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Three Essays on Canadian Household Consumption of Food Away From Home with Special Emphasis on Health and Nutrition

by

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This thesis is dedicated to the memory of my loving father, TACS Tilakarante. I miss him every day, but I am glad that what I am today is what he always wanted me to be.

Abstract

Consumption of food away from home (FAFH) is widely believed to be a contributing factor to the current obesity crisis and other diet related problems in North America. At present, in Canada, a number of issues related to FAFH consumption such as the relationship between obesity and fast foods, trans-fats, sugar and sodium content of restaurant foods, and restaurant advertising for children are being widely discussed. In these discussions, it is apparent that the interrelationships between FAFH, nutrition and diet related diseases are complex. Therefore, there are significant gaps in our knowledge. In this study, a number of important research questions related to FAFH consumption were studied in order to provide a detailed understanding of FAFH purchase trends, nutrient demand trends, factors affecting these trends and to provide some idea of the possible effectiveness of proposed policy interventions in the area.

In paper one of this study, a sample of Canadian FAFH purchases were analysed using a two stage demand model to examine the impact of industry advertising, households' habit forming preferences and socio-demographic and economic variables. Given the unique method of restaurant categorization, results provide new and additional information of the impact of above variables in Canadian context. The second study examined the demand for selected nutrients in FAFH to understand factors affecting nutrient intake in FAFH foods focusing on chain restaurants. An innovative measure of nutrient content (nutrient density) was used in the analysis and study results provides interesting new information about nutrient consumption from chain restaurants in the FAFH market. The third study examined how some specific food industry changes in product formulations aimed at reducing trans-fatty acids (TFAs) could and have affected consumers' overall diet quality and their demand for food away from home. This study provides some indications of effectiveness of the current trans-fat recommendations in Canada.

In summary, this study is an empirical investigation of a number of questions related to Canadian FAFH consumption: What is the structure of the FAFH market in Canada? What are the households' FAFH purchasing patterns? What is the impact of advertising and habit forming preferences and socio-economic and demographic factors on FAFH

purchases? What are the nutrition profiles of the most popular menu items of chain restaurants? What are the factors affecting nutrient demand in FAFH foods? Would a specific food industry change in product formulation such as reducing TFAs have affect consumers' overall diet quality and their demand for FAFH? In general, results from the three independent studies provide useful information to fill some of the gaps in our knowledge of FAFH consumption, especially on health and nutrition with implications for public policy.

Acknowledgment

It is a pleasure to thank many people who made this thesis possible.

Foremost, I would like to express my sincere gratitude to my supervisor, Prof. Ellen Goddard. Her perpetual energy and enthusiasm in research had motivated me to complete my study successfully. Her guidance and support helped me all the time of research and writing of this thesis. Beside my supervisor, I would like to thank the rest of thesis committee: Dr. Sandeep Mohapatra, Dr. James Rude and Tomas Nilsson for their encouragement and insightful comments.

The generous financial support from Co-operative program in Agricultural Marketing and Business, Consumer and Market Demand Network, Faculty of Graduate Studies and Research and Department of Rural Economy are greatly appreciated. My sincere thanks also goes to Robin, Dawn and other department support staff for always lending me their helping hand.

I thank all my colleagues at Department of Rural Economy whose presence was helpful and memorable.

I am indebted to my father for his care and love. Although he is no longer with us he is forever remembered. I am sure he shares our joy and happiness in the heaven. I cannot ask for more from my mother as she is simply perfect. Mother, I love you and wish you the best health and a long life. I feel proud of my sisters and brothers. Their love and encouragements meant a lot for me.

Last but not least, this thesis is simply impossible without my loving Priyantha and my two dearest sons: Kaveen and Sarosh. Their unconditional love, patience, support and encouragements meant a world to me. They have been my greatest strength against all the disappointments, frustrations and draw back as well as the greatest joy of my achievements during my PhD program. Their love made me feel like I am one of the luckiest mom and a wife in this world.

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Chapter 1: Introduction

1.1. Background and Problem Statement

A large body of scientific research shows that diet plays an important role in the prevalence of obesity and the risks of other diet associated non-communicable chronic diseases (coronary heart disease, cancer, strokes, diabetes, hypertension, and osteoporosis). The economic impact of unhealthy food choices is linked to increasing health care costs (direct costs), lost productivity and premature mortality (indirect costs). A recent study has estimated that the direct costs attributed to overweight and obesity in Canada were $6.00 billion in 2006, with 66% attributable to obesity (Anis *et al.* 2009). In recent years, public discourse about this issue has had some focus on the foods that are consumed away from home (FAFH). The increasing consumption of FAFH in developed countries, especially in the US (Blisard *et al.* 2003) and its possible link to obesity has added to the growing demand for public policies aimed at improving the nutritional quality of food served in the FAFH market (Variyam 2005). In response, governments are starting to pay attention and work towards designing and implementing interventions to promote healthy eating in FAFH. A few widely discussed policy options that relate to FAFH are mandatory nutrition labelling of restaurant foods, taxes on snack food, restrictions on food advertising to children (Quebec government has introduced the Quebec Consumer Protection Act in 1980, which bans advertising targeting children under the age of 13 (Dhar and Baylis 2009) and, banning or restrictions of trans fats (TFA) levels in FAFH (Kuchler 2005). In Canada, FAFH consumption is reported to have increased and the share of the household food dollar in FAFH consumption was estimated at 24.7% in 2008 (Statistics Canada 2008, CRFA 2009).

Despite many studies on consumer demand and FAFH, the link between diet related diseases and the nutrient quality[1] of overall FAFH is far from clear.

[1] A nutrient is defined as a chemical substance obtains from foods and used in the body to promote growth, maintenance and repair of body tissues. Nutrients are classified into two broad groups: Macronutrients (carbohydrate, fat, protein) and Micronutrients (vitamins and minerals). Nutrient quality of a food depends on the absence or presence of problematic nutrients such as fat, sugar, sodium, etc. Healthful foods are defined by the absence of these problematic ingredients (Drewnowski 2005).

Moreover, the impacts of proposed policy interventions are debatable and yet to be fully understood. This situation about FAFH has created significant gaps in understanding. In this dissertation an attempt is made to explore three different but closely related issues in the FAFH market in Canada. The dissertation contributes to extending the existing knowledge and provides new knowledge in terms of consumer demand, policy interventions and nutrition in the FAFH market.

The first paper is focused on identification of the factors affecting Canadian consumers' demand for FAFH. Given that there are health concerns about FAFH diets, a detailed understanding of this market and the FAFH consumer is warranted. The consumer demand for FAFH has been studied widely in different contexts with considerable variation in terms of objectives, methods, data, and variables chosen (Prochaska and Schrimper 1973; Sexauer 1979; Capps *et al*. 1985; McCracken and Brandt 1987; Nayga and Capps 1992; Reynolds and Goddard 1993; Yen 1993; Nagya 1996; Byrne *et al.* 1996; Jensen and Yen 1995; Minalopoulos and Demoussis 2001; Jekanowski *et al.* 2001; Piggott 2003; Multu and Gracia 2004; Min *et al.* 2004; Stewart *et al.* 2004; Ma *et al.* 2006; Binkley 2006). The variables included in these studies are consumers' economic and socio-demographic characteristics, opportunity costs of time, female participation in the workforce, convenience, accessibility and consumers' nutrition concerns and knowledge. However, some important variables have yet to be incorporated into FAFH demand analysis.

FAFH advertising expenditure and habit forming preferences for FAFH can be considered to be two important factors that may have significant effects on FAFH consumption. Advertising is considered to be a significant factor in FAFH demand, given the fact that food service providers are spending billions of dollars to promote their products (Advertising Age 2008). There is literature on advertising and FAFH in various contexts (French *et al.* 2001; Hoek and Gendall 2006; Chous *et al.* 2005; Harker *et al.* 2007). These studies have been focused on

one segment (fast foods) of FAFH market and little attention has been given to investigating the impacts of advertising on overall FAFH consumption behaviour. Habit forming preferences or addiction has been identified as an imperfect rational behaviour. In health related behavioural science literature, habits are defined as behaviours that are performed with a minimum of cognitive effort (Jager 2003). According to Jager (2003) habits are less susceptible to change and therefore, presence of habits has implications for policy makers. FAFH consumption, especially fast foods, has been linked to habit forming preferences (Sapala 2002; Hill and Peters 1998; Isganaitis and Lusting 2005). Again, the effect of habit-forming preferences in the overall FAFH market has gained little attention in the empirical economics research. Despite the importance of these two factors on overall demand for FAFH, most of the studies have focused only on the fast food segment of the FAFH market (Richards and Padilla 2007; Robinson *et al.* 2007; Chou *et al.* 2005; You and Nayga 2005; Sapala 2002; Isganaitis and Lusting 2005). Given this, the first paper of the dissertation is focused on the identification of factors affecting Canadian consumers' overall FAFH consumption incorporating FAFH advertising and allowing for habit-forming preferences. This provides information as to whether increasing consumption of FAFH is induced by FAFH industry advertising and the presence of habits, in addition to the other factors widely understood and published in the literature. The relative importance of each of these factors on Canadian FAFH consumption is established.

The second paper is explicitly focused on the demand for nutrients in the foods provided by FAFH market. Several self reported consumer research studies have shown that consumers are aware of healthy eating and the nutrition of the food they eat (Health Canada 2003; Ulbricht 2002) and therefore, there is a tendency for consumers to be looking for healthy alternatives. However, particularly in the FAFH sector, there is evidence that the introduction of healthy alternatives has not been successful in terms of FAFH marketing (Cash *et al.* 2006). Therefore, a question remains as to how consumers make substitutions in their food choices in

terms of healthy alternatives given their general consciousness about healthy eating**.** Since the nutritional quality of FAFH and quality changes over the years is a matter of concern, the study results provide useful information for public health interventions in terms of design and formulation of effective tools to promote healthy eating in FAFH. In this paper specific foods are not examined per se, rather the demand for specific nutrients is considered.

The third paper of this dissertation is an attempt to explore the effectiveness of a proposed policy intervention, using the case of Trans Fatty Acids (TFAs) in restaurant foods in Canada. Recently, the Government of Canada produced recommendations on dealing with TFA (Health Canada 2006). In 2007, the Minister of Health gave the food industry notice that it had two years to voluntarily implement these measures, or the government would regulate this reduction (Health Canada 2007). Some food service providers have been proactive and voluntarily changed their TFAs forming oils to non-TFAs forming oils in the processing of their products to lower or remove TFAs (Company press releases- A&W, Harvey's, Wendy, KFC, Arby's, Taco Bell 2006, 2007). Preliminary data collection on nutrition information from restaurant menus provides evidence that some restaurants have already changed their menus and their nutrient content. This situation provides a case to explore health and economic impacts of changes taking place in FAFH and provide some empirical evidence of the effectiveness of this proposed regulatory intervention. In other words, the study provides information as to whether voluntary implementation is adequate or the regulations should be mandated.

Even if 'purchase' and 'consumption' are not the same or synonymous, in all of the above three papers, household purchases were considered as household consumption and assumed that there are no plate waste or wastages. In addition, households' purchases/consumption, instead of individual's purchases/ consumption was the focus of dissertation given the nature of data. Therefore,

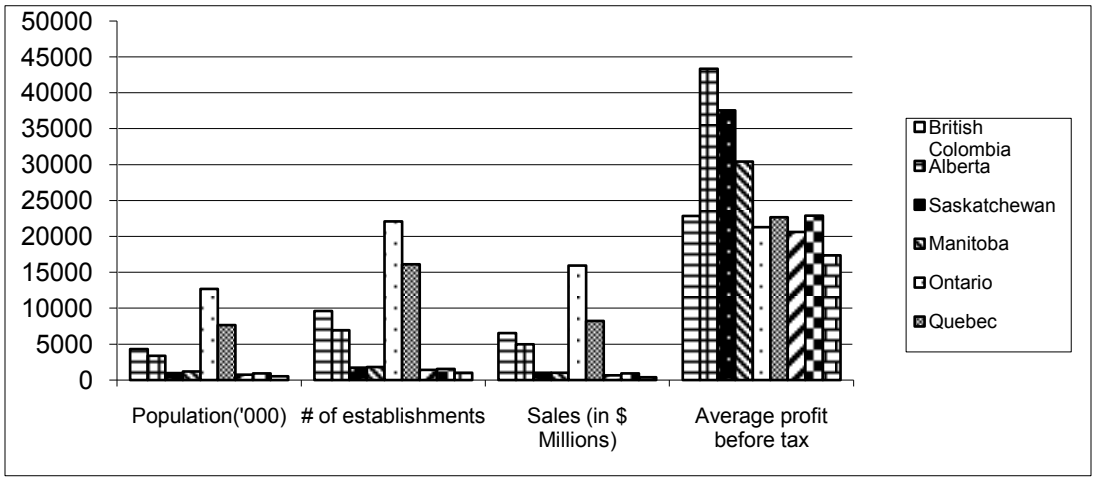
household purchases or consumptions cannot be clearly ascribed to children/adults in households.

To gain insights about the FAFH market in Canada, a brief overview of the Canadian FAFH sector, advertising in FAFH, the FAFH consumer and the marketing environment are provided in the following section.

1.1.1. Canadian Food Service Sector

The Canadian FAFH market is categorized as a sub-sector in Canada's food distribution sector. As the food distribution sector is the final sector in the food supply chain, it has the most direct interaction with consumers and can help in providing information and conveying consumer trends and demand to the rest of the food value chain (Agriculture and Agri-Food Canada (AAFC) 2007). According to the Canadian Restaurant and Food Service Association (CRFA), in Canada there were 62,600 food service establishments, selling about $53.5 billion worth of foods in 2007. This represents 3.8% of Canadian gross domestic product (GDP). In addition, the FAFH sector provides more than one million jobs for Canadians. Provincial comparisons in Figure 1.1 provide a better understanding of the pattern of sales and the number of establishments in different provinces in Canada. In terms of the number of establishments and sales, Ontario and Quebec rank first and second figures, respectively. However, it is interesting to see how Alberta leads the way in terms of profit before tax figures.

Figure 1- 1: Number of Establishments, Sales and Average Profit for FAFH Services in Canada, 2006



Source: Compiled with data from CRFA 2006 and Statistics Canada 2007

Based on market shares, the Canadian FAFH sector is divided into two main groups: commercial establishments, whose primary operation is to provide food and beverages, and non-commercial establishments, whose primary business is something other than providing food and beverage services (CRFA 2007). Their market shares and sales growth over the years are given in Table 1.1 and sales trends over the years are provided in Figure 1.2.

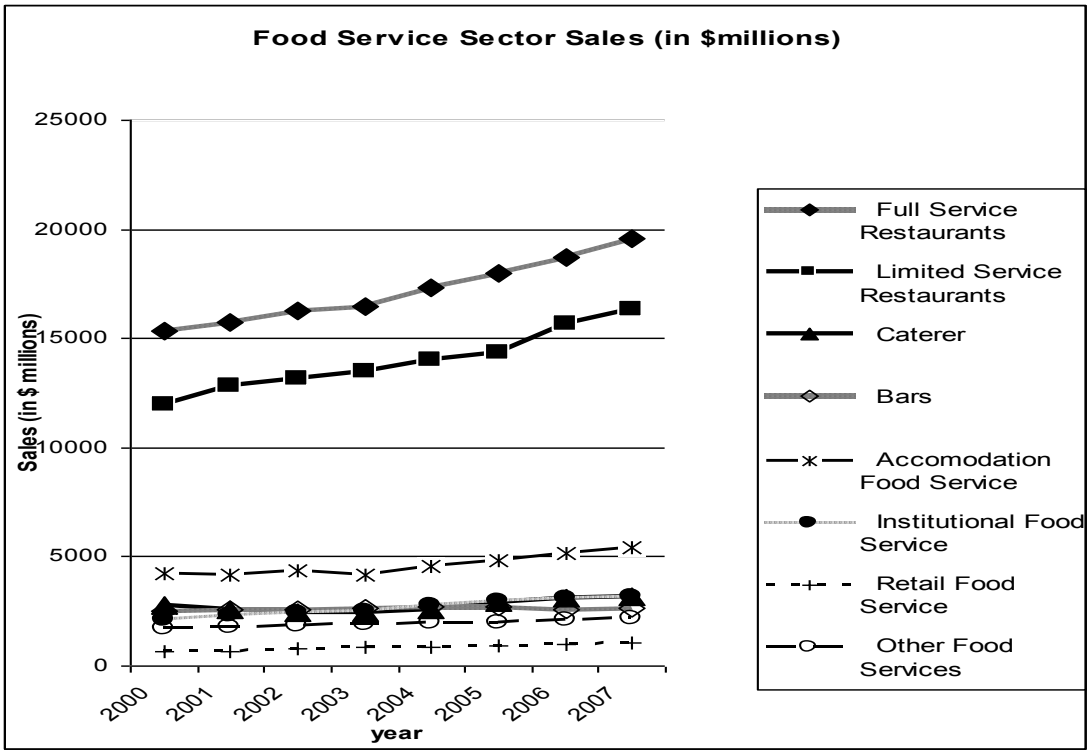
Table1- 1: Different Types of FAFH Service Establishments and Market Shares in Canada in 2006

Type	***No. of establishments***	***% Market Share***
Commercial Food Services		**78%**
Full Service Restaurants	28,664	36%
Limited Service Restaurants	24,782	31%
Caterers	4,239	5%
Bars	4,981	6%
Non- Commercial Food Services		**22%**
Accommodation Food Service		10%

Institutional Food Service	6%
Retail Food Service	2%
Other Food Services	4%

Source: CRFA 2007

Figure 1-2: Food Away From Home Sales by Type of Food Service Establishment (2000 to 2007)



Source: compiled with data from CRFA 2007

As shown in Table 1.1, the commercial sector captures 78% of total market share with full service restaurants (36%), limited service restaurants (31%), caterers (5%) and bars (6%) comparing the rest. In the non-commercial category, accommodation food services have the highest sales. About 62% of the restaurants in Canada are independent. Chain restaurants account for the remaining 38%. Many of the chain restaurants are locally owned and operated franchises (CRFA 2007). According to Figure 1.2, nominal sales revenues have been increasing over time. These figures highlight the importance of the

commercial sub-sector of FAFH market on which this dissertation is based. A profile of the commercial sub-sector as at 2004 is given in the Table 1.2.

Table1- 2: The Top Five Restaurants in Different Categories, FAFH in Canada, 2004 (Rating are based on 2004 sales revenue)

Category	***Restaurant***	***Revenue(in millions CAN$)***
Family restaurants	Kelsey's (Montana's, Outback)	435
	Prime Restaurants	345
	Keg Restaurant	322
	Northland Properties(Moxie's)	197
	Denny's (SIR Corp.)	179.6
Pizza chains	Boston Pizza	435
	Pizza Pizza	330
	Pizza Hut	327
	Domino's	122.8
	Panago Pizza	106.9
Chicken chains	KFC	681
	Swiss Chalet	435
	St. Hubert	316
	Dixie Lee	40
	Mary Brown	33.6
Coffee/Donut Chains	Tim Horton's	3165
	Starbucks	224.5
	Second Cup	185
	Coffee Time	124
	Timothy's	90.2
Burger Chains	McDonalds	2540
	Wendy's	610
	A&W	512
	Burger King	374
	Harvey's	260

Source: USDA 2006; Food Service and Hospitality Magazine 2005.

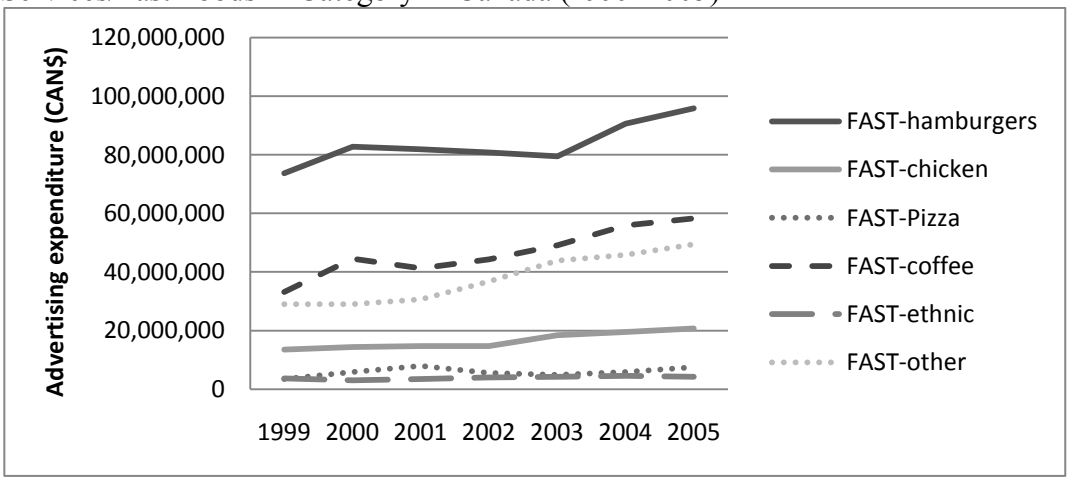
The information in Table 1.2 show marked differences in revenue, even within a given category of FAFH. Tim Horton's under Coffee/Donut Chains and McDonalds under Burger Chains stand out from the rest in terms of revenue.

These figures may indirectly provide some evidence of the effects of advertising and habits (McDonalds, Tim Horton's) and therefore, provide a case to analyze the study objectives in the first paper of this dissertation.

1.1.2. Advertising and FAFH

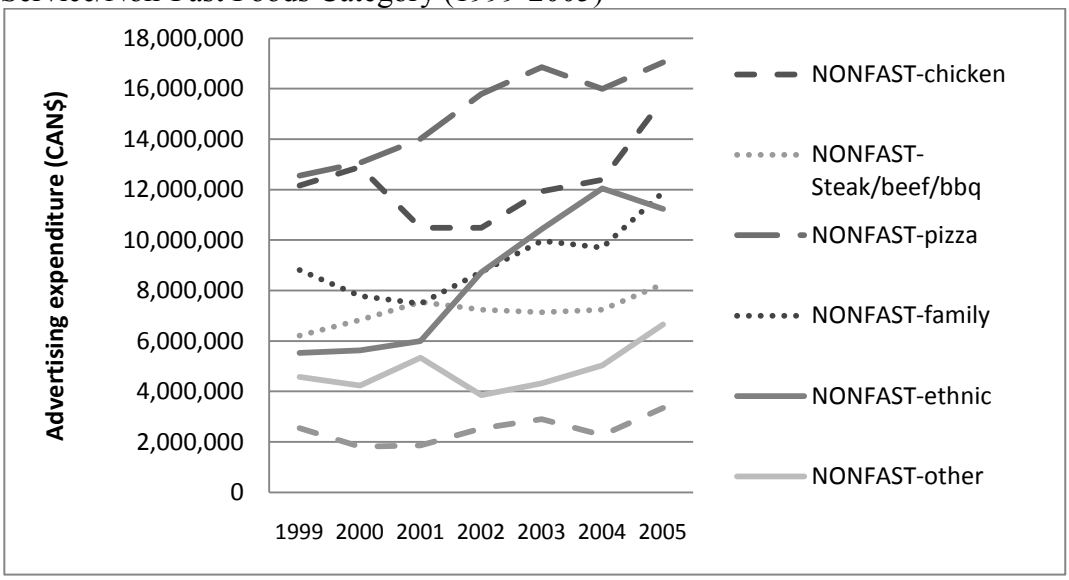
The impact of restaurant advertising was analysed in this dissertation. Therefore, a preliminary analysis of FAFH advertising expenditure (commercial sector of FAFH) is undertaken to gain some insights. Figures 1.3 and 1.4 provide some comparisons of advertising expenditure by different restaurants in the limited service/ fast foods and the full service/ non-fast foods categories of FAFH over the period 1999 to 2005. Table 1.3 provides the top three advertising spenders in 2005 in three FAFH categories: limited service/ fast foods, full service/ non-fast foods, and bars/ caterers. These are sub-categorized into thirteen different food specialities.

Figure 1- 3: Advertising Expenditure by Different Food Specialities of Limited Services/Fast Foods in Category in Canada (1999-2005)



Source: Compiled with FAFH market advertising expenditure data obtained from Nielsen Media Measurement (1999-2005).

Figure 1- 4: Advertising Expenditure by Different Food Specialities of Full Service/Non-Fast Foods Category (1999-2005)



Source: Compiled with FAFH market advertising expenditure data obtained from Nielsen Media Measurement (1999-2005).

According to Figure 1.3 and 1.4, the annual nominal advertising spending in each FAFH category has been increasing over the years. Among the limited service/fast food categories, on average, hamburger restaurants have been spending around $80 million Canadian annually. The second largest spenders are the coffee/donut restaurants. The 'other' type of limited service/fast foods restaurants (all the other restaurants which are not categorized under hamburger, chicken, pizza, coffee or ethnic categories) are the third largest advertising spenders. This group is followed by the chicken chains. Pizza and the ethnic food restaurants are the lowest advertising spenders among limited service/fast foods. When compared to limited service/fast foods, restaurants in the full service/non-fast foods category spend a lower amount on advertising. In this category, pizza restaurants are the largest advertising spenders. The second largest spenders are the restaurants specializing in chicken. The family type restaurants are the third largest advertising spenders. This followed by steak/beef/BBQ specialities, ethnic food specialities and 'all the other' sub-categories respectively.

Table1- 3: The Top Three Advertising Spenders in Different Categories of Food Specialities, FAFH Services in Canada 2005

Category	***Food Speciality***	***Restaurant Name***	***Advertising expenditure($)***
Limited Services/ Fast Foods	Burger	McDonalds	51,067,724
		Wendy's	21,300,127
		A&W	9,215,966
	Chicken	KFC	20,150,366
		Mary Browns	379,531
		Chicken Delight	52,076
	Coffee/Donut	Tim Horton's	52,379,472
		Starbuck's Coffee	2,879,310
		Country Style Donut	936,509
	Pizza	Pizza Pizza	2,508,802
		Panago	2,468,739
		Pizza Nova	1,331,692
	Ethnic Foods	Taco Bell	3,692,697
		Taco Time	424,034
		Koya Japan	15,751
	All others	Subway	25,309,321
		Dairy Queen	12,625,625
		Mr.Submarine	3,392,758
Full Services/ Non Fast Foods	Steak/Beef/BBQ	Keg Restaurant	4,385,065
		Le Biftheque Stake House	2,405,267
		Tony Roma's	373,865
	Chicken	Swiss Chalet	15,566,181
		St. Hubert	7,445,033
		Scores	530,286
	No main/family	Kelsey's	1,912,895
		Jack Astor's Bar and Grill	1,163,982
		Montana	1,095,508
	Pizza	Pizza Hut	9,214,890
		Boston Pizza	5,178,978
		Mike's Restaurant	1,592,535
	Ethnic Foods	East Side Mario	2,074,633
		Mandarine Restaurant	1,026,066
		Sushi Shop	491,777
	Others	Red Lobster	3,387,968

		White Spot Restaurant	1,735,963
		IHOP (pancake)	262,479
Bars/Catering	Bars/Catering/Night Club	Medieval Times	1,449,424
		Stage West Dinner	558,646
		Yuk Yuk's	303,507

Source: Compiled with FAFH advertising expenditure data obtained from Nielsen Media Measurement (1999-2005).

Table 1.3 provides some details on advertising spending of individual restaurants in each of the three categories, divided into food speciality sub-categories. It is interesting to see the huge advertising budgets of McDonalds and Tim Horton's in the limited service/fast food category as compared to other restaurants in their respective sub categories. While McDonalds spends twice as much as Wendy's, the second largest spender in the hamburger sub-category, Tim Horton's spends nearly 50 times as much as the second largest advertising spender (Starbuck's coffee) in the coffee/donut sub-category. Tim Horton's had the biggest advertising expenditure in the FAFH market in Canada in 2005. Compared to the restaurants in limited service/fast foods category, restaurants in the full service/non-fast foods category spend lower amounts on advertising. Among the full service/non fast foods category, Swiss Chalet was the largest advertising spender in 2005. In addition, McDonalds and Tim Horton's restaurants have been included in the top 25 advertising spenders in Canada in 2005 and 2006.

In order to provide some context for the level of restaurant advertising, it is interesting to note the restaurants that have been listed in the top 25 advertising spenders in Canada. According to the advertising expenditure data (ACNielsen 2001-2007), Wendy's restaurants group was included in this list in 2001. McDonalds was included in 2001, 2005 and 2006 while Tim Horton's was included in the list for three consecutive years: 2005, 2006 and 2007.

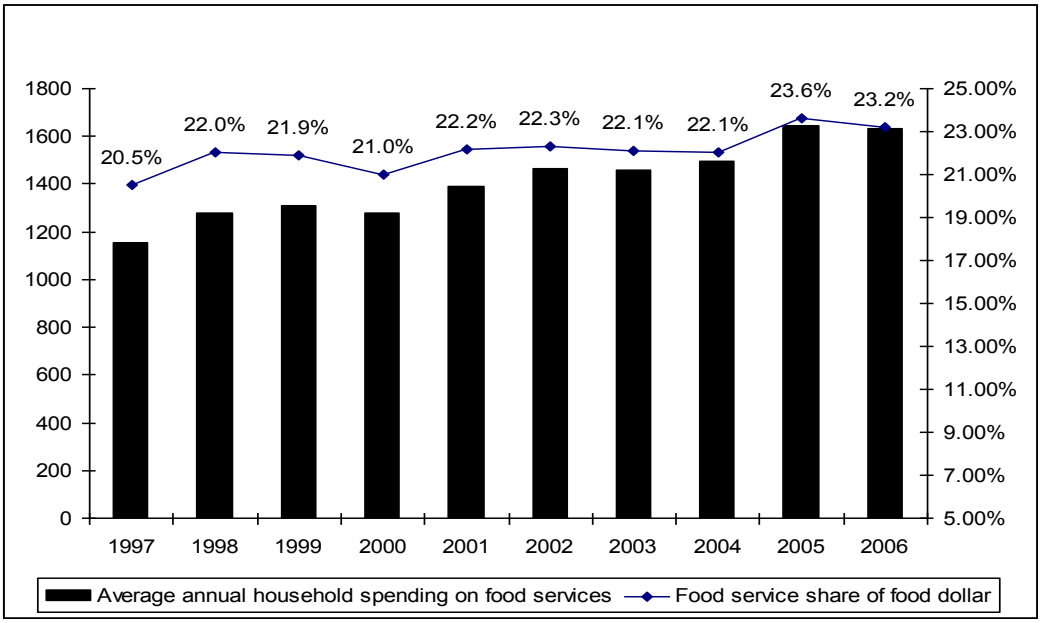
This analysis provides interesting information with regard to FAFH advertising in Canada. These huge advertising budgets provide some evidence that there may be an effect of advertising on FAFH consumption in Canada.

1.1.3. Canadian FAFH Consumer and Market Environment

Based on the 2006 Survey of Household Spending (Statistics Canada 2006), average annual household spending on food services and food services' share of household food dollars have both been increasing at a faster rate in recent years, except for a slight drop in 2006 (Figure 1.5). According to this report, average annual household spending (nominal value) has increased to $1634 in 2006 from $1152 in 1997, while the food service share of the household food dollar has increased from 20.5% to 23.1% during the same period. Referring to CREST/NPD[2] group information sources, CRFA reports that, as at October 2006, the average Canadian household visited a restaurant for a meal or snack 536 times per year and meal and snack sources from restaurants account for 1 out of 10 meal occasions.

[2] NPD Group Inc., available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html

Figure 1- 5: Average Annual Household Spending on Food Away From Home Services (1997-2006)

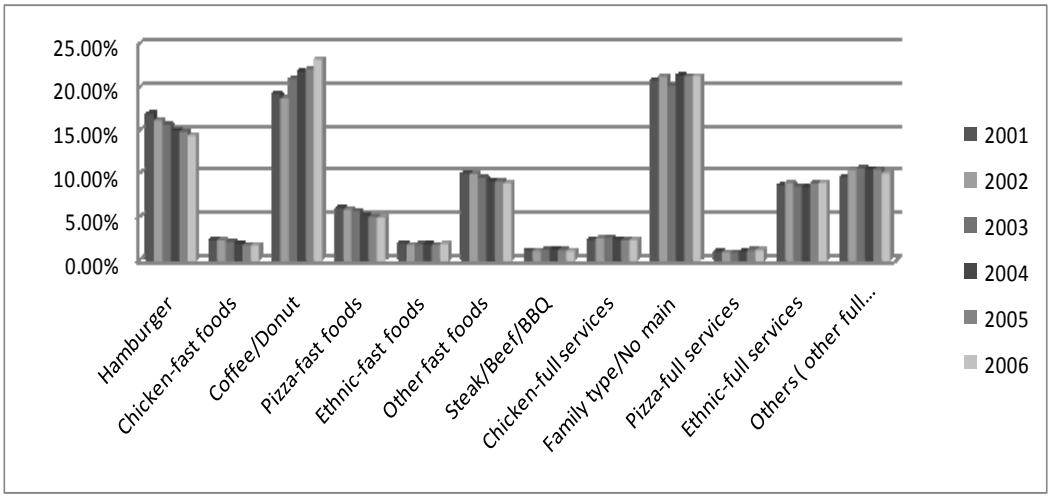


Sources: Survey of Household Spending, Statistics Canada (1997-2006)

These statistics show that the FAFH share of the household food budget is increasing steadily and therefore, the food service sector is becoming increasingly important for Canadian consumers and as an outlet for agricultural commodity producers and food processors.

A sample of the Canadian FAFH consumers' purchase data (obtained from NPD Group Inc.) was analysed to gain some insights on restaurant visits over the period 2001 to 2006 (Figure 1.6). All the restaurants that are reported in the data sample were categorized into 13 different food specialities based on the original NPD data categorization (see Table 1.4) and percentage visits to each speciality were estimated and are illustrated in Figure 1.6.

Figure 1- 6: Percentage Visits to Different Food Specialities by Canadian Food Away From Home Consumers over the Period 2001-2006



Source: Compiled with Canadian household's FAFH purchase data (obtained from NPD Group Inc).

According to Figure 1.6, a large percentage of households have visited family/no main type restaurants, coffee/donut restaurants and hamburger restaurants. While percentage visits to family/no main type restaurants have been stable over the period, percentage visits have been gradually decreasing (increasing) for hamburger restaurants (coffee/donut restaurants). The other food specialities which have comparatively higher percentages of visits are the other fast food restaurants (limited services/fast foods that are not categorized under hamburger, chicken, coffee/donut, pizza or ethnic food restaurants), ethnic full service restaurants and, other full service restaurants. When comparing percentage visits to similar specialities in limited services/fast foods category and full service/non fast food categories, marked differences can be observed in ethnic food specialities and pizza specialities. While the percentage visits to pizza specialities in limited services/fast food category is higher than the restaurants in full service/non fast foods category, percentage visits to ethnic food specialities show a reverse trend. For chicken specialities, percentage visits are slightly higher for restaurants in the full services/non fast food category. These figures reveal some interesting trends in consumer purchases in FAFH market. Given all these, a detailed understanding of FAFH sector is warranted to help explain the trends.

Apart from these trends in the Canadian FAFH market, consumer decision making about food purchases in general could change due to the interplay between various factors. Food prices, advertising on food, convenience, accessibility, tastes, information on nutrition and health, and the regulatory environment governing food, all shape and reshape consumer food choices. The complexity of our food choices is better presented by Sims (1998) as:

> "….. consumers are increasingly confronted with a plethora of food choices. It is estimated that most modern supermarkets offer more than 20,000 different food items. Even though we face an almost over whelming array of foods from which to choose, the assortment of different foods that we consume is often constrained by powerful influences on the food system—marketing orders, commodity price supports, regulations, laws, educational programs, even tax incentives—which act in concert to circumscribe the number and type of foods that are available to us at price we can afford" (p.3).

Despite this complexity in food choices in general, the FAFH consumption decision could be motivated by a completely different set of individual needs and wants. Referring to Stewart and Yen (2004), Cash *et al.* (2006) state "…FAFH consumption decisions can be triggered by more complex relationships than the decision to eat at home". Bareham (2004), in his study concludes "…consumers are less predictable than we ever thought; a range of paradigms or models may be necessary to understand the variety of behaviour engaged in by individuals in different contexts" (p.164). As these statements suggest, FAFH consumer behaviour cannot be compared to food consumption in any other context, and therefore, needs to be addressed separately. In addition to all these factors, given the fact that FAFH consumption is linked to obesity and many diet related diseases, this study is undertaken to analyze consumer demand and its interrelationships in the FAFH market with a special emphasis on nutrition and health in a comprehensive manner.

1.2. Study Objectives

The overall goal of this dissertation is to examine the factors affecting Canadian FAFH consumption and changes in consumer behaviour in the FAFH market; what factors makes consumers eat away from home, what changes are taking place in FAFH, what influences these changes and how different types of policy intervention may affect purchase behaviour. The specific objectives of the study are:

(1) to identify the impact of advertising, habit formation and socio-demographic factors on the demand for FAFH.
(2) to analyze the demand for nutrients in FAFH and to examine changes in terms of nutrient intake of households.
(3) to identify the impact of trans fat recommendations on quality and quantity of FAFH purchases.

1.3. The Contributions of the Dissertation

This dissertation provides several conceptual contributions to the existing literature. One conceptual contribution (in the first paper) lies in the attempt to examine how FAFH advertising, habit formation and socio-demographic factors influence consumers' FAFH demand by type of food specialities. The categorization of restaurants by food speciality is innovative and therefore, results extend existing knowledge and provide new knowledge on consumer behaviour in FAFH market. Another contribution (in the second paper and the third paper) is in the attempt to integrate knowledge of food nutrition and diet quality with consumer demand for FAFH. The results provide new and useful information on nutrition and health aspects of FAFH consumption. The dissertation also provides new information concerning the effectiveness of an existing/proposed intervention aimed at FAFH consumption behaviour (in the third paper). Another contribution is associated with the use of the Engel curve based demand system in the panel data estimation methods. Some of the unique characteristics of the FAFH consumption (large choice sets, provision of meals instead of individual food

groups, portion size differences, and unavailability of individual food price information in available data) and the resulting analytical limitations may be successfully dealt with in a selected Engel curve specification. In addition, an innovative measure of nutrient content of foods (nutrient density) was used in the analysis to overcome the problems of serving size differences. Since this standard is calculated using the number of calories as the basis, the resulting nutrient density ratio is independent of the serving size (Hansen 1979). This measure therefore, is important in overcoming computational difficulties due to different portion sizes reported in the FAFH intake data.

1.4. Data

This study uses a data set on Canadians' FAFH food purchases from May 2000 to February 2007, purchased from the NPD Group Inc. The specific data set, which is called Consumer Reports on Eating Share Trends (CREST), contains data on around 4000 to 5000 households per quarter. Many of the households contributed to data collection in multiple quarters. Each household in the data set recorded all of their purchases from commercial food service facilities during a two-week period in each quarter. The data set contains a variety of information on each household's socio-demographics, total expenditure on each purchase occasion, the type of the restaurant visited and its name and food speciality, and detailed information on the meal and beverage items purchased (NPD Group Inc. 2007). Advertising data (2000-2005) obtained from Nielsen Media Measurement and nutrition data collected from selected chain restaurants during 2006 and 2007 in Canada and the USDA National Nutrient data base (USDA 2007) were also used.

1.5. Organization of the Dissertation

The dissertation has five chapters. In the first Chapter, a brief introduction to the three research problems that are addressed in this study is provided. Then a brief overview of the Canadian FAFH sector, advertising in FAFH, the FAFH

consumer and the marketing environment are presented. Finally, study objectives and study contributions are provided.

In Chapter 2, demand in the overall FAFH market is analysed incorporating restaurant industry advertising and consumers' habit forming preferences. Using panel data, a two stage demand model was used to address the zero censoring nature of categorised household purchases in the FAFH market. Two estimation techniques were used and compared to obtain econometrically robust results.

Nutrient demand in FAFH was analysed in Chapter 3. Using a concept from the nutrition science literature 'nutrient densities' were used to overcome the problem of serving size differences and to calculate the nutrient demand. Then the socio-demographic and economic factors affecting FAFH food nutrients provided by chain restaurants were explored.

In Chapter 4, the effectiveness of an existing/proposed intervention – regulation of trans fatty acids in restaurant foods- aimed at FAFH consumption behaviour is explored. A diet quality index and a demand model allowing for structural change were used to explore this issue.

In the fifth and final Chapter, a summary, conclusions, policy recommendations and future research directions are presented.

1.6. Reference List

AAFA, Agriculture and Agri-Food Canada. 2007. "Food Distribution." Web page [accessed 2007]. Available at http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1170960704448&lang=eng.

ACNielsen. 1999-2005. Advertising Expenditure Measurement. Product Category: Media Research. Web page. Available at http://ca.nielsen.com/products/nmr_aem.shtml.

Advertising Age. 2008. "100 Leading National Advertising Spenders." Web page [accessed 2008]. Available at http://adage.com/datacenter/article?article_id=118652.

Anis, A.H, W Zhang, N. Bansback, D.P Guh, Z. Amarsi and C.L. Birmingham. Obesity and Overweight in Canada: An Updated Cost - of –Illness Study. *Obesity Reviews.*11, no.1:31-40.

Binkley, J. K. 2006. The Effect of Demographic, Economic and Nutrition Factors on the Frequency of Food Away From Home. *The Journal of Consumer Affairs.* 40, no. 2: 372-91.

Blisard, N., J. Variyam, and J. Cromartie. 2003. Food Expenditures by U.S. Households: Looking Ahead to 2020. Agricultural Economic Report, Washington, DC: Economic Research Service, United States Department of Agriculture,no. 821.

Byrne, P. J., O. Capps. Jr., and A. Saha. 1996. Analysis of Food-Away-from-Home Expenditure Patterns for U.S. Households, 1982-89. *American Journal of Agricultural Economics,* 78, no. 3: 614-27.

Capps, O. Jr., J.R. Tedford, and J. Havlicek. 1985. Household Demand for Convenience and Non-convenience Foods. *American Journal of Agricultural Economics.* 67, no. 4: 862-69.

Cash, S. B., E.W. Goddard, and L. Mel. 2006. Canadian Health and Food: The Links between Policy, Consumers, and Industry. *Canadian Journal of Agricultural Economics.* 54, no. 4: 605-29.

Chou, S. Y., I. Rashad, and M.Grossman. 2005. Fast-food Restaurant Advertising on Television and its Influence on Childhood Obesity. National Bureau of Economic Research Working Paper Series. Working Paper No.11879, Cambridge.

CRFA. Canadian Restaurant and Food Service Association. 2006. "Monthly Food Service Monitor." Web page[accesses 2006]. Available at http://www.crfa.ca/research/statistics/monthly ffodservicemonitor/.

CRFA. Canadian Restaurant and Food Service Association. 2008. "Economic Impact of Canada's Foodservice Industry." Web page [accessed 2008]. Available at http://www.crfa.ca/research/statistics/factsandstats.asp.

Dhar T., and K Baylis. 2009. Fast-food Consumption and the Ban on Advertising Targeting Children: The Quebec Experience.

Drewnowski, A. 2005. Concept of a Nutritious Food: Toward A Nutrient Density Score. *American Journal of Clinical Nutrition.* 82, no. 4: 721-32.

Drewnowski, A. 2003. Fat and Sugar: An Economic Analysis. *The Journal of Nutrition*. 133:838S-840S.

French, S. A., M. Story, D. Neumark-Sztainer, J. A. Fulkerson , and H. Hannan. 2001. Fast Food Restaurant Use among Adolescents: Associations with Nutrient Intake, Food Choices and Behavioral and Psychosocial Variables. *International Journal of Obesity.* 25, no. 12: 1823-33.

French, S. A., M. Story, and R. W. Jeffery. 2001. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health.* 22: 309-35.

Harker, D., M. Harker, and S. Svensen. 2007. Attributing Blame: Exploring the Link between Fast Food Advertising and Obesity in Australia. *Journal of Food Products Marketing. 13, no.2:2007* 13,

Health Canada. 2003. "Consumer Perspectives on Healthy Eating, Summary of Quantitative Research" Web page, [accessed December 2007]. Available http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/reviewexamen/research-recherche-quantitative_e.html.

Health Canada. 2006. Impact of Modifying Trans Fat Content of Foods on Dietary Intake. Appendix 11. "TRANSforming the food supply, Report of the Trans Fat Task Force Submitted to the Minister of Health." Web page, [accessed December 2007]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf

Health Canada. 2007. "Trans Fat Monitoring Program." Web page, [accessed January 2008]. Available at http://www.hc-sc.gc.ca/fn-an/nutrition/gras-trans-fats/tfa-age-eng.php.

Hill, J. O., and J.C. Peters. 1998. Environmental Contributions to the Obesity Epidemic. *Science.* 280: 1371-74.

Hoek, J., and P. Gendall. 2006. Advertising and Obesity: A Behavioral Perspective. *Journal of Health Communication.* 11: 409-23.

Isganaitis, E., and R.H. Lustig. 2005. Fast Food, Central Nervous System Insulin Resistance, and Obesity . *Arteriosclerosis, Thrombosis, and Vascular Biology***.** 25: 2451-62.

Jager, W. 2003. Braeking 'Bad Habits': A Dynamical Perspective on Habit Formation and Change. In L. Hendrickx, W.Jager, L.Steg(Eds.) Human Decision Making and Environmental Perception. Understaning and Asisting Human Decision Making in Real-Life Setting. University of Groningen.

Jensen, H., and J. Schroeter. 1991. Television Advertising and Beef Demand: An Econometric Analysis of 'Split-Cable' Household Panel Scanner Data. *C Anadian Journal of Agricultural Economics* 40, no. 2: 271-94.

Kuchler, F., E. Golan , J. N.Variyam, and S. R. Crutchfield. 2005. Obesity Policy and the Law of Unintended Consequences. USDA, Economic Research Division.

Ma, H., J. Huang, F. Fuller, and S. Rozelle. 2006. Getting Rich and Eating Out: Consumption of Food Away from Home in Urban China. *Canadian Journal of Agricultural Economics.* 54: 101-19.

McCracken, V. A., and J.A. Brandt. 1987. Household Consumption of Food-Away-from-Home: Total Expenditure and by Type of Food Facility. *American Journal of Agricultural Economics.* 69, no. 2: 274-84 .

Mihalopoulos, V.G., and M.l .P. Demoussis. 2001. Greek Household Consumption of Food Away from Home: A Microeconometric Approach. *European Review of Agriculture Economics.* 28, no. 4: 421-32.

Min, I., C. Fang, and Q. Li. 2004. Investigation of Patterns in Food-Away-From-Home Expenditure For China. *China Economic Review.* 15: 457-76.

Multu, S., and A.Gracia. 2006. Spanish Food Expenditure Away From Home (FAFH): By Type of Meal. *Applied Economics.* 38: 1037-47.

Nayga, R. M. Jr., and O. Capps, Jr. 1992. Determinants of Food Away from Home Consumption: - An Update. *Agribusiness.* 8, no. 6: 549-59.

NPD Group Inc. 2007. "Food Service: Consumer Tracking". Web page, [accessed 2007]. Available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html.

Prochaska, F.J., and R. A. Schrimper. 1973. Opportunity Cost of Time and Other Socioeconomic Effects on Away-from-Home Food Consumption. *American Journal of Agricultural Economics.* 55, no. 4: 595-603.

