increase of 3 to 6 percentage points between 1996 and 2001 (Table 2).

Regional factors

Food preferences and spending patterns are also changing in urban and rural areas. Between 1996 and 2001, both rural and urban consumers allocated a bigger share of their budget towards food purchases from restaurants. For example, of every dollar spent on food purchases in 2001,

5. *Statistics Canada, Catalogue No. 62-554, Catalogue No. 62-554-XPB and Canada Food Stats CD Rom 2003.*
6. *Statistics Canada, Catalogue No. 89FO133XIE, 2003.*

rural and urban households spent 27 and 31 cents respectively on food purchases from restaurants. This is an increase of 3 cents from the 1996 share of 24 and 28 cents respectively, for rural and urban households (Table 3).

Table 2: Percentage of total weekly food expenditure for selected types of households

TYPES OF HOUSEHOLDS	AWAY FROM HOME		AT HOME	
	1996	2001	1996	2001
	Percentage			
All households	28	30	72	70
One-person	36	35	64	65
All couples	26	29	74	71
Couple without children	29	32	71	68
Couple with children*	25	28	75	72
Couple, both 65 and over	–	26	–	74
Lone-parent	23	29	77	71
Female-headed	21	27	79	73

Children of any age who are single (never married) include foster children.

Source: Food Expenditure in Canada 2001, Catalogue No. 62-554-XIE (page 10), Family Food Expenditure 1996, Catalogue No. 62-554-XPB (pages 70-79).

Table 3: Percentage of total weekly food expenditure on food purchased from restaurants and from stores

	ALL RURAL		ALL URBAN	
	1996	2001	1996	2001
Food purchased from restaurants	0.24	0.27	0.28	0.31
Food purchased from stores	0.76	0.73	0.72	0.69

Source: Family Food Expenditure in Canada 1996 and 2001, Catalogue No. 62-554-XPB and No. 62-554-XIE.

The spending patterns of urban and rural consumers across food groups seem to have also changed in the last five years. In 2001, urban and rural consumers spent less of their budget on meat, bakery, and fats and oils and more of their budget on fish, fruit, vegetables and other food than they did in 1996.

In the same period, the spending patterns on dairy products and eggs have remained stable for consumers in urban areas while decreasing for rural consumers by 7.7 percent (Table 4). The biggest percentage increase in food spending by urban consumers between 1996 and 2001 was on other foods.

Food preferences are also changing among Canadian regions (Table 5). In 2001, for example, consumers in British Columbia, Ontario and the Prairies, spent the largest share of their food budget on food purchases from restaurants. Regionally, Ontario recorded a significant increase in the share of food away from home, more than any other province in Canada. Above average disposable income in the provinces of Alberta, British Columbia and Ontario is believed to be behind the observed higher restaurant sales.[7]

Table 4: Average weekly expenditure per household by food group, (percentage change 1996-2001)

	RURAL			URBAN		
	1996	2001	% change	1996	2001	% change
Meat	18.59	18.33	-1.40	17.30	17.17	-0.75
Fish and other marine products	2.01	2.46	22.39	2.77	2.87	3.61
Dairy products and eggs	14	12.92	-7.71	12.42	12.64	1.77
Bakery and other cereal products	13.3	12.75	-4.14	12.31	12.47	1.30
Fruit and nuts	8.19	8.47	3.42	9.05	10.06	11.16
Vegetables	7.13	8.3	16.41	7.73	8.73	12.94
Fats and oils	2.33	2.76	-8.63	2.15	2.53	-12.50
Other food*	2.56	3.67	16.15	2.49	2.90	25.18
Non-alcoholic beverages	1.79	1.47	-11.27	1.59	1.40	-7.71

*Includes sugar and sugar preparations; condiments, spices and vinegar; coffee and tea; and other food, materials and food preparations.

Source: Family Food Expenditure in Canada 1996 and 2001, Catalogue No. 62-554-XPB and No. 62-554-XIE.

Table 5: Percentage of total food expenditure, by province, 1996-2001

PROVINCE	YEAR	FOOD PURCHASED FROM RESTAURANTS	FOOD PURCHASED FROM STORES
Atlantic	1996	22.8	77.2
	2001	25.2	74.8
	% change	10.53	-3.11
Quebec	1996	27.2	72.8
	2001	28.5	71.5
	% change	4.78	-1.79
Ontario	1996	26.3	73.7
	2001	30.9	69.1
	% change	17.49	-6.24
Prairies	1996	28.7	71.3
	2001	31.7	68.3
	% change	10.45	-4.21
British Columbia	1996	32.4	67.6
	2001	32.7	67.3
	% change	0.93	-0.44

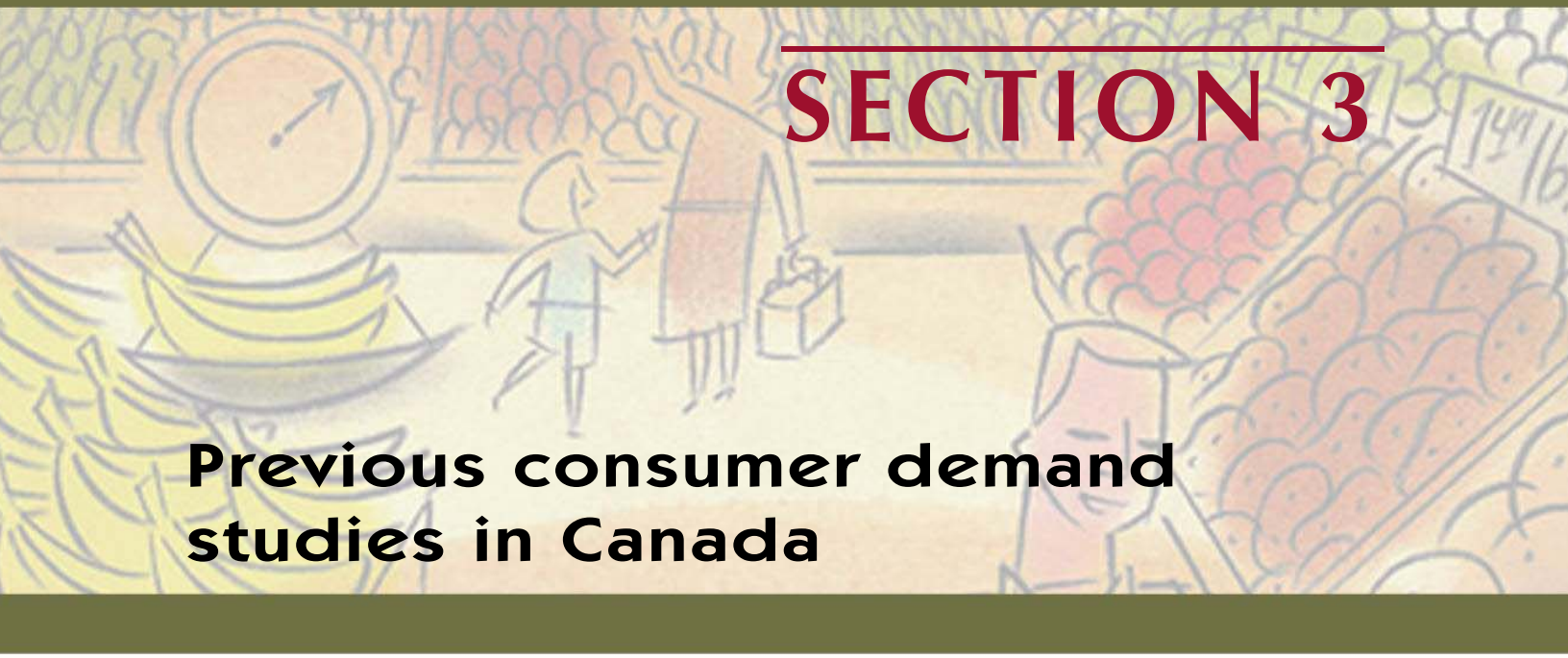
Source: Statistics Canada, Food Expenditure 1996, Catalogue No. 62-554-XPB and Food Expenditure in Canada 2001, Catalogue No. 62-554-XIE.

The observed trends in food consumption and food preferences by various income groups, household size, area, region and gender provide us with interesting insights into some of the

7. *Canadian Restaurant and Food Services Association: "Household spending at restaurants cools in 2003", 2001.*

forces behind the changing consumer demands for food in Canada. Eating habits of Canadians today are significantly different from what they were a decade or two ago.

These changes in food consumption will be incorporated into the consumer demand model that will be used in this study. Proxies that explain changes in urbanization, regionalization, income, household size and type will also be considered.



SECTION 3

Previous consumer demand studies in Canada

This section provides a brief summary of previous consumer demand studies for Canada. A number of studies have been conducted in Canada since the early 1970's and 1980's to estimate the consumer demand for food.

Hassan and Johnson (1976) estimated individual demand functions for important food commodities in Canada and developed a full demand matrix. By employing time series data, for the period 1950 to 1972, on per capita consumption, current income and retail prices, the authors derived price and income elasticities of demand for the various food commodities included in the study. Using individual estimated parameters as augmented by results from a previous study by Hassan and Lu (1974), the authors developed a complete set of demand parameters for 27 food commodities. Results showed that demand for food is inelastic with respect to price and income, and the estimates were consistent with those obtained in previous studies in Canada.

Hassan and Johnson (1977) estimated direct price elasticities from cross sectional data. They analyzed food consumption patterns of urban families in Canada using the 1974 Urban Family Food Expenditure Survey. A semi-logarithmic function was used to estimate Engel curves and estimate direct price and income elasticities for 122 food items. Results showed that the estimated elasticities were consistent with theory and with other available empirical estimates from time series data.

Denton and Spencer (1979) developed an econometric model of food demand and nutritional requirements in Canada. The objective was to model nutrient requirements and to provide projections up to 2001, under different scenarios of economic and demographic developments. The authors reported a series of 13 projections and provided insights into the effects of changes in demographic, technology and income. Results indicated that while food consumption patterns are sensitive to price changes, nutrient consumption was less responsive to changes in price and income. The average per capita daily nutrient requirements were found to be sensitive to changes in age distribution and the number of pregnant and nursing women in the population, but barely responsive to differences in immigration levels. The projections also suggested that the future rates of technical progress in the economy would alter food expenditures and eating habits of Canadians. These results are actually supported by recent trends in food consumption and expenditure in Canada, as presented in the previous section.

Using Canadian data, Curtin et al. (1987) updated most of the elasticities estimated by Hassan and Johnson in 1976. The study estimated demand elasticities for 29 food commodities grouped in meats, beverages, vegetables, fats and oils, cheese, ice cream and eggs. Own price elasticities were estimated by ordinary least squares using time series data. Income elasticities were derived based on the results of Engel analysis using cross sectional data. The authors found that demand elasticities were less price elastic than in the 1970's while income elasticities has declined significantly during the previous 10 years.

Johnson and Safyurtlu (1994) estimated a set of final demand parameters for major food groups in Canada for the period 1960 through 1981. By using restricted least squares to impose the Slutsky conditions on the model and by using the stochastic restrictions represented by the sample data, the authors estimated price, income and expenditure elasticities. Result showed that elasticity estimates have the predicted signs. Consumption for meats, dairy, and fruit and vegetables were more responsive to changes in price than consumption for cereals, sugar and fat. Food expenditure elasticities were higher than one for meat, fruits and vegetables and fat.

Moschini and Moro (1993) specified and estimated a complete demand system for Canadian food consumption. They specified and estimated a set of 20 equations, two stage model relying on explicit separability assumptions within the parametric form of the Almost Ideal Demand System. The authors computed price elasticity matrices using annual food expenditures from the system of national accounts, food away from home and non-food expenditure data. Results showed a system of food demand that is generally inelastic to both own price and total expenditures with cross elasticity effects. Their estimates of food expenditure elasticities showed that all goods were normal, with the exception of fats and oils. Meat products appeared to be somewhat more expenditure elastic than dairy products, bread and bakery, sugar and other food. Fresh fruits and vegetables were more expenditure elastic than processed fruit and vegetables.

Hailu and Veeman (1995) compared the empirical performance of the Rotterdam, Almost Ideal Demand System (AIDS), Central Bureau of Statistics (CBS) and National Bureau of Research (NBR) demand models using two sets of quarterly Canadian consumption data expressed in per capita terms and prices: one set for meat, included beef, chicken and pork consumption and prices from 1967 to 1992; the second set, for fats and oils, included margarine, butter, shortening and salad oil from 1978 to 1993. The authors concluded that the appropriateness of the model may depend in large measure on the particular data set that is subject to analysis. However, the results on Canadian meats and fats and oils suggested that the AIDS model performs the best among the four applied demand models.

Xu and Veeman (1995) studied the choice of functional form and structural specification in the demand analysis of meat. The data used in this study were quarterly retail weight aggregate Canadian consumption series for beef, pork and chicken, expressed in per capita terms from 1967 to 1992. The authors used two sets of non-nested tests to test the AIDS and Rotterdam models with and without structural changes in Canadian meat consumption patterns. The authors found that the functional specification did not greatly affect estimated elasticities for meat consumption but the effects of structural change on the estimates were significant. After structural change, chicken becomes less income elastic and more price elastic while the changes for pork are in the other direction. The changes in elasticities indicated that structural change has been biased in favour of white meat.

Mupondwa (1995) estimated a complete matrix of price, expenditure and demographic parameters for a system of 12 food commodities. The study uses 1984, 1986 and 1990 Canadian Food Expenditure Survey microdata. Applying a derivation of the AIDS and the Translog model the

author generates elasticities for 12 disaggregated food commodities (beef, pork, poultry, other meat, fish, cereals, vegetables, sugars, dairy, fats and oils, non alcoholic beverages and other processed food) and tested for functional form. The results show that the two models are more or less identical in terms of both explanatory power and estimated parameters. Second, Marshallian and Hicksian elasticities agree with economic theory. Third, household size, age, region and season have relatively significant effects on Canadian household food consumption patterns.

Veeman and Peng (1997) derived demand estimates for four major dairy product groups using the linearized version of the Almost Ideal Demand System, incorporating seasonality and habit formation variables for each subgroup. The study used quarterly per capita disappearance of fluid milks and related beverages from 1979 to 1993. From the results, both the signs and magnitudes of the elasticities were according to economic theory, as expected. Only butter, salad oil and specialty cheese were price elastic. Most of the items were income elastic such as soft drinks, coffee and tea, butter, salad oil and pork (albeit barely), ice cream, yoghurt, cheddar cheese and specialty cheese. The authors also found that the estimates of concentrated milk and skim milk powder were income elastic, which reflected the increasing use as inputs in the processing of manufactured and specialty food.

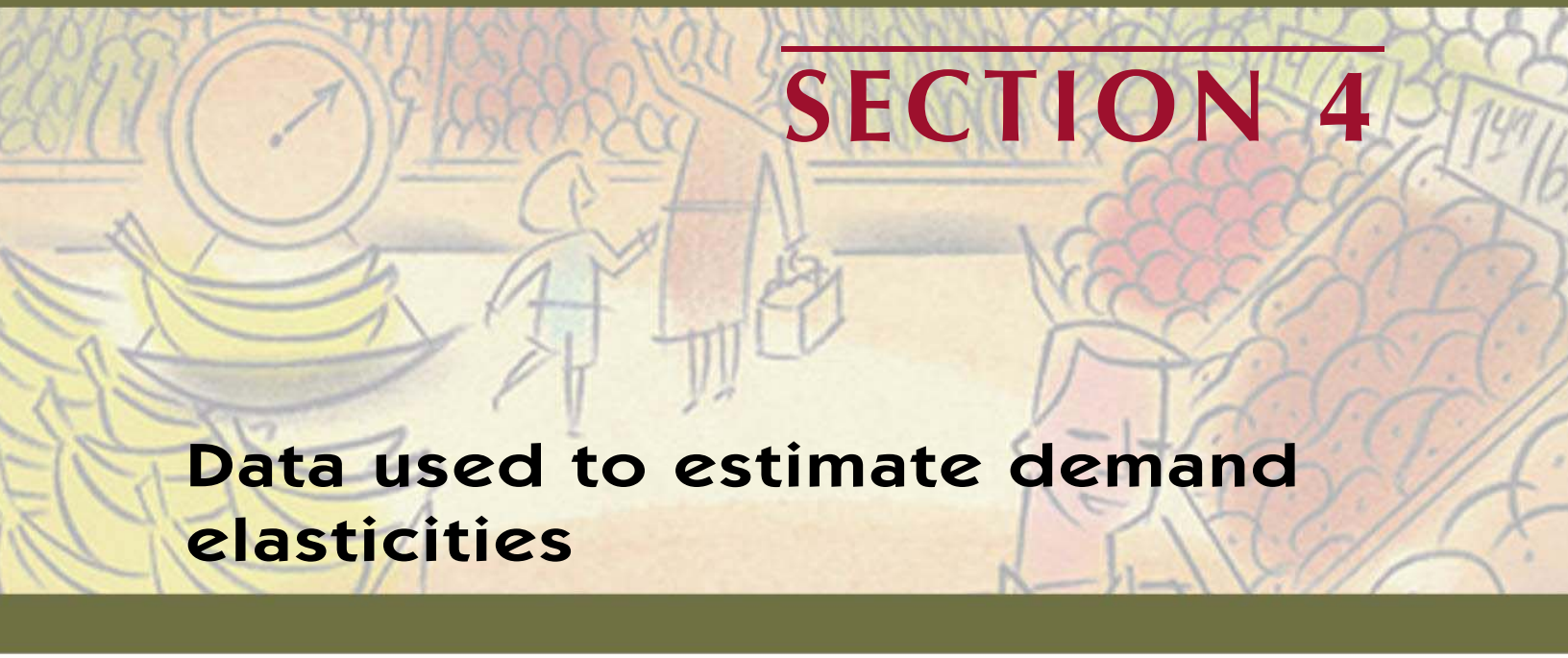
Table 6 summarizes the main results from this literature review on demand estimation in Canada.

Table 6: Summary of main findings of Canadian literature on food demand

AUTHOR	YEAR	TITLE	DATA	RESULTS
Hassan and Johnson	1976	Consumer Demand for Foods in Canada	Time series on per capita consumption, current income, and retail prices, 1950-1972	• Price and income elasticities for 27 food commodities • Estimates were consistent with those obtained in previous studies
Hassan and Johnson	1977	Urban Food Consumption Patterns in Canada	Cross Sectional Urban Family Food Expenditure Survey 1974	• Price and income elasticities for 122 food items • Estimates were consistent with theory and with empirical results from time series data
Denton and Spencer	1979	Food Demand and Nutritional Requirements in Canada: an Econometric-Demographic Model with Projections for the Period 1976-2001	Time series on projections up to 2001	• Estimates for food demand and nutrient requirements • Food consumption is more sensitive to price changes than nutrient consumption
Curtin et al.	1987	Demand for Food in Canada: Recent Estimates	Time series to forecast own price elasticities cross sectional data to estimate income elasticities 1982 Family Food Expenditure Survey	• Price and income elasticities for 29 food commodities grouped in 8 groups • Demand elasticities are less price elastic from 1970 • Income elasticities declined significantly in 10 years
Johnson and Safyurtlu	1984	A Demand Matrix for Major Food Commodities in Canada	Time series 1952-1972 Family Food Expenditure Survey	• Price, income and expenditure elasticities for 8 food commodities • Consumption for meat, dairy, fruit and vegetables were more elastic • Expenditure elasticities were higher than one for meat, fruits, vegetables and fats
Moschini and Moro	1993	A Food Demand System for Canada	Time series 1962-1988 Food Expenditures from the System of National Accounts	• Estimates for a complete demand system for 20 commodities • Marshallian and Hicksian price, income and expenditure elasticities • Price elasticities were inelastic • Price elasticities for meat were more elastic • Fresh fruit and vegetables were more elastic than processed • Expenditure elasticities showed all goods are normal except fats and oils
Atakelty and Veeman	1995	Canadian Consumption of Selected Foods: a Comparison of Four Demand Systems on Data for Meat and Fats and Oils	Time series Quarterly Canadian Consumption 1967-1992 for meat, 1978-1993 for fats and oils	• The appropriateness of the model depends on the particular data set used • The AIDS model performed better for a demand model on meat and fats and oils

Table 6: Summary of main findings of Canadian literature on food demand (Continued)

AUTHOR	YEAR	TITLE	DATA	RESULTS
Xu and Veeman	1995	Model Choice and Structural Specification for Canadian Meat Consumption	Time series quarterly retail weight aggregate Canadian consumption series for beef, pork and chicken from 1967-1992	• Functional form specification do not affect estimates for meat consumption • Structural changes have effects on the estimates on meat consumption
Mupondwa	1995	Food Demand in Canada: a Microeconometric Model Using Microdata	Times series Food Expenditure Survey Microdata 1984, 1986, 1990	• Complete demand system estimates for 12 food commodities • Marshallian and Hicksian price elasticities and expenditure elasticities • Household size, age, region and season have relatively significant effects on Canadian household food consumption patterns
Veeman and Peng	1997	Dairy Demand Analysis	Time series quarterly per capita disappearance of fluid milks and related beverages	• Demand elasticities for 4 major dairy products • Few food items were price elastic (butter, salad oil and specialty cheese) • More of the food items were income (expenditure) elastic



SECTION 4

Data used to estimate demand elasticities

The food expenditure survey

Since 1953, Statistics Canada has conducted 17 household Food Expenditure Surveys. Starting in 1972, these surveys were carried out in a periodic base but were restricted to selected cities. The Food Expenditure Surveys for 1969, 1982, 1986, 1992, 1996 and 2001 included small urban and rural areas to provide a better coverage of Canada. The 2001 survey covered the 10 Canadian provinces as well as Whitehorse, Yellowknife and Iqaluit.

The data were collected by personal interview of one or more household member. In the interview households were asked to record expenditures on food for a period of two consecutive weeks. The sample size for the Food Expenditure Survey was 9,488 dwellings of which 8,414 were eligible households[8]. After screening, a total of 5,999 households participated in the interviews from which 5,643 are included in FOODEX. The response rate for the 2001 Household Food Expenditure Survey was 71.3 percent.

The Food Expenditure Survey 2001 classifies food consumption in two categories: food consumed at home and food consumed away from home. Data on food consumed at home includes food purchased locally and on day trips and food purchased while on trips overnight or longer. In this study, we focus on food consumed at home that corresponds to purchases on day trips. This is because households did not report expenditures on each food item while on trips overnight or in restaurants; rather they reported total food expenditures.

Food consumed at home[9] and on day trips data, which were collected under purchases from stores in quantity and in dollar value, is defined in more than 246 food categories and aggregated into 12 food groups. The groups include: meat, fish and other marine products, dairy products

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8. *Eligible households were those selected and were occupants of the selected dwelling. A total of 1,074 dwellings were not considered because they were vacant, under construction, demolished, moved, abandoned, or converted to business premises or were occupied by persons not to be interviewed or living temporarily.*

9. *Food consumed at home is sometimes consumed as purchased but more often is converted into meals. This home production element is important but not addressed here.*

and eggs, bakery and other cereal products, fruits and nuts, vegetables, condiments, spices and vinegar, sugar and sugar preparations.

The FOODEX database

FOODEX is a compiled micro-database of the 2001 Food Expenditure Survey that provides the basis for this study. The FOODEX database includes 5,643 households from the total of 5,999 households that were interviewed. It excludes records from Whitehorse, Yellowknife and Iqaluit.

FOODEX is comprised of two files, the summary household file and the detailed food category file. The summary household file has 11,034 weekly records for every household (1 or 2 weeks) and 79 variables. It summarizes the dollar expenditure of each household in 14 food groups. The detailed food category file has 456,219 records and 7 variables. Each food category has a record by week and by store for each household. The detailed food category file presents dollar expenditure value and quantities of 257 food categories by household. Quantities of each of the food category in FOODEX are expressed by different units of measurement such as litres, kilograms and number of units.

FOODEX 2001 also provides data on various socio-economic and demographic characteristics of Canadian households. It collects data on each household by:

- *Region*
- *Size of area of residence: rural and urban*
- *Characteristics of reference person: marital status, age, and gender*
- *Characteristics of spouse of reference person: age of spouse*
- *Household description: household type, household size, number of seniors (65 years or more), number of adults (25 to 64 years), number of youths (15 to 24 years), number of children (under 15 years), number of economic families in households and income group.*

Estimation database

For the purpose of this study, we grouped the 246 food categories into 14 food groups: beef, pork, poultry, other meats, fish, dairy, eggs, bakery, cereal and pasta products, fruits and nuts, vegetables, fats and oils, other food-food materials and preparations, and non-alcoholic beverages (see Appendix A for details).

In calculating weekly averages, the number of weeks reported by each household was considered. For the households that reported two weeks, an average weekly expenditure was calculated by simple average. For the households that reported only one week, the value reported was assumed to be representative of average weekly expenditure. This procedure corresponds to the one recommended by Statistics Canada, under the guidelines for Data Tabulation, Analysis and Dissemination in the 2001 Food Expenditure Survey Public-use Micro-data Files.