Reynolds, A., and E. W. Goddard. 1993. Food Consumption Away From Home by Type of Facility and Type of Meal. *Canadian Journal of Agricultural Economics.* 42, no. 2: 225-30.

Richards , T. J., and L. Padilla . 2007. Promotion and Fast Food Demand: Where is the Beef? Research Project Number CMD-07-03. Department of Rural Economy. University of Alberta.

Robinson, T. N., D.L.G. Borzekowski, D. M. Matheson, and H.C. Kraemer. 2007. Effects of Fast Food Branding on Young Children's Taste Preferences. 2007. *Archives of Pediatrics and Adolescent Medicine.* 161, no. 8: 792-97.

Robinson, L., and E. Zafirious. 1986. The Food Expenditure Patterns of Elderly in Canada: 1974-82. *Food Marketing Commentary*. 8:29-43.

Sapala, J. A. 2002. Is the Fast Food Industry Becoming the Next Tobacco Industry? *Obesity Surgery.* 12, no. 1:1-2.

Sexauer , B., 1979. The Effect of Demographic Shifts and Changes in the Income Distribution on Food-Away-from-Home Expenditure. *American Journal of Agricultural Economics.* 61, no. 5: 1046-57 .

Statistics Canada. 2008. "Survey of Household Spending and CANSIM II (table no. 203-0002)." Web page, [accessed January 2008]. Available at http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function =getSurvey&SDDS =3508&lang = en&db=imdb&dbg=f&adm=8&dis=2 .

Statistics Canada. 2006. Food Services and Drinking Places, Summary Statistics by North American Industry Classification. CANSIM II (table no. 355-0005). Web page, [accessed 2006]. Available at http://www40.statcan.gc.ca/l01/cst01/serv26a-eng.htm.

Stewart, H., N. Blisard, D. Jolliffe, and S. Bhuyan. 2005. The Demand for Food Away from Home: Do other Preferences Compete with Our Desire to Eat Healthfully? *Journal of Agricultural and Resource Economics.* 30, no. 3: 520-536.

Stewart, H., N. Blisard, S. Bhuyan, and R. M. Nayga, Jr. 2004. "The Demand for Food Away from Home: Full-Service or Fast Food?" *USDA-ERS Economic Research Report.* Report, no. 829.

Ulbricht, G.J. F. 2002. Nutritional Information and Consumer Behavior – Their Relationship To Nutritional Balance. A study conducted in Berlin. *Food Service Technology.* 2, no. 1: 5-11.

USDA National Nutritent Data Base. 2007. "Nutrient Data Laboratory". Web page [accessesd in 2007]. Also available at http://www.nal.usda.gov/fnic/foodcomp/search/

Variyam, J. N. 2005. Nutrition Labeling in the Food-Away-From-Home Sector: An Economic Assessment. *USDA-ERS Economic Research Report.* Report no.4.

Yen , S.T. 1993. Working Wives and Food Away from Home: The Box-Cox Double Hurdle Model. *American Journal of Agricultural Economics.* 75, no. 4: 884-95 .

You, W., and R.M. Nayga Jr. 2005. Household Fast Food Expenditures and Children's Television Viewing. *Journal of Agricultural and Resource Economics.* 30, no. 2: 302-14.

Chapter 2: Factors Affecting Demand for FAFH with Advertising and Habit Formation

2.1. Motivation

Increasing expenditure on FAFH (Statistics Canada, 2006) and concerns about possible effects of fast foods on dietary quality have generated a greater interest in understanding FAFH consumption in Canada. Among many factors that have already been identified as leading to an increased demand for FAFH (see Table 2.1 for a list of FAFH demand studies), the effects of FAFH advertising and habit forming preferences for FAFH, can be considered as two important factors which need further exploration.

Despite some empirical evidence of the link between FAFH advertising, especially fast food advertising and consumption (Story and French 2004; Chou *et al.* 2005; Harker *et al.* 2007), the huge advertising budgets of the food service sector provide some evidence to suggest significant effects of advertising. Otherwise, advertising budgets would be smaller and the funds would be allocated elsewhere. According to Advertising Age (2008), food service providers are spending billions of dollars to promote their products. In 2006, among the top 100 advertising spenders in the world, the restaurant industry spent US$ 3,553 million. McDonalds Corporation, Yum Brands and Burger King are included in these top 100 advertising spenders in the world. Canadian data on advertising expenditure by different categories of FAFH also provide evidence of large advertising budgets, especially in the fast food category. In particular, McDonalds was included in the top 25 advertising spenders in Canada in 2005 and 2006, while Tim Horton's was included in the same list in 2005, 2006 and 2007 (ACNielsen 2007).

The most recent – and most comprehensive – review of the evidence shows that advertising does affect children's food choices and dietary habits (Hastings *et al.* 2003) and therefore, provides indirect evidence that there is a relationship between the heavy marketing of foods and beverages to young children and

obesity (Borzekowski and Robinson 2001, Story and French 2004). There is literature linking obesity and food advertising in various contexts (French *et al.* 2001; Hoek and Gendall 2006). Even though there is literature on the impact of advertising on food demands (see Table 2.2.1.), only a few studies have directly investigated the economic effects of advertising on consumer demand for FAFH (Herington 2004; Bhuyan 2005; Richards and Padilla 2007). Richards and Padilla (2007) have investigated the effect of price promotion by the fast food sector in Canada, which is only 31% of the total FAFH market share in Canada, ignoring the other categories. They found that promotion primarily increases demand and has very little effect on restaurant market shares as opposed to the claims made by advertisers. However, a further investigation of the effect of advertising on the entire commercial sector of FAFH market (78% of market share) is important given the level of expenditure by some restaurants on advertising. Further, such an investigation may have implications for public policy concerns about advertising to children.

In the nutrition and health literature, especially in the obesity related literature, the consumption of FAFH, fast food in particular, is often presented as making consumers addicted to certain food characteristics and to the environment where these foods are provided (Sapala 2002; Hill and Peters 1998; Isganaitis and Lustig 2005). Using a Spanish data set, Browning and Collado (2007) found that 'food outside the home' is habit forming, Richards and Padilla (2007), using a discrete-choice modeling framework, found that sample households in a Canadian fast food consumption study, behave in a way that is consistent with addiction. Habit forming preferences have been identified as an important factor that contributes to market failure (Variyam 2005). According to behavioural science literature, habit is a behaviour that can perform with minimum cognitive effort and therefore, when habits are formed, it is hard to change (Jager 2003). Habit forming behaviour can contribute to irrational consumer behaviour and therefore, the outcomes of market intervention strategies are largely dependent on the proper identification of its presence in a particular situation. In addition, identification of

habit forming behaviour is also important to answer many economic and policy questions. For example, habit formation has significant implications for tax policies that change relative prices of food as long-term responses to changes will be large compared to short-term responses (Browning and Collado 2007). Since available economic studies in FAFH have largely ignored this phenomenon, it is important to incorporate habit formation in the demand for FAFH.

Apart from the importance of identifying the effects of advertising and habit formation in the FAFH market in Canada, another factor that motivates this study is the lack of timely economic studies of the Canadian FAFH market. Kara *et al.* (1995) found that there are significant differences between the frequent fast-food buyers in the US and Canada in terms of consumers' perception of FAFH consumption. Therefore, a timely Canadian study will be useful to identify important differences if any, between Canadian and US FAFH consumers.

2.2. The Research Objective and Significance of the Study

2.2.1 The Research Objective

The overall goal of this study is to better understand the factors associated with FAFH expenditures in Canada. The specific objective is to identify the impact of advertising, habit formation and socio-demographic factors on the demand for FAFH in Canada.

2.2.2. Significance of the Study

While this study will contribute to the literature by addressing a gap in studies of the Canadian FAFH market, it may also have implications for food commodity markets and public policy in the area of diet and health. For example, using the most recent socio-demographic data, this study will provide important information on the effects of changing socio-demographic factors on the demand for FAFH, which may be unique to the Canadian context. While identification of the effects of these factors may be important for food service providers to formulate and direct their marketing strategies to different consumer categories,

food commodity producers may also be able to obtain indirect information on commodities which are likely to be demanded by food processors and food service providers. Incorporating advertising data may help to identify the effects of advertising on the demand for food in different categories of FAFH services. Further, by looking at the relationship between family composition and advertising (as an interaction term), the effects of advertising on households with children can be isolated. By examining habit forming preferences in this study, it will be possible to find out whether habit formation is significant in demand for FAFH. Together with the information on socio-demographic effects, the impact of habit formation can be used to design policy interventions or programs to promote healthy eating in FAFH.

2.3. Conceptual Framework

2.3.1. Consumer Theory as It Applies to Food Demand

Traditionally, there are two approaches to analyzing consumer behaviour and demand, which are based on sets of choice axioms and behavioural assumptions: utility maximization and expenditure minimization. These two approaches yield Marshallian demand functions and Hicksian demand functions, respectively. Marshallian demand functions can be substituted into the consumers' original utility function to obtain indirect utility functions and substitution of Hicksian demands into the consumers' budget constraint yields consumer's expenditure (cost) function. From duality theory, the above concepts provide a theoretical basis for estimating demand in different ways (Deaton and Muellbauer, 1980). Demand functions have four basic properties. In summary, they are as follows:

- Adding up: The total value of both Hicksian and Marshallian demand is the total expenditure. In other words, the sum of expenditure on each consumption bundle must equal income.
- Homogeneity of degree zero: This property is also known as 'absence of money illusion', meaning that the consumer will not believe that real values have changed because of changes in monetary values. It assures that an equal percentage change in all prices and income affects demand. Marshallian demand functions

are homogeneous of degree zero in both prices and income and Hicksian demand functions are homogeneous of degree zero in prices (Deaton and Muellbauer, 1980).

- Symmetry: This property states that an increase in the price of any good *i* causes the same substitution effect on another good *j* as an identical increase in the price of *j* causes on *i.* Symmetry results from consistent preferences.
- Negativity: Negativity means that if the price of one good increase, then the effect on demand for that good is negative.

There have been various empirical applications of consumer demand theory. The Generalized Leontief (Diewert 1971), the Translog (Christensen *et al*. 1975), the Rotterdam (Theil 1965; Barten 1968), and the Almost Ideal Demand System or AIDS (Deaton and Muellbauer 1980 a) are examples of popular demand models with locally flexible functional forms. Locally flexible functional forms do not require a priori restrictions on elasticity estimations. However, these functional forms have some limitations with regard to consistency with microeconomic theory (Barnet and Seck 2008). In order to overcome some of the limitations of these locally flexible functional forms, alternative flexible functional forms have been developed. The examples include the Quadratic AIDS model (QUAIDS) (Banks *et al.* 1997), the Laurent model (Barnett 1983), and the Generalized Exponential Form (G.E.F) (Cooper and McLaren 1996). However, in food demand analysis, the Rotterdam model and different versions of AIDS specification have been widely used. In addition, Engel Law specifications: Working-Lesser, double log, semi-log, and quadratic forms have also been used in food demand analysis, especially when price information is not available (Holcomb *et al.* 1995).

Another widely used extension of neoclassical demand theory is the theory of household production, which is an integration of choice theory and the theory of the firm (Becker 1965). The resulting concept of characteristics demand (Lancester 1966) is based on an assumption that a consumer's utility is determined by the characteristics of goods, which may be assumed to enter the

consumer's utility functions directly, or as inputs into household production processes. Building on the concept of characteristics demand, McFadden (1973) developed the theory of discrete choice, which is very popular in applied food demand studies using revealed preference (market data) and stated preference (choice experiments) data.

Accordingly, there is a wide variety of empirical modelling approaches to food demand analysis. However, selecting a modelling approach for this study needs careful analysis of study context, objectives and the data availability.

2.3.2. Modeling Consumer Demand for FAFH

Consumer demand for FAFH has been studied widely in different contexts, using different empirical approaches. However, it is worth noting that timely Canadian studies on FAFH demand are limited. See Table 2.1 for a summary of research undertaken in this area. There are several noteworthy issues in modeling consumer demand for FAFH. One important problem is the complexity of consumer food choices in this market. The FAFH market consists of a large number of restaurants providing a large number of menu items. Under this situation, it is very difficult to understand what guides consumer food choices (consumers' preference for the type of restaurant or their preference for the types of foods). Therefore, in modelling, one has to decide whether to model consumer demand in terms of food categories, restaurant categories or some other forms of aggregated demand categories. In a majority of previous studies, the objective was to find out the impact of consumers' economic and socio-demographic characteristics on the demand for FAFH and therefore, FAFH has been described as one aggregated category (Prochaska and Schrimper 1973; Sexauer 1979; Capps *et al.* 1985; Lee and Brown 1986; Horton and Campbell 1991; Yen 1993; Byrne *et al.* 1996; Jekanowski *et al.* 2001; Mihalopoulos and Demoussis 2001; Min *et al.* 2004; Ma *et al.* 2006; Binkley 2006). Some researchers have extended this analysis by considering FAFH expenditure by market segments/ type of facility (McCracken and Brandt 1987; Byrne *et al.* 1998; Stewart), by the type of meal

(Jensen and Yen 1995; Nayga 1996; Mutlu and Gracia 2006) and both by the types of facility and by the type of meal (Reynolds and Goddard 1993; Hiemstra and Kim 1995). These analyses have shown that the demand for FAFH is influenced by a number of important socio-demographic characteristics. These include the household's income, time constraints faced by household head, the household head's age, education level of the household head, number of people in the household, the household composition, the household's region of residence and household's race and ethnicity. Recently, household's concerns and knowledge of nutrient aspects of FAFH (Binkley 2006), the effect of fast food promotion (Richards and Padilla 2007), the effect of brand advertising (Bhuyan 2006) and the effect of addiction to fast foods (Richards and Padilla 2007) have also been incorporated into FAFH demand studies.

Another issue of modeling FAFH using micro-level data is the unavailability of price, quantity or both price and quantity information. Various types of data have been used with varying degrees of success to analyse the demand for FAFH. Traditionally food demand studies have relied upon data collected by public agencies which are cross sectional in nature, although some studies have used time series data. Recently, researchers have used panel data collected by private agencies like NPD Group Inc. (Byrne *et al.* 1998; Richards and Padilla 2007). Often, these data sources do not provide price data, quantity data or both price and quantity data. To overcome this data issue, previous studies have modeled FAFH demand using expenditure information (see studies listed in Table 2.1).

Any study dealing with household or individual data also has to face the issue of zero censoring. In FAFH purchase data one can find households or individuals who do not purchase some food products or from certain restaurants in a given data period. Therefore, FAFH demand estimation using expenditure data requires special statistical procedures to account for households with zero expenditure (Stewart *et al.* 2004). To overcome the potential bias and inconsistencies that may result from censored responses, researchers have used Tobit models (McCracken

and Brandt 1987) and Double Hurdle models (Yen 1993, Mihalopoulos and Demoussis 2001). However, use of Tobit models raises some concerns as it restricts the directional effects to be same for both the participation decision and the expenditure level decision (Byrne *et al.* 1996). The Double hurdle model on the other hand is more suitable when the purchase infrequencies are very low for a certain category in the data set (Byrne *et al.* 1996). An alternative to Tobit models and Double-hurdle models is the two-step approach (Heckman 1978). Following Heckman's two-step method, Heien and Wessells (1990), Shonkwiler, and Yen (1999) have developed two different specifications that can be used to estimate multiple equations simultaneously allowing zero-censoring (Stewart *et al.* 2004).

There are a number of issues concerning the modelling of FAFH demand. To address these issues, different model specifications have been developed and applied over the years. The selection of an empirical model for this study therefore, should be based on a model's ability to address the above identified issues such as categorical purchases, unavailability of product prices and zero censoring.

2.3.3. Analytical Technique: Panel Data Methods

In empirical demand analysis, three kinds of data have been used. They are time series data, cross-sectional data and panel data. Compared to time series and cross sectional data, panel data has some advantages as it blends the inter-individual differences and intra-individual dynamics (Hsiao 2007). Given that this study will be using a panel data set, advantages are briefly discussed here in order to highlight the robustness of estimates of panel data models. First, panel data provide more accurate inferences of model parameters than the models which use cross sectional or time series data. Panel data usually contain more degrees of freedom and more sample variability than cross-sectional data and time series data, hence improving the efficiency of econometric estimates (Hsiao 2007). Second, panel data have a greater capacity for capturing the complexity of human behaviour than a single period cross-sectional data set or time series data as it is

possible to follow the same individual's behaviour over time. This facilitates the analysis of dynamic responses and the control of unobserved heterogeneity (Arellano 2003). Third, the use of panel data simplifies computation and statistical inferences under certain situations. For an example, panel analysis is simpler than analysis of non-stationary time series models (Hsiao 2007). Apart from these advantages, panel data also have some disadvantages, mainly due to the nature of data gathering units. Measurement errors, selectivity problems: self-selectivity, non-response and attrition, and short time series dimensions are some of them (Baltagi 1995).

The most widely used panel data models are called the Fixed Effect and Random Effect models (Greene 2003). The basic model framework to explain these model specifications is as follows:

$$y_{it} = X_{it}\beta + Z_i'\alpha + \varepsilon_{it} \qquad (1)$$

where y_{it} is the dependent variable, X is a vector of explanatory variables and *i* and *t* are subscripts to denote individual and time dimensions, respectively. The individual effect or heterogeneity is given by the $Z_i'\alpha$ term and Z_i contains a constant term and a set of individual or group specific variables, which may be observed, such as race, sex, and location or unobserved, such as family specific characteristics, individual heterogeneity of skills or preferences and so on (Greene 2003). According to Greene (2003), in fixed effect models, Z_i is unobserved, but correlated with X_{it}. Therefore, the equation (1) above is specified as:

$$y_{it} = X_{it}\beta + \alpha_i + \varepsilon_{it},$$

where $\alpha_i = Z_i'\alpha$ is a group specific constant term and is 'fixed' or does not vary over time.

In random effect models, the unobserved individual heterogeneity is assumed to be uncorrelated with the included variables in a model. Then the model is specified as:

$$y_{it} = X_{it}\beta + \alpha_i + u_i + \varepsilon_{it}$$

where u_i is a group specific random element, similar to ε_{it} except that for each group, there is but a single draw that enters the regression identically in each period (Greene 2003). Based on the above discussion, a fixed effect approach is conditional upon the value for α_i. Inferences are, therefore, with respect to the effects that are in the sample. The random effects approach is not conditional upon the individual α_i s, and allows one to make inferences with respect to the population characteristics (Verbeek 2004).

Whether to treat individual effects α_i as fixed or random is not an easy question to answer (Verbeek 2004). The treatment of individual effects depends on many factors such as dynamic vs. static modelling specifications, use of endogenous vs. exogenous regressors in the model, and research objectives: whether prediction is required or not (Baltagi 2005). According to Verbeek (2004), proper use of these specifications improves the efficiency of the estimates. As Arellano (2003) states "…..given the variety of existing panel data sets and the diversity of objectives economists may have in using them, there is no such thing as the methodology of analysing panel data, but a collection of disparate techniques that have accumulated from a series of heterogeneous motivations in theoretical and applied econometrics"(p. 2).

Only a few studies have used panel data in FAFH demand models (Byrne *et al.* 1996; Angulo *et al.* 2007). However, in these studies, they have used either estimation of model for each year in the sample (Byrne *et al.* 1996) or the two-step estimation procedure introduced by Chamberlain (1984) (Angulo *et al.*

2007), without directly specifying their models as fixed effect models or random effect models.

2.3.4. Advertising and Consumer Demand for Food

In this study, the effect of advertising on demand for FAFH will be investigated. In order to understand the theoretical background and to develop a conceptual model, a brief review of the theory of advertising and empirical applications is undertaken in the following sections.

2.3.4.1. Theory of Advertising as It Applies To Consumer Demand for Food

There has been an extended debate in the applied economics literature about the effect of advertising on consumer demand and the best way to incorporate this effect into demand models. Much of the debate stems from pre-conceptions regarding the purpose of advertising (Tremblay and Tremblay 1995). One of the earliest concepts was that advertising is deceptive (Kaldor 1950). According to Kaldor, advertising changes consumer preferences, creates brand loyalty and persuades consumers to favour commodities that they did not previously demand. Bauer and Greyser (1968) also find that consumers believe that much advertising is persuasive. These perceptions are believed to have a negative impact on the consumer, in terms of social welfare, as advertising persuades people to buy things that they do not need. However, Telser (1964) and Nelson (1974) argue that advertising can benefit society by informing consumers about products that have more preferred characteristics, are sold at lower prices, and are available at locations that are more convenient. Fisher and McGowan (1979) claim that advertising can enhance consumer utility by creating desirable product images and therefore, advertising is more favourable. Although some debate exists regarding these pre-conceptions (see Fisher and McGowan 1979; Dixit and Norman 1979; Kotowitz and Mathewson 1979) applied economists have been using various modeling approaches to incorporate this persuasive effect of advertising into their respective studies.

As described above modelling the persuasive effects of advertising can take a variety of forms. The most obvious thing about advertising is that it is designed to encourage us to buy more of a product or service. In essence, from an economic theoretical basis, what it aims to do is to shift the demand curve for specific goods to the right and/or change the price elasticity of demand for the product or service concerned. In reducing the price elasticity, there could be an increase in consumer loyalty and the consumer could become less affected by substitutes that may be available and less responsive to changes in price.

2.3.4.2. Modeling Advertising Effect in Consumer Demand for Foods

Our focus is on the modeling of advertising's impact on consumer demand for food products in the FAFH market. Modeling advertising effects depends on the assumed interaction of advertising with the demand for a product (Brester and Schroeder 1995). If we are to assume that advertising only shifts demand, then advertising expenditure can be incorporated into demand functions as a shift variable. When advertising is assumed to affect the demand elasticity by persuasion or provision of information to consumers, then advertising can be incorporated as a scaling factor on price and expenditure variables in the model. In the case of scaling, advertising can generate both quality effects and indirect price-related effects (Brown and Lee 1993). Assumptions that advertising generates a psychological need or subsistence requirement for a product suggest that advertising should be incorporated as a translating factor in the model (Brester and Schroeder 1995). In this case, advertising generates an income related effect (Brown and Lee 1993). See Table 2.2.1, for a list of economic studies and for different approaches to incorporating advertising variables into modeling consumer demand for food products. A majority of the listed economic research studies have used aggregate time series data (Table 2.2.1). Only a few have used cross sectional data or panel data (Jensen and Schroeter 1992; Schmit *et al.* 2002; Richards and Padilla 2007).

According to the above review, to model advertising as a scaling effect, one needs to have a price variable in the model. However, modelling advertising as a demand shifter or a translating factor is plausible without a price variable and therefore, can be considered in this study context.

2.3.4.3. Advertising and FAFH

A number of studies have analysed advertising in the FAFH market. Among available studies, Richards and Padilla (2007) have looked at the effect of fast food promotional activities and found that these promotions both influence a company's market share and expand the demand for their foods. Some have investigated the impact of brand advertising on FAFH in general (Bhuyan 2005) and on mature, takeaway markets in particular (Eagle *et al.* 2005). Bhuyan (2005) found that brand advertising had a significant impact on consumers' choice of type of outlet and menus. However, in mature markets, it has been found that brand advertising is aimed at only protecting existing market share (Eagle *et al.* 2005). Herrington (2002) has investigated the current effect and carryover effect of advertising in the restaurant industry and found that while immediate, positive effects of advertising are low, there is a significant carry over effect. Some have investigated fast food franchisee advertising (Herrington 2004; Stasson and Millelstaedt 2002) and found that immediate returns for such advertising are low. Many have examined the relationship between fast food advertising and obesity (Chou *et al.* 2005; Harker *et al.* 2007; Hoek and Gendall 2006). Chou *et al.* (2005) compared a total advertising ban and a tax on unhealthy fast food as intervention strategies and found that a total ban on advertising would result in a higher reduction in obesity. The advertising measure used in their study is the number of hours of spot television fast-food restaurant advertising messages seen per week. Harker *et al.* (2007) provides an account of the link between fast food and obesity in Australia by reviewing relevant issues based on a theory of attribution, while Hoek and Gendall (2006) provide the same for New Zealand using a behaviour modification theory to analyse the ''fast-food'' industry's promotions.

The influence of food advertising on children has been studied by Story and French (2004) and Eagle and Brennam (2007) with some emphasis on issues related to FAFH. Some other aspects of FAFH advertising have also been studied to include a cross-cultural content analysis of restaurant advertisements (Wang 2003), the effects of corporate social responsibility in advertising (Schroder and McEachern 2005), effects of advertising by family type restaurants, atmosphere restaurants and gourmet restaurants (Lewis 1981), advertising spending and quality of restaurant services (Hortsmann and Moorthy 2003), the relationship between advertising expenditure and intangible value and risk for restaurants and exploration studies on restaurant advertising and promotion strategies (Jackson *et al.* 2004 , 2008). For a list of studies and a brief section on main findings of these studies, see Table 2.2.2. All of these studies provide some insights on the effect of advertising in the FAFH market and could be used in empirical modelling as well as aid in interpreting this study's results.

There are a number of theories about the effects of advertising on consumer demand. Applied economists have been using various modelling approaches to incorporate these effects into their studies. A number of studies have been undertaken to examine the effects of advertising on the FAFH market in various contexts, especially in selected segments of the FAFH market (fast foods). However, no one has systematically tested for shifting, scaling and translating effects of advertising using panel data, in consumer demand in the overall FAFH market. This study aims to fill that gap in literature by testing for shifting and translating effects of advertising.

2.3.5. Habit Formation and Consumer Demand

Identification of habit forming preferences in the demand for FAFH is another objective of this study. Therefore, the theory of habit formation and modeling approaches to habits in food demand are briefly reviewed in the next sections.

2.3.5.1. Theory of Habit Formation

Habit formation has been prominent in micro-economic studies of addiction. Addiction is a strong form of habit formation and can be rational or myopic (Messinis 1999). According to Becker and Murphy (1988), in rational habit formation/addiction, a particular good is considered addictive if past consumption of that good raises the marginal utility of current consumption and therefore, raises current consumption. In other words, there is a complementarity between past and current consumption. However, in myopic habit formation/addiction, consumers ignore the effect of current consumption on future utility, and therefore, on future consumption (Grossman and Chaloupka 1988). Becker and Murphy (1988) also explained that addictive behaviour, either rational or myopic, corresponds to more price elastic long-run demand as compared to the price elasticity of short-run demand. Out of these two theories, the rational addiction theory has been used more often in empirical applications and is considered superior to the myopic theory of addiction (Fenn *et al.* 2001). However, Muellbauer (1988) found the myopic habit formation model is preferred to the rational habit formation model. The empirical evidence provides mixed results and modeling approaches should be tested with empirical data.

2.3.5.2. Modeling Habit Formation in Consumer Demand for Foods

Rational habit formation is generally incorporated into demand models by specifying certain parameters to be a linear function of consumption of a particular commodity in the immediately preceding period and immediately future period. In other words, both lag and lead consumption levels are used. However, myopic habits are incorporated into demand models only through a lagged consumption level. When the system of equations approach, similar to the Almost Ideal Demand System (AIDS) in budget share form is used, the coefficient of the

intercept term of the budget share equation is specified as a linear function of both lag and lead consumption levels or a function of only lagged consumption levels (Blanciforti and Green 1983; Alessie and Kapteyn 1991). When the representative agent utility maximization models are used, the resulting consumption level of the demand equation is specified as a function of both lag and lead consumption levels or a function of only lag consumption levels (Grossman and Chaloupka 1998; Auld and Grootendorst 2004; Fenn *et al.* 2001). According to empirical evidence, it is very difficult to discriminate between rational and myopic habits and they are observationally equivalent in a demand system context (Muellbauer and Pashardes 1988; Phlips and Spinnewijn 1981). Habit formation is a specific class of time non-separable preference. Therefore, habit formation models have in common, a lagged dependent variable, which implies a geometric distributed lag, a partial adjustment mechanism or an adaptive expectation scheme. See Table 2.3.1. for a summary of previous studies done on habit formation/addiction.

2.3.5.3. Habit Formation and FAFH

While it is very common to incorporate habits in food demand analysis in general, only a few studies have investigated the effect of habits in demand for FAFH (see Table 2.3.2). Browning and Collado (2007), using a Spanish panel data set including FAFH, found that FAFH is habit forming. Based on the fact that certain nutrients in fast foods are addictive (Del Parigi *et al.* 2003; Colantuoni *et al.* 2002; Grigson 2002, Cawley 1999), Richards *et al.* (2007) used a spatial hedonic pricing model to test whether fast food firms set prices to exploit the inherent addictiveness of fast foods. They found that firms price products, dense with addictive nutrients, below marginal cost. Ji and Wood (2007), using a longitudinal survey design found that regardless of consumers' explicit intentions, they would repeat purchases of fast food among few other purchases. In a study, which analyzed promotion and fast food demand, Richards and Padilla (2007) found that the sample households behave in a way that is consistent with rational addiction. Other available studies provide medical evidence linking obesity and the habit-forming nature of fast foods (Sapala 2002; Isganaitis and Lustig 2005).

This review showed that there are two prominent theories of habit formation and two respective modelling approaches to incorporate habits into demand estimations. Some studies of FAFH market provide evidence of habit forming preferences for fast foods, but no specific evidence has been provided for the other segments of the FAFH market. Therefore, in this study habit formation will be examined for the overall FAFH market.

2.3.6. Social and Behavioural Determinants of FAFH Consumption

Identification of socio-economic and demographic factors on FAFH consumption is another objective of this study. In addition to many studies which have been undertaken in economic and marketing disciplines, a number of studies are available in social and behavioural science disciplines. In order to gain insights and to facilitate better interpretation of analytical estimations, a brief review of studies in social and behavioural science was undertaken.

Shepherd (1999) studied the social determinants of food choice using a social psychological attitude model, Theory of Planned Behaviour with some extensions to the basic model and found that there could be a number of reasons as to why it is difficult to effect dietary change. According to Shephered (1999), one of the reasons is the phenomenon called optimistic bias, where individuals believe themselves to be at less risk from various hazards than the average person. This effect has been demonstrated for nutritional risks, and this might lead individuals to take fewer notes of health education messages. Another concern is that individuals do not always have clear-cut attitudes, but rather can be ambivalent about food and about healthy eating. Therefore, he highlighted the importance of having a measure for this ambivalence, and an understanding of how it might impact on behaviour. Goldsmith *et al.* (1997) studied the values-attitudes-behaviour structure in women's purchasing behaviour towards snack food, convenience foods and cooking and found that several values were associated with attitudes towards snack foods and use of convenience foods, suggesting that social values may influence buyer behaviour.

Patric and Nicklas (2005) studied the family and social determinants of children's eating patterns and demonstrated that social factors such as parents' education, time constraints, and ethnicity influence the type of food that they eat. In addition source of food (e.g. home, restaurants, and schools) and physical environment play a direct role in children's eating patterns. Fast food consumption behaviour is studied using a Theory of Reasoned Action by Bagozzi *et al.* (2000). They found that depending on the social setting (eating alone or eating with friends) and cultural orientation (independent vs. interdependent) prediction can vary. Among other results, subjective norms were found to influence decisions when eating with friends, but not when alone; the effects of attitudes, subjective norms, and past behaviour on intentions were greater for Americans than Italians, Chinese, or Japanese; and in general, more explained variance occurred for Western (American, Italian) than Eastern (Chinese, Japanese) cultures.

The Reasoned Action Theory was also used to model the consumption of convenience food by Verlegh and Candel (1999). They investigated five situations, which were either time-related (weekdays vs weekends) or social "dinner alone", "dinner with family", and "dinner with friends"). The intention to use a TV dinner decreased from "alone" via "with family" to "with friends", but did not differ between weekdays and weekends. Subjective norms were a stronger influence on intentions than attitudes in all situations, except for "weekdays" and "dinner alone". Primary reference groups were a stronger influence on intentions than secondary reference groups, and the motivation to comply with a particular reference group increased substantially when that group joined for dinner. Consumption frequency for TV dinners was higher in households where the person responsible for meal preparation held a paid job, and it was positively related to the number of hours that this person was employed. Bringberge and Durand (1983) have used two behavioural intention models (Fishbein and probability models) to analyse eating at fast-food restaurants. By comparing intentions and some selected attitudes with actual behaviour, they found that

intentions are significant and a sufficient predictor of behaviour. They also highlighted that the results can be used to design nutrition education programs.

According to social and behavioural literature, habits have been known to play a pivotal role in human behaviour. According to Jager (2003), habits are defined as behaviours that are performed with a minimum of cognitive behaviour. Lindbladh and Lyttkens (2002) define habits as non-reflective, repetitive behaviour. Due to automaticity of behaviour, habits are less susceptible to change than reasoned behaviour (Jager 2003). When a habit provides a positive outcome in the present, but detrimental outcomes on the long run, one can speak of 'bad habits'. Such bad habits are hard to change because cognitive outcome will hardly affect the automatised behaviour (Jager 2003). Jager (2003) provides a detailed account on dynamical perspective on habit formation and breaking habits highlighting the implications for policy makers.

These few selected study reviews underscore that there are number of social and behavioural factors that affect households' food purchasing behaviours. Therefore, it is important to include variables that measure social and behavioural factors in food demand studies whenever possible in order to obtain accurate estimates for prediction or policy analysis purpose.

2.4. Literature Review

In this section, a comprehensive review of literature was undertaken in the areas of demand for FAFH (Table 2.1), food demand and advertising (Table 2.2.1 and 2.2.2), and food demand and habits (Table 2.3.1. and 2.3.2). In Table 2.1, the review focused on identifying different methodological applications of FAFH demand analysis, variables included in the models, data sources and final results. In Table 2.2.1, food demand studies in general were reviewed to identify different methods of incorporating advertising variables into demand estimation. Studies which have specifically undertaken advertising in FAFH are reviewed in Table 2.2.2. While the studies in Table 2.3.1 provide some empirical methods to

incorporate habits into food demand models, Table 2.3.2 contains few studies which have specifically addressed the issue of habit forming preferences in FAFH. This literature review will be used to define the empirical model for this study.

Table 2- 1: Previous Studies in Food Away From Home in Chronological Order

Author /Year/ Country	Study/Data/Model	Results
Prochaska and Schrimper / 1973/USA	• Opportunity cost of time and other socioeconomic effects on Away-From-Home food consumption • Household Food Consumption Survey 1965-66 (USDA) • Single equation demand function	Opportunity cost of time shown to have a positive effect on FAFH consumption, both among employed homemakers and unemployed homemakers. Effect of income, family composition, family size and race was also analyzed.
Sexauer/ 1979/USA	• The effect of demographic shifts and changes in the income distribution on FAFH expenditure • Survey of Consumer Expenditure and Income (USDA & BLS) and Consumer Expenditure Survey 1972 (BLS) • Single equation expenditure function	Demographic and income distribution shifts have a significant effect on long-run changes in consumer demand. 22.3% of observed change in average aggregate expenditure on FAFH might be explained by demographic shifts.
Goddard/1983/ Canada	• An analysis of Canadian aggregate demand for food at home and away from home • Annual and quarterly Canadian food consumption data (1949 to 1981) • Linear Expenditure system and AIDS	Expenditure on FAFH have incensed at a faster rate than expenditure on food at home. Income is the most significant factor for FAFH expenditure increase.
Capps *et al* . /1985/USA	• Household demand for convenience and non-convenience foods • USDA- Nationwide Food Consumption Survey (1977-78) • AIDS	Determined the impacts of total food expenditure, income, food prices, household size, and demographic variables on household demand for convenience and non-convenience foods in the United States. The budget shares are generally more responsive to prices than to real total expenditure. Additionally, the quantities demanded of convenience and non-convenience foods are generally more sensitive to changes in income and

Table 2.1 continues….

		own-prices than to changes in cross-prices. With regard to demographic variants, primary users of convenience foods are white households with employed household managers less than 35 years of age.
Lee and Brown/ 1986/USA	• Food expenditure at home and away from home: what socio-demographic characters affect these spending decisions • USDA- Nationwide Food Consumption Survey • Switching regression analysis	Rising income of households, increase the chances that households will eat away from home.
Barewal /1987 / Canada	• Canadian spending of food service dollars • Family Food Expenditure Survey -1984 • Classifications and cross tabulations	Analyzed expenditures on food eaten away from home by socio-demographic groups and provide demographic projections.
Robbins and Zafiriou/ 1987/Canada	• The spending patterns of Canadian consumers- an overview • Family Expenditure Survey-1984 and Urban Family Food Expenditure Survey • Cross tabulations	Percentage shares of total food expenditure on meals eaten in restaurants are provided for various socio-demographic characteristics
McCracken and Brandt 1987/USA	• Household consumption of FAFH: Total expenditure and by type of food facility • 1977-78 Nationwide food consumption survey, USDA • A system of multivariate Tobit equations	Differential importance of market participation effects of household size, income and time value by level of the variable and by the type of food facility
Horton and Campbell / 1991/ Canada	• Wife's employment, food expenditures and apparent nutrient intake: Evidence from Canada • Family Food Expenditure Survey 1984 • Two budget share equation (food share of income and FAFH share of expenditure)	Found that wife's employment increases the share of FAFH in the food budget. Wife's full-time employment has a negative effect on apparent nutrient intake of households.
Reynold and Goddard 1993/Canada	• Determinants of FAFH for Canada both by types of facilities and by types of meal	Impacts of household characteristics on FAFH expenditure by type of facility and by type of meals are

Table 2.1 continues….

	• Family food expenditure survey data for 1986 (cross section) • Heteroscedasticity corrected Tobit model	explained.
Yen/1993/USA	• Effect of working wives on food away from home • Consumer Expenditure Survey • The Box-Cox Double-hurdle model	Households with working wives and those with higher income are more likely to consume more food away from home. Wife's age and household size increase the level of FAFH consumption.
Jensen and Yen 1995/USA	• Food expenditures away from home by type of meal • Consumer Expenditure Diary Survey 1992-1993(USDA, BLS) • Double-hurdle model	Nearly 40% of households purchased breakfast, and about three quarters of households purchased lunch or dinner in a two-week period. Wife's employment has a positive effect on the probability and level of lunch and dinner expenditures but not on breakfast expenditures. Income effects are all statistically significant and positive. The role of household composition, other demographics and region are also important.
Hiemstra and Kim 1995/USA	• Factors affecting expenditures for FAFH in commercial establishments by type of eating place and meal occasion • NPD data-four quarters in1989 • Disaggregated expenditure relationship equations	Analyzed the relationship between food spending and socio-demographic and economic characteristics by type of meal occasions (breakfast, lunch, dinner and snacks) and the type of eating place (fast food, family type, atmosphere, cafeteria, coffee shops, and take out from restaurants).
Kara *et al.*/ 1995/ Canada and USA	• Marketing strategies for fast food restaurants: a customer view • A survey through self-administered questionnaires • Correspondence analysis and multidimensional scaling	They found that there are significant differences between the frequent fast food buyers in the USA and in Canada in terms of the factors perceived important by fast food consumers. Frequent buyers in the USA considered variety, speed and friendly staff as the most important factors of their fast-food restaurant choice while less frequent buyers indicated that price and promotional deals were the most important factors. On the other hand, frequent Canadian fast-food buyers considered seating capacity and nutritional value as the most important factors while less frequent buyers indicated, like their US counterparts, that price, novelties and location were the most important attributes. However, no differences were

Table 2.1 continues….

		found between the US and Canadian consumers' perceptions of the similarity of the fast-food restaurants studied.
Byrne *et al.* 1996/USA	• Effect of socio-economic and demographic variables both on the decision to consume FAFH and on the decision of how much to spend. • NPD data (National Panel Diary Group) • Two-step process of Heien and Wessells (1990)	Similar results of previous FAFH research. Income elasticity is about 0.20, suggesting that FAFH commodity is a necessary good for U.S. society. Found differences in consumption patterns of households living in different regions.
Nayga 1996/USA	• Analysis of food away from home expenditure by meal occasions • Consumer Expenditure Survey- 1992 (BLS) • Two-step procedure of Heien and Wessells (1990)	Provide a profile of households that spend more on FAFH by meal occasion.
Nayga 1996/USA	• Wife's labour force participation and family expenditures for prepared food, food prepared at home, and FAFH • Consumer Expenditure Survey- 1992 (BLS) • Two-step procedure of Heien and Wessells (1990)	Number of children, home ownership with mortgage, seasonality, region, wife's age, and income are important determinants of expenditure on food prepared at home. A wife's education and participation in the labour force affect expenditures on prepared food and food away from home. The impact of both these factors is greater on food away from home than on prepared food
Byrne *et al.* 1998/USA	• Analysis of quick serve, mid-scale and up-scale FAFH expenditure • NPD data • Three-step procedure using and Heien and Wessells (1990)-linear equations system	Analysed the effects of socio-demographic and economic variables, both on the decision to consume FAFH by facility and on the decision of how much to spend on selected facility.
Jekanowski *et al.* 2001/USA	• Impact of convenience and accessibility on demand for food away from home • Census of retail trade • Single equation demand model for two time periods	Greater availability has led to increased FAFH consumption

Table 2.1 continues….

Mihalopoulos and Demoussis 2001/Greece	• Greek household consumption of food away from home • Greece Household Budget Survey 1993-1994 • Double –hurdle participation model	Participation in the FAFH market is found to be determined by household income, household size and place of residence. Meal planners' education, marital and employment status also affect FAFH use.
Guthrie *et al.* 2002/USA	• Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: Changes and consequences • Nationwide Surveys of Food Consumption 1977-78 and 1994-96 (USDA). • Assessment of percent calories from total fat and saturated fat, and the cholesterol, sodium, fibre, calcium, and iron densities of foods prepared at home versus those prepared away from home	Between 1977-78 and 1994-96, consumption of food prepared away from home increased from 18% to 32% of total calories. Meals and snacks based on food prepared away from home contained more calories per eating occasion, and "away" food was higher in total fat and saturated fat on a per-calorie basis than at-home food. "Away" food contained less dietary fibre, calcium, and iron on a per-calorie basis. Among adults but not children, food prepared away from home was more sodium and cholesterol dense.
Piggott /2003/ USA	• The nested PIGLOG model: an application • to US food demand • Time series expenditure data from 1968-99 • Nested PIGLOG model, nesting thirteen other demand systems	Based on the PIGLOG model, FAFH is estimated to be price and income elastic compared to FAH which was price and income inelastic. The implied income elasticity of demand for FAFH in this study is larger than most previous estimates.
Min *et al.* 2004/ China	• Households' FAFH expenditure across two time periods and across two regions • China's urban household level survey data (1992-1998) • Both parametric (linear regression) and non-parametric methods	Compared parametric and non-parametric method results. Non-parametric model showed income elastisities have increased from 1992 to 1998, while the parametric model suggested the contrary. Non-parametric method is superior to parametric method

Table 2.1 continues….

Stewart *et al.* 2004/USA	• Effect of socio-demographic characteristics on food spending: on fast food and full services • Data from consumer expenditure survey • Two-step process of Shonkwiler and Yen (1999)-linear expenditure equation	Larger increase in consumer spending is predicted to occur in full service restaurants compared to fast food service restaurants. Single person households and multiple adults without children spend more on each segment while aging of population decrease the spending of fast food compared to full services.
Stewart / 2005 / USA	• The demand for FAFH: Do other preferences compete with our desire to eat healthfully? • Household survey data for one state in U.S. • Two single equation demand model	Explored the effect of consumer preference on the demand for FAFH including frequency of eating out and choice of outlet type. Found that preference and ambience highly influence FAFH eating behaviour.
Binkley 2006/USA	• The effect of demographic, economic and nutrition factors on frequency of food away from home • Continuing Survey of Food Intake by Individuals (CSFII) and Diet and Health Knowledge Survey-1994-1996 (USDA) • Limited dependent count data model-Poisson Model	Demographic effects are similar to previous studies. Nutrition factors have little impact on table survive, but nutrition oriented consumers tend to have lower fast food consumption.
Ma *et al.* 2006/China	• Trend of FAFH consumption and determinants of FAFH demand in China • National household income and expenditure survey and survey conducted by the research team • A system of multivariate Tobit equations	Increasing trend in FAFH and it is fuelled by the increasing income levels of Chinese.
Mutlu and Gracia 2006/ Spain	• Household expenditure on lunch, breakfast and snacks in away from home. • Spanish Continuous Household Survey for 1996	FAFH purchasing behaviour of Spanish consumers differ by type of meal. Income, household characteristics and the opportunity cost of women time are important factors determining FAFH consumption patterns.

Table 2.1 continues….

	• Double Hurdle/Infrequency of purchase model	
Richards *et al.* /2007/ USA	• Fast food, addiction and market power • Prices and nutrient profiles for a cross section of items offered by seven popular fast food restaurants • Dynamic equilibrium model of oligopoly pricing with addiction and a spatial hedonic pricing model	With dynamic equilibrium model, they found that firms with market power would price below marginal cost. With the hedonic pricing model they found that fast food firms set prices in order to exploit their inherent addictiveness
Richards and Padilla / 2007/ Canada	• Promotion and fast food demand: Where is beef? • NPD data (National Panel Diary Group) • A discrete/continuous model of fast food restaurant choice and food expenditure that explicitly accounts for both spatial and temporal determinants of demand.	Showed that promotional activity by fast food vendors is effective in both increasing the market share of the promoting firm, and in expanding the demand for fast food in general? Further, by accounting for the nutritional, demographic and temporal proximity of fast food purchase occasions, found that the sample households behave in a way that is consistent with a rational addiction.

Table 2- 2: Modelling Advertising Effects in Food Demand Studies

Author /Year/ Country	Study/Data/Model	How to incorporate advertising variable.
Alston *et al.* / 2000 / USA	• Investigated the incidence of costs and benefits of generic meat advertising. • Time series data • AIDS model	Advertising is incorporated as translating parameter
Boetel & Liu /2002/ USA.	• Evaluating the effect of generic advertising and food health information within a meat demand system. • Time series data • Linearized AIDS	Advertising is incorporated as a translating variable.
Brester and Schroeder/ 1995/ USA.	• The impacts of brand and generic advertising on meat demand Time series • Nonlinear Rotterdam model	Advertising is incorporated into the model as both demand shifter and price and total expenditure scaling factors.
Brown and Lee /1993/USA.	• Alternative specifications of advertising in the Rotterdam model • Time series data • Rotterdam model	Advertising effect on demand is treated as a price scaling factor.
Chang and Kinnucan / 1991/Canada	• Advertising, information, and product quality: The case of butter • Time series data • A semi -log demand equation	The advertising variable is modeled as a demand shifter.
Comeau *et al.* /1997/ USA.	• Assessing the effectiveness of MPP and TEA advertising and promotion efforts in the Japanese market for meats • Time series data • An Inverse Almost Ideal Demand System	The effect of advertising modeled using translating procedure of Pollak and Wales (1980).

Table 2.2 continues….