Quantities of each of the various food categories in the detailed food category file in the database are expressed in different units of measurement such as litres, kilograms and number of units. Prior to aggregation, quantities of each food item were converted to kilograms. The conversion factors used are those developed by Agriculture Agri-Food Canada's Value Chain (see Appendix B).

Since not all households reported consumption of all food categories, the unit value for those non-consuming households is treated as missing. In dealing with missing data, the mean value was used to replace missing values. Bernier et al. (2002) recommended this approach[10].

In calculating the unit value for a food group, unit values for individual categories in the groups were calculated and then aggregated using weighted average unit value.

Shares of total food expenditure for each of the 14 food groups were calculated by dividing the expenditure of each food group by the sum of expenditures of all 14 food aggregates. The expenditures include food purchased from stores while on trips overnight or longer and food purchased locally and on day trips. Since consumers did not report quantities with total expenditures while on overnight trips, these expenditures were allocated proportionately to purchases from local stores based on the respective shares of each food group.

In FOODEX, household[11] disposable income includes income from all sources for all household members in a year. Twelve income groups were defined in the Food Expenditure Survey. Respondents were asked to indicate in which of these income groups their household income fell. In our analysis, only households with positive incomes were considered. As a result, 456 households were eliminated from the sample. Eliminating the 456 observations left us with a sample of 4,685 households.

For each income group, the upper and lower income levels are reported. In this study we perform sensitivity analysis on the upper and lower income levels to identify the income level to be included in the model[12]. Estimates were significant for the lower level of each income group. As a result, this is the level that was used as a proxy for income for each household.

Household size data are used to calculate per capita values. For example, the per capita at home food expenditure is derived by dividing the average weekly at home food expenditure by household size.

Not all observations available were used. Households with zero total weekly food expenditure, zero total weekly food expenditure in stores, and income not stated were excluded. Similarly, households with expenditure share of a food group equal to 1 (29 in total) were removed. Extreme values (5 percent in total) were deleted as these were considered to be outliers. A sample of 4,685 households remained.

In this analysis the following socio-economic and demographic characteristics are considered: the lower range of disposable income per household, per household expenditure at home, away from home share of the food budget, gender of the head of the household (household reference person[13]), age of the head of the household (less than 25 years, 25 to 44, 45 to 64, and 65 and over), household composition (one person household, couple with children, couple without children,

10. *This is when the absence of information in a survey is limited to some variables and when the probability of response for a variable of interest is the same for all units in the population. Use of mean value is an option among others given by Bernier et al. (2002).*

11. *Statistics Canada defines a household as a person or group of persons occupying one dwelling unit.*

12. *A sensitivity analysis was performed by first running the demand model with the upper limit of income and later running the same model with the lower limit of income. We found that most of the coefficients were significant in the model when we use the lower limit of income.*

13. *Household reference person is the member of the household who has been chosen by the respondents to be responsible for the household financial maintenance.*

single (either one person or a lone parent household) with children), size of area of residence (rural and urban) and region (West, Central, East)[14]. Appendix C contains the summary of the variables used in this study. Dummy variables were created to represent socio-economic and demographic characteristics of the households.

14. *For the purposes of this paper Central region refers to respondents who reside in Manitoba, Saskatchewan or Alberta; East region refers to respondents who reside in Quebec, Ontario or the Atlantic.*

SECTION 5

Model specification

At a grocery store/local market, food commodities are purchased in elementary products where each product is homogeneous and has its own distinctive price. The traditional utility maximization problem facing a household, in this case, can be expressed in terms of the elementary commodities q_s as follows:

$$MAX\ U\ \ q_1, q_2, \ldots\ldots\ldots q_s \qquad s.t. \sum_{s\ 1}^{S} P_s q_s \quad M \qquad (1)$$

where P_s is the price of the s^{th} elementary commodity, S is the number of commodities, and M is household income.

In practice, a large number of elementary commodities are available in the market/grocery store[15]. This prohibits the estimation of a system of all of them. These commodities are, as a result, aggregated into 14 food aggregates. Let N=14 be the number of aggregate food categories where N<S.

Then under the weak separability assumption, equation (1) can be written in terms of the N aggregate food commodities Q_j as follows:

$$MAX\ \ U\ \ (Q_1, Q_2, \ldots\ldots\ldots\ldots Q_N) \qquad s.t. \sum_{j=1}^{N} V_j Q_j = M \qquad (2)$$

where $Q_j = \sum_{i \in y} q_i$, $V_j = \frac{Y_j}{Q_i}$, which is the unit value of the aggregate commodity Q_j, and $Y_j = \sum_{i \in j} P_i q_i$, which is the expenditure on aggregate commodity Q_j.

15. *The Food Expenditure Survey data used in this study, for example, are comprised of more than 246 elementary commodities.*

The solution to equation (2) gives:

$$Q_j = Q_j(V_1, V_2, \ldots\ldots\ldots V_N, M), \quad j = 1,2,\ldots\ldots N \qquad (3)$$

Estimated elasticities from equation (3) will not be correct because, as demonstrated by Deaton 1988 (page 421, equation (4)), the unit value of an aggregate commodity V_j is a product of average market prices P_j and a quality choices index, π_j as indicated in equation (4):

$$InV_j = InP_j + In\pi_j \qquad (4)$$

Following Deaton (1988) and Huang and Lin (2000) it is clear that unit values can be used in place of market prices to estimate prices provided the resulting elasticities are adjusted to remove the quality effects (the last item in equation (4)) embodied in the unit values.

In this study we assumed that food consumption decisions (for various food categories) are made separately from consumption decisions for other goods and services. In other words, consumption decisions are made in a two-stage budgeting process, as a result, we allocated food expenditures to various food categories.

The demand for each food category is expressed as a function of food expenditures and a set of prices for food categories. In the FOODEX data, prices of each food category are not reported. We instead used unit values in place of market price as in Deaton (1988) and Huang and Lin (2000), where unit value is calculated as a ratio of expenditure to quantity.

The empirical model employed in this study is similar to the Almost Ideal Demand System model (AIDS) suggested by Huang and Lin (2000). The model consists of a modified version of an AIDS and a set of unit value equations. By applying Shepard's lemma, Huang and Lin (2000) derived a modified version of an AIDS, in which food expenditure share of a food category is a function of unit values and the related food expenditures as follows:

$$W_{ih} = \alpha_i + \sum_j \beta_{ij} \ln V_j + \varphi_i \ln\left(X / V^*\right) \qquad (5)$$

where: W_{ih} is at home food expenditure share of aggregate commodity i for household h.

V_j is the unit value of the food category

X is per capita at home food expenditures

V^* is a unit value aggregate index derived using the following formula:

$$\ln V^* = \sum_j W_j \ln V_j \qquad (6)$$

where: W_j is at home food expenditure share. All subscripts of variables and summation throughout this paper refer to a total of N aggregate food commodities (i, j = 1,2, …., N).

The system of share equations (equation 5) also includes household demographics as independent variables. The following properties of a theoretically consistent demand function were directly imposed on the system[16]:

Symmetry: $\beta_{ij} = \beta_{ji}$

Adding up: $\sum_i \alpha_i = 1$

Homogeneity: $\sum_i \varphi_i = \sum_i \beta_{kj} = \sum_j \beta_{ij} = 0$

The second set of equations following the approach by Deaton (1988) and thereafter Huang and Lin (2000) is the set of unit values. This equation captures the influence of economic and socio-demographic factors on unit values. Two proxies are used: per capita food expenditure and the proportion spent on food away from home. Per capita food expenditure captures the link between income, consumption and quality. Our prior expectation is that there is a positive relationship between unit value and per capita food expenditure. Thus, a consumer who is well off will spend more on better quality food products. The second proxy is the proportion spent on food away from home. This variable captures the value consumers attach to taste and convenience. A consumer who values more convenience will spend more on food away from home. Therefore, a positive relationship will exist between unit values and the proportion of food away from home.

$$\ln V_{ih} = \psi_i \log X + \phi_i FAFH_{ih} + \sum_k \gamma_{ik} HSDV_{kh} \qquad (7)$$

$$i = 1,2,..., N \text{ and } h = 1,2,..., H$$

where: $FAFH_{ih}$ is the portion of the total food budget spent on food away from home by household h.

$HSDV_h$ is a vector of household socio-demographic variables[17].

ψ_i is the elasticity of unit value with respect to per capita expenditure for food consumed at home. It is obtained by taking the following derivative: $\partial \log V_i / \partial \log X$.

Price and expenditure elasticities are derived by differentiating equations (5) and (6) with respect to unit values and expenditure to obtain the following expressions. Note that price elasticities are uncompensated or Marshallian.

Own price elasticity: $\Omega_{ii} = (\beta_{ii} - \varphi_i W_i) / w_i - 1 \qquad (8)$

Cross price elasticity: $\Omega_{ij} = (\beta_{ij} - \varphi_i W_j) / w_i \qquad (9)$

Expenditure elasticity: $\eta_i = \left[\varphi_i + \sum_j (\beta_{ij} - \varphi_i W_j) \psi_j \right] \Big/ W_i + (1 - \psi_i) \qquad (10)$

16. *The restrictions mean that the cost/expenditure function is homogeneous of degree one in prices and income.*

17. *Definitions of the socio-demographic variables are in Appendix C.*

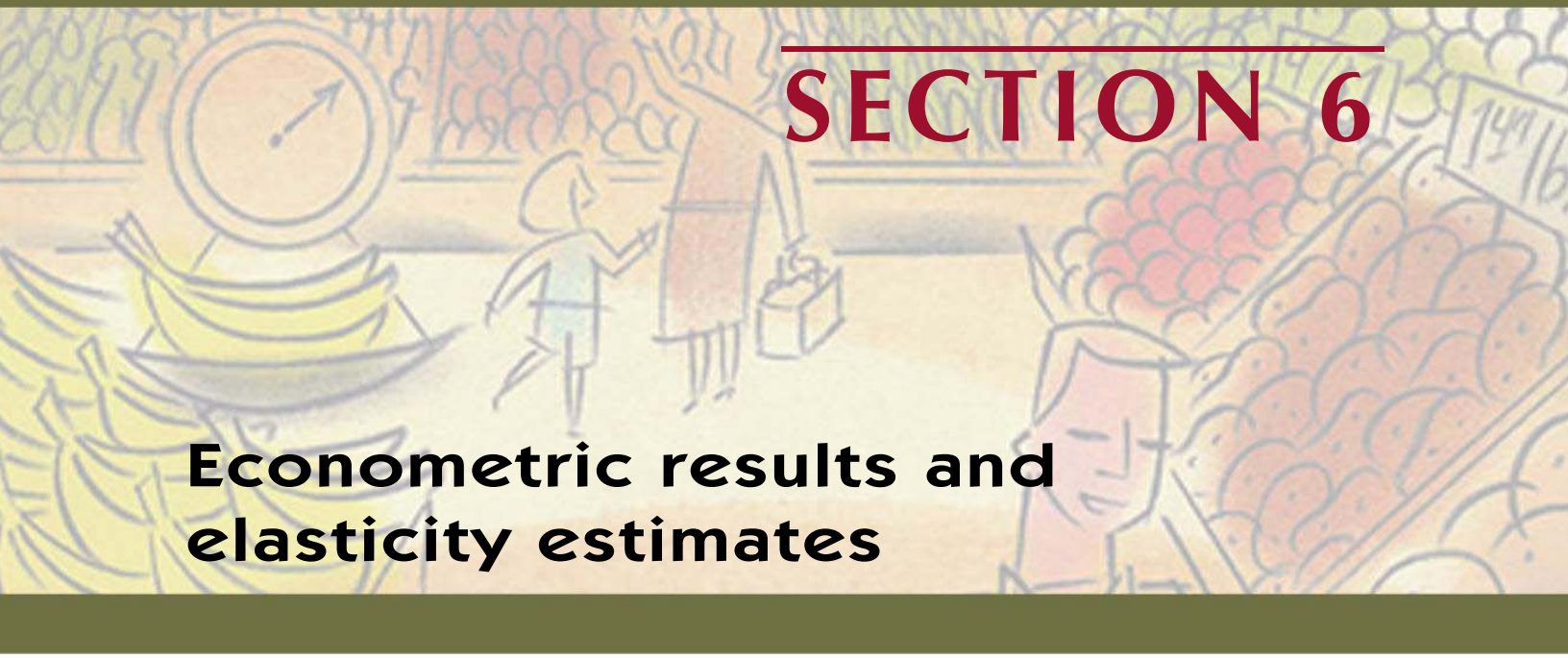
Equation (1) was estimated as a system of thirteen equations by Seemingly Unrelated Regression (SUR). The fourteenth equation was dropped to ensure non-singularity, since household shares sum to one i.e. $\sum_i W_{ih} = 1 \quad \forall$ h. (h = 1,2,..., H). The parameters of the fourteenth equation are however, recoverable using the symmetry, adding up and homogeneity restrictions. Equation (7) was estimated by Ordinary Least Squares (OLS). In both cases SHAZAM Version 9 Econometric Software is used.