Duffy /1991/U.K.	• Advertising in demand systems: testing a Galbraithian hypothesis • Time series data • AIDS model	Advertising as an augmented term
Duffy/1995/U.K	• Advertising in demand systems for alcoholic drinks and tobacco: A comparative study • Time series data • Rotterdam , and static and dynamic AIDS model	Each of the three models were estimated using advertising as both a scaling and a translating term
Goddard and Amuah /1989/Canada	• The demand for Canadian fats and oils: a case study of advertising effectiveness • Time series data • Two-stage demand model: first stage-single equation aggregate expenditure equation , second stage: system of translog indirect utility functions	Advertising is incorporated into the utility function s as a taste changing parameter, and advertising is incorporated in both stages of the demand system.
Green *et al.* / 1991/ USA	• Some empirical methods of estimating advertising effects in demand systems: An application to dried fruits • Time series data • A double-log model and AIDS model is used	Double-log model, advertising is treated as a demand shifter; AIDS model, advertising is incorporated in two different ways, one is a special application of Ray's dynamic generalization of the AIDS, the other is similar to Duffy's method in Rotterdam model.
Jensen and Schroeter /1992/ USA	• Television advertising and beef demand: An econometric analysis of Split cable household panel scanner data • Household level panel • Single equation linear demand model	Advertising as an explanatory variable
Kinnucan *et al.* /1997/USA	• Effect of health information and generic advertising on U.S. meat demand • Time series data • Rotterdam model –absolute price version	Advertising is modeled as a separate shift parameter

Table 2.2 continues….

Lariviere *et al.* /2000/ Canada	• Modeling the demand for alcoholic beverages and advertising specifications • Time series data • Two sub-models: the first one endogenous expenditures on alcoholic beverages and soft drinks. The second sub-model: LAIDS demand system	Three ways to model advertising: the first one is a PDL scheme for degree 2 with end-points restrictions; the second one is the Kinnucan's structural heterogeneity specification ($A_i t$), and the third one is lag transformation specification ($L^k A_i$). The three results are compared. Advertising is in both stages of the demand system.
Nelson/ 1999/ USA	• Broadcast Advertising and U.S. Demand for Alcoholic Beverages • Time series data • The Rotterdam model of a differential demand system	Advertising augment terms in the model.
Piggott *et al.* /1996/ Australia	• Demand Response to Advertising in the Australian Meat Industry. Examined model specification choices • Time series data • A comparison of single equation model (logarithmic model) versus Complete demand system (Almost Ideal demand system)	Advertising is incorporated as intercept shifter both in the logarithmic model and the AIDS model.
Rickertsen /1998/ (1998) Norway	• The effects of advertising in an inverse demand system: Norwegian vegetables revisited • Time series data • Inverse AIDS model	Advertising is introduced into the demand system as a shift variable.
Rickertsen *et al.* /1995 Norway	• The effects of advertising on the demand for vegetables • Time series data • A dynamic AIDS model	The advertising is introduced as demand shifter into the demand system.
Schmit and Kaiser /1998/USA	• Egg advertising, dietary cholesterol concerns, and U.S. consumer demand • Time series data • Single equation demand model	Advertising expenditure as a demand shifter

Table 2.2 continues….

Schmit *et al.* /2002/USA	• Identifying the effect of generic advertising on household demand for fluid milk and cheese • ACNielsen Home Scan Panel Data • Two- step demand estimation	Advertising as a translating factor
Verbeke and Ward/ 2001/ Belgium	• A fresh meat almost ideal demand system incorporating negative TV press and advertising impact. • Time series data • AIDS model incorporating a media index of TV coverage and advertising expenditures as explanatory variables.	Actual TV advertising expenditures is modeled as a demand shifter. Generic and brand advertising are combined together as one variable.

Table 2- 3: Advertising and Food Away From Home

Author /Year/ Country	Study	Findings.
Bhuyan/ 2005/US	Impact of brand advertising on foods consumed away from home Data- collected through a mail survey Method- Discrete choice framework	He found that families with children in the household preferred chain restaurants and said that they were influenced by restaurant advertising. When consumers' priority to taste and quality food and ambience, they do not prefer chain restaurants. They also found that advertising does have impact on consumer's choice of type of outlet and menu choices.
Chou *et al.* /2005/ UK	Fast-food restaurant advertising on television and its influence on childhood obesity (economic)	Their results indicate that a ban on fast food advertisements would reduce the number of overweight children ages 3-11 in a fixed population by 10 percent and would reduce the number of overweight adolescents ages 12-18 by 12 percent. The elimination of the tax deductibility of this type of advertising would produce smaller declines of between 3 and 5 percent in these outcomes but would impose lower costs on children and adults who consume fast food in moderation because positive information about restaurants that supply this type of food would not be banned completely from television.
Eagle and Brennan /2007/ UK	Beyond advertising: in-home promotion of ''fast food''	This paper discuss the range of potential influences on children's food choices, while suggesting that recent restrictions on advertising of some foods may not be as effective as expected. It aims to use home-delivered food promotional materials to illustrate the types of promotional activity that are not covered by recent regulatory actions.
Eagle *et al.*/ 2005/ new Zealand	Defending brand advertising's share of voice: A mature market(s) perspective	This paper begins with a conceptual review of the literature relating to the impact of advertising in mature markets, and applies this to the New Zealand takeaway food, cafe´ and restaurant (primarily 'fast food') market. Substantial reported increases in advertising expenditure over time effectively mask the struggle that advertisers have to maintain share of voice in this fragmented and highly competitive market. Indeed, advertising in mature markets such as this seems to be primarily defensive, and, from the data examined in this paper,

Table 2.3 continues….

		advertising aimed at protecting existing market shares rather than having an impact on overall market size. The findings have relevance beyond the single market examined in the paper.
Harker *et al.*/ 2007/ Australia	Attributing Blame: Exploring the Link Between Fast Food Advertising and Obesity in Australia (Marketing)	This paper reviews the issues of obesity and fast food advertising, adding to the debate of contribution of fast food on obesity. The paper considers the regulatory response to the problem in Australia and the important role of attribution theory.
Herrington /2004/ USA	Are Restaurant Franchisees Getting a Positive Return on their Advertising Fees? (promotional management)	This study examines two primary issues related to conflict in franchiser-franchisee relationships in the restaurant industry: the effectiveness of national advertising campaigns with respect to returns to franchisee advertising investment and the potential for data aggregation bias resulting from system-wide analyses. The results suggest that a large proportion of chains do not realize a positive, immediate return to franchisee advertising investment and that data aggregation can lead to false advertising response estimates.
Herrington/ 2002/ US	The Current Impact and Carryover of Advertising on Sales in the Restaurant Industry (Marketing)	This paper reports the results of a study conducted on both the short-term and long-term effectiveness (duration) of advertising among restaurant chains. The findings suggest that only a small proportion of restaurant chains enjoy immediate, positive returns to their advertising fees. However, over half of all chains examined realized a significant carryover effect of advertising. Several explanations are offered as to why these results are found and recommendations are made as to how restaurant chains should react to these findings
Hoek and Gendall/2006/New Zealand	Advertising and Obesity: A Behavioural Perspective (Health Communication)	This article presents an alternative analysis of how marketing contributes to obesity and uses behaviour modification theory to analyse the ‘‘fast-food’’ industry’s promotions. They also review the New Zealand government’s response to obesity and suggest policy interventions that would foster healthier eating behaviours.
Hortsmann and Moorthy	Advertising Spending and Quality for Services:	Data from a sample of New York City restaurants show that mid-quality restaurants spend more on advertising than either high quality or low quality

Table 2.3 continues….

/2003/USA	The Role of Capacity (Marketing and Economics)	ones, contradicting the usual Nelson-type prediction that advertising spending increases with quality. Also, controlling for quality, restaurants with larger capacities advertise more. We present a model of services to explain these observations. The key features of the model are: (1) capacity constraints, (2) uncertain demand, (3) the presence of both informed and uninformed consumers, and (4) a technological link between capacity and quality. We argue that for services, advertising not only informs consumers, but it also can improve capacity utilization. Given this dual role, advertising is more valuable to firms with larger capacities and higher price-cost margins. The variation of these two elements with quality determines the advertising-quality relation.
Hsu and Jang/ 2007/ USA	Advertising expenditure, intangible value and risk: A study of restaurant companies (Hospitality Management)	This study investigates the relationships between advertising expenditure, intangible value, and risk in stock returns of restaurant firms between 2000 and 2005. Tobin's Q was used to examine intangible value, and the variance of common stock return was used to measure the investment risk. The results indicate that the level of advertising expenditure has a significant positive effect on the intangible value of the firm, suggesting that advertising expenditures could help generate intangible value in restaurant firms. However, this study did not support a significant relationship between the advertising expenditure level and the stock return risk of restaurant firms.
Jackson *et al.* / 2004/ USA	Frequency of Restaurant Advertising and Promotion Strategies: Exploring an Urban Market (Marketing)	Overall, respondents reported limited use and benefit from advertising and promotion activities. However, radio advertising, coupons, electronic/Internet media, and food samples appeared to be more frequently used and produce greater benefit when differences did exist. Franchisees, larger restaurants, and higher guest check establishments indicated greater use of and more benefit from these selected advertising and promotion strategies.
Jackson *et al.* /2008 / USA	Restaurant Advertising and Promotion Strategies of Two Gateway Cities: An Exploratory Study (Hospitality management)	This study compares perceived frequency and benefit of selected advertising strategies as reported by 390 restaurateurs in Houston, Texas and Beijing, China. Data analysis consists of quantitative and qualitative measures based on type of service and ownership. While restaurateurs in both cities reported using a variety of advertising and promotion strategies, overall, Beijing restaurants were more

Table 2.3 continues….

		likely to benefit from these varied activities. Beijing restaurateurs reported strong benefit in food sampling and coupon use as advertising and promotion tools. Perceived benefit of selected strategies by Houston restaurateurs on average did not directly correlate with its frequency of use.
Laroch *et al.*/ 2005/ China	Effects of coupons on brand categorization and choice of fast foods in China (Business research)	They find both direct and cross-advertising effects. In other words, the presence of a coupon for a local brand positively (negatively) influences consumers' attitudes and intentions toward that brand (competing brands). They discuss their results in light of the important implications they have for brand management in multi-brand situations and international management of sales promotions.
Lewis/1981/USA	Restaurant Advertising: Appeals and Consumers' Intentions. Family, atmosphere, and gourmet restaurants were analysed (advertising research)	The results of the study indicate that consumers simultaneously process a total-benefit bundle in deciding whether or not to go to a particular restaurant when their only information is obtained from an advertisement. The importance of the various benefits differs among at least three different types of restaurants: Family, Atmosphere and Gourmet
Robinson *et al.* /2007/ USA	Effects of Fast Food Branding on Young Children's Taste Preferences	In their experimental study they found that children preferred the tastes of foods and drinks if they thought they were from McDonald's. Moderator analysis found significantly greater effects of branding among children with more television sets in their homes and children who ate food from McDonald's more often.
Richards and Padilla / 2007/ Canada	Promotion and fast food demand: Where is beef? (Economics)	Showed that promotional activity by fast food vendors is effective in both increasing the market share of the promoting firm, and in expanding the demand for fast food in general. Further, by accounting for the nutritional, demographic and temporal proximity of fast food purchase occasions, found that the sample households behave in a way that is consistent with a rational addiction.

Table 2.3 continues….

Schroder and McEachern/2005/ UK	Fast foods and ethical consumer value: a focus on McDonald's and KFC (British Food Journal)	The paper aims to investigate the effect of communicating corporate social responsibility (CSR) initiatives to young consumers in the UK on their fast-food purchasing with reference to McDonald's and Kentucky Fried Chicken (KFC). Using a focus group, they found that most respondents (82 per cent) regularly purchased fast food from one of the companies; purchases were mostly impulsive (57 per cent) or routine (26 per cent), suggesting relatively low-level involvement in each case. While there was scepticism regarding the CSR activity being promoted, expectations about socially responsible behaviour by the companies were nevertheless high. Four factors were isolated, together explaining 52 per cent of the variance in fast-food purchasing behaviour. They were brand value, nutritional value, ethical value and food quality.
Stassen and Mittelstaedt/2002 /US	Do Franchise Systems Advertise Enough? U.S. Restaurant Expenditures and Performance 1989 to 1998 (Marketing)	This study examines promotion expenditure (as % of sales) and found that it is quite variable both within and across franchise system in restaurants. They analysed this variance and found that substantial amount of variable is attributed to the size, ownership and contractual nature of the franchise system relationship. They also found returns to advertising with-in franchise system is low.
Story and French/ 2004/ US	Food Advertising and Marketing Directed at Children and Adolescents in the US (Behavioural nutrition)	This article examines the food advertising and marketing channels used to target children and adolescents in the US, the impact of food advertising on eating behaviour, and current regulation and policies.
You and Nayga/ 2005/ USA	Household fast food expenditure and children's television viewing: can they really significantly influence children's diet quality?	Studied the issue of relationship between FAFH expenditure and television viewing and children's diet. Found that fast food and television viewing negatively affect the quality of children's diet.

Table 2.3 continues….

	(economics)	
Wang/2003/ New Zealand	A Cross-Cultural content analysis of restaurant ads in New Zealand	A content analysis of restaurant ads for Chinese restaurants and English restaurants in newspapers printed in New Zealand was done. The results show that number of ads for Chinese restaurants in English newspapers is significantly greater than the number of ads for English restaurant in Chinese newspapers and various other differences.

Table 2- 4: Modelling Habit Formation in Food Demand Studies

Author /Year/Country	Study/Data/Model	How habit formation is incorporated
Alessie and Kapteyn /1991/ Netherland	• Habit formation, interdependent preferences and demographic effects in Almost Ideal Demand System • Household level panel data of 6 expenditure categories including food • Almost Ideal Demand System (AIDS)	Incorporated habit formation by expressing the intercept term of the budget shares, lagged one period or dynamic translating procedure
Auld and Grootendorst/ 2004/Canada	• An empirical analysis of milk addiction • Time series(Aggregate Canadian data on cigarettes, milk, eggs, oranges, and apples) • Representative agent utility maximization model	Through lag and lead variables .
Baltagi and Griffin/2001/USA	• The economics of rational addiction: the case of cigarette • Panel data on 46 states over the period 1963-1992 • Representative agent model	Through lag and lead variables
Blanciforti and Green/ 1983/USA	• An Almost Ideal Demand System incorporating habits: An analysis of expenditures on food and aggregate commodity groups • Time series data on 11 commodity groups (only 3 food and beverage groups) • AIDS model	Intercept term of the budget share equation was specified to be a linear functions of previous consumption levels or dynamic translating procedure.
Browning and Collado /2007/ Spain	• Habits and heterogeneity in demands: a panel data analysis • Panel data- Spanish Family Expenditure Survey	Under the assumption that there are no fixed effects, They used current and lagged income and lagged total expenditures as instruments for habit

Table 2.4 continues….

	(1985-1996) • Engel curve form of the QAIDS	preferences.
Chen and Veeman /1991/ Canada	• An Almost Ideal Demand System Analysis for Meats with Habit Formation and Structural Change • Quarterly time series data • AIDS model	Intercept term of the budget share equation was specified to be a linear functions of previous consumption levels or dynamic translating procedure
Dynan/2000/USA	• Habit formation in consumer preferences: Evidence from panel data • Household level panel data on food consumption • Euler equation (9) –representative agent model	Consumption parameter in Euler equation is adjusted for lag consumption foods
Fenn *et al.* / 2001/ USA	• Cigarettes and addiction information: new evidence in support of the rational addiction model • Time series data • Representative-agent, discrete time, inter temporal utility maximization problem	Through lag and lead variables
Grossman and Chaloupka/ 1998/USA	• The demand for cocaine by young adults: a rational addiction approach • Panel data 1976-1985 • Panel data (High school seniors) • Representative agent utility maximization model	Habit formation is incorporated through lag terms in consumption equation.
Halt and Goodwin /1997/ USA	• Generalized Habit Formation in an Inverse Almost Ideal Demand System: An Application to Meat Expenditures in the U.S. • Time series-quarterly meat expenditures (1961-1993). • The Inverse Almost Ideal Demand System	Included: (I) general, nonlinear, non-additive habit effects; and (2) a specification for habit stock terms that allows purchases from the distant past to influence current consumption (long memory) Adjusted intercept term in share equation or dynamic translating

Table 2.4 continues….

	(IAIDS) model	
Heien and Durham /1991/USA	• A Test of the Habit Formation Hypothesis Using Household Data • Interview Panel data, cross-section data and compared with a similar system based on time series data(17 goods including food) • Quadratic Expenditure System (QES) or demographically augmented QES demand system (* No price data in the model)	Intercept term in QES is adjusted to incorporate habits
Iwaski *et al.* /2006 /USA	• Advertising restrictions and cigarette smoking: Evidence from myopic and rational addiction models. • Estimates are obtained from a reduced-form model of the equilibrium level of consumption, which derives from the structural demand function and supply relation	Habit formation is incorporated through lag terms of consumption
Manser /1996/ USA	• Elasticities of Demand for Food: An Analysis Using Non-Additive Utility Functions allowing for Habit Formation • Time series data for seven food commodity groups • System of budget share equations (used non-additive indirect Translog utility function)	Allow for habit formation by specifying a one parameter to be dependent upon past consumption
Richards *et al.* /2007/ USA	• Obesity and nutrient consumption: a rational addiction? • A.C. Nielsen, Inc. "HomeScan" data (1998-2001) • Random coefficients (mixed) logit model	Making an adjustment to mean utility of the logit model. Whether or not each nutrient can indeed be defined as addictive involved examining the sign and significance of each of the nutrient distance measures.
Zhen and Wohlgenant/ 2006/ -	• Meat Demand under Rational Habit Persistence • A theoretical paper Euler equation –representative agent model	Consumption parameter in Euler equation is adjusted for lag consumption foods

Table 2.4 continues….

Table 2- 5 Habits and Food Away From Home

Author /Year/Country	Study/Data/Model	Results
Browning and Collado /2007/ Spain	Habits and heterogeneity in demands: a panel data analysis Panel data- Spanish Family Expenditure Survey (1985-1996) Engel curve form of the QAIDS	Their specific findings are that food outside the home, alcohol and tobacco are habit forming, whereas clothing and small durables exhibit durability. .
Isganaitis and Lustig / 2005 /USA	Fast Food, Central Nervous System Insulin Resistance, and Obesity	They posit that fast food, through its effects on insulin homeostasis, adversely impact the neuroendocrine regulation of energy balance and play a key causal role inn the pathogenesis of obesity. Provide a small description as to how insulin contributes to habits.
Ji and Wood / 2007/ USA	Purchase and Consumption Habits: Not Necessarily What You Intend Longitudanal Survey Poisson regression analyses	This research tested these ideas using a longitudinal design. They have predicted that regardless of their explicit intentions, consumers would repeat habits to purchase fast food, watch TV news, and take the bus. The results yielded the anticipated pattern in which participants repeated habitual behaviours even if they reported intentions to do otherwise. Intentions only guided behaviour in the absence of strong habits
Richards and Padilla / 2007/ Canada	Promotion and fast food demand: Where is beef? (Economics) NPD CREST data base A discrete/continuous model	By accounting for the nutritional, demographic and temporal proximity of fast food purchase occasions, they found that the sample households behave in a way that is consistent with a rational addiction.
Richards *et al.* /2007/USA	Fast food addiction and market power Used prices and nutrient profiles for the cross section of items seven popular fast food chains in Arizona	They found that firms price products dense with addictive nutrients below marginal cost and exploit the potential addictive nature of the nutrients in the fast foods in order to build a cohort of loyal, addictive

Table 2.4 continues….

	A hedonic model of fast food nutrients	customers.
Sapala /2002/ USA	Is the Fast Food Industry Becoming the Next Tobacco Industry? Editorial	In this editorial comment he stated that people have become addicted to the taste of fast foods, its texture, and the sensation of fullness after its ingestion. It is this addiction that keeps people coming back for more. Some patients personally have told him that they actually have food cravings not dissimilar from nicotine cravings.

2.5. Data

In this study, a data set on Canadians' FAFH food purchases from May 2000 to February 2007, purchased from NPD Group Inc. is used. The specific data set, which is called Consumer Reports on Eating Share Trends (CREST), contains data on around 4000 to 5000 households per quarter. Many of the households contributed to data collection in multiple quarters. Each household in the data set recorded all of their purchases from commercial food service facilities during a two-week period in each quarter. The data set contains a variety of information on each household's socio-demographics, total expenditure on each purchase occasion, the type of the restaurant visited and its name and food speciality, and detailed information on the meal and beverage items purchased (NPD Group Inc. 2007). Advertising data (2000-2005) obtained from AC Nielsen Media Measurement were also used in this study. Advertising data provide annual total media advertising spending by restaurants.

In order to minimize the problems of self-selectivity, non-responses, and attrition in the panel data set and to minimise the computational difficulties, focusing on households who consistently report their restaurant visits yearly from January 2001 to December 2006, a sample of 1523 households was selected. However, selecting households who are persistent in responding may introduce a different type of selection bias.

Descriptive statistics for the sample of 1523 households in year 2001 are given in Table 2.4, with a comparison to 2001 census data and entire NPD CREST data set in 2001.

Table 2- 6: Descriptive Statistics of the Study Sample Compared to Census and Whole NPD CREST Data Set in 2001

Variable definition	*Census (30,007,094)*	*NPD CREST data set (5478 households)*	*Study sample (1523 households)*
	Mean values of categories and ratios of sub groups		
Annual income of household	**55016.00**	**45161.00**	**45031.18**
Low income (under $30,000)	0.58	0.30	0.29
Middle income	0.27	0.38	0.40

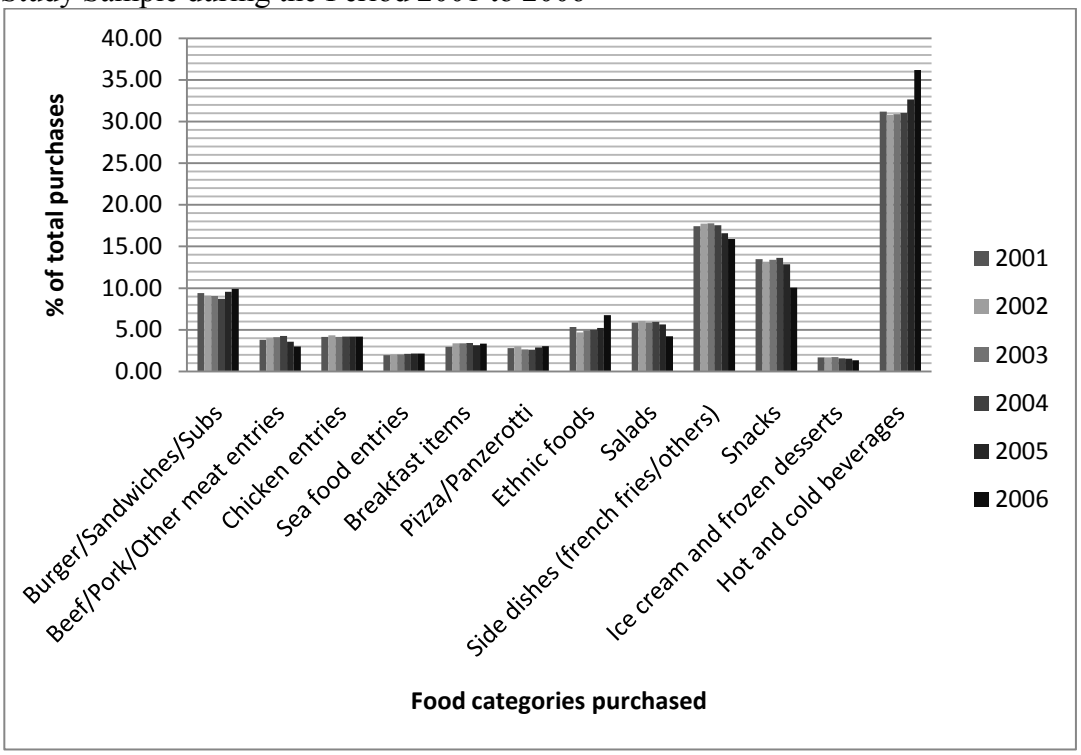
($30,000 to $60,000)			
High income (more than $60,000)	0.15	0.32	0.31
Age of household head	**37.60**	**49.65**	**54.05**
15 years to 44yearss	0.43	0.41	0.28
45 years to 65 years	0.24	0.38	0.46
above 65 years	0.13	0.21	0.26
Education			
Junior high or less	0.10	0.08	0.02
Senior high, college certificate diploma	0.66	0.72	0.70
University degree	0.24	0.20	0.28
Region			
British Columbia	0.13	0.19	0.18
Alberta	0.11	0.12	0.13
Saskatchewan	0.03	0.06	0.06
Manitoba	0.04	0.05	0.06
Ontario (+ HULL, PQ)	0.38	0.30	0.30
Quebec(- HULL, PQ)	0.24	0.17	0.16
New Brunswick	0.02	0.05	0.05
Prince Edward Island	0.004	0.003	0.003
Nova Scotia	0.03	0.05	0.05
Newfoundland	0.02	0.01	0.007
Household composition			
Households with children		0.32	0.21
Households without children		0.68	0.79
Total annual expenditure on FAFH		$124.20	$199.50

Source; Canadian census 2001, Statistics Canada 2002, NPD CREST data 2001-2007

As compared to census data and NPD data, the study sample can generally be considered to be a representative sample of the NPD data set and the Canadian population, with some variations. One variation is that annual average household income of the study sample is lower than the NPD sample and the census data. In addition, the representation of low-income households is low in both the NPD sample and the study sample as compared to census data while the representation of middle-income households is higher in both the NPD sample and the study sample. The average age of the household head is higher in the study sample than census data and NPD sample. Representation from the educational sub- groups and the regional sub groups are more or less similar in all three data sets. The regional representations are more or less similar across the three groups of data, except the fact that the selected sample representation from Newfoundland is lower than the census data and NPD data. Comparisons of household composition

and the city sizes were made only between the NPD data set and the study sample data set and representation from sub groups are similar for both data sets. As the study sample is reasonably representative of the Canadian population, the study results can be extrapolated. However, it should be noted that overly broad generalizations can be misleading when applied to populations that were not well represented by a sample. For an example, there could be response biases introduced by the persistent participants in longer panel data samples such as NPD sample. Figure 2.1 provides information on the food and beverage items purchased by the households in the study sample during the sample period.

Figure 2- 1: Food and Beverage Items Purchased by the 1523 Households in the Study Sample during the Period 2001 to 2006



Source: Compiled with the study sample data- NPD CREST

The coding system of the NPD CREST data set identifies the above broad categories for the items purchased. According to Figure 2.1, about 30% of the items purchased are beverages. Side dishes which include French Fries, Onion Rings and Hash Browns appeared as the second largest purchase category. The

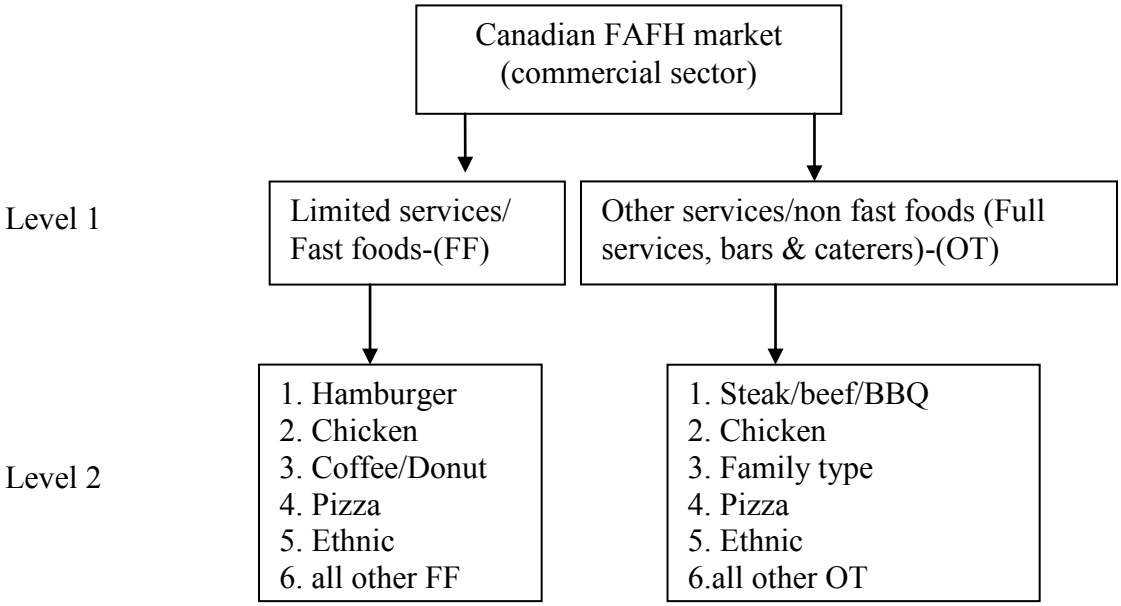
third category is snacks. Both side dishes and the snacks categories show a gradual decrease over the years in the sample period. Burger/ sandwiches/subs is the fourth largest category and shows a slight increase during the last two years of the sample period. The ethnic foods and salads categories have more or less similar level of purchases (about 5% of total purchases). However, the ethnic foods category which is largely represented by Chinese foods shows an increase while the salads show a decrease towards the end of the sample period. Beef/pork/other meat food items, chicken entries, sea food entries, breakfast items and pizza/panzerotti categories all have less than 5% level of total purchases. Ice cream and frozen desserts are the lowest category of purchases in this sample.

2.6. Empirical Model Specification

One of the issues in developing an empirical model of FAFH demand is to identify product or service categories of demand. Given the large number of product varieties in the FAFH market, categorization based on product is complex and may require careful aggregation of similar products. Previous studies have used categorisations based on restaurant types: fast foods, full services or based on meal types: breakfast, lunch, snacks and dinner (McCracken and Brandt 1987; Byrne *et al.* 1998; Jensen and Yen 1995; Nayga 1996; Mutlu and Gracia 2006; Reynolds and Goddard 1993; Hiemstra and Kim 1995; Stewart *et al.* 2004). In this study given the objective of identifying the effects of advertising and habits, it was decided to model FAFH purchases using the following categorization. First, food service facilities were disaggregated into two broader categories: limited service/fast foods and other services/non fast foods (full services/ bars/ caterers /retail) (level 1 in the Figure 2.2). Then, these two categories were further disaggregated into food specialties (level 2 in the Figure 2.2) to obtain a reasonable number of sub-categories. The most of the Level 2 categories were identified in the NPD purchase data and the unidentified restaurants were categorized into 'all other' category in both FF and OT restaurant categories. It should be noted that bars and caterers were not properly identified in the NPD purchase data. Therefore, the restaurants which have not been identified as limited

services/fast foods or five (1-5) specializations under full services/non fast foods, were categorized under 'all other OT' (see figure 2-2). This categorization implies that level 1 restaurant types are separable in each household's FAFH budget.

Figure 2- 2 : Categorization of Restaurants in FAFH Market for the Empirical Analysis



Another problem of modeling the above categorized food (in the form of meals) purchases in the FAFH market would be that for many items in the budget, households were observed to spend zero amounts on meals/foods from the type of restaurant under consideration. Therefore, a censored demand analysis approach is required. Haines *et al.* (1988) argue that food consumption decisions should be modeled as a two-stage decision process where not only are the decisions separate, but also the determinants of each decision may differ. The general two-step process is typically represented by a first-stage dichotomous choice model of whether to purchase or not. Then a second-stage consumption model using purchase observations is augmented with an additional variable (the inverse Mill's ratio) to control for selection bias (Heckman 1978). These types of demand models are common and have been applied to general models of food

consumption (Schmit *et al.* 2002). Heien and Wessells (1990) examined dairy product demand using a method developed based on Ameniya's (1974) two step approach. Unlike Heckman's (1978) approach, Heien and Wessells used all of the observations in both steps. Byrne *et al.* (1996) and Nagya (1996) have used Heien and Wessell's method in modelling FAFH demand. Another two-step method is proposed by Shonkwiler and Yen (1999) to overcome some of the estimation inefficiencies of Heien and Wessell's method. Vella and Vebreek (1999) have introduced a two-step estimator for panel data models with censored endogenous variable and selection bias. According to Vella and Vebreek (1999) and Tauchman (2005), all available two-step estimators are asymptotically inefficient as compared to a Full Information Maximum Likelihood (FIML) estimation approach, which is computationally difficult to apply.

In a panel data context, one has to allow for unobserved household heterogeneity and state dependence as there is an assumed relationship between current and prior period selection. Yet, in panel data, many estimators assume that selection bias is due to a time invariant individual effect (Vella and Vebreek 1999). But such biases can be also operated through time varying individual effects (see Vella and Vebreek 1999 for more details).

Consider the following model where equation (a) is the primary equation while (b) is the reduced form equation based on the selection rule. The censoring and selection rules are in equations (c) and (d).

$$y_{it}^{*} = m_1(x_{it}, z_{it}; \theta_1) + \mu_i + \eta_{it} \qquad \text{(a)}$$

$$z_{it}^{*} = m_2(x_{it}, z_{i,t-1}; \theta_1) + \alpha_i + \upsilon_{it}, \qquad \text{(b)}$$

$$z_{it} = h(z_{it}^{*}, \theta_3), \qquad \text{(c)}$$

$$y_{it} = y_{it}^{*} \; if \; g_i(z_{i1}, \ldots\ldots z_{iT}) = 0,$$

$$y_{it} = 0 (unobserved) if \; g_i(z_{i1}, \ldots\ldots z_{iT}), \qquad \text{(d)}$$

where i indexes households and t indexes time; y_{it} is the observed dependent variable and it is 1 if certain values of z_{it} are observed and 0 if certain values of z_{it} are unobserved; y_{it}^{*} is the corresponding latent variable ; Z_{it} is the vector of these exogenous factors; θ is vector of parameters relating Z_{it} to y_{it}. The equation's errors comprise random individual effects, μ_i and α_i and random individual specific time effects η_{it} and υ_i .

Unfortunately, inclusion of both time invariant individual effects and time variant individual effects complicates the model estimations in terms of correcting for selection bias (see Vella and Vebreek (1999) and Wooldridge (1995) for more details). Wooldrige (1995) has introduced a fixed effect modelling method for testing and correcting for selection bias in linear unobserved components in panel data models by allowing unobserved components to be correlated with the observable explanatory variables. However, Wooldridge's method requires a standard probit or Tobit regression for each time period followed by a multivariate linear regression, regardless of the time series properties of the errors. In this study context however, application of methods introduced by Vella and Vebreek (1999) or Wooldridge (1995) is complicated given the nature of restaurant categorization, the two levels of model estimation, possible endogeneity of one regressor which is used to identify habit forming preferences and system estimation with interactions. It is well known that selection models, with time varying selection effects, have difficulties achieving convergence when estimated with maximum likelihood and other efficient estimators. For this reason, a practical solution here is to use a method, suggested by Heckman (1978), where selection bias that may arise due to time variant individual effects (effects of error components, η_{it} and υ_i) are not taken into account.

To this end it is necessary to use a two-step modelling frame work that minimizes computational difficulties. Therefore, it is decided to use Heien and Wessell's estimation method extended to panel data context but without taking time specific individual effects into account. Moreover, in second stage estimation, Heien and Wessell's method facilitates use of a system of equations which may be suitable

for analysing categorised restaurant purchases. In addition, as our focus is to identify relative differences in the impacts of factors considered rather than absolute values, Heien and Wessell's method seems adequate.

In the first stage, the decision to consume foods from different types of restaurants can be modeled as a dichotomous choice problem,

$y^*_{mht} = f(Z_{mht}, \gamma_{mt}) + U_{mht}$, and

$y_{mht} = 1$ if $y^*_{mht} > 0$

$y_{mht} = 0$ if $y^*_{mht} \leq 0$

where y_{mht} is the observed dependent variable and it is 1 if the h^{th} household consumes from m^{th} restaurant at time t and 0 if the household does not consume from that particular restaurant type, y^*_{mht} is the corresponding latent variable which may depend on the exogenous factors such as advertising, habits, household's socio-demographic characteristics and other variables, Z_{mht} is the vector of these exogenous factors. γ_{mt} is vector of parameters relating Z_{mht} to y_{mht}, and U_{mht} is normally a distributed error term.

Then, given the assumption that U_{mht} is normally distributed, the probability that household h makes positive purchases from restaurant m in time t is represented as:

$$\text{Prob}\ (y_{mht} = 1) = \phi(Z_{mht}, \gamma_{mt}) = \frac{1}{\sqrt{2\pi\sigma_\alpha^2}} \exp\left\{\frac{-\gamma, Z^2_{mht}}{2}\right\} \qquad (1)$$

where $\phi\,(Z_{mht}, \gamma_{mt})$ is the cumulative normal distribution evaluated at (Z_{mht}, γ_{mt}). Equation (1) can be specified for each restaurant type in the FAFH market and can be estimated with probit techniques (Ameniya 1981).

Next, for *h*th household in the *m*th restaurant type in time *t* (who may or may not consume foods from a particular restaurant), we calculate the inverse Mills ratio (R_{mht}). The inverse Mills ratio can be calculated from the above probit analysis and will be used as an addition variable to incorporate the censoring latent variables in the second stage estimation of the demand relations. From the maximum likelihood estimates in equation (1), R_{mht} for the household who consumes foods from a particular restaurant type is calculated as:

$$R_{mht} = \theta(Z_{mht}, \gamma_{mt}) \; / \Theta \; (Z_{mht}, \gamma_{mt})$$

where θ and Θ are the standard normal density and cumulative probability functions respectively. The inverse Mills ratio for households who do not consume any foods from a particular restaurant type is estimated as:

$$R_{mht} = \theta(Z_{mht}, \gamma_{mt}) \; / (1 - \Theta \; (Z_{mht}, \gamma_{mt}))$$

For the second stage of analysis, an expenditure share equation introduced by Deaton and Muellbauer (1980, p.19), called the Working-Lesser model can be used. While there are many model specifications that can be used in food demand analysis, the Working-Lesser model has been identified as a suitable model for demand estimation of FAFH (Byrne and Capps 1996). Banks *et al.* (1997) also found that the Working-Lesser model could not be rejected for food demand estimations. Recently, Browning and Collado (2007) have used the Engle curve form of the QAIDS (quadratic log formulation) in their study and found that none of the quadratic terms of the log of total expenditure were significant. Therefore, they have used a model similar to Working-Lesser, augmenting the QAIDS model. According to Deaton and Muellbauer (1980), in this specification, it is usually assumed that all households face identical prices so that explanation of behavioural differences is sought through differences in total expenditure and household characteristics. This assumption may be plausible for Canadian FAFH market as a preliminary data collection of restaurant menu prices (mainly limited service restaurants) revealed that there are no actual price differences in menus in

two major cities in Alberta and Ontario. In this research context, this assumption allows the viewing of household's expenditure on foods as value-weighted quantities (Stewart *et al*. 2004). According to Stewart *et al.* (2004), viewing prices as weights for aggregating purchases in this way is consistent with classical demand theory. The model is specified as:

$$w_{mht}=\alpha_{mht}+\beta_m \log x_{ht} + \varepsilon_{mht} \quad (2)$$

where w_{mht} is household *h*'s expenditure share in restaurant type *m*, and in time *t,* and x_{ht} denotes the total expenditure. α_{mht} and β_m may depend on household characteristics and other exogenous factors. Since there is no price variation, in this model, the required homogeneity of demand functions does not play any role. However, the adding up property is important and to fulfill that, it is required that $\sum w_{mh}=1$ and this could be satisfied provided that $\sum \alpha_{mh}=1$ and $\sum \beta_{mh}=0$. Equation (2) can be specified as follows, incorporating the inverse Mills ratio:

$$w_{mht}=\alpha_{mht}+\beta_m \log x_{ht} + \delta R_{mht} + \varepsilon_{mht} \quad (3)$$

In order to model advertising and habit-forming effects, equation (3) should be modified. Despite the various methods for modelling advertising depending on assumed interactions of advertising with demand, FAFH market advertising can be assumed to encompass more than one interaction such as shifting demand, persuasion or provision of information, and generating psychological needs or subsistence requirements for products. Given other limitations in this particular study, especially unavailability of individual food product prices, (rather, total expenditure for a purchase occasion is available) modelling advertising as a scaling effect is implausible. However, given that suggested model (equation 3) is based on the Engel relationship, assuming advertising affects perceptions and basic needs and therefore, generates income-related effects would be appropriate. Therefore, a translating factor can be introduced to the model. When a system of demand equations is used, translation implies modification of α in the share

equation (Alston *et al.* 2000). According to Alston *et al.* (2000), this specification allows one to include subsistence quantities of demand in the model and define the subsistence quantities to be functions of demand shifters without introducing any dependence on scaling. In other words, modification of α in the share equation can be considered as incorporating advertising, both as a shifter and a translating factor. Many studies have used this form of translating approach to incorporate advertising effects in demand systems (Rickertson *et al.* 1995; Alston *et al.* 2000; Boetel and Liu 2002). According to Rickertson *et al.* (1995) modification of the α in the share equations seems the simplest approach, preserves the adding-up conditions, shifts the demand curves in an intuitively appealing way, and does not increase the number of parameters excessively. Accordingly, the effect of advertising can be introduced to the model by modifying the intercept parameter of the expenditure share equation as follows:

$$\alpha_{mht} = \alpha_0 + \phi A_{mt}$$

where A_{mt} is advertising expenditure by companies in *m* restaurant type in time *t.*

As described above, there are two forms of habits: rational and myopic. These two forms of habits are modelled using lags and leads, and lagged consumption levels respectively. However, according to empirical evidence, it is very difficult to discriminate between rational and myopic habits and they are observationally equivalent in a demand system context (Muellbauer and Pashardes 1988; Phlips and Spinnewijn 1981). Therefore, without distinguishing rational or myopic habits, habit formation can be introduced using only a lagged expenditure share into equation (3) as follows, similar to Alessie and Kapteyn (1991):

$$\alpha_{mht} = \alpha_0 + \phi A_{mt} + \varphi w_{mh(t-1)}, \qquad (4)$$

where $w_{mh(t-1)}$ is the expenditure share of the *h*th household in the *m*th restaurant type lagged one period. With this specification equation (3) above will become:

$$w_{mht} = \alpha_0 + \phi A_{mt} + \varphi w_{mh(t-1)} + \beta_m \log x_{ht} + \delta R_{mht} + \varepsilon_{mht} \qquad (5)$$

It should be noted that given habit formation is defined as a situation where current consumption increases the utility of future consumption, the lag structure (whether daily, monthly or yearly lag consumption) does not affect the model estimation. An introduction of a lagged dependent variable into a panel data model can create biases in model estimation due to autocorrelation (Baltagi 2005). Consider a linear model with lagged dependent variable,

$$y_{it} = x'_{it}\beta + \gamma y_{i,t-1} + \alpha_i + \varepsilon_{it}, \qquad (e)$$

where the error term in the model consists of two components: a time-invariant component, α_i and a time-variant component ε_{it} which is uncorrelated over time. In this dynamic model situation by construction $y_{i,t-1}$ is correlated with unobserved individual level effect α_i. Generally, taking first difference of both sides of the equation (e) and estimation with instrumental variable (IV) and generalized method of moment (GMM) would eliminate individual effect α_i as follows;

$$\Delta y_{it} = \Delta y_{it-1}\gamma + \Delta x'_{it}\beta + \varepsilon_{it} \qquad (d)$$

But the y_{it-1} in Δy_{it-1} is a function of the ε_{it} which is also in $\Delta\varepsilon_{it}$. Therefore, Δy_{it-1} is correlated with $\Delta\varepsilon_{it}$ by construction.

To overcome this problem, Arellano and Bond (1991) and Arellano and Bover (1995) (hereafter AB) suggested a model in which it is assumed that the endogenous variables have a constant correlation with the individual or household specific effects. If this assumption holds, a GMM can be used with two types of

instruments: lagged levels of endogenous variables for the equations in first differences and, lagged first differences of endogenous variables for the equations in levels (Browning and Collado 2007). This method can be applied to the above expenditure share equations (5) specified for each restaurant type in the second stage estimation, only in a single equation context.

In this study context, estimation of equation (5) as a system with cross equation restrictions may provide more theoretically consistent estimates. In estimating the model as a system, the adding up property of the equation (5) can be achieved by imposing the following restrictions:

$$\sum \alpha_0 = 1, \sum \phi = 0, \sum \varphi = 0, \sum \beta = 0$$

However, since R_{mht} could take on any value, Heien and Wessells (1990) proposed the following specification for the deleted or dropped equation to preserve the adding up property:

$$w_{mht} = \alpha_0 + \phi A_{mt} + \varphi w_{mh(t-1)} + \beta_m \log x_{ht} - \sum_{m=1}^{n-1} \delta R_{mht} + \varepsilon_{mht} \qquad (6)$$

Then the equation (6) can be specified for each of the restaurants type identified (Figure 2.1) in the FAFH market and can be estimated as a system of equations in a panel format.

The theoretical framework and the model specification suggest estimation of two equations; first, a probit analysis in the first stage and either an AB dynamic panel model or a system of expenditure share equations in the second stage. In this study it is decided to estimate both the AB dynamic panel data model in a single equation context and as a system of equations. Model specifications are as follows:

Stage 1

$$Y_{mht} = f(TE_{mht}, AD_{mt}, HHA_{ht}, HHI_{ht}, HHC_{ht}, HFL_{hht}, RD_{ht}) \qquad (7)$$

Stage 2

Single equation example:

$$ES_{mht} = f(\log TE_{ht}, ES_{mht-1}, AD_{mt}, HHA_{ht}, HHI_{ht}, HHC_{ht}, HFL_{ht}, RD_{ht}, RMILLh_{ht}) \quad (8.1)$$

System of equations example:

$$ES_{mht} = f(\log TE_{ht}, ES_{mht-1}, AD_{mt}, HHA_{ht}, HHI_{ht}, HHC_{ht}, HFL_{ht}, RD_{ht}, RMILLh_{ht}) \quad (8.2)$$

where Y_{mht} is the dichotomous choice variable: 1 if the *h*th household purchases from *m*th restaurant and 0 if household does not purchases from that restaurant type. ES_{mht} is the *h*th household's expenditure share on *m*th restaurant. Given the seperability assumption, TE_{ht} is the total FAFH expenditure for level one model and total expenditure on limited service/fast foods and other/non fast food for level two models. TE_{ht} were deflated by regional Consumer Price Indices (CPI). ES_{mht-1} is the lagged expenditure share to capture the effects of habits, AD_{mt} is the advertising expenditure by restaurant *m* in time *t*. Different specifications of advertising were tested and as advertising expenditures are annual, a lag structure of 3/4(current year AD) +1/4(previous year AD) was used based on previous studies, to account for carry over effects of advertising (Herrington 2002). HHI_{ht} is the household income and HHA_{ht} is the age of the household head. Dichotomous variables were used to identify the five regions (RD_{ht}); West Coast, Prairie Provinces, Ontario, Quebec and Atlantic Provinces; the household composition variables (HHC_{ht}); and household's first language (HFL_{ht}). $RMILL_{ht}$ is the inverse Mills ratio to account for censored latent variable obtained from the probit analysis of the first step of estimation.