The uncompensated, or Hicksian elasticities can be derived from the Marshallian elasticities using the formula:

Hicksian elasticity: $\varepsilon_{ij}^{H} = \Omega_{ij} + N_i W_j$ (11)

where: ε_{ij}^{H} is the compensated (Hicksian) elasticity of demand of food commodity i with respect to the price of commodity j, Ω_{ij} is the uncompensated (Marshallian) elasticity of demand of food commodity i with respect to the price of commodity j, N_i is the expenditure elasticity for commodity i and W_j is the share of total expenditure accounted for by the purchase of commodity j.

The compensated elasticities have the property that ε_{ij}^{H} and ε_{ji}^{H} will always have the same sign.



SECTION 6

Econometric results and elasticity estimates

System of share equations

The estimated coefficients of the at home food expenditure share equation (5), are presented in Table 7. The R-squares calculated independently for each equation are relatively low ranging from 0.03 (for the other meat equation) to 0.18 (for the bakery equation). Whereas these coefficients measure the fit of changes in shares of each food group, they are not useful indicators of fitness of the model as it is the overall adjusted R-square of the system which is 0.64.

The standard errors of all the estimated coefficients for the share equations are low ranging from 0.0002 (for the cross non-alcoholic beverage-egg coefficient) to 0.0032 (for the own dairy coefficient). The smaller standard error indicates the lower margin of error of these estimates to the true value. Because the estimated coefficients in the share equation are relatively high compared to the cross coefficients, t- values for the own estimated coefficients are highly significant. Nevertheless, most of the estimated coefficients are statistically significant at a 95 percent level.

The estimated coefficients for unit values have positive effects on the budget shares within each particular food group with the exception of non-alcoholic beverages, which has a negative effect. This may indicate that as the average market price changes and consumer choices of food quality improve, households assign more of the budget to the expenditure of all food groups and less on non-alcoholic beverages.

Per capita food expenditure coefficient (as a measure of household budget) is negative for beef, poultry, pork, other meat, fish, eggs, bakery, cereal, fats and oils, and non-alcoholic beverages, and positive for dairy, fruit and vegetables. This appears to suggest that as the per capita food expenditure increases the share of beef, poultry, pork, other meat, fish, eggs, bakery, cereal, fats and oils, and non-alcoholic beverages in the food budget decreases, whereas that for dairy, fruit and vegetables increases.

Before assessing the impacts of socio-demographic[18] variables on budget shares, it is important to recall that one category within each group of socio-economic variables was used as a base var-

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18. A detailed description of the socio-demographic variables is presented in Appendix C.

iable. In this case, estimates will represent the marginal impact on budget shares of a socio-demographic characteristic with respect to that base variable.

The parameter estimates related to socio-economic variables, in the share equations, are jointly significant with Wald Chi-Square statistics of 1055.23 and 181.26 for demographic and regional variables respectively, as indicated in Table 7. This shows that spending patterns vary across regions, as well as across household characteristics.

For instance, looking at the area of residence, urban households allocate more of their food budgets to fish and fruit and less to other meat than households in rural areas. The coefficients for households in urban areas were significant for fruit, fish and other meat.

Region variables (East, Central and West) are jointly significant in explaining the observed variations in the budget shares. Coefficients were significant for other meat, eggs, bakery, cereal, fruit, vegetable, fats and oils, and non-alcoholic beverages for the Eastern region. For the Central region coefficients were significant for fish, eggs, vegetables, fats and oils, and non-alcoholic beverages.

This indicates that households in the East tend to allocate marginally more of their budget to other meat, bakery and non-alcoholic beverages and less to eggs, cereal, fruit, vegetables and fats and oils than households in the West. Whereas, households in Central Canada tend to spend less on fish, eggs and vegetables and more on non-alcoholic beverages.

Spending patterns also seem to vary across households when looking at age. A household head who reported to be less than 24 years old, spent less of their budget on pork, fish, bakery, fats and oils, and vegetables than household heads over 65 years old, while those who were between 25 to 44 years old, spent less on fish, eggs, bakery, fruits and fats and oils.

Looking at household structure, a one person household and couple with children households seem to explain the most the observed variations in expenditure shares. Coefficients for one person households were significant for all food groups except for bakery. Meanwhile, coefficients for couples with children households were significant for poultry, pork, dairy, eggs, bakery, cereal, fats and oils, and non-alcoholic beverages. This may indicate that one person households allocate more of their budget to beef, poultry, pork, fish and cereal, and less to dairy and fruit and vegetables; whereas couples with children devote more of their budget to dairy, cereal and bakery and less to poultry, pork, eggs and non-alcoholic beverages. Overall, results suggest that there is a general tendency across regions and among households to spend less on fats and oils.

Before assessing the effects of income on budget shares, it is important to recall that income values correspond to the lower limit of the income range reported by the household head. In this case, estimates will represent the marginal impact on budget shares of an increase in income at the lower level of the income group.

The income coefficients were significant for pork, other meat, fish, dairy, eggs, cereal, fruit, fats and oils, bakery and non-alcoholic beverages. The coefficients for beef, poultry and bakery in the budget share were negative but insignificant. Overall, results show that there is a negative and positive relationship between income and budget shares respectively. The budget shares of pork, other meat, eggs, cereal, fats and oils, and non-alcoholic beverages decrease as total income increases while the budget shares of fish, dairy and fruit increase with an increase in income. This is to be expected because people with high income are the ones who can afford to pay for expensive but healthy food stuffs such as fish, fruits and vegetables.

Table 7: Estimated coefficients of share equation (*)

BUDGET SHARES EQUATION													
Explanatory variables	Beef	Poultry	Pork	Other meat	Fish	Dairy	Eggs	Bakery	Cereal	Fruit	Vegetable	Fats and oils	Non-alcoholic bev.
Beef	0.03963 *12.85*	0.00111 *0.77*	0.00152 *0.90*	-0.00579 *-2.86*	-0.00506 *-2.76*	-0.00379 *-1.83*	-0.00031 *-0.51*	-0.00659 *-4.54*	-0.00466 *-2.59*	-0.00242 *-1.42*	-0.00721 *-3.39*	-0.00128 *-1.50*	-0.00126 *-1.07*
Poultry	0.00111 *0.77*	0.01093 *7.42*	-0.00041 *-0.40*	-0.00056 *-0.41*	-0.00409 *-3.55*	0.00105 *0.69*	-0.00149 *-4.47*	-0.00524 *-4.86*	0.00011 *0.10*	-0.00138 *-1.07*	-0.00218 *-1.50*	-0.00017 *-0.35*	0.00152 *1.69*
Pork	0.00152 *0.90*	-0.00041 *-0.40*	0.01151 *5.85*	-0.00302 *-2.02*	-0.00214 *-1.45*	0.00050 *0.35*	0.00031 *0.54*	-0.00223 *-2.21*	0.00208 *1.47*	-0.00089 *-0.76*	-0.00448 *-2.84*	-0.00067 *-0.87*	-0.00014 *-0.18*
Other meat	-0.00579 *-2.86*	-0.00056 *-0.41*	-0.00302 *-2.02*	0.01399 *5.32*	-0.00226 *-1.37*	-0.00042 *-0.21*	-0.00044 *-0.87*	-0.00642 *-4.64*	0.00481 *2.96*	0.00371 *2.26*	-0.00064 *-0.32*	-0.00239 *-3.24*	-0.00016 *-0.14*
Fish	-0.00506 *-2.76*	-0.00409 *-3.55*	-0.00214 *-1.45*	-0.00226 *-1.37*	0.03868 *17.49*	-0.00098 *-0.61*	-0.00078 *-1.36*	-0.00543 *-4.79*	-0.00787 *-5.17*	-0.00447 *-3.41*	-0.00126 *-0.73*	-0.00131 *-1.68*	0.00085 *0.94*
Dairy	-0.00379 -1.83	0.00105 0.69	0.00050 0.35	-0.00042 -0.21	-0.00098 -0.61	0.01550 4.85	-0.00164 -3.63	-0.00420 -2.63	-0.00461 -2.87	-0.00339 -1.75	-0.00208 -0.99	-0.00151 -2.25	0.00232 1.71
Eggs	-0.00031 -0.51	-0.00149 -4.47	0.00031 0.54	-0.00044 -0.87	-0.00078 -1.36	-0.00164 -3.63	0.00990 14.14	-0.00190 -6.02	-0.00158 -3.01	-0.00089 -2.46	-0.00202 -3.74	0.00001 0.03	0.00009 0.36
Bakery	-0.00659 *-4.54*	-0.00524 *-4.86*	-0.00223 *-2.21*	-0.00642 *-4.64*	-0.00543 *-4.79*	-0.00420 *-2.63*	-0.00190 *-6.02*	0.04744 *29.88*	-0.00213 *-1.88*	-0.00198 *-1.45*	-0.01091 *-7.44*	-0.00197 *-4.17*	-0.00260 *-2.73*
Cereal	-0.00466 *-2.59*	0.00011 *0.10*	0.00208 *1.47*	0.00481 *2.96*	-0.00787 *-5.17*	-0.00461 *-2.87*	-0.00158 *-3.01*	-0.00213 *-1.88*	0.01691 *8.12*	-0.00195 *-1.49*	-0.00570 *-3.32*	-0.00126 *-1.72*	0.00320 *3.51*
Fruit	-0.00242 *-1.42*	-0.00138 *-1.07*	-0.00089 *-0.76*	0.00371 *2.26*	-0.00447 *-3.41*	-0.00339 *-1.75*	-0.00089 *-2.46*	-0.00198 *-1.45*	-0.00195 *-1.49*	0.01881 *7.94*	-0.00384 *-2.21*	-0.00137 *-2.55*	0.00280 *2.38*
Vegetable	-0.00721 *-3.39*	-0.00218 *-1.50*	-0.00448 *-2.84*	-0.00064 *-0.32*	-0.00126 *-0.73*	-0.00208 *-0.99*	-0.00202 *-3.74*	-0.01091 *-7.44*	-0.00570 *-3.32*	-0.00384 *-2.21*	0.03420 *11.65*	-0.00280 *-3.59*	0.00230 *1.91*
Fats and oils	-0.00128 *-1.50*	-0.00017 *-0.35*	-0.00067 *-0.87*	-0.00239 *-3.24*	-0.00131 *-1.68*	-0.00151 *-2.25*	0.00001 *0.03*	-0.00197 *-4.17*	-0.00126 *-1.72*	-0.00137 *-2.55*	-0.00280 *-3.59*	0.01439 *21.48*	0.00106 *2.84*
Non-alcoholic beverages	-0.00126 *-1.07*	0.00152 *1.69*	-0.00014 *-0.18*	-0.00016 *-0.14*	0.00085 *0.94*	0.00232 *1.71*	0.00009 *0.36*	-0.00260 *-2.73*	0.00320 *3.51*	0.00280 *2.38*	0.00230 *1.91*	0.00106 *2.84*	-0.00958 *-8.29*
Other food	-0.00390 *-1.93*	0.00079 *0.50*	-0.00195 *-1.44*	-0.00041 *-0.21*	-0.00390 *-2.54*	0.00325 *1.35*	0.00072 *1.75*	0.00417 *2.48*	0.00266 *1.73*	-0.00275 *-1.29*	0.00662 *3.18*	-0.00072 *-1.16*	-0.00040 *-0.27*
Food expend. per capita	-0.01203 *-6.13*	-0.01014 *-6.11*	-0.00732 *-5.80*	-0.00775 *-4.01*	-0.00900 *-6.23*	0.01021 *3.89*	-0.00598 *-16.11*	-0.00495 *-2.69*	-0.00624 *-4.30*	0.02920 *11.88*	0.02796 *13.66*	-0.00588 *-10.45*	-0.00654 *-3.81*
East	0.00361 *1.84*	0.00211 *1.28*	-0.00035 *-0.28*	0.00671 *3.48*	-0.00037 *-0.26*	0.00490 *1.87*	-0.00129 *-3.50*	0.00911 *4.96*	-0.00726 *-5.01*	-0.00523 *-2.13*	-0.00762 *-3.74*	-0.00190 *-3.40*	0.00459 *2.68*
Central	0.00291 *1.26*	0.00127 *0.65*	0.00019 *0.12*	0.00389 *1.71*	-0.00397 *-2.33*	-0.00298 *-0.96*	-0.00092 *-2.09*	0.00352 *1.62*	-0.00223 *-1.30*	-0.00275 *-0.95*	-0.01290 *-5.35*	-0.00148 *-2.23*	0.00418 *2.06*
Urban	-0.00319 *-1.70*	0.00053 *0.33*	0.00039 *0.33*	-0.00429 *-2.32*	0.00443 *3.21*	-0.00330 *-1.31*	0.00019 *0.53*	-0.00196 *-1.11*	-0.00055 *-0.40*	0.00918 *3.89*	0.00337 *1.72*	-0.00080 *-1.50*	-0.00170 *-1.03*

Table 7: Estimated coefficients of share equation (*) (Continued)

BUDGET SHARES EQUATION													
Explanatory variables	Beef	Poultry	Pork	Other meat	Fish	Dairy	Eggs	Bakery	Cereal	Fruit	Vegetable	Fats and oils	Non-alcoholic bev.
To 24 years	0.00544 *0.08*	-0.01804 *-0.30*	-0.13306 *-2.87*	-0.09598 *-1.35*	-0.10564 *-1.99*	0.11360 *1.18*	-0.00956 *-0.70*	-0.14992 *-2.22*	0.19694 *3.69*	-0.08732 *-0.97*	-0.19266 *-2.57*	-0.07730 *-3.75*	-0.03818 *-0.61*
25 to 44 years	-0.00686 *-1.28*	0.00044 *0.10*	-0.00532 *-1.54*	-0.00131 *-0.25*	-0.01243 *-3.15*	0.00709 *0.99*	-0.00207 *-2.05*	-0.01288 *-2.56*	0.01196 *3.01*	-0.03067 *-4.56*	-0.00045 *-0.08*	-0.00600 *-3.91*	0.00642 *1.37*
45 to 65 years	0.00777 *1.29*	0.00501 *0.99*	-0.00016 *-0.04*	0.00969 *1.64*	-0.01009 *-2.29*	-0.01089 *-1.35*	0.00013 *0.12*	-0.00066 *-0.12*	-0.00010 *-0.02*	-0.03397 *-4.50*	0.00170 *0.27*	-0.00324 *-1.89*	0.01531 *2.91*
Female	-0.00166 *-1.18*	0.00016 *0.13*	-0.00009 *-0.10*	-0.00197 *-1.42*	-0.00159 *-1.54*	0.00419 *2.22*	-0.00025 *-0.93*	0.00016 *0.12*	-0.00075 *-0.72*	0.00040 *0.23*	0.00193 *1.31*	-0.00009 *-0.23*	-0.00253 *-2.05*
One person	0.01392 *3.98*	0.00736 *2.49*	0.00575 *2.56*	0.00799 *2.32*	0.01082 *4.21*	-0.02173 *-4.64*	0.00393 *5.97*	0.00439 *1.34*	0.00716 *2.77*	-0.02046 *-4.65*	-0.02072 *-5.68*	0.00545 *5.45*	0.00665 *2.17*
Couple without children	0.00708 *2.24*	-0.00100 *-0.37*	0.00052 *0.26*	0.00127 *0.41*	0.00358 *1.54*	-0.00307 *-0.72*	0.00049 *0.82*	0.00572 *1.92*	-0.00070 *-0.30*	-0.00697 *-1.75*	-0.00373 *-1.13*	0.00264 *2.92*	0.00240 *0.86*
Couple with children	-0.00428 *-1.38*	-0.00760 *-2.90*	-0.00606 *-3.04*	-0.00566 *-0.89*	-0.00383 *-1.68*	0.01240 *2.99*	-0.00284 *-4.87*	0.00592 *2.03*	0.00479 *2.09*	0.00243 *0.63*	-0.00201 *-0.62*	-0.00214 *-2.42*	-0.00543 *-2.00*
Lone parent	0.00218 *0.57*	-0.00357 *-1.10*	-0.00429 *-1.75*	-0.00333 *-0.89*	-0.00036 *-0.13*	0.00277 *0.54*	-0.00072 *-1.00*	0.00427 *1.19*	0.00440 *3.36*	-0.00618 *-1.29*	-0.00725 *-1.82*	-0.00184 *-1.69*	-0.00550 *-1.64*
Expenditure on food away from home	0.00239 *0.73*	0.00258 *0.93*	-0.00206 *-0.97*	0.00187 *0.58*	0.00016 *0.07*	-0.01337 *-3.03*	0.00011 *0.18*	0.00540 *1.75*	0.00818 *3.36*	0.00812 *1.97*	0.00172 *0.50*	-0.00157 *-1.67*	0.00925 *3.21*
Income (lower limit of range)	-0.00135 *-1.12*	-0.00181 *-1.77*	-0.00233 *-3.00*	-0.00318 *-2.67*	0.00173 *1.95*	0.00503 *3.12*	-0.00102 *-4.43*	-0.00127 *-1.12*	-0.00283 *-3.16*	0.00606 *4.01*	0.00023 *0.18*	-0.00182 *-5.24*	-0.00508 *-4.82*
Constant	0.09287 *7.08*	0.09978 *9.14*	0.07546 *8.88*	0.12152 *9.48*	0.01793 *1.84*	0.05024 *2.92*	0.04260 *16.84*	0.10476 *8.62*	0.09608 *9.89*	0.00174 *0.11*	0.05721 *4.18*	0.06031 *15.80*	0.12469 *11.12*
R square of each equation	*0.071*	*0.037*	*0.039*	*0.031*	*0.094*	*0.052*	*0.160*	*0.178*	*0.056*	*0.064*	*0.094*	*0.169*	*0.041*
System adjusted R square	0.6448												

(*) t- ratios in parenthesis.
own all t>> 1.96 cross: where t>= 1.96
Joint Test Regional Variables Chi2=181.260 d.f.26 P-value=0.000
Joint Test Socio-Economic Variables Chi2=1055.229 d.f.=104 P-value=0.000

Unit value equation

The unit value equation (7) was estimated by OLS and the parameter estimates are as presented in Table 8. Unit values are listed horizontally across the top of the table and food expenditure, food away from home and socio-economic variables (independent) are listed vertically on the left. Coefficient estimates in Table 8 represent variations in the choice of food quality in response to changes in the per capita food expenditure, food away from home, and socio economic variables.

The R-square coefficients range from 2 percent (for the pork equation) to 16 percent (for the bakery equation). These coefficient estimates are low but appear to be reasonable when analysing cross sectional household survey data. For example, while Deaton (1988) reported R-squared ranging from 5 to 45 percent, Huang and Lin (2000) reported R-squared ranging from 6 to 15 percent.

Results show that, per capita food expenditure has positive effects on the unit value of each food group with all estimates significant at the 5 percent confidence level. The elasticity of quality varied among food groups from 0.031 for pork to 0.304 for bakery. The quality elasticity estimates for dairy, bakery, fruits, and vegetable are greater than 0.10, indicating the importance of food quality effects on consumer food choices.

The second parameter in the unit value equation is food away from home. This parameter captures the variation on food quality choices in response to changes in spending on food away from home. Coefficients are significant for fish and other marine products, dairy, cereal and pasta, and non-alcoholic beverages. The results indicate that food away from home has a significant positive effect on unit value (quality) with regard to spending on fish and other marine products, dairy, and cereal and pasta. Freshness, taste and convenience may be the most important indicators driving spending on food away from home on these food groups.

The estimated coefficients for socio-economic variables in the unit value equation show that consumer choice of food quality varies among groups and regions. Households in urban areas value more quality choices of beef, pork, other meats, bakery and vegetables than rural households. This may be because urban households tend to have higher income than rural households and also tend to be more health conscious. Households in the East and Central regions value less quality choices on other meat, dairy, eggs, bakery, vegetables, fats and oils, and non-alcoholic beverages than households in the West. Quality choices of cereal seem to be valued more in the East than in the rest of Canada. These differences in quality preferences are also a reflection of regional differences in income.

The estimated coefficients for household age in the unit value equation shows that the age of the household head is important in explaining the observed variations in unit values. For households whose head is less than 44 years old, expenditures on chicken, dairy eggs, cereal, fruit, vegetables, non-alcoholic beverages and fats and oils seem to explain the observed changes in unit value. These households tend to value chicken, dairy, eggs, cereal, and vegetables more and fish, bakery, fruits, fats and oils, and non-alcoholic beverages less. This may be explained by the fact that households in this age group are more family oriented, usually employed and on average quite wealthy. They would tend to spend more on food that is more nutritious and healthier. On the other hand, households older than 44 years old seem to value more dairy and less bakery, fruit, fats and oils, and non-alcoholic beverages. Coefficients for older households were significant for dairy, bakery, fruit, fats and oils, and non-alcoholic beverages.

Table 8: Coefficients of unit value equation

UNIT VALUE EQUATION														
Explanatory variables	Beef	Poultry	Pork	Other meat	Fish	Dairy	Eggs	Bakery	Cereal	Fruit	Vegetable	Fats and oils	Non-alcoholic bev.	Other food
Food expenditure	0.05108 *6.35*	0.09649 *6.29*	0.03117 *3.80*	0.07009 *6.97*	0.08996 *10.52*	0.16460 *14.42*	0.04426 *6.77*	0.30490 *18.88*	0.06744 *7.27*	0.17220 *12.19*	0.13604 *14.20*	0.06119 *5.45*	0.03453 *1.69*	0.09886 *7.84*
Proportion of food away from home	-0.01458 *-1.03*	0.01630 *0.60*	-0.01419 *-0.98*	0.01940 *1.09*	0.03543 *2.35*	0.04763 *2.36*	0.00184 *0.16*	0.00365 *0.13*	0.03837 *2.34*	0.01017 *0.41*	0.00239 *0.14*	0.02676 *1.35*	-0.08522 *-2.36*	0.01783 *0.80*
East	0.00926 *1.10*	-0.01329 *-0.83*	0.01061 *1.24*	-0.05207 *-4.95*	-0.01099 *-1.23*	-0.05598 *-4.69*	-0.05200 *-7.61*	-0.06253 *-3.71*	0.00117 *0.12*	-0.02302 *-1.56*	-0.03012 *-3.01*	-0.03087 *-2.63*	-0.08206 *-3.84*	-0.03326 *-2.52*
Central	-0.01132 *-1.14*	-0.01681 *-0.89*	0.00655 *0.65*	-0.03370 *-2.71*	-0.01861 *-1.76*	-0.05285 *-3.75*	-0.12317 *-15.27*	-0.08229 *-4.13*	0.03311 *2.89*	-0.00471 *-0.27*	-0.02557 *-2.16*	-0.02562 *-1.85*	-0.09794 *-3.88*	0.00339 *0.22*
Urban	0.02348 *2.91*	0.00092 *0.06*	0.02933 *3.56*	0.05835 *5.78*	0.00318 *0.37*	0.01740 *1.52*	0.00407 *0.62*	0.05038 *3.11*	-0.00409 *-0.44*	0.02544 *1.80*	0.02648 *2.76*	0.00569 *0.51*	0.00239 *0.12*	0.01221 *0.97*
To 24 years	-0.22004 *-0.71*	1.51240 *2.57*	-0.04639 *-0.15*	0.12756 *0.33*	-0.23124 *-0.70*	1.22812 *2.80*	0.43107 *1.72*	-1.46560 *-2.36*	1.86847 *5.24*	-1.00562 *-1.85*	0.91418 *2.48*	-0.95409 *-2.21*	-2.88726 *-3.68*	-0.49941 *-1.03*
25 to 44 years	-0.00237 *-0.10*	0.16878 *3.86*	-0.02099 *-0.90*	-0.02823 *-0.98*	-0.04662 *-1.91*	0.08628 *2.65*	0.05891 *3.16*	-0.01363 *-0.30*	0.14408 *5.44*	-0.12869 *-3.19*	0.09414 *3.44*	-0.13472 *-4.21*	-0.25083 *-4.30*	-0.02164 *-0.60*
45 to 65 years	-0.00883 *-0.34*	0.04479 *0.91*	-0.04278 *-1.62*	-0.04293 *-1.33*	-0.04609 *-1.68*	0.08682 *2.37*	0.04093 *1.95*	-0.12241 *-2.36*	0.02827 *0.95*	-0.14125 *-3.12*	0.04425 *1.44*	-0.08382 *-2.33*	-0.15220 *-2.32*	-0.02226 *-0.55*
Female	0.00730 *1.21*	0.01038 *0.90*	0.00997 *1.61*	0.00725 *0.96*	0.02008 *3.12*	0.00374 *0.43*	0.00202 *0.41*	0.02321 *1.91*	0.01828 *2.61*	0.03459 *3.25*	0.02115 *2.93*	0.00059 *0.07*	-0.00392 *-0.25*	0.01628 *1.71*
One person	-0.02431 *-1.61*	-0.04942 *-1.72*	-0.00880 *-0.57*	-0.02326 *-1.23*	-0.06432 *-4.02*	-0.05816 *-2.72*	-0.02529 *-2.07*	-0.22669 *-7.49*	-0.02851 *-1.64*	-0.08744 *-3.30*	-0.04780 *-2.66*	-0.02089 *-0.99*	-0.03809 *-0.99*	-0.04511 *-1.91*
Couple without children	-0.01795 *-1.32*	-0.03117 *-1.20*	0.01650 *1.19*	-0.01452 *-0.85*	-0.01396 *-0.96*	-0.04224 *-2.18*	-0.02469 *-2.23*	-0.01019 *-0.37*	-0.00874 *-0.56*	0.00431 *0.18*	-0.00781 *-0.48*	-0.00923 *-0.49*	0.00541 *0.16*	0.01945 *0.91*
Couple with children	-0.03344 *-2.52*	-0.00605 *-0.24*	0.00693 *0.51*	-0.01399 *-0.84*	-0.01314 *-0.93*	-0.03177 *-1.68*	-0.02153 *-1.99*	0.16995 *6.37*	0.03616 *2.36*	0.04887 *2.09*	0.02476 *1.56*	-0.00404 *-0.22*	-0.06712 *-1.99*	-0.00576 *-0.28*
Lone parent	-0.03276 *-1.99*	0.02252 *0.72*	0.00156 *0.09*	0.00129 *0.06*	-0.00621 *-0.36*	-0.01199 *-0.51*	-0.01652 *-1.24*	0.07235 *2.19*	0.04833 *2.55*	-0.01739 *-0.60*	-0.02224 *-1.14*	-0.03030 *-1.32*	-0.06557 *-1.57*	0.01492 *0.58*
Income	0.03159 *5.98*	0.06510 *6.46*	0.02431 *4.51*	0.06614 *10.01*	0.03006 *5.35*	0.04987 *6.65*	0.00523 *1.22*	0.08532 *8.05*	0.02858 *4.69*	0.02710 *2.92*	0.05220 *8.30*	0.02641 *3.59*	0.00779 *0.58*	0.05372 *6.49*
Constant	1.62043 *29.25*	0.69929 *6.61*	1.57172 *27.79*	1.14158 *16.47*	1.79655 *30.49*	0.48978 *6.23*	1.05201 *23.35*	-0.50389 *-4.53*	1.13073 *17.68*	0.37093 *3.81*	0.10582 *1.60*	0.77990 *10.09*	1.51821 *10.78*	1.48042 *17.04*
R square	***0.0312***	***0.0328***	***0.0172***	***0.0627***	***0.0451***	***0.0812***	***0.0648***	***0.1598***	***0.0517***	***0.0496***	***0.0897***	***0.0227***	***0.0220***	***0.0410***