The restaurant categorization above has two levels. Therefore, in modelling, specifications (7) and (8.1 or 8.2) were applied to each level and 3 models were estimated both in single equation context (as dynamic panel data models) and

system of equations context separately. The demand for FAFH from different restaurants may be contemporaneously correlated through the error term. In this case Seemingly Unrelated Regression (SUR) estimates would be unbiased, asymptotically consistent, and efficient (Griffith *et al.* 1992). Therefore, in the system of equations specification, for the two levels identified, stage 2 models (8) were estimated as a system of equations using SUR. The three models were:

(1) Model-1: at level 1 for two broader categories: Fast foods/Limited Services and other/non fast foods services.
(2) Model-2: at level 2 for six food specializations in fast foods/limited service category: under fast foods: Hamburger, Chicken, Coffee/Donut/ Pizza, Ethnic foods and all others.
(3) Model -3: at level 2 for six food specializations in other services/ non fast food category: Steak/Beef/BBQ, Chicken, No-main/Family, Pizza, Ethnic foods, and all others (bars/ caterers/retail).

Table 2.7 provides the descriptive statistics of the data used (a household panel of six years) for the three model estimations. Average expenditure share data show that the highest expenditure share is attributed to other/non fast food category at level 1. Hamburger specialities in limited service/fast foods and family type specialities in other/non fast foods categories have the highest expenditure shares in their respective categories at level 2. The largest advertising spenders are: limited service/fast food category in level 1, the hamburger specializations within limited service/fast foods category in level 2, and the pizza specializations within full service/non fast foods in level 2. Average annual income of the households in the sample is at the range of $45000 to $48000, and this is increasing over the sample period. Mean values of household head's age, family composition and, regional and ethnic representation of the sample are also included.

Table 2- 7: Descriptive Statistics of the Panel Sample (2001 to 2006)

Variable definition	*Variable name and sub-groups*	*Mean 2001*	*Mean 2002*	*Mean 2003*	*Mean 2004*	*Mean 2005*	*Mean 2006*
Dependent variables							
MODEL 1							
Expenditure shares on Fast Foods/Limited Services	ES1	0.2990	0.3196	0.2971	0.3028	0.2790	0.3049
Expenditure shares on other/non fast foods	ES2	0.7010	0.6804	0.7029	0.6972	0.7210	0.6951
MODEL 2							
Expenditure shares on Hamburger	es1	0.3100	0.3192	0.3063	0.2876	0.2916	0.2835
Expenditure shares on Chicken	es2	0.0701	0.0671	0.0558	0.0715	0.0600	0.0347
Expenditure shares on Coffee/ Donut	es3	0.1755	0.1913	0.1817	0.2062	0.2116	0.1997
Expenditure shares on Pizza	es4	0.1049	0.1275	0.1355	0.1050	0.1090	0.1417
Expenditure shares on Ethnic	es5	0.0504	0.0340	0.0434	0.0460	0.0321	0.0508
Expenditure shares on All others	es6	0.1668	0.1544	0.1786	0.1456	0.1458	0.1353
MODEL 3							
Expenditure shares on Steak/Beef/BBQ	es7	0.0408	0.0440	0.0378	0.0479	0.0380	0.0300
Expenditure shares on Chicken	es8	0.0619	0.0568	0.0612	0.0532	0.0653	0.0633
Expenditure shares on Family type	es9	0.4453	0.4212	0.4411	0.4483	0.4540	0.3498
Expenditure shares on Pizza	es10	0.0333	0.0386	0.0288	0.0426	0.0362	0.0215
Expenditure shares on Ethnic	es11	0.2251	0.2189	0.2458	0.2224	0.2028	0.2238
Expenditure share on All others	es12	0.1697	0.1612	0.1496	0.1499	0.1600	0.2559
Independent variables							
Total Expenditure							
MODEL 1	TE	174.46	178.10	194.81	181.40	182.53	183.49
MODEL 2	TEFF	59.33	62.05	60.16	59.12	59.19	58.92
MODEL 3	TEOT	115.64	127.30	126.94	129.13	130.72	111.58
Restaurants' advertising expenditure/per capita real(in million $)							
MODEL 1							
Fast foods/Limited Services	AD1	5.90	5.90	6.11	6.56	7.29	7.75
Other restaurants/non fast foods	AD2	1.71	1.72	1.88	2.08	2.12	2.42
MODEL 2							
Hamburger	ad1	2.65	2.58	2.50	2.72	2.90	2.88
Chicken	ad2	0.47	0.46	0.54	0.59	0.62	0.65
Coffee/ Donut	ad3	1.36	1.39	1.50	1.68	1.77	1.79
Pizza	ad4	0.24	0.19	0.15	0.17	0.21	0.22
Ethnic	ad5	0.11	0.12	0.13	0.14	0.13	0.14
All others	ad6	0.97	1.12	1.32	1.40	1.49	1.60
MODEL 3							
Steak/Beef/BBQ	ad7	0.23	0.23	0.22	0.22	0.24	0.24
Chicken	ad8	0.35	0.33	0.36	0.38	0.45	0.43
Family type	ad9	0.24	0.26	0.30	0.30	0.34	0.34
Pizza	ad10	0.44	0.49	0.52	0.50	0.51	0.55
Ethnic	ad11	0.19	0.25	0.31	0.36	0.35	0.39
All others	**Ad12**	0.22	0.21	0.22	0.22	0.28	0.27
Annual income of household	HHI	45031.18	45512.14	45589.30	46994.41	47291.52	47828.29
Age of household head	HHA	54	55	56	57	58	59
Region	**RD**						
West Coast=1, otherwise=0	RD1	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**
Prairie Provinces=1, otherwise=0	RD2	0.24	0.24	0.24	0.24	0.24	0.24
Ontario=1,otherwise=0	RD3	0.30	0.30	0.30	0.30	0.30	0.30
Quebec=1, otherwise=0	RD4	0.16	0.16	0.16	0.16	0.16	0.16

Atlantic Provinces=1, otherwise=0	RD5	0.12	0.12	0.12	0.12	0.12	0.12
Household composition	**HHC**						
Households without children	0						
Households with children (<182 yrs)	1	0.21	0.20	0.20	0.20	0.19	0.18
Household's first language	**HFL**						
English=1; otherwise=0	HFL1	0.72	0.72	0.72	0.72	0.72	0.72
French=1; otherwise=0	HFL2	0.17	0.17	0.17	0.17	0.17	0.17
Chinese=1;otherwise=0	HFL3	0.01	0.01	0.01	0.01	0.01	0.01
Other=1;otherwise=0	HFL4	0.10	0.10	0.10	0.10	0.10	0.10

Source: Study sample of 1523 households –NPD CREST data

2.7. Results and discussions

Parameter estimates for the three models (probit estimations in the stage one, system estimations and single equation estimations in the stage two) are provided in Tables 2.8, 2.9.1, 2.9.2, 2.9.3, 2.10.1, 2.10.2, and 2.10.3.

Table 2- 8: Two Step Model Estimates For the Level One Categories of FAFH Market

	Probit estimation-level 1				***System estimation-level 2***				***Single equation- level 2***			
	Limited services/fast foods		Other services/non-fast foods		Limited service/fast foods		Other services/non-fast foods		Limited service/fast foods		Other services/non-fast foods	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	2.883***	0.257	1.848***	0.534	0.676***	0.018	0.323***	0.018	0.732***	0.042	0.235***	0.041
Total expenditure	0.273***	0.019	1.656***	0.078	-0.074***	0.003	0.074***	0.003	-0.084***	0.002	0.067***	0.002
Lagged expenditure share					0.004***	0.0001	-0.004***	0.0001	-0.013	0.038	0.069*	0.034
Advertising expenditure	0.290**	0.019	-0.008	0.080	0.0003***	0.00001	-0.0003***	0.00001	0.0004	0.004	0.006	0.013
Household income	-0.0007***	0.0001	-0.0001	0.0001	-0.0001***	0.00001	0.0001***	0.000001	-0.00016***	0.00002	0.0002***	0.00002
Household head's age	-0.013***	0.001	0.006***	0.001	-0.003***	0.00001	0.0003***	0.0002	-0.004***	0.0003	0.004***	0.0003
Household composition	0.356***	0.071	-0.411***	0.078	0.113***	0.001	-0.113***	0.007	0.107**	0.019	-0.121***	0.018
Households' first language												
French	0.100	0.865	0.153	0.111	-0.22**	0.010	0.002*	0.010	-0.026	0.024	0.042*	0.023
Chinese	-0.786***	0.158	0.398	0.402	-0.098***	0.018	0.098***	0.018	-0.105*	0.058	0.152***	0.055
Other	0.057	0.070	-0.222**	0.087	0.017*	0.010	-0.017*	0.010	0.007	0.021	-0.021	0.020
English	Reference Group											
Region of living												
West Coast	-0.453***	0.077	0.341***	0.100	-0.097***	0.010	0.097***	0.010	-0.096***	0.021	0.135***	0.020
Prairie Provinces	-0.238***	0.077	0.302***	0.092	-0.073***	0.010	0.073***	0.010	-0.072***	0.020	0.105***	0.019
Ontario	-0.190***	0.075	0.117	0.087	-0.055***	0.010	0.055***	0.010	-0.056***	0.020	0.082***	0.019
Quebec	-0.473***	0.077	-0.086	0.125	-0.050***	0.014	0.050***	0.014	-0.056*	0.057	0.074***	0.018
Atlantic Provinces	Reference Group											
Mills ratio					0.006	0.000004	-0.006	0.00003	0.203***	0.006	0.337***	0.008
Fraction of correct prediction	90.77%		94.61%									
R^2					0.2074		0.1808					
Sargen test									2.86		2.80	
d.f									78		78	
p value									1.0000		1.0000	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-9- 1: Probit Model Estimation For Restaurant Specializations In The Limited Service/Fast Food Category

Variables	***Probit estimation***											
	Hamburger		Chicken		Coffee/Donut		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	1.735***	0.417	0.721***	0.240	0.519**	0.260	-0.704***	0.237	-1.057***	0.312	0.645***	0.235
Total expenditure	1.089***	0.012	0.691***	0.026	0.824***	0.030	1.168***	0.032	0.576***	0.026	1.051***	0.033
Advertising expenditure	-0.461***	0.116	-1.092***	0.221	-0.154*	0.079	0.213	0.522	-9.100***	1.512	-0.294**	0.065
Household income	-0.0007***	0.0001	-0.0007***	0.0001	-0.0002***	0.00001	0.0001	0.00009	0.00003	0.0001	0.00005	0.00009
Household head's age	-0.010***	0.001	-0.0067**	0.001	0.003***	0.001	-0.009***	0.196	-0.015***	0.003	-0.010***	0.001
Household composition	0.280***	0.047	0.008	0.044	-0.149***	0.041	0.075*	0.042	-0.224***	0.045	-0.180***	0.042
Household's first language												
French	-0.095	0.066	-0.059	0.066	-0.055	0.058	0.158***	0.060	-0.035	0.070	0.127**	0.059
Chinese	-0.063	0.162	0.413***	0.133	-0.278**	0.128	-0.618***	0.149	0.311**	0.130	-0.191	0.129
Other	0.023	0.054	0.089*	0.056	-0.094	0.049	-0.198***	0.056	0.159***	0.056	-0.101**	0.050
English	Reference Group											
Region of living												
West Coast	-0.048	0.060	-0.385***	0.062	-0.409***	0.054	-0.376***	0.059	0.409***	0.071	-0.092*	0.054
Prairie Provinces	0.112*	0.057	-0.066	0.057	-0.506***	0.052	-0.162***	0.055	0.410***	0.069	-0.128**	0.053
Ontario	0.380	0.261	-0.106*	0.055	-0.506***	0.052	-0.048	0.052	0.363***	0.068	-0.133***	0.051
Quebec	-0.099*	0.057	-0.175*	0.081	-0.051	0.051	0.006	0.074	0.102	0.097	-0.174**	0.072
Atlantic Provinces	Reference Group											
Mills ratio												
Fraction of correct prediction	71.93%		80.98%		65.25%		74.21%		83.10%		69.12%	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-9- 2: System Estimation For Restaurants Specializations In The Limited Service/Fast Food Category

Variables	***System estimation***											
	Hamburger		Chicken		Coffee/Donut		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	0.232***	0.044	0.128***	0.010	0.046***	0.024	0.220***	0.016	0.096***	0.012	0.190***	0.016
Total expenditure	0.006***	0.0009	0.002***	0.0004	0.003***	0.0009	0.011***	0.0006	0.001***	0.0003	0.004***	0.0007
Lagged expenditure share	0.014**	0.007	0.017***	0.006	0.022***	0.007	-0.014**	0.006	0.014***	0.007	0.002	0.007
Advertising expenditure	0.040**	0.015	-0.048***	0.015	0.045***	0.012	-0.025	0.058	-0.407***	0.085	0.005	0.008
Household income	-0.0001***	0.00001	-0.00004***	0.000007	-0.00003**	0.00001	0.0001***	0.00001	0.00001**	0.000006	0.00007***	0.00001
Household head's age	-0.0006***	0.0001	-0.0003***	0.00009	0.002***	0.0001	-0.001***	0.0001	-0.0007***	0.00007	-0.0004***	0.0001
Household composition	0.093***	0.006	0.006*	0.003	-0.052***	0.006	0.014***	0.004	-0.017***	0.002	-0.020***	0.005
Households' first language												
French	-0.005	0.009	-0.002	0.004	-0.023**	0.009	0.019***	0.007	-0.004	0.003	0.025***	0.008
Chinese	0.032	0.021	0.030***	0.010	-0.078***	0.021	-0.076***	0.006	0.042***	0.008	-0.012	0.017
Other	0.045***	0.008	0.008**	0.003	-0.020**	0.008	-0.030***	0.006	0.016***	0.003	-0.015**	0.006
English							Reference Group					
Region of living												
West Cost	0.059***	0.009	-0.019***	0.004	-0.049***	0.008	-0.038***	0.006	0.019***	0.003	-0.005	0.007
Prairie provinces	0.071***	0.008	0.006	0.004	-0.083***	0.008	0.003	0.006	0.017***	0.003	-0.025***	0.007
Ontario	-0.005	0.008	0.001	0.003	0.010	0.008	-0.0007	0.006	0.022***	0.003	-0.032***	0.007
Quebec	0.014	0.012	0.0008	0.005	-0.096***	0.011	0.044***	0.002	0.005	0.004	-0.0041	0.009
Atlantic Provinces							Reference Group					
Mills ratio	0.216***	0.002	0.177***	0.001	0.228***	0.002	0.247***	0.002	0.149***	0.001	0.216***	0.002
R^2	0.4530		0.5489		0.6038		0.4713		0.5746		0.5098	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-9- 3: Single Equation Estimation for Restaurant Specializations In The Limited Service/Fast Food Category

	Single equation											
	Hamburger		Chicken		Coffee/Donut		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	0.493***	0.055	0.136***	0.015	0.101***	0.033	0.011***	0.0008	0.038**	0.016	0.277***	0.004
Total expenditure	0.003***	0.001	0.002***	0.0005	0.002**	0.001	0.011***	0.0008	0.001***	0.0004	0.003***	0.001
Lagged expenditure share	0.054*	0.033	0.032	0.036	0.045	0.037	-0.107***	0.031	-0.002	0.036	0.044	0.037
Advertising expenditure	0.114***	0.010	-0.055***	0.017	0.026*	0.0003	0.114*	0.066	-0.005	0.099	-0.024**	0.010
Household income	-0.00013***	0.00002	-0.00004***	0.000009	-0.00003**	0.00001	0.00008***	0.00001	0.00002***	0.000008	0.00007***	0.00001
Household head's age	-0.001***	0.0003	-0.0004***	0.0001	0.001***	0.0003	-0.0007***	0.0002	-0.0009***	0.0001	-0.0008***	0.0002
Household composition	0.078***	0.019	0.00002	0.008	-0.070***	0.018	0.025*	0.013	-0.026***	0.007	-0.038*	0.015
Households' first language												
French	-0.016	0.023	-0.003	0.010	-0.034	0.022	0.015	0.016	-0.004	0.009	0.046**	0.019
Chinese	0.030	0.056	0.055**	0.025	-0.063	0.053	-0.011	0.039	0.014	0.023	-0.066	0.046
Other	0.048**	0.020	0.026***	0.009	-0.00007	0.019	-0.021	0.014	0.012	0.008	-0.039**	0.016
English	Reference Group											
Region of living												
West Coast	0.066***	0.020	-0.021**	0.009	-0.050**	0.020	-0.040***	0.014	0.015*	0.008	0.016	0.017
Prairie Provinces	0.084***	0.020	0.003	0.009	-0.078	0.019	-0.010	0.014	0.012	0.008	0.205	0.016
Ontario	-0.005	0.019	-0.004	0.009	0.026	0.019	0.002	0.013	0.012	0.008	-0.033**	0.016
Quebec	0.024	0.028	0.006	0.013	-0.086***	0.027	0.040**	0.020	-0.001	0.011	0.00001	0.023
Atlantic Provinces	Reference Group											
Mills ratio	0.300***	0.057	0.127***	0.019	0.250***	0.004	0.251***	0.003	0.155***	0.002	0.235***	0.004
Sargen test	4.18		1.00		3.97		1.59		0.88		1.78	
d.f	78		78		78		78		78		78	
p value	1.0000		1.0000		1.0000		1.0000		1.0000		1.0000	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-10- 1: Probit Model Estimation For Restaurant Specializations In The Other/Non Fast Food Category

Variables	*Probit estimation*											
	Steak/beef/BBQ		Chicken		Family type		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	0.188	0.453	-1.490***	0.165	0.982***	0.156	0.506*	0.282	-0.240**	0.109	-0.078	0.144
Total expenditure	0.246***	0.011	0.188***	0.010	0.826***	0.024	0.165***	0.010	0.503***	0.015	0.399***	0.014
Advertising expenditure	-6.018***	1.884	-0.581*	0.359	-3.566***	0.415	-2.319***	0.526	-0.362*	0.205	-0.009	0.489
Household income	0.0001	0.0001	0.000003	0.0001	-0.000005	0.0001	0.0003***	0.0001	0.000007	0.00009	-0.0002***	0.00009
Household head's age	-0.002	0.001	0.010***	0.001	0.003***	0.001	-0.012***	0.001	-0.006***	0.001	0.001	0.001
Household composition	-0.153***	0.050	-0.002	0.046	-0.315***	0.045	0.196***	0.046	-0.063	0.041	-0.036	0.040
Households' first language												
French	-0.023	0.073	0.257***	0.0599	0.100	0.067	0.188***	0.072	-0.197***	0.060	0.054	0.059
Chinese	-0.135	0.153	-0.427**	0.162	-1.029***	0.150	-0.254*	0.149	0.556***	0.176	-0.488***	0.131
Other	-0.074	0.064	-0.026	0.056	-0.198***	0.056	0.026	0.061	0.056	0.051	-0.015	0.050
English	Reference Group											
Region of living												
West Coast	-0.439***	0.067	-0.600***	0.064	0.271***	0.063	0.079	0.067	0.306***	0.053	0.014	0.054
Prairie Provinces	-0.009	0.061	-0.351***	0.059	0.156***	0.059	0.462***	0.063	0.267***	0.051	-0.105	0.050
Ontario	-0.319***	0.061	0.272***	0.054	-0.089	0.056	-0.049	0.063	0.267***	0.51	-0.079	0.05
Quebec	-0.374***	0.089	0.360***	0.075	-0.015	0.080	-0.529***	0.094	0.505***	0.073	-0.211***	0.072
Atlantic provinces	Reference Group											
Mills ratio												
Fraction of correct prediction	85.52%		76.80%		78.97%		85.66%		70.93%		67.21%	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-10- 2: System Estimation For Restaurant Specializations In The Other/Non Fast Food Category

Variables	***System estimation***											
	Steak/beef/BBQ		Chicken		Family type		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	0.115**	0.023	-0.010	0.013	0.524***	0.025	0.117***	0.015	0.177***	0.016	0.074***	0.022
Total expenditure	0.0002***	0.0003	-0.002	0.0004	0.002***	0.001	-0.0005	0.0003	0.002***	0.0008	-0.005***	0.001
Lag expenditure	-0..007	0.006	-0.001	0.007	-0.004	0.003	-0.004	0.007	-0.009	0.006	0.004	0.007
Advertising expenditure	-0.329***	0.095	0.0003	0.028	-0.649***	0.066	-0.092***	0.028	0.077**	0.030	0.578***	0.076
Household income	0.00003***	0.000006	0.000002	0.000008	-0.00003	0.00001	0.00001**	0.000006	0.00007*	0.00001	-0.00004***	0.00001
Household head's age	-0.00007	0.00007	0.0007***	0.0001	0.001***	0.0002	-0.0007***	0.00007	-0.001***	0.0001	0.00007	0.0001
Household composition	-0.008***	0.002	0.011***	0.003	-0.057***	0.007	0.030***	0.002	0.009	0.006	-0.006	0.006
Households' first language												
French	-0.002	0.003	0.026***	0.005	0.019*	0.010	0.007**	0.003	-0.069***	0.008	0.020**	0.009
Chinese	-0.006	0.008	-0.024*	0.011	-0.199***	0.024	-0.026***	0.008	0.315***	0.019	-0.042**	0.020
Other	-0.005	0.003	0.007*	0.004	-0.065***	0.009	0.003	0.003	0.013**	0.007	0.013*	0.008
English	Reference Group											
Region of living												
West Coast	-0.029***	0.003	-0.045***	0.004	0.072***	0.010	-0.002	0.003	0.058***	0.008	-0.031***	0.008
Prairie provinces	-0.002	0.003	-0.036***	0.004	0.039***	0.009	0.029***	0.003	0.053***	0.008	-0.060***	0.008
Ontario	-0.025***	0.003	0.0236***	0.004	-0.008	0.009	-0.007**	0.003	0.056***	0.007	-0.030***	0.008
Quebec	-0.030***	0.004	0.031***	0.006	-0018	0.013	-0.028***	0.004	0.120***	0.002	-0.081***	0.011
Atlantic Provinces	Reference Group											
Mills ratio	0.155***	0.001	-0.156	0.001	0.253***	0.003	0.133***	0.001	0.219***	0.002	0.178***	0.002
R^2	0.5782		0.519		0.452		0.513		0.505		0.369	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 2-10- 3 : Single Equation Estimations For Restaurant Specializations In The Other/Non Fast Food Category

Variables	***Single equation***											
	Steak/beef/BBQ		Chicken		Family type		Pizza		Ethnic		Others	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	0.099***	0.027	0.003	0.018	0.522***	0.040	0.133***	0.002	0.217***	0.028	0.047	0.033
Total expenditure	0.002***	0.0004	-0.0009	0.0006	0.012***	0.001	-0.0005	0.0005	0.008***	0.001	-0.004***	0.001
Lag expenditure share	-0.081**	0.038	0.011	0.047	0.017	0.038	-0.075*	0.042	-0.025	0.037	0.051	0.053
Advertising expenditure	-0.309***	0.108	-0.012	0.031	0.009	0.070	-0.088***	0.032	0.085**	0.033	0.452***	0.093
Household income	0.00003***	0.000007	-0.000001	0.00001	-0.00004	0.00002	0.00002***	0.000008	0.00005***	0.00001	-0.00003	0.00001
Household head's age	0.00007	0.0001	0.001***	0.0001	0.001***	0.0003	-0.0009***	0.0001	-0.001***	0.0003	0.0006***	0.0003
Household composition	-0.005	0.007	0.023**	0.009	-0.030	0.020	0.013**	0.007	0.013	0.017	0.010	0.018
Households' first language												
French	0.002	0.008	0.033***	0.012	0.003	0.026	0.001	0.009	-0.105***	0.020	0.044**	0.022
Chinese	0.015	0.021	-0.023	0.029	-0.160***	0.059	-0.042*	0.022	0.308***	0.050	0.040	0.053
Other	-0.006	0.007	0.007	0.010	-0.077***	0.021	-0.005	0.008	0.0006	0.018	0.025	0.019
English	Reference Group											
Region of living												
West Coast	-0.020***	0.007	-0.040***	0.010	0.072***	0.022	-0.011	0.008	0.059***	0.018	-0.044**	0.019
Prairie Provinces	0.011	0.007	-0.034***	0.010	0.046***	0.021	0.026***	0.008	0.065***	0.017	-0.070***	0.018
Ontario	-0.017**	0.007	0.026**	0.009	-0.005	0.020	-0.017	0.007	0.050***	0.017	-0.047**	0.018
Quebec	-0.018*	0.010	0.038***	0.014	-0.006	0.030	-0.033***	0.011	0.143***	0.025	-0.113***	0.027
Atlantic Provinces	Reference Group											
Mills ratio	0.154***	0.002	0.164***	0.003	0.322***	0.006	0.133***	0.002	0.258***	0.002	0.219***	0.004
Sargen test	0.66		0.911		4.01		0.60		2.23		3.30	
d.f	78		78		78		78		78		78	
p value	1.0000		1.0000		1.0000		1.0000		1.0000		1.0000	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

In these model analyses, in stage one, the probit estimations were used to describe the decisions to spend at a restaurant type and to obtain the inverse Mills ratio. These estimates were then used as additional variables to incorporate the censoring latent variables in the second stage of the estimation. Probit estimations of these models provide a measure of the impact of the selected independent variables on the probability of selecting a particular restaurant type for households who have purchased from that restaurant category. A comparison of estimations obtained from the probit estimations, system estimations and single equation (AB method) estimations are provided for each variable in the model.

Effect of industry advertising

Table 2-11- 1: Effect of Industry Advertising -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation	0.290**	-0.008
System estimation	0.0003***	-0.0003***
Advertising elasticity	**0.007**	**-0.001**
Single equation (AB)	0.0004	0.006
Advertising elasticity	**0.009**	**0.017**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2.8 and estimated by author

Table 2-11- 2: Effect of Industry Advertising -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation	-0.461***	-1.092***	-0.154*	0.213	-9.100***	-0.294**
System estimation	0.040***	-0.048***	0.045***	-0.025	-0.407***	0.005
Advertising elasticity	**0.301**	**-0.105**	**0.226**	**-0.030**	**-0.265**	**0.043**
Single equation (AB)	0.114***	-0.055***	0.026*	0.114*	-0.005	-0.024**
Advertising elasticity	**0.858**	**-0.120**	**0.131**	**0.137**	**-0.003**	**-0.205**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 3: Effect of Advertising- Level 2, Other Service/Non-fast Foods

Type of estimation	Steak/beef/ BBQ	Chicken	Family type	Pizza	Ethnic	Others
Probit estimation	-6.018***	-0.581	-3.566***	-2.319***	-0.362*	-0.009
System estimation	-0.329***	0.0003	-0.649***	-0.092***	0.077***	0.578***
Advertising elasticity	**-1.904**	**0.002**	**-0.451**	**-1.378**	**0.106**	**0.784**
Single equation (AB)	-0.309***	-0.012	0.0097	-0.088***	0.085***	0.452***
Advertising elasticity	**-1.788**	**-0.076**	**0.006**	**-1.318**	**0.117**	**0.613**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

As expected industry advertising has a significantly positive effect on the decision to eat at limited service/ fast food categories according to both probit estimation and system estimation. This finding is consistent with previous findings. Using different modelling frameworks, Buyan (2004) found significant effects of brand advertising of chain restaurants and Richards and Padilla (2007) found that there is an effect of fast food price promotion (not mass advertising) on restaurants company's market share and demand. However, coefficient estimates of AB estimation at level 1 advertising do not show a significant effect on expenditure shares as expected. At level 2, a more disaggregated level, advertising does not show a significantly positive effect on the probability of selecting restaurant categories. However, system estimation and AB estimation results show some significant similar effects of advertising. In model 2, at level 2 (among restaurants in the limited service/fast food category), hamburger and coffee/donut chains' advertising show significant positive effects on restaurant expenditure shares while advertising from chicken chains advertising show a significant negative effect on expenditure shares based on both types of estimations. In model 3 at level 2 (among restaurants in the other/non fast foods), ethnic and 'all others' restaurant categories show positive advertising effects on expenditure shares in both type of models. The level 2 model analysis provide further evidence that advertising expenditure on only certain categories of restaurants exerts significant positive influence on FAFH purchase behaviour. Further, advertising elasticity

estimations indicate that most of the restaurant categories in level 1 and level 2 have relatively inelastic advertising demand.

Effect of habit forming preferences

Habit forming preferences are captured through the lagged expenditure share on a particular restaurant type. According to the definition of habits forming preferences, effects of habits can only be captured at the expenditure share equation stage. If past consumption or expenditure on a particular restaurant raises the marginal utility of the current consumption or expenditure and therefore raises current consumption or expenditure, then consumers can be identified as having habit forming preferences for foods or other services offered in that particular restaurant. Therefore, if the effect of lagged expenditure share on expenditure share is positive and significant, households could be identified as having habit forming preferences for that particular restaurant. The negative effects are defined as durability in consumption (Browning and Collado 2007).

Given that habit formation is modeled through a lagged dependent variable, the estimated results should be interpreted with care. While the AB method has been especially designed to allow the inclusion of a lagged dependent variable in the model, the system estimation has not taken this factor into consideration. Therefore, in interpreting habit forming preferences, the estimates of AB method are considered here.

Table 2-11- 4: Effect of Habit Forming Preferences -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
System estimation	0.004***	-0.004
Single equation (AB)	-0.013	0.069*

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 5: Effect of Habit Forming Preference - Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	***Chicken***	**Coffee/Donut**	**Pizza**	**Ethnic**	**Others**
System estimation	0.014**	*0.017***	0.022***	-0.014***	0.014**	0.002
Single equation (AB)	0.054*	*0.032*	0.045*	-0.107***	-0.002	0.044

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 6: Effect of Habit Forming Preferences -Level 2, Other Services/Non-fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
System estimation	-0.007	-0.001	-0.004	-0.004	-0.009	0.004
Single equation (AB)	-0.081*	0.011	0.117***	-0.075*	-0.025	0.051

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

Based on the above description, in model 1 level 1, only the other/non fast food category can be considered to have significant habit forming preferences. While this result supports the findings of Browning and Collado (2007) that FAFH are habit forming, our results show that not every category of FAFH is habit forming. In level 2 estimations, among limited service/fast foods, hamburger and coffee/donut chains could be considered as having significant habit forming preferences. Among other/non-fast foods only family type restaurants show significant habit forming preferences. When consumption is habitual, the long run response will be more elastic than the short run response to permanent change in other factors that affects demand. In this study, for example, advertising targeted at restaurants that demonstrate habitual purchases could be more effective in the long-run.

Other variables included in the model

Some economic and socio-demographic variables were included in the model to identify the effects of these variables on Canadian households' consumption of FAFH. These are: total expenditure, household income, household head's age, household composition, households' first language and the region of living.

Table 2-11- 7: Total FAFH Expenditure -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation	0.273***	1.656***
System estimation	-0.074***	0.074***
Expenditure elasticity	**-0.75**	**1.11**
Single equation (AB)	-0084***	0.067***
Expenditure elasticity	**0.72**	**1.10**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 8: Total Expenditure-Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation	1.089***	0.691***	0.824***	1.168***	0.576***	1.051***
System estimation	0.006***	0.002***	0.003***	0.011***	0.001***	0.004***
Expenditure elasticity	**1.017**	**1.008**	**1.010**	**1.067**	**1.020**	**1.026**
Single equation (AB)	0.003***	0.002***	0.002***	0.011***	0.001***	0.003***
Expenditure elasticity	**1.008**	**1.008**	**1.006**	**1.067**	**1.005**	**1.019**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 9: Total FAFH Expenditure -Level 2, Other Service/Non-Fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
Probit estimation	0.246***	0.188***	0.826***	0.165***	0.503***	0.399***
System estimation	0.002***	-0.002	0.002***	-0.0005	0.002***	-0.005***

Expenditure elasticity	**1.002**	**0.996**	**1.004**	**0.998**	**1.005**	**0.971**
Single equation (AB)	0.002***	-0.0009	0.009***	-0.0007	0.007***	-0.004***
Expenditure elasticity	**1.020**	**0.996**	**1.026**	**0.998**	**1.020**	**0.977**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

In both levels of the model, probit estimations indicate that higher the total expenditure in respective categories of restaurants, the higher the probability of selecting the restaurants in these categories. the probabilities of selecting is comparatively higher for other services/non fast food category in level 1, hamburger, pizza and other types in limited service/fast food category and family type in other services/non fast food categories than the other restaurant types in each category.

In model 1, level 1, total FAFH expenditure has exerted a significantly negative influence on limited services/fast foods spending and has significantly positive influence on other/non fast foods spending indicating that the higher the total expenditure on FAFH consumption, the lower the expenditure on limited services/fast foods, and the higher the expenditure on other/non fast foods. These findings for the Canadian context are somewhat different from the findings for a US study, where household spending on average is higher on limited service/fast foods compared to other/non fast foods (Stewart *et al.* 2004). These differences could be associated with the different profile in the US with much higher FAFH spending. This US study was based on 1998-2000 data and its simulation results predicted comparatively slow growth in spending on limited service/fast foods. In model 2 level 2, the total expenditure on limited service/fast food category exerts a significantly positive influence on all the restaurant specializations in that category. While the lowest impact was observed on ethnic food specializations, the highest impact was observed on pizza specializations. The total expenditure on other /non fast food categories (in model 3, level 2) shows significantly positive effects on steak/beef/BBQ, family type and ethic food specializations and shows a significant negative effect on 'all other' type of restaurants. These

findings provide evidence of relative household spending on different restaurant types in two levels of restaurant categorization.

Expenditure elasticity calculations indicate that at level 1, at a more aggregated level, limited service/fast foods are expenditure inelastic compared to full services/non fast foods. However, at a more disaggregated level, at level 2 in our models, expenditure is elastic.

Household Income

Table 2-11- 10: Household Income- Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation	-0.0007***	-0.0001
System estimation	-0.0001***	0.0001***
Single equation (AB)	-0.0001***	0.0002***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 11: Household Income -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/ Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation	-0.0007***	-0.0007***	-0.0002***	0.00001	0.00003	0.00005
System estimation	-0.0001***	-0.00004***	-0.00003**	0.0001***	0.00001***	0.00007***
Single equation (AB)	-0.00004***	-0.0004***	-0.00004**	0.00008***	0.00002***	0.00006***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 12: Household Income -Level 2, Other Services/Non-Fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
Probit estimation	0.0001	0.000003)	-0.000005	0.0003***	0.000007	-0.0002***
System estimation	0.00003***	0.000002	-0.0003	0.00001**	0.00007*	-0.00004***
Single equation (AB)	0.00004***	-0.000003	-0.00004	0.00003***	0.00007**	-0.00003

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

Among the variables included, household income is a key variable. The effect of this variable has been analysed in many FAFH demand studies. In fact, it was generally found that the higher the income the higher the consumption of FAFH (Byrne *et al*. 1998; McCracken and Brandt 1987). In particular, the higher the household income the higher the consumption of both limited services/fast foods and full services/non fast foods in other contexts (Stewart *et al*. 2004; Stewart and Yen 2004). Both fast food and full-service restaurants can be hypothesised to provide leisure for a household who is freed from cooking, cleaning and shopping. Moreover, along with the additional leisure, households with higher income may buy more of other goods, like variety and dining amenities (Stewart *et al.* 2004). However, as opposed to previous findings in other contexts, in this study-in Canadian context, estimates in model 1 at level 1 shows that the higher the household income, the higher the probability of selecting (in probit estimation) or expenditure on other/non fast foods and the lower the expenditure share on limited service/fast foods. Among limited service/fast food specialities, the higher the income the lower the probability of selecting or expenditure share on hamburger, chicken chains and coffee/donut specialities and the higher the probability of selecting or expenditure shares on pizza, ethnic and 'all others' specialities. Among other/non fast food specialities, the household income has significantly positive effects on steak/beef/BBQ, pizza and ethnic restaurants, and has significantly negative effects on 'all others' restaurants specializations. Our

analysis provides addition information as to what food specializations are more appealing to households with higher income levels.

Table 2-11- 13: Household Head's Age -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation	-0.013***	0.006***
System estimation	-0.003***	0.003***
Single equation (AB)	-0.004***	0.004***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 14: Household Head's Age -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/ Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation	-0.010***	-0.006**	0.003***	-0.009***	-0.015***	-0.010***
System estimation	-0.0006***	-0.0003***	0.002***	-0.001***	-0.0007***	-0.0004***
Single equation (AB)	-0.0006*	-0.0003***	0.001***	-0.0007***	-0.0009***	-0.0007***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 15: Household Head's Age -Level 2, Other Service/Non-Fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
Probit estimation	-0.002	0.010***	0.003***	-0.012***	-0.006***	0.001
System estimation	-0.00007	0.0007***	0.001***	-0.0007***	-0.001***	0.00007
Single equation (AB)	0.0001	0.001***	0.004***	-0.0007	-0.00009	0.0008***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

According to previous studies we expected mature households might tend to cook more often and therefore, consume less at FAFH restaurants, especially at limited

service/fast foods, whereas younger households may purchase these foods more often (Stewart *et al*. 2004). As expected, supporting previous studies, in model 1 at level 1, the older the household head's age the lower the probability of selecting (in probit estimation) or expenditure share (in system and AB estimations) on limited services/fast foods and the higher the expenditure shares of other/non fast food restaurants. In model 2 at level 2 , age effects are significantly negative for all limited service/fast food specialities, except for the coffee/donut speciality. The positive effect of aging on selecting or spending in coffee/donut speciality could be linked to possible preferences for socialization and limited time constraints for households who are aged and retired. In model 3 at level 2, age effects are significantly positive for chicken and family type specialities and negative for pizza specialities. The level of health consciousness and preference for socialization again could play a role in this decision making.

Household composition

Table 2-11- 16: Household Composition -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation	0.356***	-0.411***
System estimation	0.113***	-0.113***
Single equation (AB)	0.107***	-0.121***

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 17: Household Composition -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/ Donut**	**Pizza**	**Ethnic**	**Others**
Proit estimation	0.280***	0.008	-0.149***	0.075*	-0.224***	-0.180***
System estimation	0.093***	0.006*	-0.052***	0.014***	-0.017***	-0.020***
Single equation (AB)	0.084***	0.006	-0.070***	0.028**	-0.026***	-0.024

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 18: Household Composition -Level 2, Other Services/Non-Fast Foods

Type of estimation	Steak/beef/ BBQ	Chicken	Family type	Pizza	Ethnic	Others
Probit estimation	-0.153***	-0.002	-0.315***	0.196***	-0.063	-0.036
System estimation	-0.008***	0.011***	-0.057***	0.030***	0.009	-0.006
Single equation (AB)	-0.005	0.023**	-0.046*	0.019**	0.071***	0.018

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

Household composition was incorporated in the model to identify the effects of households having younger children on the FAFH purchases. In the broader category level, (in model 1 at level1-in both type of estimations) the households with children show significantly higher probabilities of selecting or spending more on limited services/fast foods and less on other/non fast foods as compared to households without children. Among limited service/fast food specialities (model 2 at level2), households with children tend to select or spend more on hamburger chains and pizza chains and less on coffee/donut and ethnic food chains as compared to households without children. If households chose to purchase from full service/non fast food restaurants (model 3 at level 2), households with children select or spend more on chicken and pizza specialities and less on family type specialities as compared to households without children. The finding that households with children select or spend less on family type restaurants is an unexpected result. However, many factors including menu prices, accessibility and other amenities (explanations of which are beyond the scope of this study) may have impacted the results.

Effect of ethnic diversity

Table 2-11- 19: Effect of Ethnic Diversity -Level 1

Type of estimation	Limited service/fast foods	Other services/non fast foods
Probit estimation		
French	0.100	0.153
Chinese	-0.786***	0.398
Other	0.057	-0.222**

English		
System estimation		
French	-0.022	0.002*
Chinese	-0.098***	0.098***
Other	0.017	-0.017*
English	Reference group	
Single equation (AB)		
French	-0.026	0.042*
Chinese	-0.105*	0.152***
Other	0.007	-0.021
English	Reference group	

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 20: Effect of Ethnic Diversity -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/ Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation						
French	-0.095	-0.059	-0.055	0.158***	-0.035	0.127**
Chinese	-0.063	0.413***	-0.278**	-0.618***	0.311**	-0.191
Other	0.023	0.089*	-0.094	-0.198***	0.159***	-0.101**
English						
System estimation						
French	-0.005	-0.002	-0.023***	0.019***	-0.004	0.025***
Chinese	0.032	0.030***	-0.078***	-0.076***	0.042***	-0.012
Other	0.045***	0.008**	-0.020**	-0.030***	0.016***	-0015**
English	Reference Group					
Single equation (AB)						
French	-0.013	0.0001	-0.034	0.013	-0.005	0.042***
Chinese	0.027	0.058**	-0.063	-0.010	0.012	-0.071
Other	0.046**	0.026***	0.001	-0.022	0.012	-0.038**
English	Reference Group					

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 21: Effect of Ethnic Diversity -Level 2, Other Service/Non-Fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
Probit estimation						
French	-0.023	0.257***	0.100	0.188***	-0.197***	0.054
Chinese	-0.135	-0.427**	-1.029***	-0.254*	0.556***	-0.488***
Other	-0.074	-0.026	-0.198***	0.026	0.056	-0.015
English						
System estimation						
French	-0.002	0.026***	0.019*	0.007**	-0.069***)	0.020**
Chinese	-0.006	-0.024*	-0.199***	-0.026***	0.315***	-0.042**
Other	-0.005	0.007*	-0.065***	0.003	0.013**	0.013*
English	Reference Group					
Single equation (AB)						
French	0.003	0.033***	0.015	0.005	-0.087***	0.047**
Chinese	0.015	-0.024	-0.138**	-0.039*	0.326***	0.044
Other	-0.005	0.007	-0.090***	-0.005	0.000005	0.024
English	Reference Group					

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

The household's first language was included to capture the effect of ethnic diversity on FAFH purchases in Canada. The majority; English speaking households were used as the reference group. Considering both types of estimations, in model 1 at level 1, compared to English speaking households, French speaking households spend significantly more on other/non fast food; Chinese speaking households spending is significantly lower on limited service/fast food and significantly higher on other/non fast foods. Probit estimations also show a similar pattern in terms of probability of selection of these restaurant types. Differences in spending and differences in selection probabilities are also observed at level 2 of our models. Within the limited service/fast food category, compared to English speaking households, French speakers spend significantly more on 'all others' specialities; Chinese speaking households spend more on chicken specialities; Other language speakers spend significantly more

on hamburger and chicken specialities and significantly less on 'all others' specialities. In probit estimation, in limited service/fast food category, compared to English speaking households, French speaking households' show higher probability of selecting pizza and ethnic specialities: Chinese speaking households show higher probability of selecting chicken and ethnic specialities and lower probability of selecting coffee and pizza specialities; other language speakers show higher probability of selecting chicken and ethnic food specialities while they show a lower probability of selecting pizza and other specialities. Among other/non fast food specializations, compared to English speaking households, French speakers spend significantly more on chicken and 'all others' specialities and significantly less on ethnic food specialities; Chinese speakers spend significantly more on ethnic food specialities and less on family type and pizza specialities; Other language speakers spent significantly less on family type specialities. According to the probit estimations, French speaking households show a higher probability of selecting chicken and pizza specialities and a lower probability of selecting ethnic specialities; Chinese speaking households show a higher probability of selecting ethnic specialities and a lower probability of selecting chicken, family type, pizza and other specialities; other language speakers show a significantly lower probability of selecting family type specialities. These results show that there are considerable impacts of ethnic diversity in FAFH purchases in Canada.

Regional differences

Table 2-11- 22: Regional Differences -Level 1

Type of estimation	**Limited service/fast foods**	**Other services/non fast foods**
Probit estimation		
West Coast	-0.453***	0.341***
Prairie Provinces	-0.238***	0.302***
Ontario	-0.190***	0.117

Quebec	-0.473***	-0.086
Atlantic Provinces		
System estimation		
West Coast	-0.097***	0.097***
Prairie Provinces	-0.073***	0.073***
Ontario	-0.055	0.055
Quebec	-0.050	0.050
Atlantic Provinces		
Single equation (AB)		
West Coast	-0.096***	0.135***
Prairie Provinces	-0.072***	0.105***
Ontario	-0.056***	0.082***
Quebec	-0.056	0.074***
Atlantic Provinces		

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-8, estimated by author

Table 2-11- 23: Regional Differences -Level 2, Limited Service/Fast Foods

Type of estimation	**Hamburger**	**Chicken**	**Coffee/ Donut**	**Pizza**	**Ethnic**	**Others**
Probit estimation						
West Coast	-0.048	-0.385***	-0.409***	-0.376***	0.409***	-0.092*
Prairie Provinces	0.112*	-0.066	-0.506***	-0.162***	0.410***	-0.128**
Ontario	0.380	-0.106*	-0.506***	-0.048	0.363***	-0.133***
Quebec	-0.099*	-0.175*	-0.051	0.006	0.102	-0.174**
Atlantic Provinces						
System estimation						
West Coast	0.059***	-0.019***	-0.049***	-0.038***	0.019***	-0.005
Prairie Provinces	0.071***	0.006	-0.083***	0.003	0.017***	-0.025***
Ontario	-0.005	0.001	0.010	-0.0007	0.022***	-0.032***
Quebec	0.014	0.0008	-0.096***	0.044***	0.005	-0.0041
Atlantic Provinces						
Single equation (AB)						

West Coast	0.066***	-0.021**	-0.050**	-0.040***	0.015*	0.016
Prairie Provinces	0.084***	0.003	-0.078	-0.010	0.012	0.205
Ontario	-0.005	-0.004	0.026	0.002	0.012	-0.033**
Quebec	0.024	0.006	-0.086***	0.040**	-0.001	0.00001
Atlantic Provinces						

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-9-1, 2-9-2, and 2-9-3, and estimated by author

Table 2-11- 24: Regional Differences -Level 2, Other Service/Non-Fast Foods

Type of estimation	**Steak/beef/ BBQ**	**Chicken**	**Family type**	**Pizza**	**Ethnic**	**Others**
System estimation						
West Coast	-0.439***	-0.600***	0.271***	0.079	0.306***	0.014
Prairie Provinces	-0.009	-0.351***	0.156***	0.462***	0.267***	-0.105
Ontario	-0.319***	0.272***	-0.089	-0.049	0.267***	-0.079
Quebec	-0.374***	0.360***	-0.015	-0.529***	0.505***	-0.211***
Atlantic Provinces						
System estimation						
West Coast	-0.029***	-0.045***	0.072***	-0.002	0.058***	-0.031***
Prairie Provinces	-0.002	-0.036***	0.039***	0.029***	0.053***	-0.060***
Ontario	-0.025***	0.0236***	-0.008	-0.007**	0.056***	-0.030***
Quebec	-0.030***.	0.031***	-0018	-0.028***	0.120***	-0.081***
Atlantic Provinces						
Single equation (AB)						
West Coast	-0.019	-0.041***	0.120***	-0.005	0.096***	-0.039**
Prairie Provinces	0.012	-0.035***	0.108***	0.033***	0.101***	-0.060***
Ontario	-0.016**	0.025**	0.050**	-0.012	0.082***	-0.042**
Quebec	-0.017	0.038***	0.041	-0.030***	0.167***	-0.110
Atlantic Provinces						
Type of estimation						

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Table 2-10-1, 2-10-2 and 2-10-3, and estimated by author

Five regional dummies were included in the models to identify the impact of regional differences in FAFH purchases in Canada. Atlantic Provinces were considered as the reference group and the results are reported with comparisons to household purchases in the Atlantic Provinces. Considering system and AB estimations, in model 1 at level 1, households in the West Coast and Prairie Provinces spend significantly less on limited service/fast foods and spend significantly more on other/non-fast food speciality restaurants as compared to households in the Atlantic Provinces. Spending at level 2 also shows some regional differences. Again, considering the above two types of estimations, among limited service/fast food services, households in the West Cost and Prairie Provinces spend significantly more on hamburger chains; households in the West Coast spend significantly less on chicken chains; households in the West Coast and Quebec spend significantly less on coffee/donut chains; households in the West Coast spend significantly less on pizza chains while households in Quebec spend significantly more on pizza chains; households in the West Coast again spend more on ethnic foods chains; Ontario households spend significantly less on other chains. Among other/non fast food specialities, compared to households in Atlantic Provinces, Ontario households show significantly lower spending on steak/beef/BBQ specialities; West coast and Prairie provinces households spend significantly less on chicken specialities and Ontario and Quebec households spend significantly more on chicken specialities; West Coast and Prairie Province households spend significantly more on family type; Prairie Provinces spend significantly more and Quebec spend significantly less on pizza specialities; West coast, Prairie Provinces, Ontario and Quebec all spend more on ethnic specialities; West Coast, Prairie Provinces and Ontario spend significantly less on 'all other' specialities. These results indicate that there are significant regional differences in household spending on different categories and food specializations in the FAFH market.

Other than the above discussed variables, restaurant density in the households' purchase environment can have a significant impact on purchase behaviour. To

account for this variable, city size where households live was tested in the model. However, as parameter estimates were not statistically significant, these variables were removed from the model.

The Inverse Mills Ratio is estimated from the first step probit estimation and used as an extra regressor in the second step estimation to reduce the selection biases. The parameter estimates for the inverse Mills ratio in all of the expenditure share equations are significantly positive providing evidence that selection bias is quantitatively important in explaining expenditure.

2.8. Conclusions and Recommendations

This study examined the impact of industry advertising, households' habit forming preferences and socio-demographic and economic variables on the demand for FAFH in Canada. Using a unique set of panel data, allowing for zero purchase observations, a two stage demand model was applied to two levels of purchasing decisions: decision to select and expenditure on two broader categories of restaurants (limited services/fast foods and other/non fast foods services) and decision to select and expenditure on different food specialities in each of the above two categories. Three models were estimated: one for the selection and expenditure decision among two broader categories of FAFH, one for the selection and expenditure decision among limited services/fast foods, and the other for the section and expenditure decision among other/non fast food restaurants.

The estimates of the effect of industry advertising revealed some interesting details. As expected, limited services/fast food advertising has a significant influence on Canadian households' FAFH spending. Among the food specialities in this category hamburger and coffee/donut chains restaurant advertising exert a large influence on household purchase decisions. Despite the insignificant effect of advertising on other/non fast food category at level 1 of our analysis, advertising by ethnic and 'all other' food specializations have significant

influences on FAFH purchase decisions. Given these, in this study we can conclude that there is a significant influence of firm advertising on FAFH purchases in certain restaurant types supporting some previous findings. However, this study did not include cross advertising effects in the model in order to reduce the computation difficulties. Moreover, the study tested only one form of incorporating advertising: a translating variable. Given that there has been an extended debate in the applied economics literature about the effects of advertising on consumer demand and the best way to incorporate this effect into demand models, it will be useful to test for different modelling frameworks with cross advertising effects.

In this study the impact of advertising was estimated and this provides a partial examination of whether advertising affects children's food consumption behaviour and therefore, the nutrition and health of their diet. The results of this study show that, on one hand, advertising has a significant impact on limited service/fast food purchasing behaviour and on the other hand households with children are spending significantly more on limited service/fast foods as compared to households without children. The same relationship could be observed for hamburger chains among limited service/fast food specialities. In other words, this study provides enough evidence to validate that there is link between advertising and higher consumption of limited service/fast food by households with children. This result has implication for policies that consider restricting related advertising to children. However, if the adults are making the decision about whether to eat or level of spending at certain restaurants, restricting advertising to children may not affect spending. In this study, a formal test of the effect of advertising on households with children (by an interaction term for these two variables) was not possible due to model estimation complexities. Therefore, further research should be undertaken to quantify effect of advertising on households with children.

In analysing households' habit forming preferences for FAFH, this study found evidence that there are significant habit forming preferences for other/non fast food spending at the level 1 categorization. In level 2, habit forming preferences are observed for hamburger specialities and coffee/donut specialities. Habit forming preferences are significant only for family type restaurants among other/non fast food specialities. While these results support previous findings that FAFH are habit forming (Browning and Collado 2007), this study also provides addition information as to what categories of FAFH are habit forming. In level 1 categorization, our results contradict the findings of Richards and Padilla (2007), where they found that fast foods are addictive (strong form of habits). However, our findings at level 2-strong habit forming preferences for hamburgers and coffee/donut specialities among limited services/fast foods support their findings. Even though Richards and Padilla (2007) used the same data, they have not compared the nature of habits for fast foods and full services. In addition, differences could be due to many factors such as differences in modelling approaches, sample size and variables chosen. Given that evidence of habit forming preferences has various implications for nutrition and health policy formulation and various tax based policies, further investigation to obtain consistent results is required. Moreover, in order to understand the nature of the habit forming preferences, further analysis of nutrients and other components of the foods and an investigation of factors that may be associated with consumer habits are required.

The analysis of socio-demographic and economic factors has provided useful information in the context of Canadian FAFH purchases. Interestingly, as opposed to the common finding that spending on limited services/fast foods is higher than that of other/non fast foods in other contexts, in Canada; the trend shows relatively higher spending on other/non fast foods than on limited services/fast foods. Other than this finding and the effects of ethnic diversity and regional differences, the effects of other socio-demographic variables generally agree with the past studies of FAFH demand. However, the impact of these variables on food

specialities within the two broader categories provide new information which could be used in policy related to diet and health, industry marketing and promotional activities. For example, this study results together with Canadian socio-economic and demographic projections can be used to identify important areas to be addressed in formulating policies with regard to diet and health in FAFH market. Moreover, this study provide insights into factors that may allow FAFH industry to anticipate trends and future changes in the market and to plan and design marketing programs to provide better services to their customers.

This study is not without its limitations. First and foremost, the unavailability of individual product prices prevented us from undertaking an in-depth economic analysis and providing elasticity estimations for different restaurant categories/items. Second, the zero-censoring nature of categorical purchases, together with the lagged dependent variable (to capture habits) structure in panel format complicated the model estimation. After estimating the model in both types of estimations: as a system and as a single equation (as dynamic panel data model-AB), the estimations which are similar in directional effect are reported to provide econometrically consistent inferences. It should be noted that standard error correction for both two-step estimations was not undertaken as it was not feasible to correct standard errors in the system estimation. In order to compare results of two methods (e.g. system estimation and single equation estimation) standard error correction for single equations was not undertaken intentionally. This may have resulted in inconsistencies in the absolute value of parameter estimates.

2.9. Reference List

ACNielsen. 1999-2005. Advertising Expenditure Measurement. Product Category: Media Research. Web page. Available at http://ca.nielsen.com/products/nmr_aem.shtml.

Advertising Age. 2008. "100 Leading National Advertising Spenders." Web page [accessed 2008]. Available at http://adage.com/datacenter/article?article_id=118652.

Alessie, R., and A. Kapteyn. 1991. Habit Formation, Interdependent Preferences and Demographic Effects in the Almost Ideal Demand System. *The Economic Journal.* 101, no. 406: 404-19.

Alston, J. M, J.A.Chalfant, and N. E. Piggott. The Incidence of the Costs and Benefits of Generic Advertising. *American Journal of Agricultural Economics* 82, no. 3: 665-71.

Angulo, A.M., J.M. Gil, and J. Mur. 2007. Spanish Demand for Food Away from Home: Analysis of Panel Data. *Journal of Agricultural Economics.* 58, no. 2: 289-307.

Ameniya, T. 1974. Multivariate Regression and Simultaneous Equation Models When the Dependent Variables are Truncated Normal. *Econometrica*. 42 : 999-1012

Arellano, M. 2003. Panel Data Econometrics. Oxford University Press. Oxford, New York.

Arellano, M. And S. Bond. 1991. Some Tests of Specification for Panel Data. *Review of Economic Studies*. 58:277-297

Arellano, M and O. Bover. 1995. Another Look at the Instrumental- Variable Estimation of Error-Component Models. *Journal of Econometrics*. 68:29-51

Auld, D.A.L. 1974. Advertising and the Theory of Consumer Choice. *The Quarterly Journal of Economics* 88, no. 3: 480-487.

Auld, M. C., and P.Grootendorst. 2004. An Empirical Analysis of Milk Addiction. *Journal of Health Economics.* 23, no. 6: 1117-33.

Baltagi, B.H. 2005. Econometric Analysis of Panel Data. Third Edition. Chichester: Wiley.

Baltagi B. H., and J.M. Griffin. 2001. The Econometrics of Rational Addiction: The Case of Cigarettes. *Journal of Business & Economic Statistics.* 9, no.4:449-54

Banks, J., R.Blundell, and A. Lewbel. 1997. Quadratic Engel Curves and Consumer Demand. *Review of Economics and Statistics.* 79: 527-39.

Barewal, S. 1987. Canadian Spending of Food Service Dollars. *Food Marketing Commentary*. 9:32-41.

Barnett, W.A. 1983. New Indices of Money Supply and the Flexible Laurent Demand System. J*ournal of Business and Economic Statistics. 1*: 7-23.

Barnett, W.A., and O.Seck. 2008. Rotterdam Model versus Almost Ideal Demand System: Will the Best Specification Please Stand Up? *Journal of Applied Econometrics* (Forthcoming).

Barten, A.P. 1968. Estimating Demand Equations. *Econometrica.* 36, no. 2: 213-51.

Barten, A.P. 1977. The Systems of Consumer Demand Functions Approach: A Review. *Econometrica.* 45: 23-51.

Bauer, R.A., and S.A.Greyser. 1968. Advertising in America: Consumer view. Harvard University Press, Boston, MA, USA.

Becker, G.S. 1965. A Theory of Allocation of Time. *The Economic Journal.* 75, no. 299: 493-517.

Becker, G. S., and K. M. Murphy. 1988. A Theory of Rational Addiction. *The Journal of Political Economy*. 96, no. 4: 675-700.

Bhuyan, S. 2005. Impact of Brand Advertising on Food Consumed Away From Home. *Selected Paper Presented at the 2005 AAEA Annual Meeting*.

Binkley, J. K. 2006. The Effect of Demographic, Economic and Nutrition Factors on the Frequency of Food Away From Home. *The Journal of Consumer Affairs.* 40, no. 2: 372-91.

Blanciforti , L., and R. Green. 1983. An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups. *The Review of Economics and Statistics.* 65, no. 3: 511-15.

Boetel B.L, and D. J. Liu. 2002. Evaluating The Effect of Generic Advertising and Food Health Information within a Meat Demand System. *Agribusiness.* 19, no. 3: 345-54.

Borzekowski, D.L.G., and T.N. Robinson. 2001. The 30-second Effect: An Experiment Revealing the Impact of Television Commercials on Food Preferences of Preschoolers. *Journal of the American Dietetic Association.* 101, no.1:42-46.

Brester, G.W, and T.C. Schroeder. 1995. The Impacts of Brand and Generic Advertising on Meat Demand. *American Journal of Agricultural Economics.* 77, no. 4: 969-79.

Brinberge, D. and J. Durand. 1983. Eating at Fast-Food Restaurants:An Analysis Using Two Behavioural Intention Models. *Journal of Applied Social Psychology*.13,no 6:459-472.

Brown, M.G., and J.Y. Lee. 1993. Alternative Specifications of Advertising in the Rotterdam Model. *European Review of Agricultural Economics*. 20, no. 4:419-436.

Browning, M., and M.D. Collado. 2007. Habits and Heterogeneity in Demands: A Panel Data Analysis. *Journal of Applied Econometrics.* 22, no. 3: 625-40

Byrne, P. J., O. Capps. Jr., and A. Saha. 1996. Analysis of Food-Away-from-Home Expenditure Patterns for U.S. Households, 1982-89. *American Journal of Agricultural Economics,* 78, no. 3: 614-27.

Byrne, P. J., O. Capps. Jr., and A. Saha. 1998. Analysis of Quick Serve, Mid-Scale and Up-Scale FAFH Expenditure. *International Food and Agribusiness Management Review*. 1, no.1:51-72.

Capps, O. Jr., J.R. Tedford, and J. Havlicek. 1985. Household Demand for Convenience and Non-convenience Foods. *American Journal of Agricultural Economics.* 67, no. 4: 862-69.

Chalfant, J., and J. Alston. 1986. Accounting for Changes in Tastes. *Journal of Political Economy.* 96:391-410.

Chamberlain, G. 1984. 'Panel data', In: Z. Griliches and M. Intriligator (eds.) Handbook of Econometrics, Vol. 2. Amsterdam: North-Holland.

Chang, H. S, and H.W. Kinnucan. 1991. Advertising, Information, and Product Quality: The Case of Butter . *American Journal of Agricultural Economics.* 73, no. 4: 1195-203.

Chen, P. Y, and M.M. Veeman. 1991. An Almost Ideal Demand System Analysis for Meats with Habit Formation and Structural Change. *Canadian Journal of Agricultural Economic.* 39:223-235.

Chou, S. Y., I. Rashad, and M.Grossman. 2005. Fast-food Restaurant Advertising on Television and its Influence on Childhood Obesity. National Bureau of Economic Research Working Paper Series. Working Paper No.11879, Cambridge.

Christensen, L.R., D.W. Jorgenson, and L.J. Lau. 1975. Transcendental Logarithmic Utility Functions. *American Economic Review.* 65: 367-83.

Colantuoni, C., P. Rada, J. McCarthy, C. Patten, N.M. Avena, A. Chandeayne, and B.G. Hoebel. 2002. Evidence that Intermittent, Excessive Sugar Intake Causes Endogenous Opioid Dependence. *Obesity Research*. 10:478-488.

Comeau, A., C. Mittelhammer, and T.I. Wahl. 1997. Assessing the Effectiveness of MPP and TEA Advertising and Promotion Efforts in the Japanese Market for Meats. *Journal of Food Distribution Research.* 20, no.2:27-35.

Cooper, R.J., and K.R. McLaren. 1996. A System of Demand Equations Satisfying Effectively Global Regularity Conditions. *Review of Economics and Statistics.* 78, no. 2: 359-64.

Deaton, A., and J. Muellabauer. 1980. Economics and Consumer Behaviour. Cambridge: Cambridge University Press.

Deaton, A., and J. Muellbauer. 1980a. An Almost Ideal Demand System. *American Economic Review* 70: 312-26.

Del Parigi, A., K.Chen, A.D. Salbe, E.M. Reiman, and P.A. Tataranni. 2003. Are We Addicted to Food? *Obesity Research*. 11:439-495.

Diewert, W.E. 1971. An Application of the Shepherd Duality Theorem: a Generalized Leontief Production Function. *Journal of Political Economy.* 79 : 461-507.

Dixit, A., and V. Norman. 1979. Advertising and Welfare: Reply. *Bell Journal of Economics.* 10, no.2:728-29.

Duffy, M. 1991. Advertising in Demand Systems: Testing a Galbraithian Hypothesis. *Applied Economics.* 23, no. 3: 485-96.

Duffy, M. 2003. Advertising and Food, Drink and Tobacco Consumption in the United Kingdom: A Dynamic Demand System. *Agricultural Economics.* 28: 51-70.

Duffy, M. 1995. Advertising in Demand Systems for Alcoholic Drinks and Tobacco: A Comparative Study. *Journal of Policy Modeling.* 17, no. 6: 557-77.

Dynan, K. 2000. Habit Formation in Consumer Preferences: Evidence from Panel Data. *American Economic Review.* 90, no. 3: 391-406.

Fenn, A. J., F. Antonovitz, and J.R. Schroeter. 2001. Cigarettes and Addiction Information: New Evidence In Support Of the Rational Addiction Model. *Economics Letters.* 72 : 39-45.

Finkelstein, E., S. French, J. N. Variyam, and P.S. Haines. 2004. Pros and Cons of Proposed Interventions to Promote Healthy Eating. *American Journal of Preventive Medicine.* 27, no. 3:163-71.

Fisher, F. M., and J.J. McGowan. 1979. Advertising and Welfare: Comment. *Bell Journal of Economics.* 10, no.2: 726-27.

French, S. A., M. Story, and R. W. Jeffery. 2001. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health.* 22: 309-35.

French, S.A., L. Harnack, and R.W. Jeffery. 2000. Fast Food Restaurant Use Among Women In the Pound of Preservation Study: Dietary, Behavioral and Demographic Correlates. *International Journal of Obesity*. 24;1353-1359.

Goddard, D. 1983. An Analysis of Canadian Aggregate Demand for Food at Home and Away from Home. Canadian Journal of Agricultural Economics. 31, no.3:289-318.

Goddard, E. W., and A. K Amuah. 1989. The Demand for Canadian Fats and Oils: A Case Study of Advertising Effectiveness. *American Journal of Agricultural Economics.* 71, no. 3: 741-49.

Goldsmith, R.E., J. Frieden and K.V. Henderson. 1997. The Impact of Social Values on Food –Related Attitudes. *British Food Journal*. 99, no.9 :352-357.

Green, R. D., H. F. Carman, and K. McManus. 1991. Some Empirical Methods of Estimating Advertising Effects in Demand Systems: An Application to Dried Fruits. *Western Journal of Agricultural Economics.* 16, no. 1: 63-71.

Greene, W. 2003. Econometrics. New York: Prentice Hall.

Grigson, P.S. 2002. Like Drugs for Chocolate: Separate Rewards Modulated by Common Mechanisms. *Physiological Behavior*. 76:389-395.

Grossman, M., and F.J. Chaloupka. 1998. The Demand for Cocaine by Young Adults: A Rational Addiction Approach. *Journal of Health Economics.* 17: 427-74.

Griffith, D. 1992. Simplifying The Normalizing Factor In Spatial Autoregressions For Irregular Lattices. *Papers in Regional Science* 71, 71–86

Guthrie, J., F. B. Lin, and E. Frazao. 2002. Role of Food Prepared Away From Home in the American Diet, 1977-78 versus 1994-96: Changes and Consequences. *Journal of Nutrition Education and Behaviour.* 34, no. 3: 140-150.

Haines, P., D. Guilkey, and B. Popkin. 1988. Modeling Food Consumption Decisions as a Two-Step Process. *American Journal of Agricultural Economic.* 543-552.

Harker, D., M. Harker, and S. Svensen. 2007. Attributing Blame: Exploring the Link between Fast Food Advertising and Obesity in Australia. *Journal of Food Products Marketing. 13, no.2:2007* 13,

Hastings, G., M. Stead, L. McDermott, A. Forsyth, A. MacKintosh, M. Rayner, C. Godfrey, M. Caraher, and K. Angus. 2003. Review of Research on the Effects of Food Promotion to Children. Final Report. Food Standards Agency: London.

Health Canada. 2006. Food Industry Perspective on Eliminating Trans Fats in Food Products. Appendix 12. TRANSforming the food supply, Report of the Trans Fat Task Force Submitted to the Minister of Health. Web page, [accessed December 2007]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf

Heckman, J. 1978. Dummy Endogenous Variables in a Simultaneous Equation System. *Econometrica.* 46: 931-59.

Heien, D., and C.R.Wessells. 1990. Demand Systems Estimation with Microdata: A Censored Regression Approach. *Journal of Business & Economic Statistics.* 8, no. 3: 365-71.

Heien, D., and C.R.Wessells. 1988. The Demand for Dairy Products: Structure, Predictions and Decomposition. *American Journal of Agricultural Economics*. 70:219-228

Herrington, D. J. 2004. Are Restaurant Franchisees Getting a Positive Return on Their Advertising Fees? *Journal of Promotion Management.* 11, no. 1:71-81.

Herrington, D. J. 2002. The Current Impact and Carryover of Advertising on Sales in the Restaurant Industry. *Journal of Foodservice Business Research.* 5, no. 3: 1537-8020.

Hiemstra, H. J, and W.G.Kim. 1995. Factors Affecting Expenditures for Food Away From Home in Commercial Establishments by Type of Eating Place and Meal Occasion. *Journal of Hospitality and Tourism Research* 19, no. 3: 15-31.

Heien, D., and C. Durham. 1991. A Test of the Habit Formation Hypothesis Using Household Data. *The Review of Economics and Statistics*. 73, no.2:189-199.

Hill, J. O., and J.C. Peters. 1998. Environmental Contributions to the Obesity Epidemic. *Science.* 280: 1371-74.

Hoek, J., and P. Gendall. 2006. Advertising and Obesity: A Behavioral Perspective. *Journal of Health Communication.* 11: 409-23.

Holocomb, R., J. Park, and O. Capps, Jr. 1995. Examining Expenditure Patterns for Food at Home and Food Away from Home. *Journal of Food Distribution Research*. 26:1-8.

Holt, M. T., and B.K. Goodwin. 1997. Generalized Habit Formation in an Inverse Almost Ideal Demand System: An Application to Meat Expenditures in the U.S. *Empirical Economics.* 22: 293-320.

Horstmann, I. J., and S. Moorthy. 2003. Advertising Spending and Quality for Services: The Role of Capacity. *Quantitative Marketing and Economics.* 1, no. 3: 337-65.

Horton, S., and C. Campbell. 1991. Wife's Employment, Food Expenditures, and Apparent Nutrient Intake: Evidence from Canada. *American Journal of Agricultural Economics*. 73, no. 3:784-794.

Hsiao, C. 2007. Panel Data Analysis,Advantages and Challenges. *TEST.* 16: 1-22.

Hsu, L. T., and S.C. Jang. 2008. Advertising Expenditure, Intangible Value And Risk: A Study Of Restaurant Companies. *International Journal of Hospitality Management.* 27: 259-67.

Huang, C.L., and S. Misra. 1991. Assessing Nutritional Adequacy of Americans Based on Individual Food Intake Patterns. *Journal of Consumer Studies and Home Economics*. 15:147-159.

Isganaitis, E., and R.H. Lustig. 2005. Fast Food, Central Nervous System Insulin Resistance, and Obesity . *Arteriosclerosis, Thrombosis, and Vascular Biology***.** 25: 2451-62.

Iwasaki, N., C. H. Trembay, and V.J. Tremblay. 2006. Advertising Restrictions and Cigarette Smoking: Evidence from Myopic and Rational Addiction Models. *Contemporary Economic Policy.* 24, no. 3: 370-381.

Jackson, F. H., K.Titz, and A.L. DeFraaco. 2004. Frequency of Restaurant Advertising and Promotion Strategies: Exploring an Urban Market. *Journal of Food Products Marketing.* 10, no. 2:17-31.

Jackson, F. H., A. DeFranco, K. Titz, and H. Gu. 2008. Restaurant Advertising and Promotion Strategies of Two Gateway Cities: an Exploratory Study. *International Journal of Hospitality and Tourism.* 9, no. 1: 36-51.

Jager, W. 2003. Braeking 'Bad Habits': A Dynamical Perspective on Habit Formation and Change. In L. Hendrickx, W.Jager, L.Steg(Eds.) Human Decision Making and Environmental Perception. Understaning and Asisting Human Decision Making in Real-Life Setting. University of Groningen.

Jekanowski, M.D., J. K Binkley, and J. Eales. 2001. Convenience, Accessibility, and the Demand for Fast Food. *Journal of Agricultural and Resource Economics* 26, no. 1: 58-74.

Jensen, H., and J. Schroeter. 1991. Television Advertising and Beef Demand: An Econometric Analysis of 'Split-Cable' Household Panel Scanner Data. *C Anadian Journal of Agricultural Economics* 40, no. 2: 271-94.

Jensen, Helen H, and Yen Steven T. 1995. Food Expenditures Away From Home by Type of Meal . *Canadian Journal of Agricultural Economics.* 44, no. 1: 67-80.

Ji, M.F., and W.Wood. 2007. Purchase and Consumption Habits: Not Necessaraly What You Intend. Journal of Consumer Phychology. 17, no. 4:261-276.

Kaldor, N. 1950. The Economic Effects of Advertising. *Review of Economic Studies* 18, no. 1: 1-27.

Kara, A., E.Kaynak, and O. Kucukemiroglu. 1995. Marketing Strategies for Fast-Food Restaurants: A Customer View. *International Journal of Contemporary Hospitality Management*. 7, no.4:16-22.

Kinnucan, H.W., H. Xiao, C.J.Hsia, and J.D.Jackson. 1997. Effects of Health Information and Generic Advertising on U.S. Meat Demand. *American Journal of Agricultural Economic.s* 79, no. 1: 13-23.

Kotowitz, Y., and F. Mathewson. 1979. Informative Advertising and Welfare. *American Economic Review.* 69, no. 3: 284-94.

Lancaster, K.G. 1966. A New Approach to Consumer Theory. *Journal of Political Economy.* 74, no. 2.

Larivičre, E., B. Larue, and J. Chalfant . 2000. Modeling the Demand for Alcoholic Beverages and Advertising Specifications. *Agricultural Economics.* 22, no. 2: 147-62.

Laroche, M. L., M. Kalamas, and Q. Huang. 2005. Restaurant Advertising and Promotion Strategies of Two Gateway Cities: an Exploratory Study. *Journal of Business Research.* 58, no. 5: 674-86.

Lee, J. Y., and M.G. Brown. 1986. Food Expenditures at Home and Away from Home in the United States-A Switching Regression Analysis. *The Review of Economics and Statistics.* 68, no. 1: 142-47.

Lewis, R., 1981. Restaurant Advertising: Appeals and Consumers' Intentions. *Journal of Advertising Research,* 21, no. 5: 69-74.

Lin, B., and E. Frazao. 1999. Away-From-Home Foods Increasingly Important to Quality of American Diet [No. 749]. Agriculture Information Bulletin, Washington, DC: Economic Research Service/United States Department of Agriculture.

Lindbladh, E., and C.H. Lyttkens. 2002. Habit vs. Choice: The Process of Decision Making in Health- Related Behaviour. *Social science and Medicine.* 55(3).

Ma, H., J. Huang, F. Fuller, and S. Rozelle. 2006. Getting Rich and Eating Out: Consumption of Food Away from Home in Urban China. *Canadian Journal of Agricultural Economics.* 54: 101-19.

Manser, M. E. 1996. Elasticities of Demand for Food: An Analysis Using Non-Additive Utility Functions Allowing for Habit Formation. *Southern Economic Journal.* 43, no. 1: 879-91

McCracken, V. A., and J.A. Brandt. 1987. Household Consumption of Food-Away-from-Home: Total Expenditure and by Type of Food Facility. *American Journal of Agricultural Economics.* 69, no. 2: 274-84 .

McFadden, D. 1973. Conditional Logit Analysis of Qualitative Choice Behavior. in Zarembka ed. *Frontiers in Econometrics.* Academic Press, New York.

Mihalopoulos, V.G., and M.l .P. Demoussis. 2001. Greek Household Consumption of Food Away from Home: A Microeconometric Approach. *European Review of Agriculture Economics.* 28, no. 4: 421-32.

Min, I., C. Fang, and Q. Li. 2004. Investigation of Patterns in Food-Away-From-Home Expenditure For China. *China Economic Review.* 15: 457-76.

Muellbauer, J. 1988. Habits, Rationality and Myopia in the Life Cycle Consumption Function. *Annales D'Economie Et De Statistique,* 9: 47-70.

Muellbaure, J., and P. Pashardes. 1992. Tests of Dynamic Specification and Homogeneity in a Demand System, in (L.Philips and L.D. Taylor, eds.) Aggregration, Consumption and Trade. Kluwer Academic Publishers. Netherland. 55-98.

Multu, S., and A.Gracia. 2006. Spanish Food Expenditure Away From Home (FAFH): By Type of Meal. *Applied Economics.* 38: 1037-47.

National Audience Databank 2008. National Audience Databank Survey 2008. Web page, [accessed in 2009]. Available at http://www.nadbank.com/en/study

Nayga, R. M. Jr., 1996. Wife's Labor Force Participation and Family Expenditures for Prepared Food, Food Prepared at Home, and Food Away from Home. *Agricultural and Resource Economics Review.* 25, no. 2: 179-86.

Nelson, J. P. 1999. Broadcast Advertising and U.S. Demand for Alcoholic Beverages. *Southern Economic Journal.* 65, no. 4: 774-90.

Nelson, P. 1974. Advertising as Information. *Journal of Political Economy.* 82, no. 4: 729-754.

NPD Group Inc. 2007. "Food Service: Consumer Tracking". Web page, [accessed 2007]. Available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html.

Phlips, L., and F. Spinnewijn. 1981. Rational and Myopic Demand Systems, in (Bassman and Rhodes, eds.). Advances in Econometrics. JAI Press.

Pigott, N.E. 2003. The Nested PIGLOG Model: An Application to U.S. Food Demand. *American Journal of Agricultural Economics.* 85, no.1:1-15.

Piggott, N.E., J.A. Chalfant, J. M. Alston, and G. R. Griffith. 1996. Demand Response to Advertising in the Australian Meat Industry. *American Journal of Agricultural Economics*.78, no. 2:268-279.

Prochaska, F.J., and R. A. Schrimper. 1973. Opportunity Cost of Time and Other Socioeconomic Effects on Away-from-Home Food Consumption. *American Journal of Agricultural Economics.* 55, no. 4: 595-603.

Reynolds, A., and E. W. Goddard. 1993. Food Consumption Away From Home by Type of Facility and Type of Meal. *Canadian Journal of Agricultural Economics.* 42, no. 2: 225-30.

Richards , T. J., and L. Padilla . 2007. Promotion and Fast Food Demand: Where is the Beef? Research Project Number CMD-07-03. C. Department of Rural Economy. University of Alberta.

Richards, T. J., P.M. Patterson and A. Tegene. 2007. Obesity and Nutrient Consumption: A Rational Addiction. *Contemporary Economic Policy.* 25, no. 3: 309-24.

Richards, T. J., P.M. Patterson, M. Paul , and S.Hamilton. 2007. Fast Food, Addiction, and Market Power. *Journal of Agricultural and Resource Economics.* 32: 425-47.

Rickertsen, K., 1998. The Effects of Advertising in an Inverse Demand System: Norwegian Vegetables Revisited. *European Review of Agricultural Economics.* 25, no. 1: 129-40.

Richertsen, K., J. A. Chalfant, and M. Steen. 1995. The Effects of Advertising on the Demand for Vegetables. *European Review of Agricultural Economics* 22, no. 4: 481-94.

Robertson, A. 2004. Food and Health in Europe: A New Basis for Action. European Series, no. 96WHO Regional Publications.

Robinson, T. N., D.L.G. Borzekowski, D. M. Matheson, and H.C. Kraemer. 2007. Effects of Fast Food Branding on Young Children's Taste Preferences. 2007. *Archives of Pediatrics and Adolescent Medicine.* 161, no. 8: 792-97.

Robinson, L., and E. Zafiriou. 1986. The Food Expenditure Patterns of Elderly in Canada: 1974-82. *Food Market Commentary*. 8:29-43.

Sapala, J. A. 2002. Is the Fast Food Industry Becoming the Next Tobacco Industry? *Obesity Surgery.* 12, no. 1:1-2.

Sargan, J. 1958. The Estimation of Economic Relationships Using Instrumental Variables. *Econometrica*. 26, no.3: 393-415.

Shepherd, R., 1999. Social Determinants of Food Choice. *Proceedings of the Nutrition Society,*58:807-812.

Schmit, T. D., D. Dong, C. Chung, H.M. Kaiser, and B.W. Gould. 2002. Identifying the Effects of Generic Advertising on the Household Demand for Fluid Milk and Cheese: A Two-Step Panel Data Approach. *Journal of Agricultural and Resource Economic.* 27, no. 1: 165-86.

Schmit, T. M., and H.M. Kaiser. 1998. Egg Advertising, Dietary Cholesterol Concerns, and U.S. Consumer Demand. *Agricultural and Resource Economics Review.*27, no.1:43-52.

Schröder, M. J. A, and M.G. McEachern. 2005. Fast Foods and Ethical Consumer Value: A Focus on Mcdonald's And KFC. *British Food Journal.* 107, no. 4: 212-24.

Sexauer , B., 1979. The Effect of Demographic Shifts and Changes in the Income Distribution on Food-Away-from-Home Expenditure. *American Journal of Agricultural Economics.* 61, no. 5: 1046-57 .

Shonkwiler, J. S., and S.T.Yen. 1999. Two-Step Estimation of a Censored System of Equations. *American Journal of Agricultural Economics.* 81: 972-82.

Sims, S. M. 1998. The Politics of Fat: Food and Nutrition Policy in America. Armonk, NY: M.E. Sharpe.

Stassen, R. E., and A. Mittelstaedt. 2002. Do Franchise Systems Advertise Enough? U.S. Restaurant Expenditures and Performance 1989 to 1998. *Journal of Marketing Channels.* 10, no. 2:3-18.

Statistics Canada. 2007. "Survey of Household Spending and CANSIM II (table no. 203-0002)." Web page, [accessed January 2008]. Available at http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3508&lang=en&db=imdb&dbg=f&adm=8&dis=2 .

Stewart, H., N. Blisard, D. Jolliffe, and S. Bhuyan. 2005. The Demand for Food Away from Home: Do other Preferences Compete with Our Desire to Eat Healthfully? *Journal of Agricultural and Resource Economics.* 30, no. 3: 520-536.

Stewart, H., N. Blisard, S. Bhuyan, and R. M. Nayga, Jr. 2004. "The Demand for Food Away from Home: Full-Service or Fast Food?" *USDA-ERS Economic Research Report.* Report, no. 829.

Story, M., and S. French. 2004. Food Advertising and Marketing Directed at Children and Adolescents in the US. *International Journal of Behavioral Nutrition and Physical Activity*. 1:1-3.

Tauchman, H. 2005. Efficiency of Two-step Estimators for Censored System of Equations: Shonkwiler and Yen Reconsidered. *Applied Economics.* 37:367-374.

Telser, l.G. 1964. Advertising and Competition. *The Journal of Political Economy.* 72, no. 6:537-562.

Theil, H. 1965. The Information Approach to Demand Analysis. *Econometrica.* 33:67-87.

Tremblay C. H., and V. J. Tremblay. 1995. The Impact of Cigarette Advertising on Consumer Surplus, Profit, and Social Welfare. *Contemporary Economic Policy.* 13, no. 1: 113-24.

Ulbricht, G.J. F. 2002. Nutritional Information and Consumer Behavior – Their Relationship To Nutritional Balance. A study conducted in Berlin. *Food Service Technology.* 2, no. 1: 5-11.

Variyam, J. N. 2005. Nutrition Labeling in the Food-Away-From-Home Sector: An Economic Assessment. *USDA-ERS Economic Research Report.* Report no.4.

Vella, F. and M. Verbeek. 1999. Two-Step Estimation of Panel Data Models with Censored Endogeneous Variables and Selection Bias. *Journal of Econometrics.* 90: 239-263.

Verlegh, P.W.J. and M.J.J.M.Candel. 1999. Consumption of Convenience Foods: Reference Groups and Eating Situations. *Food Quality and Preference*. 10:457-464.

Verbeke , W., and R. W. Ward. A Fresh Meat Almost Ideal Demand System Incorporating Negative TV Press and Advertising Impact. *Agricultural Economics.* 25, no. 2-3: 359-74.

Verbeek, M. 2004. A Guide to Modern Econometrics. Secon Edition. England:John Wiley & Sons Ltd.

Wang, A. S. 2003. A Cross-Cultural Content Analysis of Restaurant Ads in New Zealand. *British Food Journal* .105, no. 1: 23-41.

Wooldridge, J.M. 1995. Selection Correction for Panel Data Models Under Conditions Mean Independence Assumption. *Journal of Econometrics.*68: 115-132.

Yen , S.T. 1993. Working Wives and Food Away from Home: The Box-Cox Double Hurdle Model. *American Journal of Agricultural Economics.* 75, no. 4: 884-95 .

You, W., and R.M. Nayga Jr. 2005. Household Fast Food Expenditures and Children's Television Viewing. *Journal of Agricultural and Resource Economics.* 30, no. 2: 302-14.

Young, B. 2003. Does Food Advertising Make Children Obese? *International Journal of Advertising and Marketing to Children.* 4, no. 3: 19-26.

Zhen, C., and M. K. Wohlgenant. 2006. Meat Demand under Rational Habit Persistence. *Canadian Journal of Agricultural Economics.* 54, no. 4: 477-95.

Chapter 3: Demand for Nutrients in Chain Restaurants in Canada

3.1. Motivation

In recent years, the determinants of nutrient demand have been the focus of a number of economic studies (see Table 3.1 for a list of studies undertaken on nutritional aspects of the foods). With an increasing awareness of diet related diseases and increasing interest in public policy interventions, the need for a more complete understanding of nutrient consumption patterns has grown. Despite many studies which have been undertaken by nutritionists to explore the nutrient quality of food away from home (FAFH), especially fast foods (Table 3.2), the economic studies focused on FAFH in general, are limited. Given an increasing trend in FAFH spending (Statistics Canada 2006) and the possible link between FAFH and diet related diseases, an empirical analysis of nutrient demand in FAFH is timely. In addition, from a policy formulation view, understanding nutrient demand is important as many policies[3] are directly targeted at a certain nutrient or nutrients.

Some studies that are available on the nutritional aspects of FAFH (Lin *et al.* 1999; Guthrie *et al.* 2002) make comparisons between food prepared at home and FAFH (using data from USDA Nationwide Food Consumption Surveys and Continuing Survey of Food Intakes by Individuals and calculating nutrient density measures) and provide information as to how the food intakes of Americans have changed over a period of time. According to Lin *et al.* (1999), over the period 1977 to 1995, Americans have had only small nutritional improvements in FAFH consumption (foods obtained at various places other than retail stores) as these foods contain more of the nutrients over consumed (calories from fat and saturated fats) and fewer of nutrients under consumed (calcium and fibre). Guthrie *et al.* (2002) had the same findings, as well as the fact that FAFH foods are also sodium and cholesterol dense. Binkley (2006) added nutrition variables (consumers' concerns and knowledge about nutrition) to standard demographic

[3] Proposed trans fat regulations, fat taxes, regulations on sodium etc.

measures in explaining demand for FAFH. According to his consumer survey data analysis, Binkley (2006) showed that nutrition oriented consumers tended to have lower fast food consumption. There are a number of other studies, which focus on the nutrition aspect of only one segment of FAFH such as fast food consumption. Nutritionists have undertaken these studies and the general finding is that frequent fast food consumption leads to higher energy and fat intake and a lower intake of healthful nutrients. See table 3.1 for a list of studies done on nutritional aspects of foods including FAFH. Meanwhile, many researchers have also shown that there is a correlation between FAFH food, especially fast food consumption and the obesity epidemic in U.S. (French *et al.* 2000; French *et al.* 2001; Binkley *et al.* 2000; Taveras *et al.* 2001).

A number of economic studies have focused on specifying the influence of socio-demographic characteristics on food nutrient demand in general (Ardrian and Daniel 1976; Devaney and Fraker 1989; Basiotis 1983; Nayga 1994; Nayga 1999; Ramezame 1995; Subramanium and Deaton 1996; Dhehibi *et al.* 2003). As most of these studies highlight, information on the differential effects of socio-demographic characteristics on nutrient intake may be useful in designing and targeting nutrition education. According to Ardrian and Daniel (1976), since certain commodities or commodity groups are primary sources of specific nutrients, specification of these relationships can also provide information concerning future demand trends, which will directly affect the types of agricultural products produced and marketed. However, Huang (1996) argues that if this measurement of nutrition contribution is to be a better guide for decision making in policy and business, it needs to be better tied to demand for food supplied. While these concerns were expressed with regard to food consumption in general, it will be interesting to analyze FAFH consumption in the above context for a better understanding.

3.2. Objective

The overall goal of this study is to understand the consumer demand for nutrients in FAFH foods in Canada in a comprehensive manner. A joint effort by Canadian Restaurant and Food Services Association and Canada's largest restaurant chains to launch a Nutrition Information Program in February 2005, made it easier for consumers to obtain detailed nutrition information for standardized menu items in the majority of chain restaurants in Canada. With this situation, consumers can at least have access to information on which to base food choices. Therefore, the specific objective is to estimate the demand for nutrients in the FAFH market focusing on chain restaurants and to identify socio-demographic characteristics affecting this demand.

3.3. Conceptual Framework

3.3.1. Modelling Demand for Nutrients

In looking for a conceptual framework to analyze the demand for food by nutrients, one can find different studies that bear some relevance in the economic literature (Table 3.1). To look at the impact of nutrition information on changing behaviour, some have used a nutrient information index as a variable in demand equations (Brown and Schrader 1990; Capps and Schmitz 1991; Burton and Young 1996; Kinnucan *et al.* 1997; Kim and Chern 1999). However, these studies did not measure the demand for nutrients directly and have focused instead on examining consumers' knowledge of nutrition in food demand. According to Dhehibi *et al.* (2003), two different measurement techniques have been used to analyse the demand for nutrients. The first method is the "direct method" where demand equations for specific nutrients are specified as functions of socio-demographic and economic variables (Ardrian and Daniel 1976; Devaney and Fraker 1989; Basiotis 1983; Nagya 1994; Subramanium and Deaton 1996; Ramazame 1995). In the second method-"indirect method"- authors have used a two-step process where first, relevant variable effects on the demand for food products are calculated by estimating a demand system and second, nutrient

intake effects are obtained by applying a nutrient conversion factor to these specific food effects (Huang 1996 and 1999; Beatty and Lafrance 2005; Dhehibi *et al.* 2003). Recently, a few other studies using different analytical methods have become available. For example, the maximum entropy principle has been used by Beatty (2007) to recover the shadow value of food nutrients and the semi-parametric quantile regression approach has been used by Variyam *et al.* (2002) and Fousekis and Lazairdis (2005) to analyse the demand for selected nutrients. Dhehibi *et al.* (2003) used a panel data model (a differential consumer demand system[4]) incorporating nutrients as attributes and Richards *et al.* (2007) investigated nutrient addiction using a random coefficient (mixed) logit model. These above methods are briefly reviewed in the next sections in order to gain some insight on nutrient demand estimation.

3.3.1.1. Direct Method of Nutrient Demand Estimation

In most of the empirical work in the direct method, the demand for nutrients by households is approximated via an Engel curve relationship in which per capita intake of a nutrient is specified as a function of a per capita food consumption expenditure and a vector of household socio-demographic characteristics (Ardrian and Daniel 1976; Huang and Misra 1991; Devaney and Fraker 1989; Nayga 1994, Nayga and Capps 1994; Biotosis *et al.* 1983). According to Fousekis and Lazaridis (2005), this specification is consistent with Becker's household production model as well as with Lancaster's goods characteristics model. In Becker's model, nutrients can be considered as inputs in production of health along with other activities such as regular physical activities and consumption of medical services (Grossman 1972; Grossman and Kaestner 1997 in Fousekis and Lazaridis (2005). In the Lancaster model, foods can be considered to have positive attributes (taste and essential nutrients) as well as negative attributes such as health risks (Chern and Rickertsen 2003). In both Becker's and Lancaster's models, socio-demographic and economic variables enter the utility function as

[4] This demand system is called as CBS demand system and it comes from the institution in which the model developers (Keller and Van Driel (1985) worked: Dutch Central Bureau of Statistics

they influence consumers' decision making in healthy dietary choices (Variyam and Golan 2002).

With regard to the relationship between nutrient demand and consumers' socio-demographic and economic variables, Morgan (1986) highlights the fact that the literature contains a diversity of findings. Morgan (1986) and Davis (1982) suggest a need for more interdisciplinary research to better understand the relationship between nutrient intake and socio-demographic and economic characteristics. Given this and assuming that variation could be attributed to different functional form specifications, Ramezani (1995) has used AVAS (Additivity and Variance Stabilization), a non parametric method to specify a multivariate function and then to estimate the demand for nutrients.

According to the above description, the direct method of nutrient demand seems appealing for obtaining information related to healthy dietary choices. However, this method has been criticized by some others arguing that the applicability of the results of such methods is limited as consumers are observed to be choosing foods not nutrients and therefore, nutrients are not directly available in the market (Dhehibi *et al.* 2003). Nonetheless, in the Canadian FAFH market, this has become less and less the case as nutrient information is available for the majority of foods provided by the largest chain restaurants. Specifically, in February 2005, the Canadian Restaurant and Foodservices Association and Canada's largest restaurant chains jointly launched a Nutrition Information Program to provide detailed nutrition information for standardized menu items. (Also this became evident according to a survey carried out by the authors who examined restaurant companies' websites and collected nutrition data on site of many restaurants). Further, public health policy is requiring more and more nutrition information to be made available to the FAFH consumers in order for them to make informed and healthful food choices (CSPI 2008; Parliament of Canada 2006).

3.3.1.2. Indirect Methods of Nutrient Demand Estimations

The studies under the indirect method have tried to link food choices with nutritional status in the context of the classical demand framework (Huang 1996; Beatty and Lafrance 2005). Huang (1996) developed a procedure, first, of estimating interdependent demand relationships including own-price, cross-price and income effects and then incorporating these elasticity estimates directly into the measurement of nutrient elasticities. For elasticity estimations he has used time series data on quantities and prices of selected food items using a demand system (Huang 1996). Beatty and Lafrance (2005) introduced another new model which nests a large class of functional forms for income and prices within a flexible demand system. Then, combining demand estimates with data on the nutrient content of foods, they make inferences on the nutritional impacts of changes in food consumption. These methods of nutrient demand estimation first require an estimation of demand for each food product under consideration using price and other relevant information. Although these methods of measuring nutrition contribution can be tied to demand for food supplied and provide useful policy relevant information, in FAFH consumption, this method will not be plausible given the large number of products and the unavailability of individual product price data. Instead of individual food product prices, FAFH purchase data usually provide total expenditure for a purchase occasion (for an example NPD CREST data (NPD Group Inc.) provides total expenditure for a purchase occasion and a purchase occasion may include a number of food products).

3.3.1.3. Other Methods of Nutrient Demand Estimations

Recently, a few studies have been undertaken with new methodological approaches. Beatty (2007) investigated the shadow value of twenty-eight different nutrients. In his study the unit prices of foods were linked to the shadow values of nutrients by building on a utility theoretic model proposed by Gorman. Maximum entropy principles are then used to estimate the values of the parameters of interest. However, Beatty (2007) did not use FAFH food intake. The Semi-parametric quantile regression approach has been used by Variyam *et al.* (2002)

and Fousekis and Lazaidis (2003) to analyse the demand for selected nutrients. In quantile regression method, a nutrient intake is specified as a dependent variable in a conditional quantile function and solved as a minimization problem. According to Variyam *et al.* (2002), in nutrient demand analysis, the marginal effects of explanatory variables estimated at the conditional mean using ordinary least squares may be of limited value as the risk of dietary inadequacy or excess is greater at the tails of the nutrient intake distribution. Quantile regression is effective in this situation since it can be used to estimate conditional functions at any part of the distribution (Variyam 2002; Fousekis and Lazaidis 2003). Dhehibi *et al.* (2007), using a panel data set (for eight quarters) and incorporating nutrients as attributes directly, estimated a demand system, in which food quantities are considered as dependent variables. Again in all of the above studies, FAFH consumption is omitted due to the unavailability of product quantities in their data. In these studies identification of different products, their quantity, and their nutrient composition is important to construct the models. All of these new approaches require proper identification of products and quantities consumed. Given that FAFH contains a very large number of products with different portion or serving sizes, applicability of these methods in FAFH nutrient demand analysis is limited due to computational difficulties. An economic model, specifically a random coefficient (mixed) logit model was used by Richards *et al.* (2007) to test nutrient addiction and to identify the relationship between obesity and nutrition consumption.