Joint Test Regional Variables Chi2=367,512 d.f.28 P-value=0.000 *Joint Test Socio-Economic Variables Chi2=768.948 d.f.=112 P-value=0.000*

The results also show that quality choices are important for couples with children and lone parents. These households value bakery, cereal and fruit more than other households. One person households seem to value quality choices of fish, dairy, eggs, bakery, fruit, and vegetables less than other types of households.

In relation to income, results show that income has a positive effect on unit values. The estimated coefficients are significant at a 5 percent confidence level in all food groups except for eggs and non-alcoholic beverages. This shows the importance that quality has on consumer food choices.

Estimated demand and expenditure elasticities

Own and cross price elasticities are presented in Table 9. The values were generated using the parameter estimates of the share and unit value equations. The estimates appear to be consistent with economic theory. Own cross price elasticities are negative and less than 1 with the exception of non-alcoholic beverages and other food. The demand for poultry, other meat, dairy, fruit, non-alcoholic beverages and other food was more sensitive to changes in unit value (price and quality) than other food groups, with elasticities ranging from -0.81 to -1.14 and all are significant at the 5 percent confidence level.

Comparative magnitudes of own price elasticity estimates also appear to be intuitively reasonable. In the case of meat for instance, the demand for pork is less price elastic than poultry, while the demand for poultry and pork are more price elastic than the demand for beef. This may indicate that beef is characterized by more frequent consumption and more prominent expenditure proportions. In the case of fish and other marine products, the own price elasticity is less elastic than beef, pork, poultry and other meat. This shows that Canadian households are insensitive to changes in the price of fish. Therefore, an increase in the expenditure on fish may not be caused by a price decrease but instead may be caused by an increase in income and probably also by the increase in the health consciousness of consumers.

In the case of vegetables and fruits, own price elasticities are within the magnitude expected, and the demand for fruit is more price elastic than vegetables. Canadian consumers seem to be more sensitive to changes in prices for fruit than for vegetables. This may be explained by the tendency of consumers to substitute fresh for processed fruits when the price of fresh fruits spikes especially during winter.

Table 10 reports the Hicksian compensated price elasticities obtained from the AIDS model for all 14 variables. Poultry, pork, dairy, eggs, fruits, vegetables, non-alcoholic beverages and other food are net substitutes, whereas beef, other meat, cereal, fats and oils show a negative Hicksian cross price elasticity, which is caused by net complementarities. In the case of fish and other marine products, our results indicate that households view it as a complement rather than a substitute for meat. However, economic reasoning indicates that fish and other marine products are a substitute for meat rather than a complement. We believe this result may be due to limitations in the aggregation level of food items.

Adjusted expenditure elasticities give the proportionate change in spending as income changes, meaning that households tends to spend more on better quality food as they get richer.

Expenditure elasticities (both unadjusted and adjusted for food quality effects) are as presented in Table 11. Expenditure adjusted elasticities are positive and less than 1 with the exception of fruit and vegetables. Quality adjusted expenditure elasticities are less in magnitude than unadjusted elasticities because of the quality effects.

Table 9: Own and cross price elasticities derived from the AIDS model

ELASTICITIES WITH RESPECT TO UNIT VALUE														
Food group	Beef	Poultry	Pork	Other meat	Fish	Dairy	Eggs	Bakery	Cereal	Fruit	Vegetable	Fats and oils	Non-alcoholic bev.	Other food
Beef	-0.45615	0.02531	0.02640	-0.06541	-0.06081	-0.03087	-0.00168	-0.07484	-0.05300	-0.01592	-0.08208	-0.01419	-0.00667	-0.02859
Poultry	0.02914	-0.81954	-0.00057	0.00334	-0.05686	0.03598	-0.02079	-0.06838	0.01113	-0.00526	-0.01961	0.00028	0.03366	0.03553
Pork	0.05620	0.00162	-0.68006	-0.06700	-0.04931	0.03826	0.01155	-0.04393	0.06836	-0.00362	-010368	-0.01445	0.00873	-0.02384
Other meat	-0.06849	-0.00079	-0.03599	-0.80841	-0.02524	0.00710	-0.00423	-0.07585	0.06925	0.05925	0.00083	-0.02956	0.00441	0.00497
Fish	-0.10042	-0.08044	-0.04129	-0.03605	-0.10529	0.00296	-0.01462	-0.10698	-0.16800	-0.08109	-0.01015	-0.02614	0.03258	-0.05898
Dairy	-0.03679	0.00323	0.00103	-0.00966	-0.01156	-0.88486	-0.01450	-0.04092	-0.04218	-0.03593	-0.02436	-0.01374	0.01351	0.01415
Eggs	0.00879	-0.07187	0.03463	0.00092	-0.03354	-0.05829	-0.35029	-0.09091	-0.07972	-0.01761	-0.09597	0.00799	0.03044	0.10410
Bakery	-0.07403	-0.05858	-0.02441	-0.07199	-0.06206	-0.04273	-0.02173	-0.43027	-0.02191	-0.01754	-0.12457	-0.02232	-0.02718	0.05829
Cereal	-0.07092	0.00870	0.03910	0.08935	-0.12841	-0.06489	-0.02509	-0.02719	-0.70802	-0.02209	-0.08680	-0.01933	0.06075	0.06037
Fruit	-0.04473	-0.03164	-0.01907	0.01449	-0.05585	-0.06811	-0.01298	-0.04313	-0.03576	-0.84626	-0.06308	-0.01866	0.00922	-0.06844
Vegetable	-0.10236	-0.04376	-0.06071	-0.03050	-0.02734	-0.06105	-0.02698	-0.14608	-0.08104	-0.07392	-0.65117	-0.03662	0.00584	0.02767
Fats and oils	-0.04505	0.01092	-0.02416	-0.10388	-0.05621	-0.04165	0.00540	-0.07862	-0.04871	-0.04089	-0.12090	-0.22675	0.02254	0.00159
Non-alcoholic beverages	-0.01218	0.03051	0.00154	0.00538	0.01794	0.04930	0.00299	-0.03228	0.05652	0.05476	0.04568	0.01860	-1.14449	0.00886
Other food	-0.03085	0.00169	-0.01542	-0.00718	-0.02907	0.01500	0.00404	0.02356	0.01468	-0.02468	0.03984	-0.00598	-0.00638	-1.03697

Note: These elasticities were computed using average for all households.

Table 10: Hicksian (compensated) elasticities

ELASTICITY WITH RESPECT TO SHARE OF FOOD GROUPS														
Food group	Beef	Poultry	Pork	Other meat	Fish	Dairy	Eggs	Bakery	Cereal	Fruit	Vegetable	Fats and oils	Non-alcoholic bev.	Other food
Beef	-0.3996	0.0731	0.0542	-0.0025	-0.0302	0.0817	0.0066	-0.0107	-0.0050	0.0956	0.0205	-0.0029	0.0493	0.0698
Poultry	0.0857	-0.7717	0.0272	0.0663	-0.0262	0.1486	-0.0125	-0.0043	0.0591	0.1063	0.0830	0.0116	0.0896	0.1373
Pork	0.1128	0.0494	-0.6523	-0.0041	-0.0186	0.1509	0.0199	0.0202	0.1163	0.1079	-0.0011	-0.0031	0.0647	0.0372
Other meat	-0.0119	0.0470	-0.0082	-0.7455	0.0054	0.1197	0.0041	-0.0118	0.1172	0.1708	0.1034	-0.0182	0.0603	0.1676
Fish	-0.0439	-0.0326	-0.0135	0.0269	-0.0746	0.1156	-0.0063	-0.0429	-0.1200	0.0305	0.0924	-0.0148	0.0885	-0.0052
Dairy	0.0198	0.0511	0.0288	0.0532	0.0191	-0.7722	-0.0062	0.0232	0.0058	0.0756	0.0782	-0.0024	0.0694	0.3566
Eggs	0.0653	-0.0241	0.0624	0.0638	-0.0029	0.0543	-0.3420	-0.0268	-0.0317	0.0939	0.0066	0.0193	0.0864	-0.0247
Bakery	-0.0175	-0.0108	0.0034	-0.0091	-0.0314	0.0699	-0.0134	-0.3662	0.0261	0.0940	-0.0220	-0.0110	0.0287	0.2592
Cereal	-0.0144	0.0565	0.0669	0.1523	-0.0977	0.0477	-0.0168	0.0369	-0.6600	0.0895	0.0158	-0.0080	0.1167	0.2147
Fruit	0.0118	0.0162	0.0087	0.0774	-0.0252	0.0445	-0.0047	0.0210	0.0122	-0.7347	0.0395	-0.0073	0.0651	0.4754
Vegetable	-0.0458	0.0041	-0.0329	0.0324	0.0033	0.0516	-0.0187	-0.0820	-0.0331	0.0376	-0.5486	-0.0253	0.0618	0.5956
Fats and oils	0.0115	0.0587	0.0036	-0.0410	-0.0255	0.0710	0.0137	-0.0145	-0.0007	0.0707	-0.0183	-0.2154	0.0785	0.0078
Non-alcoholic beverages	0.0444	0.0783	0.0293	0.0683	0.0486	0.1619	0.0113	0.0318	0.1045	0.1663	0.1483	0.0299	-1.0886	0.1656
Other food	0.0257	0.0495	0.0123	0.0557	0.0016	0.1276	0.0124	0.0876	0.0627	0.0869	0.1424	0.0054	0.0495	-0.7194

Table 11: Expenditure elasticities unadjusted and adjusted for quality effects (foods at home)

FOOD GROUP	EXPENDITURE UNADJUSTED	EXPENDITURE ADJUSTED
Beef	0.83850	0.75903
Poultry	0.84194	0.74548
Pork	0.80119	0.75424
Other meat	0.89814	0.82664
Fish	0.79390	0.70197
Dairy	1.08256	0.91082
Eggs	0.61135	0.54054
Bakery	0.94104	0.76304
Cereal	0.89447	0.81106
Fruit	1.28400	1.08481
Vegetable	1.30803	1.13022
Fats and oils	0.68649	0.60431
Non-alcoholic beverages	0.89686	0.88158
Other food	1.05772	0.96159

Note: all elasticities are significantly different from zero.
**Change from >1 to <1.*
***Big difference.*

In other words, the difference in magnitude between adjusted and unadjusted expenditure elasticities represents the bias that the estimated elasticities would have when quality effects are ignored. According to the results, the biggest downward adjustment occurs for dairy, bakery, fruit, and vegetable.