3.3.2. Measurement of Nutrient Content of Foods in General and FAFH

One of the caveats in nutrient demand studies is the measure of the nutrient content of foods (Beatty *et al.* 2007). Very often, studies have used per capita nutrient intake on a weight basis. When food intake data is available in the form of food groups and their quantities, calculation of nutrients using nutrition information sources (may be actual nutrition information of foods or assumed averages of food groups) is plausible. However, calculation of per capita nutrient intake on a weight basis is computationally difficult in FAFH due to serving size

differences. Among many measures of the nutrient content of foods, nutrition density measures are considered to be a promising tool (Drewnowski 2005), which can be applied to FAFH consumption. Nutrition density measures the amount of each nutrient for each 1000 or 2000 calories provided by a food item. Since this standard is calculated using the number of calories as the basis, the resulting nutrient density ratio is independent of the serving size (Hansen 1979). Given a large variety of meal items and portion sizes in FAFH consumption measuring exact nutrient content is difficult due to human error. Therefore, nutrient density can considered to be a suitable measure of nutrients for FAFH to avoid the complexity of calculating exact nutrient content by product and aggregating them.

3.4. Literature Review

A number of studies which have specifically studied the demand for nutrients in food in general (Table 3.1) and some studies on nutrients and FAFH (Table 3.2) are provided in the literature review. A majority of the nutrient demand studies have used cross sectional data, while only a few have used time series data (Huang 2000; Beatty and Lafrance 2005) and panel data (Dhehibi *et al.* 2003; Richards *et al.* 2007). Some of the modelling issues in cross sectional nutrient demand studies are described in Park and Davis (2001). Using different methodological approaches described in section 3.3, these studies have used many socio-demographic factors in their analysis. The number of nutrients that are analysed varies from one nutrient (Calories-Subramanium and Deaton 1996) to twenty-eight nutrients (Beatty 2007). Non-technical descriptive analysis and reviews on the relationship between food demand and nutrition are also included. Among these, Blaylock *et al.* 1999 examined the role and influence of economic factors on consumer food choices, and hence, nutritional outcomes. Drewnowski (2003) examined the link between income and macro-nutrients (fat and sugar) in developed and developing countries as well as lower income groups in developed countries. He suggests that obesity in US and similar societies may be a socio-economic issue. Nestle (2002) describe how food industry influence nutrition and

health of consumers. Popkin (2006) provides a commentary on global nutrition dynamics and highlights the effects of fast food and bottled soft drinks industries on the nutrition shift.

Some studies which are related to nutrients and FAFH (Table 3.2) have focused on the link between FAFH and obesity (Gills and Bar-Or 2003; Thompson *et al.* 2004; French *et al.* 2000, 2001; Pereira *et al.* 2005; Duffey *et al.* 2007; Burns *et al.* 2001). These studies tried to link relatively high energy and fat intake from FAFH to obesity. A few studies looked at the nutrient contribution of FAFH over the years (Lin *et al.* 2000, Gruthrie *et al.* 2001). Other studies reported in this review have examined different aspects of FAFH and nutrition. For example, nutrition associated with restaurant diet and its effects on university students (Baric *et al.* 2003), caloric and gram differences between meals at fast foods and table service restaurants (Binkley 2008), effects of fast food on children's and adults diet (Brown *et al.* 2003; Paerataket *et al*. 2003), low fat restaurant menus and customer satisfaction (Fitzpatric *et al.* 1997) and socio-demographic factors on individual intake of saturated fat and cholesterol from FAFH (Nayga and Capps 1994), nutrition labelling of restaurant foods (Variyam 2005). In addition to the studies in Table 3.1 and Table 3.2, information on nutrition labelling in restaurants and food services in Canada (Health Canada 2008) and nutrition database information provided by USDA (USDA 2008) are also reviewed.

Table 3- 1 : Previous Studies on Nutrient Demand and Food

Author /Year/Country	Study/Data/Model	Main Findings
Abdulai and Aubert/ 2004/ Tanzania	• A cross-section analysis of household demand for food and nutrients in Tanzania • A Household survey • A quadratic almost ideal demand system (QUAIDS) and a moment-based instrumental variable approach to analyse the determinants of nutrient demand.	The results show that income and other socio-economic variables exert significant effects on the demand for food and nutrients. The estimated expenditure elasticities for the nutrients range from 0.307 for iron to 1.26 for Vitamin B 12. The elasticities are higher for those micronutrients that are consumed through animal products and lower for those micronutrients that are mainly obtained through staple foods. These results reflect the higher expenditure elasticities for meat, fish, eggs, milk, and milk products, as well as fruits and vegetables, relative to cereals and pulses, reinforcing the assertion that the demand for Vitamins A and B 12, as well as calcium and zinc will increase with rising income.
Adrian and Daniel/ 1979/ USA	• Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States • 1965-66 nationwide household food consumption survey • Simple multiple regression model	The impacts of socioeconomic characteristics of the household and its constituents on consumption of protein, carbohydrate, fat, vitamin A, calcium, iron, thiamine, and vitamin C were estimated. Socioeconomic factors considered were: income, degree of urbanization, race, and educational attainment of the homemaker, stage of the household in the family life cycle, family size, meal adjustment, and employment status of the homemaker. Income had a positive impact on the consumption of all nutrients except carbohydrate. However, nutrient consumption responsiveness to income was relatively small.
Basitotis *et al.* /1983 /USA	• Nutrient Availability, Food Costs, and Food Stamps • Nationwide Food Consumption Survey 1977-78	Found that Food Stamp Program participation had a positive impact on diet component availability levels. Impacts of other socioeconomic variables examined for diet component availability were generally larger than those for program participation and income. Diet component

Table 3.1 continues

	(NFCS-LI). • Two stage estimation using a cost function and nutrients availability (system of equations)	availability levels were relatively constant across households with different income and Food Stamp Program bonus levels.
Beatty and LaFrance/ 2005/ USA	• United states demand for food and nutrition In the twentieth century • Annual time series data on average annual retail U.S. prices 21 foods • Gorman's class of exactly aggregatable demand models	The empirical results suggest that this extension has real economic content and the most commonly used functional forms for both prices and income are strongly rejected for the time series dataset that they employ.
Beatty /2007/ Canada	• Recovering the shadow value of nutrients • Family Food Expenditure Survey- 1996 • Utility theoretic model and maximum entropy principles	He investigated the shadow value of twenty-eight nutrients. However, nutrient intake at FAFH is omitted. No correlations were made with household characteristics.
Blaylock *et al.* /1999/ USA	• Economics, food choices, and nutrition • A non-technical analysis based on the economic concept-	Their goal in this paper is to examine the role and influence of economic factors, defined rather broadly, on consumer food choices, and, hence, nutritional outcomes. They attempt to do this in a non-technical fashion. They examine the role of prices, especially as they

Table 3.1 continues

	trade-off	relate to the affordability of food in the United States and as a policy lever. Income is analyzed as a driving force behind changes in eating habits, in particular increasing the demand for convenience. The role of time constraints as well as time preference are examined as links to healthy eating habits and as forces behind current trends in eating patterns. Information and knowledge are given prominent play as counter balances to economic forces driving eating habits.
Briefel and Johnson/ 2004/ USA	• Secular trends in dietary intake ○ in the united states • National Health and Nutrition Examination Surveys conducted in 1971–74, 1976–80, 1988–94, and 1999–2000 • A review	This review focuses on dietary intake and dietary supplement use among the U.S. population age 1–74. Secular trends in intake of energy, macronutrients, cholesterol, sodium, calcium, iron, folate, zinc, vitamins A and C, fruits, vegetables, and grain products are summarized. During the 30-year period, mean energy intake increased among adults, and changed little among children age 1–19, except for an increase among adolescent females. Factors contributing to increases in energy intake include increases in the percentage of the population eating away from home (particularly at fast-food restaurants), larger portion sizes of foods and beverages, increased consumption of sweetened beverages, changes in snacking habits, and improved dietary methodology. Dietary supplement use increased among adult men and women, decreased among children age 1–5, and were stable for children age 6–11 and adolescents.
Devaney and Fraker/1989/ USA	• The Dietary Impacts of the School Breakfast Program • Twenty-four-hour dietary recall data collected during the 1980-81 school year.	The important finding is that program availability has no significant relationship with the likelihood of eating breakfast, suggesting that a major program policy objective-to provide a breakfast to children who would not otherwise eat one-is not being achieved. Principal findings from the nutrient intake analysis are: (a) calcium intake, both at breakfast and over twenty-four hours, is positively related to program participation; (b) participation in the program is associated with lower intakes of cholesterol, both at breakfast and over twenty-four hours; and

Table 3.1 continues

	• Probit model and Engle function	(c) iron intake at breakfast is negatively related to program participation.
Dhehibi *et al.*/ 2003/ Spain	• Nutrient effects on consumer demand: a panel data approach • Spanish Continuous Household Expenditure Survey • A CBS demand model	They take into account the consumers concern about the relationship between food diet and health. This concern is forcing food demand analysts to assume that consumer utility is a function of nutrients instead of simply the food products themselves. Ten broad categories, nine nutrients and the most relevant socio-economic variables have been considered. Finally, after an appropriate model selection strategy, expenditure, price and nutrient elasticities, as well as main socio-demographic effects, have been calculated.
Drewnowski/ 2003/	• Fat and Sugar: An Economic Analysis • A review	Incomes and the macronutrient composition of the diet are linked at the aggregate and—most likely—the individual level. People in higher income nations consume more added sugars and fats than do people in lower income nations. Lower income consumers within rich nations consume lower-quality diets than do higher income consumers. The lowering of energy costs ($/MJ) through technological innovation has been most marked for foods containing added sugars and fat. Although wealthier persons in poor nations are more likely to be overweight, obesity in the United States is associated with lower incomes. Obesity in the United States and similar societies may be a socioeconomic, as opposed to a medical, problem and one that is related to diet structure and diet costs
Eastwood *et al.*/ 1986/ USA	• Household nutrient demand: use of characteristics theory and a common attribute model • 1977-78 Nationwide Food Consumption Survey • Consumer Good Characteristic Model	Model yielded two-equations: one was a set of hedonic price equations and nutrient demand equations. Imputed prices, income and other household characteristics including location, size, education, age distribution and race affected nutrient demand.

Table 3.1 continues

Fousekis and Lazaridis / 2003/ Greece	• The demand for selected nutrients by Greek households: an empirical analysis with quantile regression. • Household Consumption Survey Greece:1993-1994 • Quantile regression model	According to their empirical results the age of the household head, the degree of urbanization, the percentage of food expenditure devoted to food away-from-home, and the per capita consumption expenditure affect the intakes of nutrients across all the five quantiles considered. The impact, however, of the household head's gender and the impact of his (her) educational achievement are located only at the lower and the higher quantiles, respectively. The expenditure elasticities are substantially lower than unity, suggesting inelastic responses of nutrient intakes to per capita consumption expenditure
Huang and Lin/ 2000/ USA	• Estimation of food demand and nutrient elasticities from household survey data. • 1987-88 Nationwide Food Consumption Survey data. • AIDS model	The empirical results are sets of estimated demand elasticities for households segmented with different income levels. In addition, we apply these demand elasticities to estimate the implied nutrient elasticities for low-income households. The estimation results are useful in evaluating some food policy and program effects related to households of a specific income level.
Nayga /1994/ USA	• Effects of Socioeconomic and demographic Factors on consumption of selected food nutrients • 1987–88 Nationwide Food Consumption Survey (NFCS). • Engle function based nutrient demand function	The effects of socioeconomic and demographic factors on the consumption of food energy, protein, vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, phosphorus, and iron are examined. Socioeconomic and demographic factors analyzed are urbanization, region, race, ethnicity, sex, employment status, food stamp participation, household size, weight, height, age, and income. Several of these factors significantly affect consumption of certain nutrients. Income is an important factor affecting the consumption of vitamin A, vitamin C, and calcium. Income elasticities are relatively small at low income levels. For example, income elasticities range from 0.016 for calcium to 0.123 for vitamin C at an income level of $20,000.
Nayga *et al.* /1999/ USA	• Assessing the importance of health and nutrition related	The importance of health/nutrition related factors and demographics on food consumption is assessed based on consumer demand using a variable preferences approach. Results of the models show that diet-

Table 3.1 continues

	factors on food demand: a variable preference investigation • 1994 Continuing Survey of Food Intakes By Individuals (CSFII) and Diet Health Knowledge Survey (DHKS) • Heckman's two step procedure	disease, individual' s race, region of residence, urbanization, education, and perceived importance of taste influence the consumption of various food groups. Economic and policy implications of the results are discussed in the paper
Nestle/ 2002/ USA	• Food Politics: How the Food Industry Influences Nutrition and Health	This book sets out to describe and explain how the powerful vested interests of food industry influence nutrition and health—often to the detriment of public health interests.
Park and Davis/ 2001/ USA	• The Theory and Econometrics of Health Information in Cross-Sectional Nutrient Demand Analysis	Endogeneity and measurement error are two empirical problems that are inherent in this type of analysis. While some type of instrumental variables estimation would appear the obvious solution, this article provides several theoretical and empirical reasons why this is not the case in cross-sectional analysis. An alternative estimation strategy is pursued, an empirical example is given, and the implications are discussed.
Popkin/ 2006/	• Global nutrition dynamics: the world is shifting rapidly toward a diet linked with non-communicable diseases • A commentary	Dietary changes appear to be shifting universally toward a diet dominated by higher intakes of animal and partially hydrogenated fats and lower intakes of fibre. Activity patterns at work, at leisure, during travel, and in the home are equally shifting rapidly toward reduced energy expenditure. Large-scale decreases in food prices (eg, beef prices) have increased access to supermarkets, and the urbanization of both urban and rural areas is a key underlying factor. Limited documentation of the extent of the increased effects of the fast food and bottled soft drink industries on this nutrition shift is available, but some examples of the heterogeneity of the underlying changes are presented.

Table 3.1 continues

Ramezani/ 1995/USA	• Determinants of Nutrient Demand: A nonparametric Analysis • Nationwide Food Consumption Survey (NFCS 1987-88) • AVAS, nonparametric methods	The influence of socioeconomic variables on nutrient intake is studied using nonparametric procedures that admit estimation of multivariate functions. The analysis indicates a nonlinear relation between intake, age, education, and income. Specifically, intake rises with income reaching an inflection point beyond which it is essentially flat. Socioeconomic variables influence intake primarily at lower-income levels. Nonparametric procedures prove useful in avoiding ad hoc specifications that would fail to uncover these findings.
Richards *et al.* / 2007/ USA	• Obesity and Nutrient Consumption: A Rational Addiction? • AC Neilson home scan data- 1998 to 2001 • A random coefficients (mixed) logit model	This study tests for an addiction to food nutrients as a potential explanation for the apparent excessive consumption. A random coefficients (mixed) logit model is used to test a multivariate rational addiction model. The results reveal a particularly strong addiction to carbohydrates. The implication of this finding is that price-based policies, sin taxes, or produce subsidies that change the expected future costs and benefits of consuming carbohydrate intensive foods may be effective in controlling excessive nutrient intake
Subramanian and Deaton / 1996/India	• The Demand for Food and Calories • National Sample Survey (NSS)-1983 for rural households in Maharashtra state in (south) western India. • A log linear regression function	They estimate that the elasticity of calorie consumption with respect to total expenditure is 0.3-0.5, a range that is in accord with conventional wisdom. The elasticity declines only slowly with levels of living and is far from the value of zero suggested by a recent revisionist literature. In these Indian data, the calories necessary for a day's activity cost less than 5 percent of the daily wage, which makes it implausible that income is constrained by nutrition rather than the other way around.

Table 3.1 continues

Variyam *et al.* /2002/ USA	• Characterizing the distribution of macronutrient intake among US adults: a quantile regression approach • Intake data for two non-consecutive days through in-person interviews using 24-hour recall-USDA , CFSII data 9!994-1996) • Quantile regression approach	Quantile regression results suggest that age, education, and income have a larger influence at intake levels where the risk of excess is greater compared with intake levels where the risk of excess is lower.

Table 3- 2 : Nutrients and Food Away From Home

Author /Year/Country	Study/Data/Model	Main Findings
Baric *et al.* / 2003/ Croacia	• Nutritive value of meals, dietary habits and nutritive status in Croatian university students according to gender • Survey-self administered questionnaire	Evaluated daily menus at students' restaurants and reported dietary habits and other health-related behaviour of Croatian university students (n_/2075) according to gender. One hundred and twenty daily menus were chosen by random sampling, and the nutritive value was calculated using food composition tables. Daily menus on average provide an adequate amount of energy, protein and most micronutrients: 88.2% of daily menus provide a balanced intake of protein, fat and carbohydrates, 22.5% of daily menus provide more than 300 mg of cholesterol, and 58.8% have more than 25 g dietary fibre.

Binkley / 2008/ USA	• Calorie and Gram Differences • between Meals at Fast Food and Table Service Restaurants • 1994–96 Continuing Survey of Food Intakes by Individuals (CSFII)	He found that there is no specific evidence that fast food is worse than other food eaten away from home (FAFH). He used the Continuing Survey of Individual Food Intake to compare fast food and table service meals. He found that both are larger and have more calories than meals prepared at home, with table service exceeding fast food, possibly due to different pricing methods. However, for the full day, both result in similar calorie increases relative to no FAFH, with fast food perhaps somewhat worse.
Bowman *et al.*/ 2004/ USA	• Effects of Fast-Food Consumption on Energy Intake and Diet Quality • Among Children in a National Household Survey	Children who ate fast food, compared with those who did not, consumed more total energy more energy per gram of food, more total fat , more total carbohydrate, more added sugars, more sugar-sweetened beverages , less fibre , less milk , and fewer fruits and non-starchy vegetables.
Fitzpatrick *et al.* /1997/ Canada	• Lower-fat menu items in restaurants satisfy customers • Questionnaire and interview	Evaluated a restaurant based nutrition program by measuring customer satisfaction with lower fat menu items. They found that higher satisfaction with lower-fat menus.
Lin *et al.*/ 2000/ USA	• Nutrition Contribution of FAFH • 1977-78 and 1987-88 National Food Consumption Survey & Nationwide food intake studies • Nutrient content analysis	Found that over the years FAFH showed smaller nutritional improvements than food at home. FAFH generally contain more of the nutrients over consumed and less of the nutrients under consumed in the U.S.
Nayga and Capps/ 1994/ USA	• Analysis of Away-from-Home and At-Home Intake of Saturated Fat and Cholesterol • 1987–88 Nationwide Food Consumption Survey (NFCS). • Engle function based nutrient demand function	This article examines the impact of socio-economic and demographic factors on individual intake of saturated fat and cholesterol from away-from-home and at- home markets. Factors that significantly affect saturated fat intake in both away from home and at home markets are urbanization, region, race, diet status, age, and income. Urbanization, race, ethnicity, sex, household size, age, date of consumption, and income affect cholesterol intake at home

Table 3.2 continues

Paeratakul *et al.*/ 2003/USA	• Fast-food consumption among US adults and children: Dietary and nutrient intake profile • 1994-1996 and 1998 Continuing Survey of Food Intakes by Individuals. • A comparison of dietary intake: individuals who reported eating fast food on one or both survey days was compared with those who did not report eating fast food	Adults and children who reported eating fast food had higher intake of energy, fat, saturated fat, sodium, carbonated soft drink, and lower intake of vitamins A and C, milk, fruits and vegetables than those who did not reported eating fast food
Variyam /2004/ USA	• Nutrition Labelling in the Food-Away-From-Home Sector: An Economic Assessment • A descriptive analysis	Because consumers are less likely to be aware of the ingredients and nutrient content of away-from-home food than of foods prepared at home, public health advocates have called for mandatory nutrition labelling for major sources of food-away-from-home, such as fast-food and chain restaurants. This report provides an economic assessment of a food-away-from-home nutrition labelling policy, including justifications for policy intervention and potential costs and benefits of the policy.

3.6. Data

This study used a data set on Canadians' food away from home food consumption from the year 2001 to 2006 obtained from NPD Group Inc., Consumer Reports on Eating Share Trends (CREST) database. Based on a voluntary program starting in 2005 (CRFA 2005), nutrition information is supposed to be available for all chain restaurants in Canada. As a part of this study collection of a significant amount of nutritional fact information by Canadian restaurants over the past four years (2006 to 2009) has been undertaken and this has revealed that nutrition information is available for a majority of large chain restaurants in Canada. In the CREST data set, despite approximately equal levels of annual average spending by households on chain and non-chains over the sample period (about $110 to $125), the annual percentage of total purchase occasions are higher for chain than for non-chain restaurants (63% for chain restaurants and 37% for non chain restaurants). Therefore, given that Canadian households have access to nutrition information only at chain restaurants and the fact that high frequency of purchases are from chain restaurants, the focus of this study is on chain restaurants. The data set contains a variety of information on each household's socio-demographics, total expenditure on each purchase occasion, the type of the restaurant visited and its name and food speciality, and detailed information on the meal and beverage items purchased (NPD Group Inc. 2007).

The collection of nutrition fact information from restaurants in Canada revealed that number of restaurants that provided nutrition information increased from 22 in 2006 to about 70 in 2009. In 2009, about 50% of the restaurants have provided information on all 14 nutrients which are required in nutrition facts panels for processed food products in Canada (Health Canada 2008).

Focusing on households who consistently report their visits to chain restaurants yearly from January 2001 to December 2006, a sample of 1202 households was selected. To understand the representativeness of this sample as compared to that

of Canadian population, descriptive statistics for the sample of 1202 households in year 2001 are given in Table 3.3 with a comparison to 2001 census data and also to the entire NPD CREST data set in 2001.

Table 3- 3 : Descriptive Statistics of the Sample, Compared to Census and Whole NPD CREST Data Set in Year 2001

Variable definition	*Census (30,007,094)*	*NPD CREST data set (5478 households)*	*Study sample (1202) households)*
	Mean values of categories and ratios of sub groups		
Annual income of household (Canadian $)	**55016.00**	**45161.00**	**45653.00**
Low income (under $30,000)	0.58	0.30	0.30
Middle income ($30,000 to $60,000)	0.27	0.38	0.40
High income (more than $60,000)	0.15	0.32	0.30
Age of household head	**37.60**	**49.65**	**53.00**
Under 15	0.20	0.00	0.00
15 years to 44yearss	0.43	0.41	0.25
45 years to 65 years	0.24	0.38	0.45
above 65 years	0.13	0.21	0.30
Education			
Junior high or less	0.10	0.08	0.02
Senior high, college certificate diploma	0.66	0.72	0.71
University degree	0.24	0.20	0.27
Region			
British Columbia /West Coast	0.13	0.19	0.19
Alberta	0.11	0.12	0.13
Saskatchewan — *Prairie Provinces*	0.03 — 0.18	0.06 — 0.23	0.06 — 0.25
Manitoba	0.04	0.05	0.06
Ontario (+ HULL, PQ)	0.38	0.30	0.30
Quebec(- HULL, PQ)	0.24	0.17	0.15
New Brunswick	0.02	0.05	0.05
Prince Edward Island	0.004	0.003	0.004
Nova Scotia — *Atlantic Provinces*	0.03 — 0.074	0.05 — 0.113	0.06 — 0.119
Newfoundland	0.02	0.01	0.005
Household composition			
Households with children		0.32	0.20
Households without children		0.68	0.80
Total annual expenditure on FAFH		$124.20	$257.83

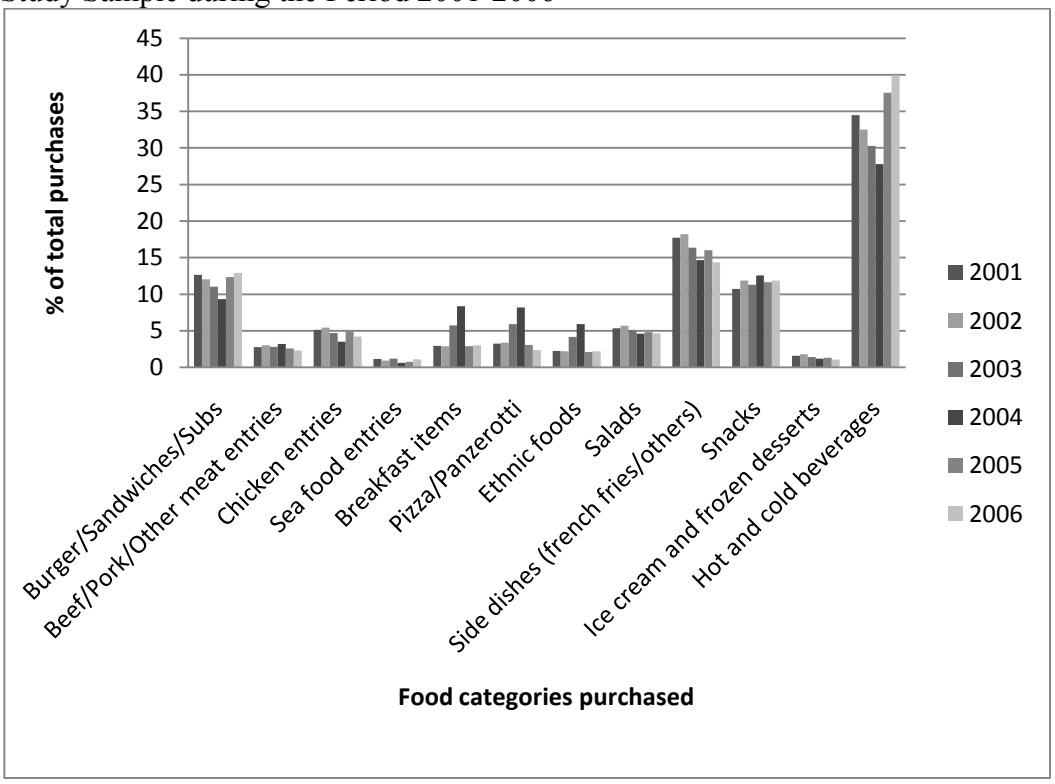
Source; Canadian Census 2001, Statistics Canada 2002, NPD CREST data 2001-2007

As compared to Census data and NPD data, the study sample can generally be considered to be a representative sample of the NPD data set and the Canadian population, with some variations. One variation is that annual average household income of the study sample is lower than the Census data but higher than the NPD

sample data. In addition, the representation of low-income households is low in both the NPD sample and the study sample as compared to Census data while the representation of middle-income households is higher in both the NPD sample and the study sample. The average age of the household head is higher in the study sample, with no representatives from the age group below 15 years. Representation from the educational sub- groups and the regional sub groups are more or less similar in all three data sets. The regional representations are more or less similar across three groups of data, except the fact that representation from Newfoundland is lower than the Census data and the NPD data. Comparisons of household composition and the average FAFH expenses were made only between the NPD data set. The proportion of households with children is lower in the study sample while average spending on FAFH is higher in the study sample. However, as the study sample is generally representative of Canadian population, the study results can be extrapolated. However, it should be noted that overly broad generalizations can be misleading when applied to populations that were not well represented by a sample. For an example, there could be response biases introduced by the persistent participants in longer panel data samples such as NPD sample.

Different categories of food items purchased from chain restaurants by the sample households over the six year period are presented in Figure 1. Hot and cold beverages were the most purchased category. Side dishes were the second most purchased category. Hamburger/Sandwiches/Subs category and snack food category purchases are in the range of 10% to 13% of the total purchases, but with some yearly variations. Chicken entries and Salad categories also show similar level of purchases (about 5% of the purchases in each year). Breakfast, Pizza/Panzerotti and Ethnic foods show similar patterns of purchases where purchases increased towards 2004 and decreased towards 2006. Seafood entries and ice cream and frozen dessert categories are the least purchased categories.

Figure 3- 1: Food and Beverage Items Purchased by the 1202 Households in the Study Sample during the Period 2001-2006



Source: Compiled with study sample data- NPD CREST data

The most purchased food or beverage item for each of the above categories are identified as follows:

Burger/Sandwiches/Subs - Hamburger

Beef/Pork/Other meat entries – Steak

Chicken entries – Fried chicken

Seafood entries – Fried fish

Breakfast items – Egg based breakfast sandwiches

Pizza/Panzerotti – Regular Pizza

Ethnic foods- Chinese

Salads – Coleslaw side dish size

Side dishes – French fries

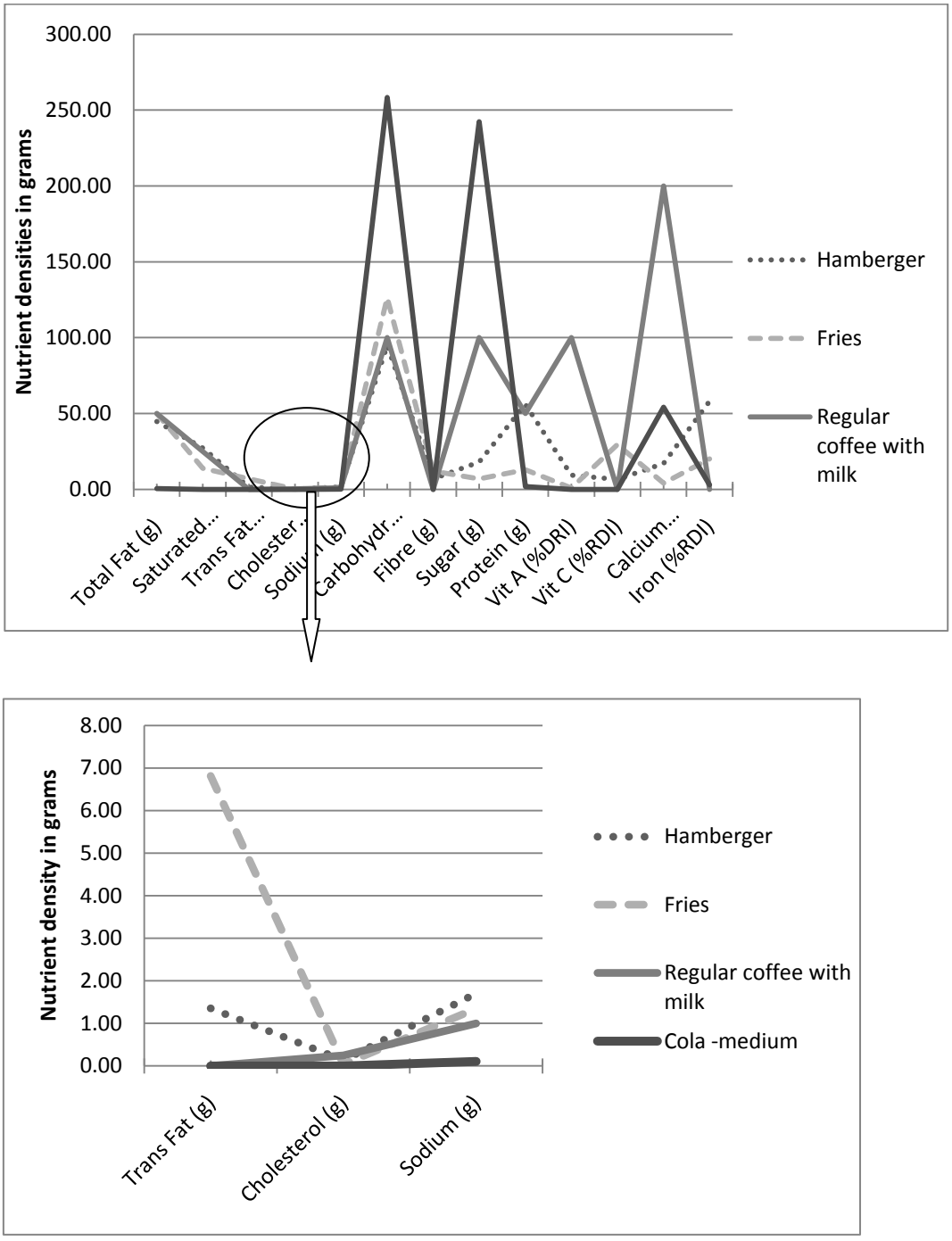
Snacks – Donuts

Ice cream and frozen desserts – Soft cones

Hot and cold beverage – Regular coffee with milk

To create nutrition data, first, all of the foods and beverage items purchased by households in the sample from various chain restaurants for the selected period were identified. Second, the nutrient composition of each identified meal and beverage item was obtained from the restaurants' nutrition data collected by the authors and for items not identified by specific restaurants, average data were obtained from USDA National Nutrition Data base (USDA 2007). The USDA data base was used as a representation when no restaurant specific data is available. In the data set containing sample household's FAFH purchases, there are 120 food and beverage items. The restaurant specific nutrition data were not available for 30 food and beverage items (about 25% of the items).Third, nutrient density, which measures the amount of a nutrient for each 1000 calories, provided by each meal or beverage item was calculated and matched with the meal and beverage item purchases by the identified households. Finally, annual aggregate nutrient densities (for 13 nutrients) were calculated for each household in the sample and were used in the nutrient demand estimations. A nutrition profile of the most demanded food and beverage products: hamburger, French fries, regular coffee with milk and cola beverage -medium is provided in Figure 3.2.

Figure 3- 2: Nutrient Densities of Selected Popular Food and Beverage Items in FAFH



Source: Nutrient density calculated by author

The above figures on the nutrition profiles illustrate that out of the most popular food and beverage items, cola beverages contain the highest density levels for carbohydrates, sugars and calcium. In terms of trans-fat densities, french fries contain the highest density followed by hamburgers.

3.7. Empirical Model Specification

The objective of this study is to estimate the demand for nutrients in chain restaurants in the FAFH market and to identify socio-demographic characteristics affecting this demand using panel data. Among the available methodological approaches, the methods described in the 'indirect methods' (see section 3.3.1.2) of nutrient demand analysis and in the 'other methods' (see section 3.3.1.3) of nutrient demand analysis require food quantity, food prices or both quantity and prices. In FAFH, there is a large variety of food choices and available household level data do not provide individual item prices. Our data only contain total expenditure for a meal occasion. Given that the application of methods described in section 3.3.1.2 and section 3.3.1.3 in this analysis is not possible. However, the 'direct methods' (see section 4.3.1.1) for nutrient demand are possible in this study context. Therefore, to achieve the study objective, a simple structural equation based on an Engel curve, as used by Devaney and Fraker (1989), Nayga (1994), Nayga and Capps (1994) is used with the following derivation:

maximizing a consumer's utility subject to a budget constraint will lead to demand functions for commodities:

$$q_j = g_j(y, p), \qquad (1)$$

where q_j denotes the quantity of a good j, y denotes income and p is a price vector for all relevant goods. By extending this model to examine the demand for nutrients, the intake of nutrient *k* is given by:

$$N_k = \sum_j a_{kj} q_j \qquad (2)$$

where a_{kj} denotes the amount of nutrient k contained in each unit of commodity q_j (Devaney and Fraker 1989). Substituting equation (1) into equation (2) leads to demand functions for nutrients of the following form:

$$N_k = f_j(y, p) \quad (3)$$

Assuming that households face identical prices so that explanation of behavioural differences is sought through differences in total expenditure and household characteristics, linear regression equations of the following form can be specified for each of the k nutrients:

$$N_{ki} = h_{ki}(y_i, S) \quad (4)$$

where N_{ki} corresponds to the intake of nutrient k by household i (in this study aggregate nutrient density)*; y,* corresponds to the income level of household *i*; and *S* is a vector representing various socio-demographic and economic factors that may affect nutrient intake.

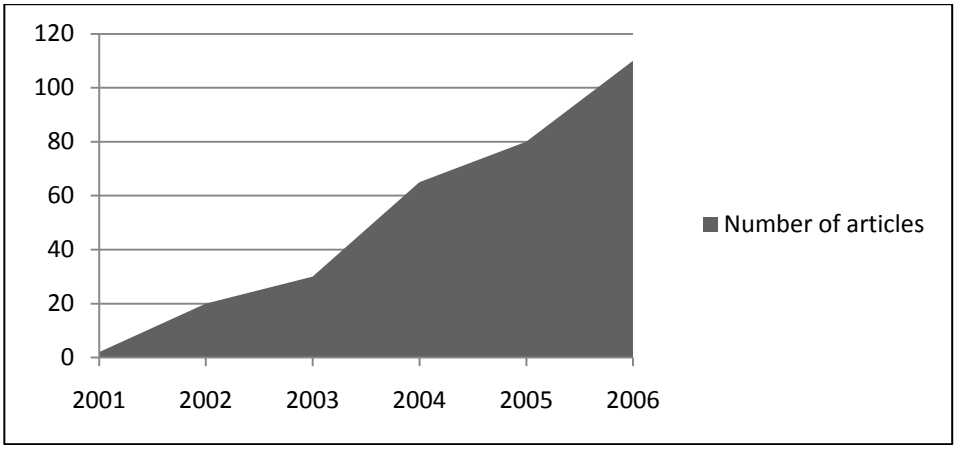
This theoretical model suggests the estimation of the following model;

$$N_{ht} = f(TEC_{ht}, TENC_{ht}, N_{ht-1}, AD_t, HHA_{ht}, HHI_{ht}, HHED_{ht}, HHC_{ht}, HFL_{ht}, RD_{ht}, T_t, MI_t) \quad (5)$$

where N_{ht} is the annual aggregated nutrient density of h^{th} household in time t, TEC_{ht} is the total expenditure on chain restaurants by household h at time t; $TENC_{ht}$ is the expenditure on non-chain restaurants by household h at time t; N_{ht-1} is the lagged nutrient density of h^{th} household in time *t; AD* is the total advertising expenditure by chain restaurants in year *t;*HHA_{ht} is household head's age; HHI ht is the household income; $HHED_{ht}$ is the household head's education (to capture the effect of nutrition knowledge) ; HHC_{ht} is the household composition; HFL_{ht} is the household's first language (to capture the effect of ethnic diversity); and RD_{ht} is the households region of living: ten Canadian

regions were categorized into five regions- West Coast, Prairie provinces, Ontario, Quebec and Atlantic Provinces. The equation (5) is specified for thirteen (the fourteenth; calories are not included as nutrient density measure calculations are based on calories) nutrients which are encouraged for use in nutrition facts tables in restaurants and food services in Canada (Health Canada 2008). The thirteen nutrients are: Total Fat, Saturated Fat, Trans Fat, Cholesterol, Sodium, Carbohydrate, Fibre, Sugar, Protein, Vitamin A, Vitamin C, Calcium and Iron. In order to find out the effect of the agreement between Canadian Restaurants and Foodservice Association and the government to provide voluntary nutrition information, a dummy variable for the year 2005 was added to the model (*T5*). The model was also extended to include a media index (*MI*) to test the hypothesis that information on nutrition quality of FAFH: trans fatty acids, sodium, fat and so on, may have impacted the types of food consumers would purchase in this market. To construct a media variable, the Factiva data base was used to search the Canadian newspaper Globe and Mail. Using key word "nutrition" and selecting 'food/beverage/tobacco' and 'hotels/restaurants/casino' as industries, newspaper articles for the 6 years period were searched. The Canadian newspaper Globe and Mail was used as this is the Canada's largest circulation national newspaper with a weekly readership of 935,000 among English speakers (National Audience Databank Survey 2008). The media variable was constructed using the number of articles found containing the key words (Figure 3). However, it should be noted that media index construction using French newspapers may have been different.

Figure 3-3: Number of Articles Containing the Word 'Nutrition' in 'Food/Beverage/Tobacco' and 'Hotels/Restaurants/Casino' Industries Related News



Source: Factive data base

According to Figure 3, in selected industries, one can see an increasing number of articles containing the word ‘nutrition’ over the years. This may be an indication that people are having access to more and more information on restaurant food nutrition.

In this study, one objective is to identify whether there are habit forming preferences for selected nutrients. To analyse that, a lagged dependent variable was introduced into the model. However, the introduction of a lagged dependent variable into the model potentially creates biases in model estimation due to autocorrelation (Baltagi 2005).The standard approach to use is instrumental variable estimation. In a panel data context, a dynamic panel data model introduced by Arellano and Bond (1991) and Arellano and Bover (1995) (hereafter AB) is commonly used. The AB method can handle many econometric problems that may arise in these model estimations. Other than the lagged dependent variable which gives rise to autocorrelation, the time –invariant characteristics such as demographics and geography (fixed effects) may be correlated with explanatory variables. The short time dimension in the panel also may contribute to biases in estimation.

The AB method is a generalized method of moments (GMM) using two types of instruments: lagged levels of endogenous variables for the equation in first differences, and lagged first differences of endogenous variables for the equation in levels. In the AB models it is assumed that the endogenous variables have a constant correlation with the household specific effects. According to Browning and Collado (2007), this assumption allows the validity of AB models is to be tested with a Sargan test (Sargan 1958). This method can be applied to above equations (5) specified for each nutrient. Descriptive statistics of the data sample are given in Table 3.4.

Table 3-4: Descriptive Statistics of the Study Sample

Variable definition	***Variable name and sub-groups***	***Mean 2001***	***Mean 2002***	***Mean 2003***	***Mean 2004***	***Mean 2005***	***Mean 2006***
Dependent variables							
Nutrient Density							
Total Fat	**TF(g)**	40.38	39.69	40.99	40.18	41.88	41.12
Saturated Fat	**SF(g)**	14.92	14.63	14.85	14.24	14.96	15.21
Trans Fat	**TRF(g)**	2.00	1.98	2.02	1.99	2.26	1.96
Cholesterol	**CHL(mg)**	171.27	170.34	182.94	184.62	176.34	183.92
Sodium	**SOD (mg)**	1697.29	1711.00	1778.11	1716.52	1813.36	1825.03
Carbohydrate	**CARB (g)**	125.01	126.28	122.60	125.09	120.20	120.06
Fibre	**FIB (g)**	6.83	6.88	6.90	7.44	7.49	6.92
Sugar	**SUG (g)**	51.52	52.25	48.45	47.98	33.94	33.85
Protein	**PRO(g)**	36.20	36.15	37.34	35.71	37.25	39.55
Vitamin A	**VITA (mcg)**	4976.94	7615.65	5492.38	5124.08	4281.20	4632.00
Vitamin C	**VITC(mg)**	55.88	62.25	58.51	62.31	59.68	56.79
Calcium	**CAL (mg)**	620.69	621.57	621.33	636.07	606.74	636.11
Iron	**IRN(mg)**	3.02	2.94	2.99	3.19	3.10	3.12
Independent variables							
Expenditure on chain restaurants	EXC ($)	109.67	119.67	121.45	115.27	116.46	114.84
Expenditure on non-chain restaurants	EXNC ($)	110.56	116.57	115.71	121.33	125.88	232.74
Restaurants' advertising Expenditure (million $)	AD ($)	0.22	0.22	0.23	0.26	0.28	0.30
Annual income of household	HHI ($)	45653.62	45693.17	45326.81	45995.00	47458.36	46280.00
Age of household head	HHA	53	54	55	56	57	58
Region	**RD**						
West Coast=1, otherwise=0	RD1	0.19	0.19	0.19	0.19	0.19	0.19
Prairie Provinces=1, otherwise=0	RD2	0.25	0.25	0.25	0.25	0.25	0.25

Ontario=1,otherwise=0	RD3	0.30	0.30	0.30	0.30	0.30	0.30
Quebec=1, otherwise=0	RD4	0.15	0.15	0.15	0.15	0.15	0.15
Atlantic Provinces=1, otherwise=0	RD5	0.11	0.11	0.11	0.11	0.11	0.11
Household composition	**HHC**						
Households without children	0	0.23	0.22	0.21	0.21	0.20	0.20
Households with children (<12 yrs)	1						
Household's first language	**HFL**						
English=1; otherwise=0	HFL1	0.73	0.73	0.73	0.73	0.73	0.73
French=1; otherwise=0	HFL2	0.16	0.16	0.16	0.16	0.16	0.16
Chinese=1;otherwise=0	HFL3	0.01	0.01	0.01	0.01	0.01	0.01
Other=1;otherwise=0	HFL4	0.09	0.09	0.09	0.09	0.09	0.09

Source: Study sample

According to Table 3-4, there are no clear trends in mean values of the nutrient densities for any nutrients over the years. Similarly, mean expenditure on chain and non-chain restaurants also do not have clear trends. However, restaurant advertising (one period lag per capita advertising) has been increasing over the years in the sample. Table 2 also provides mean values of household income, age of household head, provincial and ethnic representation of the sample.

3.8. Results and Discussion

The AB models were estimated for the thirteen nutrients identified. According to the Sargan test statistics, the set of instruments used in the AB models for each nutrient was not rejected. Therefore, model estimations could be considered as valid. AB model estimations are provided in Table 3.