The adjusted expenditure elasticities of vegetables, other food, dairy, alcoholic beverages, other meat, other food, cereal and non-alcoholic beverages are 1.13, 0.96, 0.91, 0.88, 0.82 and 0.81 respectively. These elasticities are greater than those of other food groups meaning that these food groups are highly responsive to increases in total food expenditures. The adjusted expenditure elasticities for eggs (0.54) and fats and oils (0.60) were less elastic.

Comparison of own price elasticities

In Table 12, we present a summary of own price elasticities from other studies done at AAFC that have estimated demand in Canada[19]. The estimates provide an idea of the trend in the magnitude of elasticities. However, it is important to caution not to make direct comparison of the elasticities. The estimates can vary depending on the empirical model specification, level of food commodity aggregation, theoretical restrictions, type of data employed (whether time series or a cross section), and the period covered. Overall, these elasticity estimates are within a reasonable range of our elasticity estimates.

19. *Estimates done in the United States by Huang and Lin (2000) are presented in Appendix D.*

Table 12: Results of demand estimates from studies done at AAFC

FOOD GROUPS	HASSAN AND JOHNSON – 1976	MOSCHINI AND MORO – 1993	OUR ESTIMATES 2005
Model specification	1972	1993	2001
Data	Time series	Time series	Cross sectional
Model	Utility maximization	AIDS	Modified AIDS
Beef	-0.85	-0.41	-0.45
Poultry		-0.68	-0.81
Chicken	-0.56		
Turkey	-1.09		
Pork	-0.95	-0.56	-0.68
Other meat			-0.80
Lamb	-1.87		
Veal	-2.59		
Fish	-0.79	-0.58	-0.10
Dairy			-0.88
Milk	-0.44[a]	-0.34	
Cheese	-0.91	-0.40	
Other dairy		-1.02	
Butter	-0.86	-0.92	
Eggs	-0.12		-0.35
Bakery		-0.37	-0.43
Bread			
Cereal and pasta			-0.70
Cereal	-0.20		
Fruit			-0.84
Nuts			
Fresh fruits	-0.45	-0.47	
Processed fruits	-0.75	-0.16	
Vegetable			-0.65
Fresh vegetables	-0.24	-0.35	
Processed vegetables	-0.32	-0.31	
Fats and oils		-0.12	-0.22[b]
Other food			-1.03[c]
Other food excluding sugar		-0.21	
Sugar products	-0.24	-0.11	
Frozen foods	-1.03		
Prepared foods	-0.67		
Miscellaneous foods	-0.12		
Non-alcoholic beverages	-0.37	-0.20	-1.14
Non-alcoholic beverages			
Coffee and tea			
Food away from home		-0.55	
Non food		-0.96	

[a] *Excludes skim milk products and other dairy products.*
[b] *Includes margarine, lard, shortening and cooking salad oil.*
[c] *Other food: incl. sugar and sugar preparations, condiments, spices and vinegar, and other food, food materials and food preparations.*

SECTION 7

Conclusions and policy implications

This paper presents results from the estimation of a demand system for Canada. We applied a model first proposed by Deaton (1988) and thereafter extended by Huang and Lin (2000). The model used unit value of each food category in place of market price. Then appropriate adjustments were made to remove quality effects before the own price, cross-price, and expenditure elasticities were calculated.

These results measure quantitatively the relationships between prices, quality, total expenditures and consumer demand for various food groups. They also link socio-economic variables and household characteristics, income class, regional variables and urban versus rural locations to food demand. The findings of this study are:

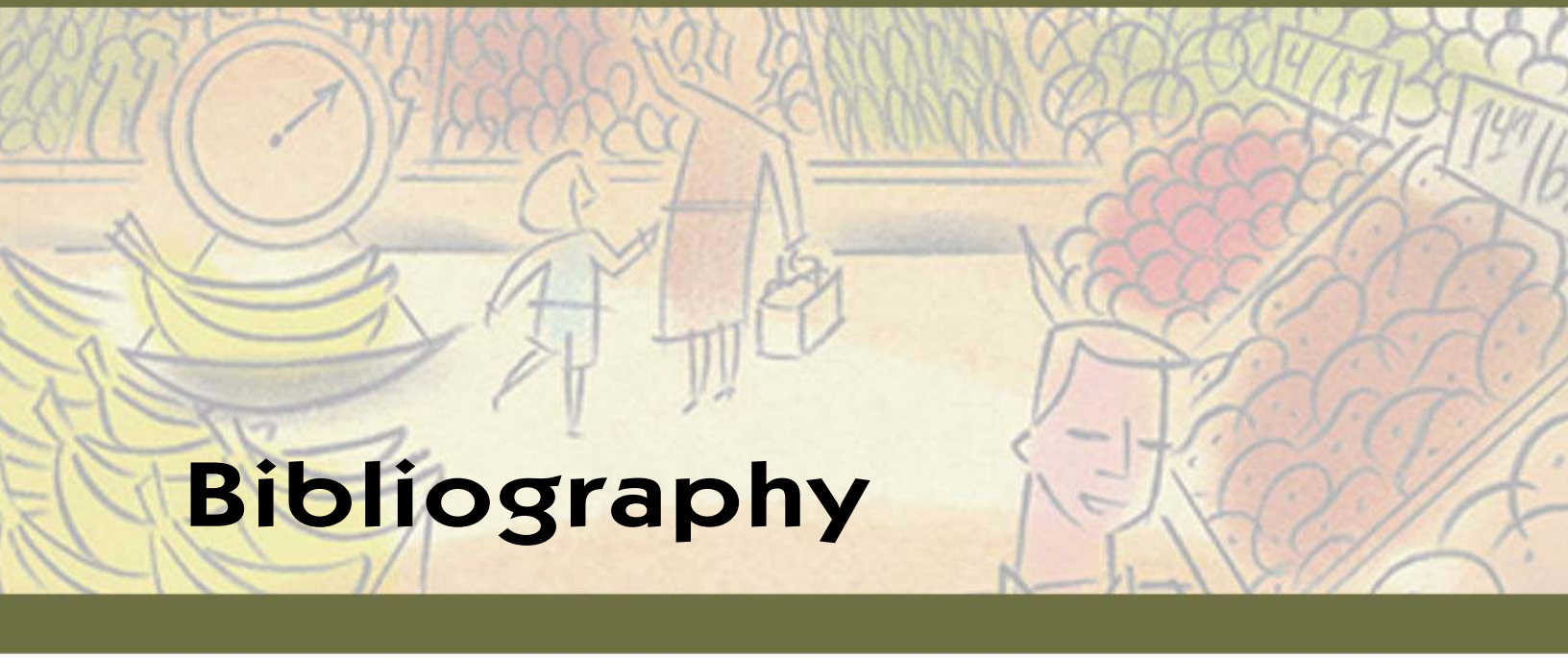
- *The parameter estimates on the share and unit value equations show that household size, region, age, gender, household structure and income are important in explaining the observed variations in household expenditure and quality choices.*
- *The quality elasticity estimates are all positive and significant indicating the importance of food quality in food choices.*
- *Own price elasticity estimates are consistent with economic theory and their magnitudes are reasonable. Own price elasticities are negative and less than 1 with the exception of non-alcoholic beverages and other food. The own price elasticities for poultry, other meat, dairy, fruit, non-alcoholic beverages and other food are more elastic than the rest of the food categories.*
- *Hicksian (compensated) cross price elasticities for poultry, pork, dairy, eggs, fruits, vegetables, non-alcoholic beverages and other food are positive indicating that these food groups are net substitutes, whereas beef, other meat, fish, cereal, fats and oils are negative indicating that these food groups are net complements.*
- *Expenditure elasticities are positive and less than 1 with the exception of fruit and vegetables. The adjusted expenditure elasticities of other meat, dairy, cereal, fruit, vegetables, non-alcoholic beverages and other food are highly responsive to increases in total food expenditures.*

The results from this study will likely be a useful source of information for policy analysis.

The food demand elasticity estimates could be used to quantify the impact of other economic policies, such as tax reforms, trade restrictions, nutrition labelling requirements, and other regulations that may lead to higher prices for some foods. The degree to which consumers will respond to these policies will depend on the demand elasticities. For instance, demand for products with highly inelastic demand elasticities will be less affected by tax or price increases than those products with more elastic demand. Also food manufacturers that are not themselves price takers can more easily pass on any cost increases to consumers when the demand for their products is inelastic.

In addition, the elasticity estimates could be useful in providing quantitative estimates of direct and secondary effects of changes in unit values (average price), expenditures and quality on consumer demand. Furthermore, the estimates could be used to evaluate the impact of domestic policy measures regulating food safety and quality (e.g. Hazard Analysis Critical Control Point (HACCP), labelling and traceability systems). These regulations would impact on the costs of the food system. With these elasticities it would be possible for policy makers to quantify the impacts food safety and food quality regulations across consumers and producers, and across different consumer income classes.

Finally, the elasticity estimates should be a valuable input into models that describe the structure of the Canadian agriculture and agri-food system, such as FARM, Aglink, CRAM, and other models. These models could help AAFC determine the impact of changes in policies and programs, regulations, prices and income on the sector. Accurate measures of consumption elasticities are important inputs.



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Food groups and food categories

APPENDIX A

Food purchased from stores locally and on day trips (weekly expenditures)

FOOD GROUPS IN DATABASE:
1. Meat
2. Fish and other marine products
3. Dairy products and eggs
4. Bakery and other cereal products
5. Fruit and nuts
6. Vegetables
7. Condiments, spices and vinegar
8. Sugar and sugar preparations
9. Coffee and tea
10. Fats and oils
11. Other food, food materials and food prep. - Soup - Infant or junior food - Pre-cooked frozen food preparations - Materials for food preparations
12. Non-alcoholic beverages - Carbonated beverages - Fruit drinks - Other non-alcoholic beverages

FOOD GROUPS USED IN STUDY:
1. Beef
2. Pork
3. Poultry
4. Other meat - Other meat and meat preparations - Other fresh and frozen meat
5. Fish - Fish - Other marine products
6. Dairy
7. Eggs
8. Bakery
9. Cereal - Cereal products - Pasta products
10. Fruit - Fruit - Nuts
11. Vegetables
12. Fats and oils
13. Other food - Sugar and sugar preparations - Condiments, spices and vinegar - Other food, food materials and food prep.
14. Non-alcoholic beverages - Coffee and tea - Carbonated beverages - Fruit drinks - Other non-alcoholic beverages

Conversion factors to kilograms

APPENDIX B

Detailed food category file: quantities

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F001	1000-1092	Meat		
F002	1000-1050	Fresh or frozen meat (excluding poultry)		
F003	1000-1006	Beef		
F004	1000	Hip cuts (excluding shank cuts)	kg	
F005	1001	Loin cuts	kg	
F006	1002	Rib cuts	kg	
F007	1003	Chuck cuts (excluding shank cuts)	kg	
F008	1004	Stewing beef	kg	
F009	1005	Ground beef (including patties)	kg	
F015	1006	Other beef (including shank cuts)	kg	
F025	1010-1014	Pork		
F026	1010	Leg cuts (excluding hocks)	kg	
F027	1011	Loin cuts	kg	
F028	1012	Belly cuts	kg	
F029	1013	Shoulder cuts (excluding hocks)	kg	
F035	1014	Other pork (including hocks)	kg	
F060	1020-1050	Other fresh or frozen meat		
F061	1020	Veal	kg	
F070	1040-1041	Offal from mammals		
F071	1040	Liver	kg	
F074	1041	Other offal	kg	
F076	1050	Lamb, mutton and other meat (excluding poultry)	kg	
F045	1060-1062	Fresh or frozen poultry meat		
F046	1060	Chicken (including fowl)	kg	
F047	1061	Turkey	kg	
F049	1062	Other poultry meat and offal	kg	
F080	1070-1092	Other meat and meat preparations		
F081	1070-1073	Cured meat		
F082	1070	Bacon	kg	
F083	1071	Ham (excluding cooked ham)	kg	
F085	1073	Other cured meat	kg	
F090	1080-1086	Meat preparations and cooked meat (excluding canned)		
F091	1080	Uncooked sausage	kg	
F092	1081	Bologna	kg	
F093	1082	Wieners	kg	

Detailed food category file: quantities (Continued)

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F096	1083	Other cooked/cured sausage	kg	
F097	1084	Cooked (boiled) ham	kg	
F100	1085	Other ready-cooked meat	kg	
F101	1086	Other meat preparations	kg	
F105	1090-1092	Canned meat and meat preparations		
F108	1090	Meat stews and hams	kg	
F110	1092	Other canned meat and meat preparations	kg	
F111	1100-1150	Fish and other marine products		
F112	1100-1132	Fish		
F113	1100-1107	Fresh or frozen fish (excluding portions)		
F114	1100	Cod	kg	
F115	1101	Flounder and sole	kg	
F116	1102	Haddock	kg	
F123	1105	Salmon	kg	
F125	1106	Other sea fish	kg	
F129	1107	Freshwater fish	kg	
F135	1110	Pre-cooked frozen fish portions	kg	
F140	1120	Cured fish	kg	
F141	1130-1132	Canned fish		
F142	1130	Salmon	kg	
F143	1131	Tuna	kg	
F146	1132	Other canned fish	kg	
F147	1140-1150	Other marine products		
F149	1140	Shrimps and prawns	kg	
F151	1150	Other shellfish and marine products	kg	
F154	1160-1186	Dairy products and eggs		
F155	1160-1185	Dairy products		
F156	1160	Cream (excluding sour cream)	L	1.012
F158	1161	Fluid whole milk	L	1.032
F159	1162	Low-fat milk (2%)	L	1.032
F157	1163	Low-fat milk (1%)	L	1.034
F160	1164	Fluid skim milk	L	1.036
F161	1165	Specialty milk products	L	1.032
F162	1166	Yogurt	L	0.98
F163	1167	Butter	kg	
F165	1170-1174	Cheese		
F166	1170	Cheddar cheese	kg	
F167	1171	Grated cheese	kg	
F168	1172	Process cheese	kg	
F169	1173	Cottage cheese	kg	
F175	1174	Other cheese	kg	
F177	1181	Condensed or evaporated milk	L	1.292
F178	1182	Ice cream and ice milk	L	0.624
F179	1183	Ice cream and ice milk novelties	L	0.624
F181	1184	Frozen yogurt	L	0.624
F187	1185	Other dairy products	L	1

Detailed food category file: quantities (Continued)

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F186	1186	Eggs	doz	0.6
F190	1190-1218	Bakery and other cereal products		
F191	1190-1198	Bakery products (excluding frozen)		
F192	1190	Bread	kg	
F193	1191	Unsweetened rolls and buns	doz	0.6
F195	1192	Crackers and crisp breads	kg	
F197	1193	Cookies and sweet biscuits	kg	
F202	1194	Muffins	doz	0.48
F198	1195	Doughnuts	doz	0.516
F199	1196	Yeast-raised sweet goods	kg	
F201	1197	Dessert pies, cakes and other pastries	kg	
F205	1198	Other bakery products	kg	
F210	1200-1202	Pasta products		
F211	1200	Canned pasta products	L	0.188
F212	1201	Dry or fresh pasta	kg	
F215	1202	Pasta mixes	kg	
F220	1210-1218	Cereal grains and other cereal products		
F221	1210	Rice (including mixes)	kg	
F226	1211	Flour	kg	
F232	1214	Other grains, unmilled or milled	kg	
F236	1215	Breakfast cereal	kg	
F237	1216	Cake and other flour-based mixes	kg	
F238	1217	Cereal-based snack food	kg	
F239	1218	Other cereal products	kg	
F240	1220-1292	Fruit and nuts		
F241	1220-1287	Fruit		
F242	1220-1234	Fresh fruit		
F243	1220	Apples	kg	
F244	1221	Bananas and plantains	kg	
F246	1223	Grapefruit	num	0.24
F247	1224	Grapes	kg	
F248	1225	Lemons and limes	kg	
F249	1226	Melons	num	2
F250	1227	Oranges and other citrus fruit	kg	
F251	1228	Peaches and nectarines	kg	
F252	1229	Pears	kg	
F253	1230	Plums	kg	
F256	1231	Other tropical fruit	kg	
F258	1233	Strawberries	L	0.628
F262	1234	Other fresh fruit	kg	
F265	1240-1287	Other fruit and fruit preparations		
F266	1240	Frozen fruit	kg	
F270	1250-1254	Dried or other preserved fruit		
F272	1251	Raisins	kg	
F274	1254	Other dried/preserved fruit (excluding canned)	kg	
F280	1260-1263	Fruit juice (excluding concentrated)		

Detailed food category file: quantities (Continued)

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F281	1260	Apple juice	L	1.048
F282	1261	Grapefruit juice	L	1.044
F283	1262	Orange juice	L	1.052
F286	1263	Other fruit juice	L	1.04
F287	1270-1271	Concentrated fruit juice		
F288	1270	Orange juice	L	1.052
F292	1271	Other fruit juice	L	1.04
F293	1280-1287	Canned fruit and fruit preparations		
F295	1281	Peaches	L	1.04
F297	1283	Pineapple	L	1.04
F298	1284	Mixed fruit	L	1.06
F302	1285	Other canned fruit	L	1.06
F304	1286	Jam, jelly and other preserves	L	0.133
F305	1287	Fruit pie fillings	L	1.06
F310	1290-1292	Nuts		
F311	1290	Unshelled nuts	kg	
F312	1291	Shelled peanuts	kg	
F313	1292	Other shelled nuts	kg	
F316	1300-1361	Vegetables		
F317	1300-1320	Fresh vegetables		
F318	1300	Green or wax beans	kg	
F319	1301	Broccoli	kg	
F321	1303	Cabbage	kg	
F322	1304	Carrots	kg	
F323	1305	Cauliflower	num	0.86
F324	1306	Celery	num	0.907
F325	1307	Corn	num	0.454
F326	1308	Cucumbers	num	0.31
F327	1309	Lettuce	num	0.22
F328	1310	Mushrooms	kg	
F329	1311	Onions	kg	
F330	1312	Peppers	kg	
F331	1313	Potatoes	kg	
F332	1314	Radishes	kg	
F333	1315	Spinach	kg	
F334	1316	Tomatoes	kg	
F335	1317	Turnips and rutabagas	kg	
F345	1318	Other seed and gourd vegetables	kg	
F346	1319	Other root vegetables	kg	
F344	1320	Other leaf and stalk vegetables	kg	
F348	1330-1361	Other vegetables and vegetable preparations		
F349	1330-1334	Frozen vegetables		
F351	1331	Corn	kg	
F352	1332	Peas	kg	
F353	1333	Potato products	kg	
F363	1334	Other frozen vegetables	kg	

Detailed food category file: quantities (Continued)

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F365	1340-1341	Dried vegetables		
F366	1340	Potato products – dried	kg	
F367	1341	Other vegetables – dried	kg	
F370	1350-1361	Canned vegetables and vegetable preparations		
F371	1350	Green or wax beans	L	0.576
F372	1351	Baked beans	L	0.576
F373	1352	Other beans	L	0.576
F376	1355	Corn	L	1.08
F377	1356	Mushrooms and truffles	L	0.66
F378	1357	Peas	L	0.72
F379	1358	Tomatoes (including paste)	L	1.02
F388	1359	Other canned vegetables	L	0.8
F390	1360	Tomato juice	L	1.032
F394	1361	Other canned vegetable juice	L	1
F395	1370-1376	Condiments, spices and vinegar		
F396	1370	Pickles (including olives)	L	0.64
F400	1372	Ketchup	L	0.113
F405	1373	Other sauces and sauce mixes	L	1.04
F406	1374	Mayonnaise and salad dressings	L	0.1
F408	1375	Other condiments (including vinegar)	L	0.1
F410	1376	Spices	kg	
F420	1380-1395	Sugar and sugar preparations		
F421	1380-1381	Sugar and syrup		
F422	1380	Sugar	kg	
F423	1381	Syrups and molasses	L	0.133
F426	1390-1395	Sugar preparations (including confectionery)		
F427	1390	Gum	kg	
F428	1391	Chocolate bars	kg	
F430	1392	Other chocolate confections	kg	
F431	1393	Sugar candy	kg	
F434	1394	Other sugar confections	kg	
F435	1395	Other sugar preparations	kg	
F436	1410-1420	Coffee and tea		
F438	1410-1411	Coffee		
F439	1410	Roasted or ground coffee	kg	
F440	1411	Other coffee	kg	
F442	1420	Tea	kg	
F445	1430-1433	Fats and oils		
F446	1430	Margarine	kg	
F447	1431	Shortening	kg	
F448	1432	Lard	kg	
F449	1433	Cooking/salad oil	L	0.92
F455	1440-1492	Other food, materials and food preparations		
F465	1440-1441	Soup		
F466	1440	Canned soup	L	1.04
F467	1441	Dried soup	kg	

Detailed food category file: quantities (Continued)

FMF CODE	STUB REF	FOOD PURCHASED FROM STORES LOCALLY AND ON DAY TRIPS	UNIT	CONVERSION FACTOR
F468	1450-1452	Infant or junior food		
F469	1450	Canned infant or junior food	L	0.982
F472	1451	Infant cereals and biscuits	kg	
F475	1452	Infant formula	L	1.064
F476	1460-1463	Pre-cooked frozen food preparations		
F477	1460	Pre-cooked frozen dinners	kg	
F480	1461	Dessert pies, cakes, other pastries	kg	
F484	1462	Frozen meat or poultry pies	kg	
F490	1463	Other pre-cooked food preparations	kg	
F491	1470	Materials for food preparations	kg	
F495	1480-1492	Other food preparations		
F497	1481	Honey	kg	
F498	1482	Peanut butter	kg	
F499	1483	Dairy product substitutes	kg	
F500	1484	Flavouring extracts and essences	L	1
F501	1485	Flavouring powders and crystals	kg	
F502	1486	Food seasonings (including salt)	kg	
F503	1487	Jelly powders	kg	
F504	1488	Prepared dessert powders	kg	
F505	1489	Potato chips and similar products	kg	
F506	1490	Food drink powders	kg	
F507	1491	Canned puddings and custards	L	1.12
F518	1492	All other food preparations	kg	
F520	1500-1502	Non-alcoholic beverages		
F521	1500	Carbonated beverages	L	1.036
F522	1501	Fruit drinks	L	1.08
F529	1502	Other non-alcoholic beverages	L	1.02
F530	1000-1502	Locally and on day trips		

Variables used in the modified AIDS model system

APPENDIX C

	VARIABLE	DEFINITION
	Unit value	Expenditure weighted average locally and on day trips divided by the quantity consumed in a food category of a household.
	Share of expenditure at home for every food group	At home food expenditure share (day and over night trips) of a food group over total food expenditure at home (day and over night trips). Food expenditure in stores is used as a proxy variable for expenditure at home.
	Income	Household income, per capita.
	Lower level	Lower level of income divided by household size.
	Per capita at home food expenditure	Total food expenditure spent in stores (day and over night trips) divided by household size.
	Expenditure away from home	Proportion of the total food budget spent on food away from home. It is estimated as total food spent in restaurants divided by total food expenditure.
Type of household head (HH)	HH Type 1	Couple without children (0, 1).
	HH Type 2	Couple with children (0, 1).
	HH Type 3	One person household (either male or female) (0, 1).
	HH Type 4	Lone parent household with children (0, 1).
		Base: other household.
Size of area Residence code	Urban	The household resides in urban area = 1, otherwise 0.
		Base = rural.

	VARIABLE (Continued)	DEFINITION (Continued)
Region	Central	The respondent resides in the Prairies (Manitoba, Saskatchewan and Alberta) (1, 0).
	East	The respondent resides in Quebec, Ontario or in the Atlantic provinces (1, 0).
		Base = West (respondent resides in British Columbia).
Age	HH age to 24	The household head (reference person) is age up to 24 years (1, 0).
	HH age 25-34	The household head is age 25 to 34 years (1, 0).
	HH age 35-65	The household head is age 35 to 65 years (1, 0).
		Base = HH age is plus 65.
Gender	Female	The household head is female = 1, otherwise 0.
		Base = HH is male.

Own price demand elasticities derived from the modified AIDS model (USDA 2000)

APPENDIX D

Case of all sample households

COMMODITY	OWN PRICE ELASTICITY
Beef	-0.3540
Pork	-0.6867
Poultry	-0.6437
Other meat	-0.3554
Fish	-0.3871
Dairy	-0.7949
Egg	-0.0569
Fat	-0.3971
Cereal	-0.5489
Bread	-0.3537
Vegetables	-0.7238
Fruit	-0.7196
Juice	-1.0109

Source: Estimation of Food Demand and Nutrient Elasticities from Household Survey Data by Kuo S. Huang and Biing-Hwan Lin. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1887. August 2000.