Table 3-5: AB Model Estimations for Thirteen Nutrients

	Total Fat	Saturated Fat	Trans Fat	Cholesterol	Sodium	Carbohydrate	Fibre	Sugar	Protein	Vit A	Vit C	Calcium	Iron
Constant	**42.709*** (4.538)**	**8.135*** (0.006)**	**2.335*** (0.050)**	**325.509*** (68.686)**	**1694.33** (306.936)**	**145.752*** (18.780)**	**11.817*** (1.810)**	**112.436*** (17.945)**	**23.115*** (5.043)**	**3184.9*** (1136.66)**	**148.52*** (36.017)**	**866.91*** (318.46)**	**4.178*** (0.704)**
Lagged nutrient density	-0.084 (0.099)	-0.054 (0.113)	-0.068 (0.091)	-0.145 (0.111)	-0.086 (0.115)	-0.069 (0.107)	-0.006 (0.106)	-0.011 (0.109)	-0.109 (0.103)	**0.195* (0.113)**	-0.066 (0.098)	**-0.286*** (0.129)**	-0.154 (0.107)
Expenditure on chain restaurants	0.197 (0.123)	0.064 (0.62)	0.010 (0.017)	0.284 (1.994)	-0.801 (8.011)	0.449 (0.348)	-0.021 (0.044)	0.192 (0.387)	-0.100 (0.154)	-153.513 (314.947)	0.559 (1.092)	-5.011 (10.076)	-0.017 (0.018)
Expenditure on non-chain restaurants	-0.146 (0.091)	-0.024 (0.047)	0.009 (0.013)	-1.318 (1.450)	-3.267 (6.065)	0.127 (0.259)	**-0.063* (0.033)**	0.079 (0.296)	0.063 (0.116)	293.006 (239.854)	0.466 (0.834)	-3.204 (7.759)	-0.005 (0.014)
Restaurants' advertising expenditure	**13.540*** (4.138)**	**38.978*** (9.822)**	-0.410 (2.417)	-385.710 (262.449)	865.935 (1083.26)	**-81.097* (48.670)**	**-24.804*** (6.472)**	**-301.231*** (63.138)**	**92.444*** (23.243)**	**-1622.44*** (493.80)**	**-423.026*** (153.29)**	-175.90 (1379.53)	-1.886 (2.592)
Annual income of household	0.0005 (0.0008)	**0.0008* (0.0004)**	-0.0001 (0.0001)	**0.032** (0.013)**	0.004 (0.055)	-0.002 (0.002)	-0.0004 (0.0003)	-0.001 (0.002)	**0.003*** (0.001)**	**-4.231* (2.190)**	-0.002 (0.007)	0.041 (0.072)	0.0001 (0.0001)
Age of household head	-0.078 (0.015)	-0.001 (0.007)	0.0008 (0.001)	**-0.508** (0.213)**	-0.021 (0.885)	0.056 (0.038)	-0.002 (0.004)	**0.088* (0.043)**	**-0.040** (0.017)**	15.095 (35.990)	-0.132 (0.122)	0.697 (1.123)	**-0.006*** (0.002)**
Education level of household head	-0.284 (0.481)	-0.257 (0.249)	0.069 (0.070)	-10.793 (7.760)	-20.766 (31.367)	0.981 (1.352)	0.229 (0.173)	1.359 (1.536)	-0.520 (0.605)	**2150.67* (1245.044)**	4.570 (4.302)	-11.265 (40.132)	-0.054 (0.074)
Region													
West Coast	**-1.369* (0.782)**	**-0.764* (0.406)**	-0.008 (0.114)	-4.029 (12.325)	9.749 (51.485)	1.265 (2.202)	0.308 (0.285)	-2.093 (2.536)	-0.131 (0.993)	**4417.22** (2022.49)**	4.028 (7.074)	-61.066 (65.528)	0.123 (0.123)
Prairie Provinces	**-1.694** (0.714)**	-0.576 (0.386)	0.012 (0.109)	-10.100 (11.656)	43.324 (49.164)	2.924 (2.082)	0.400 (0.273)	-2.503 (2.460)	-0.128 (0.933)	**4319.34** (1915.04)**	0.936 (6.657)	-22.163 (62.551)	0.160 (0.117)
Ontario	-1.071 (0.725)	-0.346 (0.376)	0.091 (0.106)	-8.936 (11.404)	53.190 (48.529)	0.856 (2.037)	0.301 (0.266)	-3.294 (2.398)	0.207 (0.916)	**4043.24** (1868.72)**	2.228 (6.536)	**-103.55* (60.704)**	0.128 (0.114)
Quebec	**-1.924* (0.993)**	-0.371 (0.517)	0.023 (0.**145**)	**-40.254** (15.839)**	1.514 (65.148)	**5.402* (2.810)**	0.075 (0.106)	-0.920 (3.177)	**-2.103* (1.254)**	2264.29 (2557.10)	-5.701 (8.913)	-48.986 (82.377)	-0.154 (0.155)
Atlantic Provinces	Reference Group												
Household composition	-0.818 (0.702)	-0.157 (0.363)	0.039 (0.102)	-16.397 (11.042)	0.310 (46.023)	2.328 (1.989)	-0.046 (0.257)	1.803 (2.252)	**-1.784** (0.888)**	-374.93 (1849.53)	-7.217 (6.306)	83.365 (58.438)	**-0.195* (0.109)**

Household's first language													
English							Reference Group						
French	0.040	-0.271	0.00009	**34.573*** **	-36.878	-0.545	-0.165	1.910	1.272	1249.62	12.060	-24.016	0.113
	(0.830)	(0.428)	(0.121)	**(13.093)**	(55.271)	(2.334)	(0.301)	(2.707)	(1.048)	(2157.41)	(7.464)	(69.313)	(0.130)
Chinese	0.020	-1.004	0.148	-20.787	40.672	5.852	**1.435***	-5.036	**-9.409*** **	654.13	13.748	-188.11	-0.202
	(2.073)	(1.070)	(0.301)	(32.440)	(135.323)	(5.830)	**(0.753)**	(6.618)	**(2.600)**	(5326.05)	(18.660)	(171.94)	(0.324)
Other	**1.618****	0.237	0.080	**22.507***	28.971	**-3.747***	-0.024	-2.578	0.635	-50.96	-3.981	**-110.43***	0.089
	(0.763)	(0.394)	(0.111)	**(11.979)**	(50.037)	**(2.141)**	(0.280)	(2.452)	(0.961)	(2014.96)	(6.880)	**(63.470)**	(0.119)
Nutrition information availability (dummy variable)	**1.285*** **	**-0.361****	**0.332*** **	**-8.765***	**36.513***	**-1.600***	**0.550*** **	**-5.764*** **	**-1.372*** **	**1962.15****	2.793	**-42.308***	**-0.051***
	(0.307)	**(0.156)**	**(0.046)**	**(4.646)**	**(19.445)**	**(0.835)**	**(0.121)**	**(1.138)**	**(0.390)**	**(817.74)**	(2.656)	**(25.049)**	**(0.045)**
Media Index	-0.0006	**-0.023*** **	-0.0004	**0.457****	0.448	0.002	**0.018*** **	0.035	**-0.031****	**68.64****	**0.266****	0.451	**0.003***
	(0.011)	**(0.006)**	(0.001)	**(0.185)**	(0.764)	(0.033)	**(0.004)**	(0.037)	**(0.015)**	**(31.700)**	**(0.107)**	(0.965)	**(0.001)**
Income elasticities													
Short tem	0.57	2.45	-2.24	8.53	0.11	-0.73	-2.67	-0.89	3.78	-38.81	-1.63	3.02	1.51
Long term	0.57	2.49	-2.26	8.27	0.10	-0.75	-2.60	-1.03	3.73	-36.41	-1.56	3.03	1.51
Expenditure elasticities													
Short term	0.54	0.47	0.55	0.18	-0.05	0.39	-0.34	0.41	-0.30	-3.38	1.10	-0.89	-0.62
Long term	0.56	0.50	0.57	0.19	-0.05	0.42	-0.34	0.50	-0.31	-3.33	1.10	-0.93	-0.65
Sarg. test	31.87	128.00	95.84	142.34	267.35	8.86	667.89	203.84	64.63	13.27	171.00	88.22	99.91
d.f	87	87	87	87	87	87	87	87	87	87	87	87	87
***p*-value**	0.9921	0.4321	0.2572	0.0010	0.9843	0.9954	0.0031	0.9971	0.9987	0.9992	0.0023	0.4478	0.1628

Source: Model estimations

In spite of no a priori expectations of the patterns of demand for the nutrients in chain restaurants, depending on the analysis of purchase patterns and the analysis of nutrient densities of the purchased food items, the model estimations can be considered acceptable.

Expenditure at chain restaurants and non-chain restaurants does not affect the household consumption or intake of selected nutrients significantly. However, it is interesting to see that for households who spend significantly more on non- chain restaurants, the fibre density of food and beverages purchased from chain restaurants is significantly low (about 6% lower than non-chain restaurants). Annual household income has a significant positive effect on saturated fat, cholesterol, and protein intake), and has a significant negative effect on vitamin A intake from the chain restaurants. The model estimates suggest that the older the household head the higher the intake of sugar (8.8%). An increase in sugar intake could be attributed to the highly demanded beverage categories such as cola soft drinks and coffee with milk. Cholesterol, and iron intakes are significantly lower as household head becomes older.

It was expected that as the level of education of the household head increases, the intake of unhealthy nutrients should decrease and the intake of healthy nutrients should increase. However, for all the nutrients, with the exception of vitamin A, this relationship is not significant in our model. The higher the level of education of the household head the higher the intake of Vitamin A. Bowman *et al.* (2004) found that children who consume FAFH have higher intakes of unhealthy nutrients than the children who do not eat FAFH. In addition to that study, there are concerns that sugary drinks and fast foods containing trans fat adversely affect children's nutrient intake. However, according to our results, there is a significantly lower intake of vitamin A and iron by households with children. Even though the trans fat, sodium, carbohydrate and sugar intakes show positive impacts, these estimates are not significant in this analysis**.**

Differences in nutrient intake among different ethnic categories were tested using the household's first language as a variable. English speaking households were considered to be the reference group. As compared to English speaking households, the other language speaking households consume significantly higher levels of total fat and cholesterol and significantly lower levels of carbohydrates and calcium. Intake of cholesterol is higher in French speaking households as compared to English speaking households. Chinese speaking households consume significantly higher level of fibre and significantly lower levels of protein as compared to English speaking households**.**

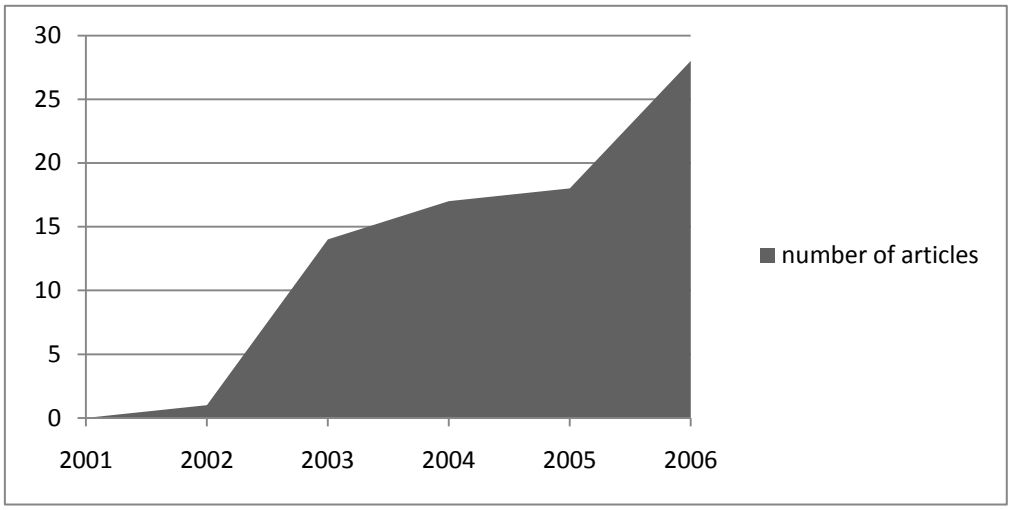
The ten provinces in Canada are categorised into five main regions: West Coast, Prairie provinces, Ontario, Quebec and Atlantic provinces. Atlantic provinces were considered to be the reference group. As compared to households in the Atlantic provinces, households on the West Coast consume less total fat and saturated fat, and more vitamin A and iron; households in the Prairie provinces consume less total fat and more vitamin A; households in Ontario consume more vitamin A and iron and less calcium; households in Quebec consume less total fat, cholesterol, protein and, more sugar.

Households' habits forming preferences for selected nutrients were modeled using a lagged dependent variable; nutrient density of each nutrient. Results indicate that only in the case of vitamin A, there is evidence of habit forming preferences. Restaurant advertising is believed to affect households' FAFH purchasing behaviour and therefore nutrient intake from these foods and beverages. Our models suggest that total fat, saturated fat and protein intakes significantly increase with increasing restaurant advertising expenditure while carbohydrate, fibre, sugar, vitamin A and vitamin are significantly lower with increasing advertising expenditure**.**

It is expected that the agreement between the Canadian Restaurant and Food Service Association and the main chain restaurants in Canada to make available

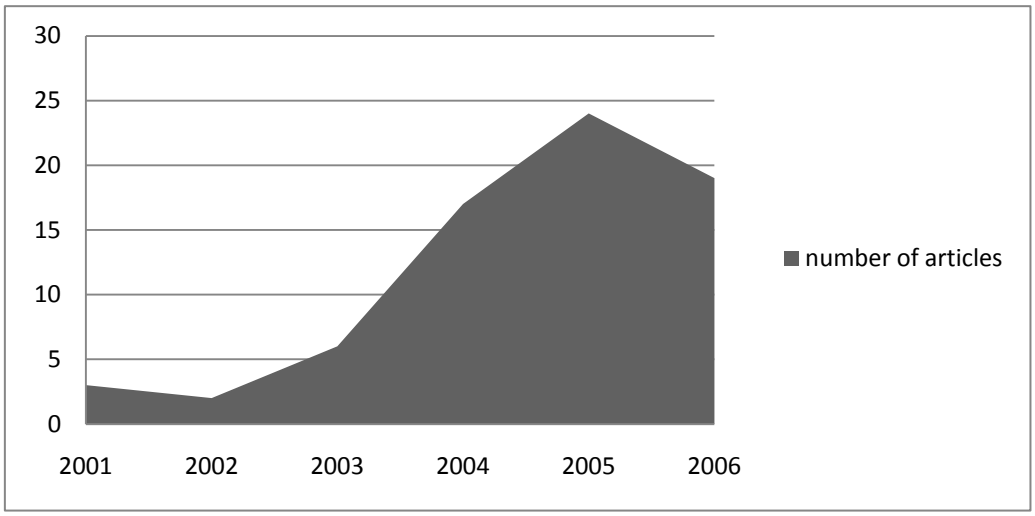
nutrition information to consumers might have impacted households' food purchasing behaviour and nutrient intake. It is hypothesised that after February 2005, when the Canadian chain restaurants voluntarily started to provide their menu nutrition information through their web sites, leaflets and by various other means, households became more aware of the nutrient content of different FAFH food and beverage items and therefore, may have selected healthier menu options. To capture the effect of this scenario, a time dummy variable was used. The results suggest that there are significant reductions in saturated fat, cholesterol, carbohydrate, sugar, protein, calcium and iron intake while there are significant increases in total fat, trans fat, sodium, fibre and vitamin A intake after the above agreement. One should expect that problematic nutrient intake to be reduced as households have more access to nutrition information. However, according to our results, households have not shown any concern in purchasing items especially with high trans-fat or sodium contents, which are considered very unhealthy nutrients. Meanwhile looking at the media indices developed for trans fat and sodium (Figure 4 and 5 -in a similar manner for the nutrition information coverage in general), one can see that media coverage on trans fat and sodium has started to increase only towards the end of the sample period of this study and therefore, results may not reflect any consumer concerns regarding these unhealthy nutrients.

Figure 3-4: Media Index for Trans Fat in 'Food/Beverage/Tobacco' and 'Hotels/Restaurants/Casino' Industries Related News



Source: Factiva database

Figure3-5: Media Index foe Sodium in Food/Beverage/Tobacco' and Hotels/Restaurants/Casino' Industries Related News



Source: Factiva database

A media index was used as a proxy to understand the impact of households' awareness of nutrition of foods and beverages purchased from FAFH markets. Our results explains that media index is correlated with lower saturated fat and protein intake while it has a positive relationship with cholesterol, fibre, vitamin A, vitamin C and iron intake.

The estimates for the time dummy variable which was used to capture availability of nutrition information and the media index variable both provide evidence that households have used nutrition information to reduce their intake of saturated fat and protein and to increase their intake of fibre and vitamin A. Our results do not provide evidence that households have used information to reduce trans fat intake despite the fact that trans fat has received wide media coverage recently. Again the reason could be attributed to higher media coverage towards the end of the study period and therefore may not be reflected in consumer consumption behaviour in this sample.

Estimated income elasticities imply that trans-fats, carbohydrate, fibre, sugar and vitamin C are inferior goods; total fat and sodium are necessities; saturated fat, cholesterol, protein, calcium and iron are luxuries. Estimated expenditure elasticities imply that vitamin A and vitamin C are expenditure elastic and all the other nutrients are expenditure inelastic. While there are no studies available on nutrient demand for restaurant foods, income and expenditure elasticity estimations are widely variable in other nutrient demand studies in other contexts.

3.9. Conclusions and Recommendations

This study examined the demand for selected nutrients from foods and beverages in Canadian chain restaurants. Given that nutrition information is available for chain restaurants in Canada, a balanced panel data set consisted of 1202 households who have purchased from chain restaurants in Canada over the period 2001 to 2006 was selected for this study. The panel data was obtained from the NPD/Crest data base. Allowing for habit forming preferences, a demand model was specified for 13 nutrients. Nutrient densities were specified as a function of selected economic and socio-demographic characteristics, lagged nutrient densities, advertising, media index and a dummy variable to capture the possible impact of increasing availability of restaurant nutrition information to consumers.

As no previous studies have been undertaken to examine nutrient demand in FAFH foods, there were no a priori expectations as to how different socio-economic and demographic factors and industry advertising might affect different nutrient intakes. Information on nutrition is considered affecting 'good' nutrient intake positively and 'bad' nutrients negatively. This study therefore, provides interesting new information about nutrient consumption from chain restaurants in the FAFH market.

It is disconcerting to learn from our results that household intake of some of the problematic nutrients, such as saturated fat and cholesterol increase with increasing household head's income. Moreover, sugar intake is increasing with increasing household heads' age. Given that Canadian household heads are aging and have higher incomes, our results suggested higher levels of unhealthy nutrient intake by Canadian chain restaurant food consumers. There are some significant variations in nutrient intake among ethnic groups and households in different regions. Another important finding is the comparatively low levels of vitamin A and iron intake of households with children as compared to households without children. These findings suggest that households with children are choosing unhealthy meal items which are low in some important healthy nutrients. Only vitamin A is found to have habit forming preferences. The absence of habits or addiction for most of the selected unhealthy nutrients does not suggest any barriers in designing education programs to promote healthy nutrient intake. However, the inelastic nature of expenditure on unhealthy nutrients such as sodium, cholesterol, fat, saturated fat and trans fat may have some implications for the success of imposing nutrient based tax policies.

Another important finding is the impact of restaurant advertising on nutrient demand. Restaurant advertising can be considered to be promoting certain kinds of food and beverage products which may enhance the intake of problematic nutrients in chain restaurants in the FAFH market: especially total fat and saturated fat. In our study fat, saturated fat, carbohydrates, fibre, sugar, protein,

vitamin A and vitamin C intake was potentially affected by restaurant advertising. The study finding can be used in many ways to design and target nutrition education programs and to develop and implement policy tools to promote healthy eating in FAFH market.

In this study, given that the modeling is done at the household level for nutrients, individual perceptions and attitudinal variables were not included in the model. Therefore, future analysis of stated preference data with the above variables is recommended to obtain more in-depth information about individual nutrient intake in chain restaurants in the FAFH market. Another limitation of this study is that model is estimated only for the chain restaurants in FAFH market (which is 38% of all commercial food service establishments) and therefore, may not represent the total demand for nutrients in all FAFH purchases. Unavailability of nutrition information for the menus offered by non -chain restaurants prevented us from including non-chain restaurants in the study. Perhaps all restaurants should be required to develop representative or average nutrient information for menu items.

Another concern about the above method of nutrient demand concerns using nutrient density (which is an index per calories), has important information on calories been removed from the analysis. In order to address this issue, a simple nutrient calculation was undertaken (see Appendix A). These calculations show that amounts of total nutrients obtained by simply adding up menu nutrients and adding up individual nutrient densities of menus are highly correlated. Given this, in future studies it is recommended that analysis of nutrient demand should be done with different forms of nutrient measures (total nutrients, nutrient densities calculated after totalling nutrients or total of individual item nutrient densities) and compared in order to obtain consistent nutrient demand estimates.

Appendix A

Nutrient Calculations

	Serving size	Calories	Total Fat (g)	Saturated Fat (g)	Trans Fat (g)	Cholesterol (mg)	Sodium (mg)	Carb. (g)	Fibre (g)	Sugar (g)	Protein (g)	Vit A (%DRI)	Vit C (%RDI)	Calcium (%RDI)	Iron (%RDI)
Food Item 1	**87**	**225.0**	**8.5**	**3.9**	**0.2**	**30.0**	**660.0**	**26.0**	**1.0**	**30.0**	**11.0**	**0.0**	**0.0**	**0.0**	**0.0**
Individual menu density		1000.0	37.8	17.3	0.9	133.3	2933.3	115.6	4.4	133.3	48.9	0.0	0.0	0.0	0.0
Food Item 2	**158**	**380.0**	**18.0**	**7.0**	**0.4**	**50.0**	**1020.0**	**35.0**	**3.0**	**6.0**	**19.0**	**2.0**	**2.0**	**3.0**	
Individual menu density		1000.0	47.4	18.4	1.1	131.6	2684.2	92.1	7.9	15.8	50.0	5.3	5.3	7.9	0.0
Food Item 3	**210**	**540.0**	**31.0**	**13.0**	**1.0**	**100.0**	**1050.0**	**35.0**	**3.0**	**7.0**	**30.0**	**2.0**	**2.0**	**4.0**	**29.0**
Individual menu density		1000.0	57.4	24.1	1.9	185.2	1944.4	64.8	5.6	13.0	55.6	3.7	3.7	7.4	53.7
Food Item 4	**263**	**702.0**	**44.0**	**19.0**	**1.0**	**150.0**	**1.8**	**35.0**	**3.5**	**7.0**	**42.0**	**3.0**	**2.0**	**4.0**	**29.0**
Individual menu density		1000.0	62.7	27.1	1.4	213.7	2.6	49.9	5.0	10.0	59.8	4.3	2.8	5.7	41.3
Total nutrients of 4 food menus [a]	**718**	**1847**	**102**	**43**	**3**	**330**	**2732**	**131**	**11**	**50**	**102**	**7**	**6**	**11**	**58**
Density calculated with total nutrients [b]		**1000.0**	**55.0**	**23.2**	**1.4**	**178.7**	**1479.1**	**70.9**	**5.7**	**27.1**	**55.2**	**3.8**	**3.2**	**6.0**	**31.4**
Total of individual nutrient densities		4000.0	205.2	86.9	5.2	663.8	7564.6	322.3	22.9	172.1	214.3	13.2	11.8	21.0	95.0
Density calculated with individual menu densities [c]		**1000.0**	**51.3**	**21.7**	**1.3**	**165.9**	**1591.1**	**80.6**	**5.7**	**33.0**	**53.6**	**3.3**	**3.0**	**5.3**	**23.8**

The correlation coefficients between data sets (a, b and c) are given below.

Data sets	Correlation coefficient
a and b	0.1000
b and c	0.9992
a and c	0.9992

These correlation coefficients indicate that a and b, a and c, d and c are highly correlated.

2.10. Reference List

Abdulai, A., and D. Aubert. 2004. A Cross-Section Analysis of Household Demand for Food and Nutrients in Tanzania. *Agricultural Economics.* 31: 67-79.

Adrian, J., and R. Daniel . 1976. Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States. *American Journal of Agricultural Economics* 58, no. 1: 31-38.

Baltagi, B. H. 1995. Econometric Analysis of Panel Data. Third Edition ed. England: John Wiley & Sons Ltd.

Baltagi, B.H. 2005. Econometric Analysis of Panel Data. Third Edition. Chichester: Wiley.

Bareham, J.R . 2004. Can Consumers be Predictable or are they Unmanageable? *International Journal of Contemporary Hospitality Management.* 16, no. 3: 159-65.

Baric,I.C, Z. Satalic and Z.Lukecic. 2003. Nutritive Value of Meals, Dietary Habits and Nutritive Status in Croatian University Students According to Gender. *International Journal of Food Sciences and Nutrition*. 54, no.6:473-484.

Basiotis, P., M. Brown, S. R. Johnson, and K. J. Morgan. 1983. Nutrient Availability, Food Costs, and Food Stamps. *American Journal of Agricultural Economics.* 65, no. 4: 685-93.

Beatty, T.K.M. 2007. Recovering the Shadow Value of Nutrients. *American Journal of Agricultural Economics.* 89, no.1:52-62.

Beatty,T. K. M., and J. T. Lafrance. 2006. United States Demand for Food and Nutrition in the Twentieth Century. *American Journal of Agricultural Economics.* 87, no. 5: 1159–1166.

Binkley, J. K. 2006. The Effect of Demographic, Economic and Nutrition Factors on the Frequency of Food Away From Home. *The Journal of Consumer Affairs.* 40, no. 2: 372-91.

Binkley, J.K., J. Eales, and M. Jekanowskei. 2000. The Relation between Dietary Change and Rising US Obesity. *International Journal of Obesity*. 24, no. 8:1032-1039.

Binkley, J. 2008. Calorie and Gram Differences between Meals at Fast Food and Table Service Restaurants. *Review of Agricultural Economic*. 30,no.4:750-763

Blaylock, J., D. Smallwood, K. Kassel, J.N.Variyam, and L.Aldrich. 1999. Economics, Food Choices and Nutrition. *Food Policy.* 24:269-286.

Bowman, S. A., and B. T. Vinyard. 2004. Fast Food Consumption of U.S. Adults: Impact on Energy and Nutrient Intakes and Overweight Status. *Journal of the American College of Nutrition.* 23, no. 2: 163-68.

Bowman, S.A., S.L. Gortmaker, G.B. Ebbeling, M.A. Pereira, and D.S. Ludwig. 2004. Effects of Fast Foods Consumption on Energy Intake and Diet Quality among Children in a Nutritional Households Survey. *Paediatrics*. 113:112-118.

Briefel, R.R. and C.L.Johnson. 2004. Secular Trends in Dietary Intake In The United States. *Annual Review of Nutrition*. 24:401-431

Brown, D.J., and L.F. Schrader. 1990. Cholesterol Information and Shell Egg Consumption. A*merican Journal of Agricultural Economics*. 72, no. 3:548-555.

Browning, M., and M.D. Collado. 2007. Habits and Heterogeneity in Demands: A Panel Data Analysis. *Journal of Applied Econometrics.* 22, no. 3: 625-40

Burns, C., M. Jackson, C. Gibbsons, and R.M. Stoney. 2001. Foods Prepared Outside the Home: Association with Selected Nutrients and Body Mass Index in Adult Australians. *Public Health Nutrition*. 5, no.3:441-448.

Burton, M. P. and T. Young. 1996. The Impact of BSE on the Demand for Beef and Other Meats in Great Britain. *Applied Economics.* 28: 687-93.

Capps, O. Jr., and J.D. Schmitz. 1991. A Recognition of Health and Nutrition Factors in Food Demand Analysis. *Western Journal of Agricultural Economics*. 16, no.1:21-35.

Chern, W.S., and K. Rickertsen. 2003. Health, Nutrition and Food Demand. CABI publishing. Wallingford, Oxon, UK.

CSPI. Center for Science in the Public Interest. 2008. "Trans Fat". Web page [accessed 2008]. Available at http://www.cspinet.org/transfat/index.html.

Davis, C.G. 1997. The Logic of Testing Structural Change in Meat Demand: A Methodological Analysis and Appraisal. *American Journal of Agricultural Economics.* 79, no. 4: 1186-92.

Davis, C.G. 1982. Linkages Between Socioeconomic Characteristics, Food Expenditure Patterns, and Nutritional Status of Low Income Households: A Critical Review. *American Journal of Agricultural Economics.* 68:1017-1025.

Devaney, B, and T. Fraker. 1989. The Dietary Impacts of the School Breakfast Program. *American Journal of Agricultural Economics* 71, no. 4: 932-48.

Dhehibi, B., J. M. Gil, and A. M. Angulo. 2003. Nutrient Effects on Consumer Demand: A Panel Data Approach. Proceedings of the 25th International Conference of Agricultural Economists (IAAE).

Drewnowski, A. 2005. Concept of a Nutritious Food: Toward A Nutrient Density Score. *American Journal of Clinical Nutrition.* 82, no. 4: 721-32.

Drewnowski, A. 2003. Fat and Sugar: An Economic Analysis. *The Journal of Nutrition*. 133:838S-840S.

Duffey, K.J., P.G. Larsen, D.R. Jacobs, Jr., O. D. Williams, and B.M. Popkin. 2007. Differential Association of Fast Food and Restaurant Food Consumption with 3-Yr Change in Body Mass Index: The Coronary Artery Risk Development in Young Adult Study. *American Journal of Clinical Nutrition*. 85:201-208.

Eastwood, D. B., J.R. Brooker, and D.E. Terry. 1986. Household Nutrient Demand: Use of Characteristics Theory and a Common Attribute Model. *Southern Journal of Agricultural Economic.* 18, no.2:235-246.

Fitzpatrick, M.P., G.E. Chapman, and S.I. Barr. 1997. Lower-Fat Menu Items In Restaurants Satisfy Customers. *Journal of American Dietetic Association*. 97, no.5:510-514.

Fousekis, P., and P. Lazaridis. 2005. The Demand for Selected Nutrients by Greek Households: An Empirical Analysis with Quantile Regressions. *Agricultural Economics*. 32:267-279.

French, S. A., M. Story, D. Neumark-Sztainer, J. A. Fulkerson , and H. Hannan. 2001**.** Fast Food Restaurant Use among Adolescents: Associations with Nutrient Intake, Food Choices and Behavioural and Psychosocial Variables. *International Journal of Obesity.* 25, no. 12: 1823-33.

French, S. A., M. Story, and R. W. Jeffery. 2001. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health.* 22: 309-35.

French, S.A., L. Harnack, and R.W. Jeffery. 2000. Fast Food Restaurant Use Among Women In the Pound of Preservation Study: Dietary, Behavioural and Demographic Correlates. *International Journal of Obesity*. 24;1353-1359.

Gills, L.J., O. Bar-Or. 2003. Food Away from Home, Sugar Sweetened Drink Consumption and Juvenile Obesity. *Journal of American College of Nutrition*. 22, no.6:539-545.

Guthrie, J., F. B. Lin, and E. Frazao. 2002. Role of Food Prepared Away From Home in the American Diet, 1977-78 versus 1994-96: Changes and Consequences. *Journal of Nutrition Education and Behaviour.* 34, no. 3: 140-150.

Grossman, M. 1972. On The Concept of Health Capital and Demand For Health. *Journal of Political Economics*. 80, 223–255.

Grossman, M., R.Kaestner. 1997. Effects of Education On Health. In Behrman, J. R., Stacey, N. G. (Eds.) The Social Benefits of Education. University of Michigan Press, Ann Arbor, MI, pp. 69–123.

Hansen R.G., B.W. Wyse, and A.W. Sorenson. 1979. Nutrition Quality Index of Food. Westport: CT: AVI Publishing Co.

Health Canada. 2008. Food and Nutrition: Food Labelling. Web page [accessed 2008]. Available at http://www.hc-sc.gc.ca/fn-an/pubs/label-etiquet/index-eng.php

Huang, K.S. and B.H.Lin. 2000. Estimation of Food Demand and Nutrition Elasticities from Household Survey Data. Food and Rural Economic Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1887.

Huang, C.L., and S. Misra. 1991. Assessing Nutritional Adequacy of Americans Based on Individual Food Intake Patterns. *Journal of Consumer Studies and Home Economics*. 15:147-159.

Kim, S.R., and W.S. Chern. 1999. Alternative Measures of Health Information and Demand for Fats and Oils In Japan. *The Journal of Consumer Affairs*. 30, no. 1:92-109.

Kinnucan, H.W., H. Xiao, C.J.Hsia, and J.D.Jackson. 1997. Effects of Health Information and Generic Advertising on U.S. Meat Demand. *American Journal of Agricultural Economics.* 79, no. 1: 13-23.

Morgan, K.J., 1986. Socio-Economic Factors Affecting Dietary Status: An Appraisal. *American Journal of Agricultural Economics.* 68, no.5:1240-1246.

Nayga, R. M. Jr., and O.Capps. Jr. 1994. Analysis of Away-from-Home and At-Home Intake of Saturated Fat and Cholesterol. *Review of Agricultural Economics*. 16, no. 3: 387-98.

Nayga, R. M. Jr., 1994. Effects of Socioeconomic and Demographic Factors on Consumption of Selected Food Nutrients. *Agricultural and Resource Economics Review.*23, no.2:171-182. .

Nayga, R. M. Jr., and O. Capps, Jr. 1992. Determinants of Food Away from Home Consumption: - An Update. *Agribusiness.* 8, no. 6: 549-59.

Nayga, R. M. Jr., J. Beverly, T.L. Rosenzweig. 1999. Assessing The Importance of Health Related Factors on Food Demand: A Variable Preference Investigation. *Applied Economics*. 31:1541-1549.

Nestle, M. 2002. Food Politics: How the Food Industry Influences Nutrition and Health: Revised and expanded version. The University of California Press.

NPD Group Inc. 2007. "Food Service: Consumer Tracking". Web page, [accessed 2007]. Available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html.

Paeratakul, S., D.P. Ferdinand, C. M. Champagne, D.H. Ryan, and G. A. Bray. 2003. Fast-Food Consumption Among US Adults and Children: Dietary and Nutrient Intake Profile. *Journal of American Dietetic Association.* 103, no. 10: 1332-1338.

Patra,J., S. Popaya, J.Rehm, S.Bondy, R. Flint and N. Giesbrecht. 2007. Economic Cost of Chronic Diseases in Canada 1995-2003. Report prepared for the Ontario Chronic Diseases Prevention Alliances and the Ontario Public health Association.

Patric, H. and T.A.Nicklas. 2005. A review of Family and Social Determinants of Children's Eating Patterns and Diet Quality. *Journal of American College of Nutrition.* 24,no2:83-92.

Pereira, M. A., A. Kartashov, C.B. Ebbeling, L.V. Horn, M.L. Slattery, D.R. Jacobs, Jr., and D.S. Ludwig. 2005. Fast Food Habits, Weights Gain and Insulin Resistance (The CARDIA Study):15-Year Prospective Analysis. *Lancet*. 365: 36-42.

Park, J., G.C. Davis. 2001. The Theory and Econometrics of Health Information in Cross-Sectional Nutrient Demand Analysis. *American Journal of Agricultural Economics.* 84, no. 4:840-851.

Parliament of Canada. 2006. Bill C-283. Web page, [accessed in 2008]. Available at http://www2.parl.gc.ca/content/hoc/Bills/391/Private/C-283/C-283_1/C-283_1.PDF

Patterson, R. E., P. S. Haines, and B. M Popkin. 1994. Diet Quality Index: Capturing A Multidimensional Behaviour. *Journal of the American Dietetic Association.* 94, no. 1: 57-64.

Popkin, B.M. 2006. Global Nutrition Dynamics: The World is Shifting Rapidly Towards a Diet Linked With Non-Communicable Diseases. *The American Journal of Clinical Nutrition. 84:289-98.*

Ramezani, C. A., 1995. Determinants of Nutrient Demand: A Nonparametric Analysis. *Journal of Agricultural and Resource Economics.* 20, no. 1: 165-77.

Richards, T. J., P.M. Patterson, M. Paul , and S.Hamilton. 2007. Fast Food, Addiction, and Market Power. *Journal of Agricultural and Resource Economics.* 32: 425-47.

Rickertsen, K., 1998. The Effects of Advertising in an Inverse Demand System: Norwegian Vegetables Revisited. *European Review of Agricultural Economics.* 25, no. 1: 129-40.

Statistics Canada. 2007. "Survey of Household Spending and CANSIM II (table no. 203-0002)." Web page, [accessed January 2008]. Available at http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3508&lang=en&db=imdb&dbg=f&adm=8&dis=2 .

Subramanian, S., and A. Deaton. 1996. The Demand for Food and Calories. *The Journal of Political Economy.* 104, no. 1: 133-62.

Tansel, A. 1993. Cigarette Demand, Health Scares and Education in Turkey. *Applied Economics.* 25: 521-29.

Thompson, O.M., C. Ballew, K. Resnicow, A. Must, L.G.Bandini, H. Cyr, and W.H. Dietz. 2004. Food Purchased Away From Home as a Predictor of Change in BMI-Z Score Among Girls. *International Journal of Obesity*. 28:282-289.

Taveras, E.M., C.S. Berkey, S. L. Rifas-Shiman, D.S. Ludwig, H.R.H. Rockett, A.E. Field, G. A. Colditz, and M.W. Gillman. 2001. Association of Consumption of Fried Food Away From Home with Body Mass Index and Diet Quality in Older Children and Adolescents. *Paediatrics*. 116, no. 4:e518-e524.

USDA National Nutrient Data Base. 2007. "Nutrient Data Laboratory". Web page [accessesd in 2007]. Also available at http://www.nal.usda.gov/fnic/foodcomp/search/

Variyam, J. N., and E. Golan. 2002. New Health Information is Reshaping Food Choices. *Food Review.* 25, no.1:13-18.

Variyam, J. N. 2005. Nutrition Labelling in the Food-Away-From-Home Sector: An Economic Assessment. *USDA-ERS Economic Research Report.* Report no.4.

Variyam, J. N., J. Blaylock, and D. Smallwood. 2002. Characterizing the Distribution of Macronutrients Intake among U.S. Adults: A Quantile Regression Approach. *American Journal of Agricultural Economics*. 84, no. 2:454-466.

Verlegh, P.W.J. and M.J.J.M.Candel. 1999. Consumption of Convenience Foods: Reference Groups and Eating Situations. *Food Quality and Preference*. 10:457-464.

Chapter 4: Structural Change in FAFH: Case of Trans Fatty Acids in Restaurant Foods.

4.1. Motivation

An issue that has received a lot of media coverage is the Trans Fatty Acids (TFA) content of food. Medical evidence links TFA with cardiovascular diseases and many other health risks, highlighting the fact that TFA appear to increase the risk of coronary heart disease (CHD) more than any other micronutrient in our diet (Mozaffian *et al.* 2006; Stender and Dyberu 2003; Ascherio *et al.* 1999; Oomen *et al.* 2001). Industrially produced TFA are formed during partial hydrogenation, a process used by the food industry to harden and stabilize liquid vegetable oils. The majority of the TFA in our diet are industrially produced and are typically found in foods such as baked and fried foods (Health Canada 2006).

In 2005, the Government of Canada formed a Task Force with a mandate to develop recommendations and strategies to effectively eliminate or reduce industrially produced TFA in Canadian foods. The Government of Canada recently produced recommendations on dealing with TFA (Health Canada 2006). The regulatory limits are two-fold and the Trans Fat Task Force (TFTF) recommendations specifically state that:

> "for all vegetable oils and soft, spreadable (tub type) margarines purchased by a retail or food service establishment for sale to consumers or for use as an ingredient in the preparation of foods on-site, the total trans fat content be limited by regulation to 2% of total fat content"
>
> for all other foods purchased by a retail or food service establishment for sale to consumers or for use as an ingredient in the preparation of foods onsite, the total trans fat content be limited by regulation to 5% of total fat content" (Health Canada 2006- (p.31)).

In addition, the TFTF recommended that foods purchased by retailers or food service establishments from a manufacturer for direct sale to consumer be regulated on a finished product or output basis and food prepared on site by retailers or food service establishments be regulated on an ingredient or input basis. TFTF also made recommendations with regard to the timing for compliance

and the use of alternative oils in reformulation of foods. TFTF provides information on recommended healthier alternatives for replacement of TFA by food applications (Health Canada 2006). Recently, Health Canada has implemented a program called the Trans Fat Monitoring Program, which provides data on TFA content for many popular pre-packaged and restaurant food items every six months beginning from December 2007 (Health Canada 2007). In addition, Canada also became the first country to introduce mandatory labelling of TFA in 2005.

The growth in Food Away from Home (FAFH) consumption in Canada (Statistics Canada 1997 to 2006) has generated concerns about its possible effect on dietary quality (Health Canada 2006). Given the fact that Canadians' total dietary intake of TFA has increased dramatically in the past few decades (Health Canada 2006), and the fact that partially hydrogenated vegetable oils are widely used in FAFH food processing the TFA content in FAFH consumption has also become of concern. In addition, it is reported that FAFH, often in fast food restaurants and other food service environment, provides 22% of the average TFA intake of Canadian adults (and as much as 31% in the case of males aged 19 to 30 years) (Health Canada 2006). However, prior to any possible regulations based on the Trans Fat Task Force recommendations, some members of the restaurant industry have already responded to public concerns by reducing the TFA content of their products (Health Canada 2006; CRFA 2006). For example, Harvey's, Wendy's, A&W, KFC, Taco Bell and Arby's restaurant chains in Canada changed their cooking oils to non-TFA forming cooking oils and claim that now their foods are zero in TFA or low in TFA. A number of restaurant chains have been changing their recipes since August 2005 and a comprehensive list of these changes are included in Table 4.1.

Table 4- 1: Information of Recipe Changes by Restaurants from August 2005 to September 2007

			Before oil change			*After oil change*			*After oil change but with original menu sizes*		
Restaurant	***Date of cooking oil change***	***Menu Item***	***Serving size(g)***	***TFAs (g)***	***Saturate Fat (g)***	***Serving size(g)***	***TFAs (g)***	***Saturate Fat (g)***	***Serving size(g)***	***TFAs (g)***	***Saturate Fat (g)***
Harvey's	Aug-05	Original Hamburger	157	0.5	8	146	0.4	7	157	0.4	7.5
		Original Cheeseburger	171	1	11	160	1	10	171	1.1	10.7
Wendy's	Aug-06	Kids' Meal French Fries-small	91	3.5	2.5	91	0.5	2	91	0.5	2.0
		Medium French Fries/regular	142	5	3.5	142	1	3	142	1.0	3.0
		Biggie® French Fries/large	159	6	4	159	1	3.5	159	1.0	3.5
		Home-style Chicken Strips	159	3	3.5	159	0.1	3.5	159	0.1	3.5
		4 Piece Kids' Meal Nuggets	60	1.5	2.5	60	0.1	2	60	0.1	2.0
		5 Piece Nuggets	75	1.5	3	75	0.1	3	75	0.1	3.0
		10 Piece Nuggets	150	3.5	6	150	0.2	6	150	0.2	6.0
		Spicy Chicken Fillet/breast Sandwich	231	1.5	3.5	231	0.1	2.5	231	0.1	2.5
		Home-style Chicken Fillet Sandwich	230	1.5	4	230	0.1	2.5	230	0.1	2.5
		Crispy Chicken Sandwich	157	1.5	3	157	1.5	3	157	1.5	3.0
A &W	Jan-07	A&W Fries - small	85	1.5	3	85	0	0.5	85	0.0	0.5
		A&W Fries - regular	135	2.5	4.5	135	0	1	135	0.0	1.0
		A&W Fries - large	170	3	6	170	0.1	1	170	0.1	1.0
		A&W Fries - family	340	6	12	340	0.2	2	340	0.2	2.0
		Poutine - small	184	11	4	184	0	10	184	0.0	10.0
		Poutine - large	333	22	6	333	0	21	333	0.0	21.0
		Fresh Onion Rings	153	4.5	8	153	0.2	2	153	0.2	2.0
		Bacon N' Egger®	141	2	7	141	0.3	8	141	0.3	8.0

		Sausage N' Egger®	170	2	10	170	0.5	12	170	0.5	12.0
		Home-style Sausage N' Egger®	192	2	11	192	0.5	12	192	0.5	12.0
		Home-style Ham N' Egger®	210	2	13	210	0.4	13	210	0.4	13.0
		Hash Brown	73	2.5	1.5	73	0	0.5	73	0.0	0.5
		French Toast (2 pc) with syrup	239.5	3	10	239.5	1	9	239.5	1.0	9.0
KFC	Jan-07	KFC® Snacker	119	1.5	3	183	0	2	119	0.0	1.3
		Crispy Twister®	252	4	7	229	0.2	3.5	252	0.2	3.9
		OR Chicken- Whole Wing	47	1	2.5	46	0.1	1.5	47	0.1	1.5
		OR Chicken- Breast	161	2.5	6	121	0	2	161	0.0	2.7
		OR Chicken-Breast without skin or breading	108	0	1	99	0	1	108	0.0	1.1
		OR Chicken- Drumstick	59	1	2	59	0	1.5	59	0.0	1.5
		OR Chicken- Thigh-skin removed	126	1.5	7	58	0	1.5	126	0.0	3.3
		Popcorn Chicken-Kids	85	3.5	3.5	99	0.1	2.5	85	0.1	2.1
		Popcorn Chicken-Individual	114	4.5	5	142	0.2	3	114	0.2	2.4
		Hot Wings™ (6)	134	4	6	142	0.5	4.5	134	0.5	4.2
Taco Bell	Apr-07	Soft Taco - Beef	113	0.5	1	99	0.2	1.5	113	0.2	1.7
		Bean Burrito	213	1	2	213	1	2	213	1.0	2.0
		Burrito Supreme® - Steak	241	1.5	2.5	255	1	5	241	0.9	4.7
		DOUBLE DECKER® Taco	156	1.5	5	156	1	4.5	156	1.0	4.5
		Spicy Chicken Soft Taco	114	0.5	2	113	0.1	1.5	114	0.1	1.5
		Spicy Chicken Burrito	191	1.5	4	177	0.2	2.5	191	0.2	2.7
		1/2 lb† Beef & Potato Burrito	252	3.5	8	248	0.5	6	252	0.5	6.1
		Soft Taco - Beef	99	1	4	78	0.3	3.5	99	0.4	4.4
		Soft Taco Supreme® - Beef	135	1	7	99	0.3	3.5	135	0.4	4.8
		Cheesy Fiesta Potatoes	138	3	3.5	135	1.5	4	138	1.5	4.1
		Bean Burrito	198	3.5	2	198	3	1	198	3.0	1.0

Arby's	Sep-07	Ham, Egg & Cheese Wrap	228	2	10	249	1	10	228	0.9	9.2
		Bacon, Egg & Cheese wrap	188	2	8	193	0.5	8	188	0.5	7.8
		Chicken Biscuit	132	1	5	132	0	5	132	0.0	5.0
		Ultimate BLT wrap	249	1	11	194	0.5	11	249	0.6	14.1
		Roast Beef & Swiss Sandwich	264	2	13	339	1.5	13	264	1.2	10.1
		Bacon, Beef'n Cheddar Sandwich	212	2	9	212	1.5	9	212	1.5	9.0
		Potato Cake	150	5	5	150	1.5	5	150	1.5	5.0
		Onion Petals-large	283	2	9	283	0.88	9	283	0.9	9.0
		Homestyle Fries-small	113	3	4	113	0.5	4	113	0.5	4.0
		Homestyle Fries-medium	142	4	4	142	0.5	4	142	0.5	4.0
		Homestyle Fries-large	213	5	7	213	1	7	213	1.0	7.0
		Cinnamon Twist	71	4	5	71	4	5	71	4.0	5.0
		Apple turnover	89	6	4.2	89	5.5	4	89	5.5	4.0
McDonalds	Not	OR McDonald Cookie	42	2	1.5	42	0.3	1.5	42	0.3	1.5
	announced	Bacon Ranch Salad with Warm Crispy Chicken	331	1	8	332	0.5	8	331	0.5	8.0
		Chicken Caesar Salad with Warm Crispy Chicken	311	1	5	312	0.5	5	311	0.5	5.0
		Crispy Chicken	185	1	4	115	0.4	3.5	185	0.6	5.6
		Muffin - Blueberry	120	2	3	307	0	1.5	120	0.0	0.6
Swiss Chalet[1]	Dec.-07	Caesar Salad	170	0	4	161	0	6	170	0.0	6.3
		Greek Salad	183	0.4	5	179	0.4	2.5	183	0.4	2.6
		Chalet Chicken Soup	355ml		0	1	355ml	1.5	2	355ml	
		Chicken Spring Rolls (2 pcs)	238	0	4	238	0	4	238	0.0	4.0
		Sun-dried Garlic Cheese Loaf	266	1.5	19	276	1	24	266	1.0	23.1

		Sun-dried Garlic Loaf without Cheese	210	1	8	219	0.5	19	210	0.5	18.2
		Chalet Chicken Wings(8 mild wings)	346	0.3	11	198	0.1	7	346	0.2	12.2
		Messy Chicken Sandwich(white meat)	344	0.1	4	386	0.1	1.5	344	0.1	1.3
		Messy Chicken Sandwich(dark meat)	344	0.3	6	386	0.1	4	344	0.1	3.6
		Chicken Club Wrap	270	1	8	335	0.5	15	270	0.4	12.1
		Chicken on a Kaiser (dark meat)	241	0.3	4	241	0.3	4.5	241	0.3	4.5
		Swiss Burger with bun and garnishes	250	1.5	18	250	1.5	18	250	1.5	18.0
		Bacon Cheese Burger	200	3.5	23				200		
		Bacon Cheese Burger with bun and garnishes	285	3.5	24	298	1.5	24	285	1.4	23.0
		Quarter Chicken Leg (with skin)	139	0	6	3.5	0.1	0	139	4.0	0.0
		Chicken Pot Pie	388	7	9	428	5	8	388	4.5	7.3
		Fresh Cut Fries-cooked in TFA free oil	168	0.5	2.5	168	0.3	2	168	0.3	2.0
		Burger with bun	90	0.4	4.5	138	0.5	8	90	0.3	5.2
		Cheese Pizza	150	2	5	150	0.3	6	150	0.3	6.0
		Chicken Sandwich	120	0.1	3	150	0.1	2.5	120	0.1	2.0
		Colossal Caramel Fudge Cheesecake	200	3.5	19	187	3	17	200	3.2	18.2
		Coconut Cream Pie	106	2.5	10	173	0	21	106	0.0	12.9
		Carrot Cake	156	3	16	156	0.2	11	156	0.2	11.0
		Perfect Pecan Pie	120	4.5	4	146	0	10	120	0.0	8.2
		Classic Apple pie	136	4	3.5	170	0	9	136	0.0	7.2

Restaurant	*Date of cooking oil change*	*Menu Item*	*Before oil change*		*After oil change*				*After oil change but with original serving size*	
			Serving size (g)	*Total fat (g)*	*Serving size (g)*	*Total fat (g)*	*TFAs (g)*	*Saturate fat (g)*	*Serving size (g)*	*Total fat (g)*
Boston Pizza[1,2]	May-07	**Kid's menu**								
		Bugs n' Cheese	204	13	198	10	0.2	5	204	10.3
		Chicken Fingers With Fries	227	19	151	10	0	1	227	15.0
		Pint Sized Pizza No Toppings	184	7	198	10	0.2	5	184	9.3
		Super Spaghetti	197	13	298	13	0	2	197	8.6
		Mama Meat Penne	526	67	666	71	0.5	22	526	56.1
		Boston's Lasagne	379	19	488	19	0.5	9	379	14.8
		Baked Seven Cheese Ravioli	413	29	582	50	1	19	413	35.5
		Boston’s Smokey Mountain Spaghetti	598	47	1096	63	1	30	598	34.4
		Spicy Italian Penne	670	69	768	78	0.1	18	670	68.0
		Pizza								
		The Basic	298	16	298	16	0.4	9	298	16.0
		Bacon Double Cheeseburger	524	54	439	39	1	19	524	46.6
		BBQ Chicken	354	24	354	24	0.5	13	354	24.0
		Boston Royal	522	27	522	27	0.4	12	522	27.0
		Hawaiian	468	20	468	21	0.4	10	468	21.0
		Pepperoni	326	27	326	27	0.5	13	326	27.0
		Sides								
		Baked French Onion Soup	328	14	328	14	6	6	328	14.0
		Caesar Salad Starter Size	168	19	168	20	0.2	3.5	168	20.0
		Chicken with no Sour Cream	365	19	291	12	0.2	5	365	15.1
		Starter								
		Boston's Oven Roasted BBQ Wings Starter	374	42	292	30	0.4	10	374	38.4

		Boston's Oven Roasted Teriyaki Wings Starter Size	397	42	299	33	0	8	397	43.8
		Bandera Pizza Bread With Santa Fe Ranch Dip	333	54	333	54	1	10	333	54.0
		Taco Beef Nachos With Sour Cream & Salsa	682	86	624	81	2	33	682	88.5
		Spicy Chicken Nachos With Sour Cream & Salsa	682	72	624	68	1.5	27	682	74.3
		With Fries	496	39	157	9	0.2	1.5	496	28.4
		Oven Roasted Chicken Quesadilla With Sour Cream & Salsa	484	39	484	46	0.5	14	484	46.0
		Team Platter With Dips/Sauces	1203	205	942	150	2	38	1203	191.6

1. For Swiss Chalet and Boston Pizza restaurants, information is given for selected items as the number of menu items available is large.
2. For Boston Pizza, figures before oil change do not contain saturate fat and trans fat content. Total fat content is compared instead.

Source: company press releases and nutrition information collected by authors, 2006, 2007

Information in Table 4.1 shows that cooking oil changes have considerably reduced the TFA content of some selected food items. For comparative purposes, TFA content and saturated fat content of menus after cooking oil change have been adjusted to similar serving sizes as those before the oil changes (last three columns to the right in Table 4.1). However, with the exception of a few menu items, the TFA content of the above listed food items has been reduced after the cooking oil changes. Despite improvements in terms of TFA content, recipe changes may change the amount of other nutrients, affecting the overall quality of restaurant foods. For an example, apart from a reduction in TFA content, the saturated fat content of the 'soft-beef taco' from Taco-Bell has increased (Table 4.1) with the recipe change, creating some gaps in our understanding with regard to overall quality of diet obtained from the FAFH when the recipes were changed.

In spite of the fact that many fast food restaurants have changed their recipes, consumers may adjust the quantities or types of foods they eat when recipes change, resulting in nutrient combinations that might remain unhealthy. It is very important to understand changes that occur in consumers' food purchasing patterns, particularly in response to voluntary changes in recipes developed by industry to be able to predict the possible need for other public health interventions aimed at enhancing diet quality.

4.2. The Research Objective

The overall objective of this study is to examine Canadian FAFH consumers' diet quality changes, emphasizing TFA recipe changes. The study objective will be achieved analyzing three component of the issue: (1) what is the potential impact of the TFA recipe changes on FAFH consumers' overall diet quality, assuming no behavioural change in consumption patterns? (2) is there evidence of structural/behavioural changes in consumers' FAFH expenditure related to particular restaurant recipe changes? (3) is there evidence of differences in individual's overall diet quality before and after particular restaurant recipe

changes, allowing for behavioural changes in consumption patterns? The results of the study may allow public policy makers to better understand the health outcomes of changes in food formulations in FAFH market and determine the need for any further policy changes to enhance consumers' health.

4.3. Conceptual Framework

The study objectives emphasize examining overall diet quality, diet quality changes and structural changes in FAFH expenditure. Therefore, related concepts are briefly analyzed in the following sections.

4.3.1. Concept of a Nutritious Food

Drewnowski (2005) states, "the concept of a nutritious food is not based on any consistent standards or criteria. In many cases, healthful foods are defined by the absence of problematic ingredients—fat, sugar, and sodium—rather than by the presence of any beneficial nutrients they might contain" (p.721). While one can find many approaches to evaluating nutrient quality of a food in the health and nutrition related literature, the focus of this study is to find an evaluation method based on the different nutrient contents of the food products. Among many evaluation methods, the nutrition density standard is considered to be a promising tool as this approach has implications for food labelling, nutritional policy making and consumer education (Drewnowski 2005).

Nutrition density measures the amount of nutrient for each 1000 or 2000 calories provided by a food item. The nutrient density standard is defined as the ratio of the nutrient composition of a food to the nutrient requirements of the human (Hansen 1979). Since this standard is calculated using the number of calories as the basis, the resulting nutrient density ratio is independent of the serving size (Hansen 1979). Nutrient requirements of humans or a set of reference nutrition standards have been developed by different health authorities in various countries. For examples, Health Canada has developed Recommended Dietary Allowances (RDA) and the Food and Drug Administration (FDA) of U.S. has developed

Recommended Daily Intake (RDI) for all major nutrients in our diet (Health Canada, FDA).

4.3.2. Diet Quality and Diet Quality Index

One of the specific objectives of this study is to examine the effect of recipe changes on overall diet quality. Diet quality measures can be subjective or objective (Drescher 2007). Subjective dietary quality, as a measure of consumers' self perception of diet quality, is not appropriate in this study context. Therefore, the objective dietary quality which is normally measured with a nutritional method is considered here. According to Drescher (2007), objective dietary quality measures are developed based on dietary recommendations such as RDA, dietary guidelines or food guide pyramids. There are three approaches to developing an objective dietary quality measure: indicators derived from nutrients only, indicators based on foods or food groups and indicators based on a combination of nutrients and foods (Kant, 1996). Available dietary recommendations are not specifically targeted at foods or food groups provided by FAFH market. Therefore, the most suitable approach would be to use indicators derived only from nutrients.

4.3.2.1. Nutrient Based Diet Quality Indicators

Nutrient based dietary quality is an assessment of dietary quality focusing on a single nutrient's intake, using RDA (Drescher, 2007). While there are many ways to develop this indicator (Cox *et al.* 1997; Murphy *et al.* 1992) most of them are criticized for their inability to be combined into an overall diet quality measure (Drescher 2007). However, recently, Thiele *et al.* (2003) created a dietary quality index, which is a combination of two indices: a deficient index for nutrients that are considered to be inadequate in normal diet (for examples, fibre, protein, vitamins) and an excess index for nutrients that are considered to be excessive in the normal diet (for examples, saturated fat, trans fat, cholesterol etc). For both the

deficient index and the excess index, higher values indicate a better dietary quality (Drescher 2007).

4.3.2.2. Construction of Diet Quality Index

The method created by Thiele *et al* (2003) is described here. As mentioned above, there are two indices for this indicator: a deficient index and excess index. For a deficient index, a single nutrient score is calculated using 'nutrient adequacy ratio' (NAR).

$$\text{NAR} = \frac{\text{nutrient intake}}{\text{RDA for nutrient}} \times 100$$

Here, the actual intake of the nutrient is divided by the recommended level. If consumers' nutrient intake reaches more than 100% of the reference intake, the single nutrient deficient score is truncated at the maximum of 100 (minimum = 0). Therefore,

$$\text{a single nutrient deficient score} = \frac{\text{actual intake of nutrient}}{\text{recommended intake of}} \times 100 = \text{NAR} \times 100$$

$$\text{and the deficient index} = \sum \text{NAR} \times 100$$

For the excess index, first, single nutrient scores are calculated in the same way for deficient index. However, since nutrients at risk of excess intake are considered, high NAR values would indicate low dietary quality. In order to correct that adjusted NAR (aNAR) is calculated using following conditions.

$$\text{single nutrient excess score} = \frac{\text{actual intake of nutrient}}{\text{recommended intake of}} \times 100 = \text{NAR} \times 100$$

Conditions are:

if NAR < 100% then aNAR= NAR

if NAR >100% and < 200% then aNAR= 200-NAR

if NAR >200% then aNAR=0

and the $\text{excess index} = \sum \text{aNARs}$

According to Thiele *et al.* (2004), the final dietary quality index is the summation of deficient index and the excess index. In calculating this dietary quality index, there is no limit to the number of nutrients to be included. Depending on the study objectives and data availability, number of nutrients be include in the calculations can be decided.

4.3.3. Consumer Demand and Structural Change

Consumer demands for foods have been studied widely using different objectives, data and methodological approaches. Among these approaches, a system of demand equations is often used to analyze the effect of, for example, income, tax, price or any other exogenous changes on consumer demand. However, when selecting and using a proper demand equation system, it should be based on empirical considerations.

Measuring changes in demand due to recipe changes is another objective of this study. In demand analysis, the hypothesis of structural change is often framed in terms of 'changing taste and preferences' (Moschini and Moro 1996). However, different studies have different notions for 'changing taste and preferences' depending on the circumstances or applications. According to Moschini and Moro (1996), there are three alternative ways of examining structural change: consistency analysis, parameter instability analysis and explicit modeling of structural change by a trend or other economic variable. In consistency analysis, data are tested to see whether they satisfy the theoretical restrictions such as homogeneity, symmetry and negativity and are examined look for evidence of structural change in other ways. For examples, Maki (1992) has found that homogeneity and symmetry are satisfied when taste changes are allowed through an intercept term. A similar approach is used in Chen and Veeman (1991). The

most common approach to detecting structural change is parameter instability analysis. In other words, it is assumed that structural changes will alter parameter values, given an unchanged functional form and analysts can test for structural change by checking for stability of parameters (Moschini and Moro 1996). The tests that can be used under this method include, Chow test (Chow 1960), CUSUM test (Brown *et al.* 1975) and modified CUSUM test (Dufour 1982) Andrew- Fair likelihood ratio equivalent test (Andrews 1993). Some applications in demand analysis include; Moschini and Meilke (1984), Atkins *et al. (*1989) and Chen and Veeman (1991). When structural change is explicitly modeled, the simplest approach is to include a time trend, a dummy variable or a set of dummy variables (Moschini and Moro 1996). The tests for structural change consider both gradual and one-time-only shifts in the demand curve. For a gradual exogenous shift in a dynamic model, a trend variable can provide a useful proxy for various effects. For one-time shift in demand, the model can be estimated with an intercept dummy. In addition, some have modeled structural change explicitly making a distinction between systematic and random variation in parameters. (Moschini and Moro 1996). Some applications of this method include Moschini and Meilke (1989), Reynolds and Goddard (1991), Bjørndal *et al*.(1992).

4.4. Literature Review

4.4.1. Trans Fat and Health Implications

Based on science, TFA (commonly termed trans fats) are a type of unsaturated fat. TFA occurs naturally in small quantities in ruminant-based foods such as dairy products and beef (generally 2-5% of fat content). However, most of the TFA in our diet today are industrially created through the process of partial hydrogenation of plant oils and animal fats. Partially hydrogenated oils have displaced natural solid fats and liquid oils in many areas, notably in fast foods, snack foods, fried food and baked goods industries. The TFA content of some of these foods may be as high as 45% of the total fat in the product (Health Canada 2006).

Health implications of TFA have been widely studied. However, substantial new data on the health effects of TFA have become available recently (Mozaffian *et al.* 2006; Stender and Dyberu 2003; Ascherio *et al.* 1999; Mensink and Katan 1990; Oomen *et al.* 2001). These findings are based on human metabolic studies and epidemiological studies, relating intake of TFA to the risk of coronary heart disease and highlighting the fact that TFA appear to increase the risk of coronary heart disease (CHD) more than any other micronutrient in our diet.

4.4.2. Regulatory Environment for TFA

TFA has become the focus of regulators and nutrition advocates due to the potential long-term adverse health effects associated with its consumption (Center for Science in the Public Interest [CSPI] 2004; FDA 2003a, 2003b). In 1999, U.S. Food and Drug Administration (FDA) proposed a rule that would require the amount of TFA present in foods to be included in the nutrition fact panel (FDA 1999). However, Canada became the first country to regulate mandatory labelling of TFA on pre-packaged foods. In line with that, Canadian labelling regulations were promulgated in late 2002 and became mandatory in late 2005 (Health Canada 2006).

Following a study by the Panel of Macronutrients of the U.S. National Academies of Science, Institute of Medicine, and World Health Organization (WHO) recommended that TFA intake be limited to less than 1% of overall energy intake (Health Canada 2006). In 2003, Denmark set an upper limit on the percentage of industrially produced TFA in foods, limiting TFA from sources other than meats and dairy products to a maximum of 2% of total fat in each food item. The Government of Canada formed a task force in 2005 to study and develop recommendations and strategies to effectively eliminate or reduce industrially produced TFA in Canadian foods. Trans Fat Task Force, in their final report made recommendations as follows:

> 'Foods purchased by retailers or food service establishments from a manufacturer for direct sale to consumers be regulated on a finished product or output basis and

> foods prepared on site by retailers or food service establishments be regulated on an ingredient or input basis' (P.4).

With regard to the actual recommended levels of TFA, Task Force recommend that:

> 'For all vegetable oils and soft, spreadable (tub-type) margarines sold to consumers or for use as an ingredient in the preparation of foods on site by retailers or food service establishments, the total trans fat content be limited by regulation to 2% of total fat content'
>
> 'And for all other foods purchased by a retail or food service establishment for sale to consumers or for use as an ingredient in the preparation of foods on site, the total trans fat content be limited by regulation to 5% of total fat content. This limit does not apply to food products for which the fat originates exclusively from ruminant meat or dairy products' (P.4).

With regard to the timing for compliance, TFTF recommends that:

> "a basic phase-in period be set at one year from the date of entry into force of the final regulations. Extended phase-in periods be specified for certain applications (e.g. baking) and for small and medium-sized firms based on demonstrated need, recognizing that in most cases the transition could be made within two years of the date of entry into force of the final regulations, and that only in very special cases or applications would the phase-in period exceed two years".

TFTF also recommended the use of alternatives, specifically stating that:

> "the Government of Canada and all concerned food industry associations urge companies affected to use the most healthful oils for their food applications when reformulating foods".

TFTF provides information of recommended healthier alternatives for replacement of TFA by food applications (Health Canada 2006).

In 2007, the Minister of Health gave the food industry notice that it had two years to voluntarily implement these measures, or the government will regulate this reduction (Health Canada 2007). The most recent regulation is introduced in U.S. and that is the mandatory declaration of TFA if the food contains 0.5 grams of TFA or more. Another initiative in Canada is the implementation of a program called a Trans Fat Monitoring Program, which provides data on TFA content of many popular pre-packaged and restaurant food items every six months beginning from December, 2007 (Health Canada 2007). Under the Trans Fat Monitoring

Program, two data sets have been released (one in December 2007 and the other in July 2008). According to Health Canada (2007), most of the top fast food and family restaurant chains in Canada have been successful in reducing TFA from menu items that have been previously high in TFA such as French fries, chicken products, fish products, and pizzas.

4.4.3. Previous Research in the Area

In this section, an attempt has been made to summarize previous studies on TFA. While there are numerous studies on the health impact of TFA in the medical literature, only a few recent studies are included in this review.

A few aspects of TFA have been studied. The Trans Fat Task Force final report (Health Canada 2006) provides information on TFAs including an overview of the health implications of consumption. They also have undertaken a study on the impact of modifying the TFAs content of foods on dietary intake. In that study, they modeled the impact of a variety of potential recommendations limits on TFAs in foods and the resultant intakes across the Canadian population, grouped by age and sex. The study found that if an upper limit of a 5% on TFAs were applied to all foods that are significant sources of industrially produced TFAs, the average TFAs intake of Canadians would decrease by at least 55%. Most of the industrially produced TFAs would be removed from the Canadian diet. This percentage will further increase by 2-3% with setting TFAs limits at 4% and 3% respectively. At 5% limit, the average daily intake of TFAs for all age groups would represent less than 1% of energy intake, consistent with the recommendations of the World Health Organization. Dietary intake data from nutrition surveys conducted in Ontario, Manitoba, British Columbia and Quebec in the late 1990s were used in constructing and evaluating the scenarios. Though there are concerns regarding the resulting levels of saturated fatty acid content of modified foods, no attempt has been made to examine the overall diet quality changes due to TFA limits. Further, this study did not allow for behavioural

changes which could occur, when modeling the different levels of TFA limits. Moreover, no differentiation was made between food at home and FAFH in the analysis.

Agriculture and Agri-Food Canada has undertaken two studies: 'Food Industry Perspective on Eliminating Trans Fats in Food Products' and 'Methods and Opportunities for Reducing or Eliminating Trans Fats' (Health Canada 2006). Both of these studies addressed the issue of TFAs from producers and processors' perspective based on interviews. They discussed the issues such as functionality of the alternative fats and oils, the attributes of the food product (including sensory evaluation), labelling and harmonization issues and technological advances, which can be used to mitigate the TFAs problem and highlighted the long-term benefits of addressing this issue at present.

Recently, substantial new data on the health effects of TFAs have become available (Mozaffian *et al.* 2006; Stender & Dyerburg 2004; Ascherio *et al.* 1999; Oomen *et al.* 2001). These findings are based on human metabolic studies and epidemiological studies, relating the intake of TFA to the risk of coronary heart disease. The study which determined the content of industrially produced TFAs in 43 servings of fast foods bought in 20 countries (Canada was not included) reported that the content of TFAs varied from less than 1 g in Denmark and Germany to 10 g in New York (McDonald's) and 24 g in Hungary (KFC). They also found that fifty percent of the 43 servings contained more than 5 g of TFAs per serving (Stender *et al.* 2006). "The trans fatty acid story in Denmark" (Astrup 2006) describes how the Danish Nutrition Council initiated the TFAs regulation process and how it had become successful. Another Danish study on the effect of TFAs regulation has highlighted the fact that after the Danish Government imposed strict regulations, the TFAs content of foods has been reduced or completely removed (Leth *et al.* 2006). The impact of nutrition labelling on TFAs intake has also been studied and study conclusions stressed the importance of more consumer awareness of TFAs in order to get the full benefit of TFAs in

nutrition labelling (Kozup *et al.* 2006). It is worth noting that to the authors' knowledge, there are no systematic economic studies which have been addressed the TFAs issue from a consumer's perspective in Canada or elsewhere.

Table 4- 2: Previous Studies on Trans Fatty Acids (TFA)

Author /Year/ Country	Study	Results
Ascherio *et al.* / 1999/ USA	Trans Fatty Acids and Coronary Heart Disease	Provide a review of studies to show the metabolic structure of trans fats and its relationship to Coronary Heart Disease
Astrup/ 2006/ Denmark	The trans fatty acid story in Denmark	Describe how Danish Nutrition Council the TFA regulation process and how it had become successful
Health Canada/ 2006/Canada	Food Industry Perspective on Eliminating Trans Fats in Food Products	Discussed the issues such as functionality of the alternative fats and oils, the attributes of the food product (including sensory evaluation), labelling and harmonization issues
Health Canada/ 2006/Canada	Methods and Opportunities for Reducing or Eliminating Trans Fats	Discussed technological advances, which can be used to mitigate TFA problem
Health Canada/2006/Canada	The impact of modifying TFA content of foods on dietary intake Dietary intake data from nutrition surveys conducted in Ontario, Manitoba, British Columbia and Quebec – 1990s	Three scenarios were analyzed where maximum allowed TFA of the foods are set at 3%, 4% and 5% of total fats. If the upper limit of 5% on TFA were applied to all foods that are significant sources of industrially produced TFA, the average TFA intake of Canadians would decrease by at least 55%.
Hunter /2005/USA	Dietary levels of trans-fatty acids: basis for health concerns and industry efforts to limit use	Feasibility and impact of TFA alternatives are studied with four technological options and concluded that finding a feasible alternative is challenging.
Kozup *et al.* /2006/USA	The Provision of Trans Fat Information and Its Interaction with Consumer Knowledge Experiment with nutrition fact panel labels	Results indicate that without consumer education efforts that enhance consumers' knowledge and understanding of trans fat, effects of the new labelling regulations on consumers may be limited.
Leth *et al.*/2006/ Denmark	The effect of the regulation on trans fatty acid content in Danish food Product monitoring and investigation	TFA content has been reduced or removed from the products with high TFA content originally, like French fries, microwave oven popcorn and various bakery products

Malla *et al.*/2005/Canada	Estimating the health care savings from trans fat free oil in Canada	Potential savings in public health care costs from trans fat free Canola oil is estimated. The estimations range from Cdn$ 280 million to CAN$ 1.09 billion annually
Mozaffarain *et al.*/2006/USA	Trans Fatty Acids and Cardiovascular Disease	Reported that trans fats increase the risk of coronary heart disease (CHD) more than any other macronutrient. The risk is substantially increased when consumption is only 1% to 3% of total energy intake
Oomen *et al.*/ 2001/ Netherland	Association between trans fatty acid intake and 10-year risk of coronary heart disease in the Zutphen Elderly Study: a prospective population-based study	Provide evidence on the relation between trans fatty acid intake and coronary heart disease is limited. We investigated this relation in a Dutch population with a fairly high trans fatty acid intake, including trans fatty acids from partly hydrogenated fish oils
Stender and Dyerburg /2004/ Denmark	Influence of Trans Fatty Acids on Health	Reported that the contribution of dietary trans fatty acids (TFAs) on the risk of ischemic heart disease (IHD). Compared to saturated fat, TFAs are, gram to gram, associated with a considerably (2.5- to >10-fold) higher risk increment for IHD. A negative effect on the human foetus and on newborns and an increase in colon cancer risk in adults are possible but, however, still equivocal. Recent findings justify further studies concerning the effect of TFAs on allergic diseases in children and on the risk of type-2 diabetes in adults
Stender *et al.*/2006/ 20 countries	High levels of industrially produced trans fat in popular fast foods	Determined the content of industrially produced TFA in 43 servings of fast foods bought in 20 countries and reported that TFA varied from less than 1g in Denmark and Germany to 10g in New York and 24g in Hungary. They also found that 50% of all 43 servings contained more than 5g of TFA per serving.

4.5. Empirical Model Specification and Data

The empirical analysis is divided into three parts. The first part is a 'what-if' type scenario analysis or a counterfactual analysis to study the potential impact of restaurant recipe change on overall diet quality of FAFH consumers if consumption patterns remained the same as they were historically. In some sense this is similar to what the Task Force did, but with an exclusive focus on FAFH. In the second part, a system of expenditure share equations is used to find if there is evidence of structural change in household expenditure associated with the timing of restaurant recipe changes. The third part is used to identify overall diet quality changes in food purchases of specific FAFH consumers, given the restaurant recipe changes and allowing for any structural changes in expenditure patterns. These three analysis and their results are discussed in the following sections.

This study used a data set on Canadians' FAFH food purchases from May 2000 to February 2007, obtained from NPD Group Inc. The data set which is called Consumer Reports on Eating Share Trends (CREST) contains data on around 4000 to 5000 households per quarter (NPD Group Inc. 2008). Many of the households contributed to multiple quarters. Each household in the data set recorded all of their purchases from commercial food service facilities during a two-week period in each quarter. The data set contains a variety of information on each household's socio-demographics, total expenditure on each purchase occasion, the type of the restaurant visited and its name, and detailed information on the meal and beverage items purchased (NPD Group Inc. 2008).

This study focused on annual aggregated purchases and therefore, data from March 2001 to February 2007 were used. First, households who made purchases in every year during the period March 2001 to February 2007, from at least one of the restaurants that changed their recipes during the sample period were selected to obtain a sub-sample of 543 households. Second, as it was important to identify

households who made frequent purchases from the restaurants who changed their recipe during the sample period, a criterion that households must have at least 10% of their total purchase occasions from the restaurants that changed their recipes was applied. The resulting sub sample consisted of 122 households. Menu nutrition data was collected for 45 popular chain restaurants during 2006 and 2007 in Canada and menu nutrition information from the USDA National Nutrient Database were also used for restaurants that do not create detailed nutritional breakdowns for individual food items. Descriptive statistics for the sample of 122 households in year 2001 are given in Table 2, with a comparison to 2001 census data and entire NPD CREST data set in 2001.

Table 4- 3: Descriptive Statistics of the Sample, Compared to Census and Whole NPD CREST Data Set in Year 2001

Variable definition	***Census (30,007,094)***	***NPD CREST data set (5478 households)***	***Study sample (122 households)***
	Mean values of categories and ratios of sub groups		
Annual income of household	**55016.00**	**45161.00**	**42824.50**
Low income (under $30,000)	0.58	0.30	0.32
Middle income ($30,000 to $60,000)	0.27	0.38	0.48
High income (more than $60,000)	0.15	0.32	0.20
Age of household head	**37.60**	**49.65**	**54.31**
Under 15	0.20	0.00	0.00
15 years to 44yearss	0.43	0.41	0.34
455 years to 65 years	0.24	0.38	0.48
above 65 years	0.13	0.21	0.18
Education			
Junior high or less	0.10	0.08	0.01
Senior high, college certificate diploma	0.66	0.72	0.80
University degree	0.24	0.20	0.19
Region			
British Columbia	0.13	0.19	0.22
Alberta	0.11	0.12	0.18
Saskatchewan	0.03	0.06	0.11
Manitoba	0.04	0.05	0.03
Ontario (+ HULL, PQ)	0.38	0.30	0.32
Quebec(- HULL, PQ)	0.24	0.17	0.04
New Brunswick	0.02	0.05	0.02
Prince Edward Island	0.004	0.003	0.00
Nova Scotia	0.03	0.05	0.06
Newfoundland	0.02	0.01	0.02
Household composition			
Households with children		0.32	0.24
Households without children		0.68	0.76
City size (urban vs. rural)			

population under 100,000	0.21	0.19
population 100,000 to 500,000	0.27	0.31
population more than 500,000	0.52	0.50
Total annual expenditure on FAFH	$124.20	$186.12

Source; Canadian census 2001, Statistics Canada 2002, NPD CREST data 2001-2007

As compared to census data and NPD data, the study sample can generally be considered to be a representative sample of the NPD data set and the Canadian population, with some variations. One variation is that annual average household income of the study sample is lower than the NPD sample and the census data. In addition, the representation of low-income households is low in both NPD sample and the study sample as compared to census data while the representation of middle-income households is higher in both the NPD sample and the study sample. The average age of the household head is higher in the study sample Representation from the educational sub- groups and the regional sub groups are more or less similar in all three data sets. The regional representations are more or less similar across three groups of data, except the fact that the study sample does not have any households from Prince Edward Island. Comparisons of household composition and the city sizes were made only between the NPD data set and the study sample data set and representation from sub groups are similar for both data sets. However, as the study sample is representative of Canadian population, the study results can be extrapolated. However, it should be noted that overly broad generalizations can be misleading when applied to populations that were not well represented by a sample. For an example, there could be response biases introduced by the persistent participants in longer panel data samples such as NPD sample.

4.5.1. Part 1: Changes in Dietary Quality with no Behavioural Changes

For the first analysis, households' FAFH purchases for a four year period: March 2001 to February 2005, were selected. Descriptive statistics of the sample are given in Table 3. Selection of these four years provides the opportunity to analyze

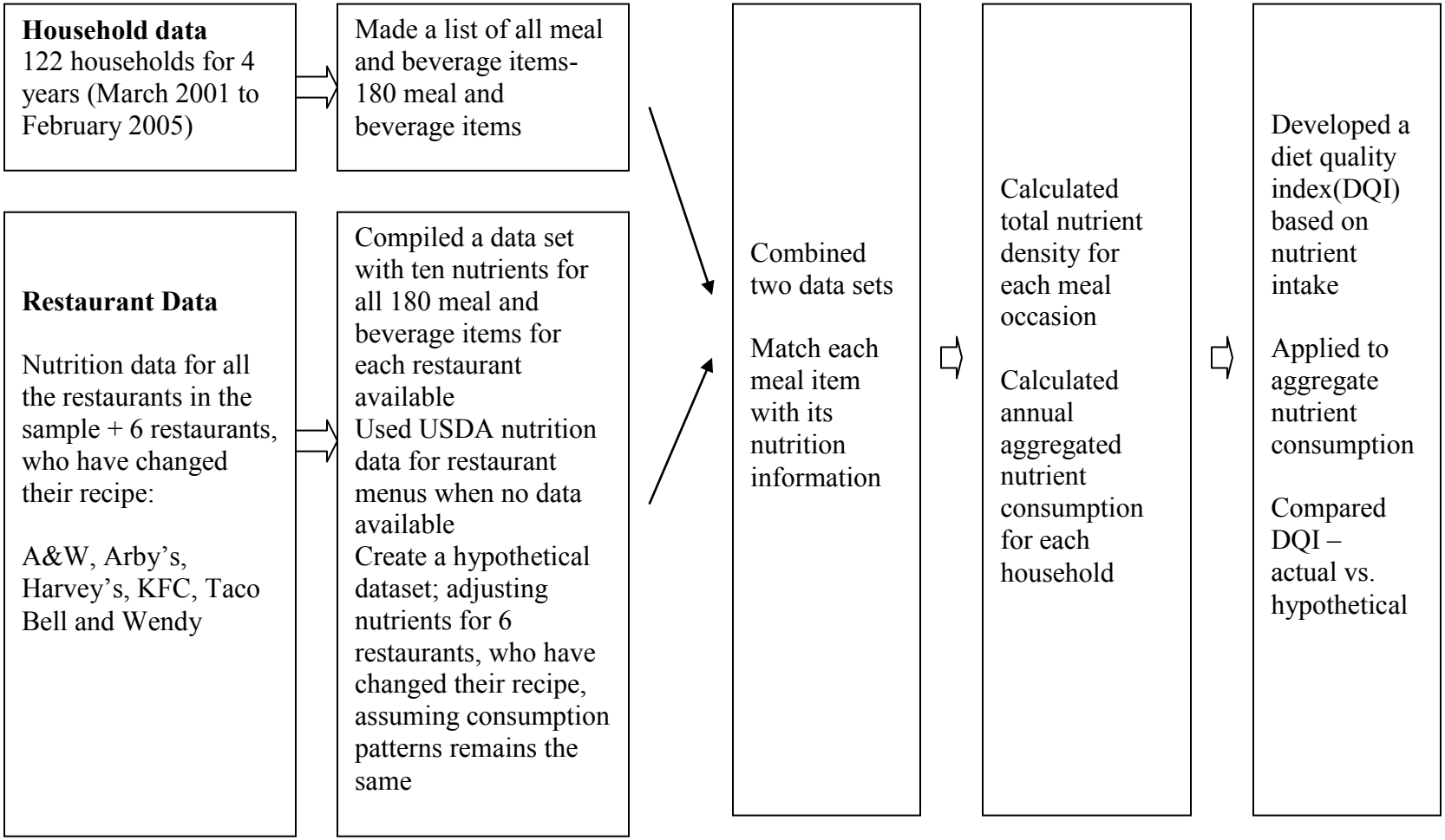
changes in dietary quality, which might have occurred in response to recipe changes. However, no restaurant recipe changes actually occurred during the particular period.

First, all of the foods and beverage items purchased by 122 households from various restaurants for the selected four-year period (there were 180 meal and beverage items) were identified. Second, ten nutrients which include nine core nutrients and calories for each of the above 180 meal and beverage items were identified for each of the restaurants in the sample using the individual restaurants' nutrition data and nutrition data obtain from the USDA National Nutrition data base when restaurant specific nutrition information is not available. The selected nine nutrients: total fat, saturated fat, trans fat, cholesterol, sodium, carbohydrate, fibre, sugar and protein are included in the 13 core nutrients, which are listed in the nutrition facts table in mandatory nutrition labelling introduced by Health Canada in 2003 (Health Canada, 2003) and used by some restaurants to provide voluntary nutrition information on their products. The other four core nutrients: calcium, vitamin A, vitamin C and iron were not included in this study as the measuring units were inconsistent in the nutrition information data obtained from restaurants and USDA. Third, nutrient density, which measures the amount of nutrient per each 1000 calories, provided by each meal or beverage item was calculated and matched with the meal and beverage items purchases identified for 122 households.

A new set of nutrient densities were also calculated for food and beverage items purchased from six restaurants: A&W, Arby's, Harvey's, KFC, Taco Bell and Wendy, who have subsequently changed TFA recipes. These new nutrition density measures were again matched with the household purchases to create a hypothetical data set for the period March 2001 to February 2005 as if the recipes had been changed earlier than they were. Finally, annual aggregate nutrient consumption for each household for the actual data set: before recipe change and for the hypothetical data set: after recipe change was calculated. To compare

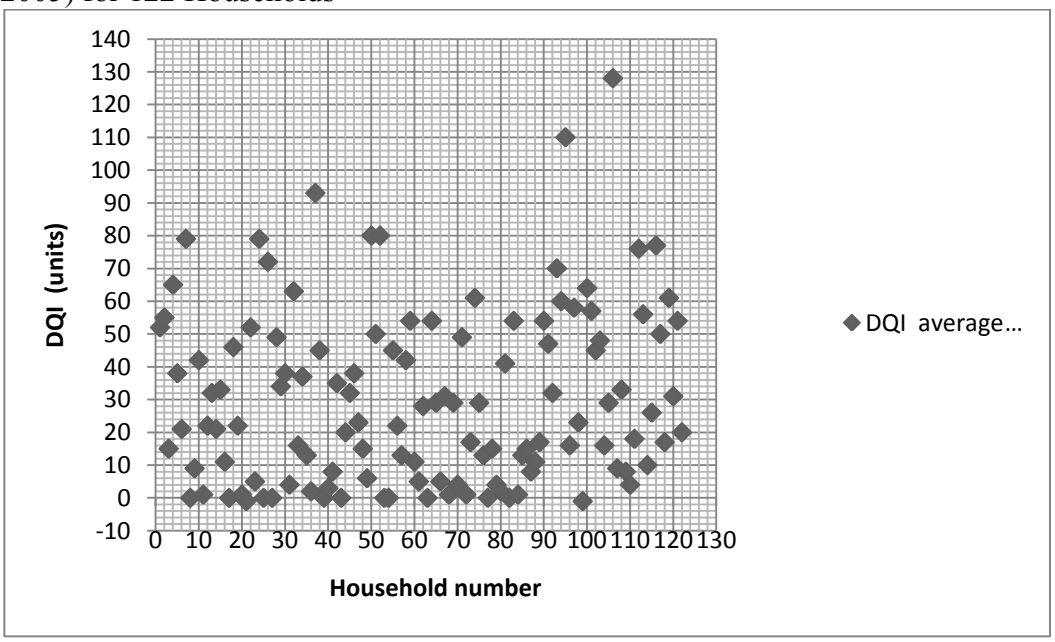
dietary quality, we devised a 'Diet Quality Index' (DQI) measure (Appendix 1) using the method of Thiele *at el.* (2003). An example of the process of calculating the DQI is provided for a selected household in Appendix 2. The DQI calculation process is illustrated in Figure 4.1.

Figure 4- 1: Flow Chart to Show The Process of Determining DQI Before (Actual) and After (Hypothetical) After Recipe Change



After calculating DQI changes, the figures were cross tabulated for all the households in the sample for 4 years. Then the average DQI change (actual vs. hypothetical) over the four years were calculated (Appendix 3) and a scatter plot was prepared to understand the pattern of DQI change (Figure 4.2).

Figure 4- 2: Average DQI Change (Over Four Years, March 2001 to February 2005) for 122 Households



Source: DQI compiled by author

According to Figure 2, a large percentage of households would have obtained higher quality diets if they had consumed the same foods as they did historically with revised recipes. Out of the households who would have shown changes in diet quality, the majority had DQI improvement. A very small number of households had small decreases or no change to diet quality.

A regression analysis was undertaken with diet quality changes as the dependent variable regressed on selected households' socio-demographic characteristics. This regression analysis can determine whether there are any discernable impacts of selected socio demographic characteristics on diet quality improvement. The following linear equation was estimated in a panel data model.

$$DQI\ change_{it} = f\ (HHI_{it,}\ HHA_{it},\ HHED_{it},\ ,\ RD_i,\ HHC_{it},\ TE_{it})$$

where HHI_{it} is the household income, HHA_{it} is the age of the household head, and $HHED_{it}$ is the household head's education level. Dichotomous regional (RD_i), households' first language (HFL_i) and household composition (HHC_{it}) variables were included to control for geographic variations, ethnic differences and households with or without children respectively. Five regional variables: West Coast, Praire provinces, Ontario, Quebec and Atlantic provinces were created from the ten regions in the data set. Deflated annual total expenditure (*TE*) on FAFH purchases were also used to capture the effect of spending patterns on diet quality. Descriptive statistics are given in Table 4.3 and the regression results are given in the Table 4.5.

Table 4- 4: Descriptive Statistics for the Sample

Variable definition	***Variable name and sub-groups***	***Mean (March 2001-February 2002)***	***Mean (March 2002-February 2003)***	***Mean (March 2003-February 2004)***	***Mean (March 2004-February 2005)***
Dependent variables					
DQI change		**32.02**	**29.08**	**30.66**	**29.08**
Independent variables					
Total FAFH expenditure	TE	193.23	187.04	190.02	192.72
Annual income of household	HHI	39795.00	39754.00	39549.18	42397.54
Age of household head	HHA	51	52	53	54
Region	**RD**				
West Coast=1, otherwise=0	RD1	0.22	0.22	0.22	0.22
Prairie Provinces=1, otherwise=0	RD2	0.32	0.32	0.32	0.32
Ontario=1,otherwise=0	RD3	0.32	0.32	0.32	0.32
Quebec=1, otherwise=0	RD4	0.04	0.04	0.04	0.04
Atlantic Provinces=1, otherwise=0	RD5	0.10	0.10	0.10	0.10
Household composition	**HHC**				
Households without children	0	0.75	0.75	0.75	0.75
Households with children (<12 yrs)	1				
Household's first language	**HFL**				
English=1; otherwise=0	HFL1	0.84	0.84	0.84	0.84
French=1; otherwise=0	HFL2	0.04	0.04	0.04	0.04
Chinese=1;otherwise=0	HFL3	0.02	0.02	0.02	0.02
Other=1;otherwise=0	HFL4	0.10	0.10	0.10	0.10

Source: Study sample

According to Table 4.3, the average DQI change ranges from about 29 to 32 points in the four year period. Average annual income ranges from around $39500 to $42400 and average age of the household head's ranges from 51 to 54. Household representation from Prairie provinces and Ontario are similar and the highest in the panel followed by the West Coast. Household representation from Quebec is the lowest. In this sample, the proportion of households with children is higher than the households without children. There is a high representation of English speaking households.

Table 4- 5: Parameter Estimates for the Regression Analysis (Dependent Variable-DQI Change, Sample Size-122)

Variable	***Coefficient estimates***
Intercept	1.868***
	(0.124)
TE	0.482***
(Deflated Total expenditure)	(0.047)
HHI	0.025***
(Household income)	(0.006)
HHA	0.025***
(Age of the household head)	(0.005)
HHED	-0.400*
(Household head's education)	(0.174)
HHC	0.569*
(Household composition)	(0.256)
Region of living	
RWC- West Coast	-0.777***
	(0.153)
RPP- Prairie Provinces	0.004
	(0.002)
RON- Ontario	-0.576*
	(0.261)
RQB-Quebec	0.034***
	(0.004)
RAT- Atlantic Provinces	Reference Group
Ethnic differences	
HFL1- English Speaking	Reference Group
HFL2- French Speaking	-1.469***
	(0.329)

HFL3- Chinese Speaking	0.012**
	(0.004)
HFL4- Other Language Speakers	-1.070*
	(0.428)
R^2	**0.5077**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

The most widely used panel data models are called Fixed Effect models and Random Effect models (Greene 2003). The basic model framework to explain these model specifications are as follows:

$$y_{it} = X_{it}\beta + Z_i'\alpha + \varepsilon_{it} \qquad (1)$$

where y_{it} is the dependent variable, X is a vector of explanatory variables and *i* and *t* are subscripts to denote individuals and time dimensions respectively. The individual effect or heterogeneity is given by $Z_i'\alpha_{it}$ term and Z_i contains a constant term and a set of individual or group specific variables, which may be observed, such as race, sex, and location or unobserved, such as family specific characteristics, individual heterogeneity of skill or preferences and so on (Greene 2003). According to Greene (2003), in fixed effect models, Z_i is unobserved, but correlated with X_{it}. Therefore, the equation (1) above is specified as:

$$y_{it} = X_{it}\beta + \alpha_i + \varepsilon_{it},$$

where $\alpha_i = Z_i'\alpha$ is a group specific constant term and 'fixed' or does not vary over time.

In random effect models, the unobserved individual heterogeneity is assumed to be uncorrelated with the included variables in a model. Then the model is specified as:

$$y_{it} = X_{it}\beta + \alpha_i + u_i + \varepsilon_{it}$$

where u_i is a group specific random element, similar to ε_{it} except that for each group, there is but a single draw that enters the regression identically in each period (Greene 2003). Based on the above discussion, a fixed effect approach is conditional upon the value for α_i. Inferences are, therefore, with respect to the effects that are in the sample. The random effects approach is not conditional upon the individual α_i s, and allows one to make inferences with respect to the population characteristics (Verbeek 2004).

The results reported in Table 4.5 are from a random-effect panel data model. According to the Hausman test statistics (Green 2003) the random effect model can be considered as superior to fixed effect model as there is no significant correlation between the unobserved individual random effect and the regressors. The coefficient estimates and the directions of the effects were invariant to different model specifications. The model with the highest R^2 value is reported in Table 4.5. The coefficient estimates indicate that the higher the total FAFH expenditure, household head's age and household income the higher the DQI changes and therefore, the larger the diet quality improvement. It is also interesting to see that when households have children, the DQI-change would significantly improve. This is an indication that the TFAs recipe changes might have higher positive impacts on the quality of food purchased by households with children. Given the fact that restaurant recipe changes would considerably alter the TFAs content of French Fries, Chicken Nuggets and other food products favourably, with these products being products often demanded by children (Table 4.1), this result could be considered as consistent with the potential impact of recipe changes. When compared to households in the Atlantic Provinces, the DQI is significantly lower for households in the West Coast and Ontario, and significantly higher for households in Quebec. As compared to English speaking households, the DQI change is significantly lower for French speaking households

and other language speaking households, and significantly higher for Chinese speaking households.

This analysis has shown that over the period March 2001 to February 2005 (no recipe change had actually occurred), if restaurant recipes had been changed, FAFH consumers would have had higher quality diets. In addition, it was found that the overall diet quality of households, who spend more on FAFH, with more income and with higher ages, would have significantly increased. In addition, the diet quality of households who have children would have significantly increased as compared to households who do not have children. Comparing these results to the study undertaken by Health Canada, this analysis provides more detailed information. For an example instead of considering only the effect of TFAs intake, this analysis provides the impact of overall diet quality of FAFH consumption associated with voluntary TFAs recipe changes by some restaurants. In addition, in a similar way to the Trans Fat Task Force study, this study illustrates potential improvements in diet quality even if a small subset of restaurants had changed recipes in the past and behaviour had not changed.

4.5.2. Part 2: Structural Change in FAFH Expenditure

Any change in recipe could also lead to behavioural changes by consumers. Possible changes include reduced purchases (changes in taste) or increased purchases (healthier, therefore can eat more) among many others. Therefore, this section is devoted to analyzing changes in FAFH consumption, which have occurred with recipe changes as one possible explanatory variable, using data on the households' expenditure on FAFH as an endogenous variable.

4.5.2.1. Theoretical Framework

In this study it was decided to model the FAFH demand using categorical purchases from six restaurant categories: A&W, Harvey's, KFC, Wendy's, other fast foods and all other restaurants. One problem with the above categorized foods

(in the form of meals) purchases in the FAFH market is that for many items in the budget, households were observed to spend zero amounts on meals/foods from the type of restaurant under consideration. Therefore, a censored demand analysis approach is required. Haines *et al.* (1988) argue that food consumption decisions should be modeled as a two-stage decision process where not only are the decisions separate, but also the determinants of each decision may differ. The general two-step process is typically represented by a first-stage dichotomous choice model of whether to purchase or not. Then a second-stage consumption model using purchase observations is augmented with an additional variable (the inverse Mill's ratio) to control for selection bias (Heckman 1978). These types of demand models are common and have been applied to general models of food consumption (Schmit *et al* 2002). Heien and Wessells (1990) examined dairy product demand using method developed based on Ameniya's (1974) two step approach. Unlike Heckman's (1978) approach, Heien and Wessells used all of the observations in both steps. Byrne *et al.* (1996) and Nagya (1996) have used Heien and Wessell's method in modelling FAFH demand. Another two-step method is proposed by Shonkwiler and Yen (1999) to overcome some of the estimation inefficiencies of Heien and Wessell's method. According to Tauchman (2005), all available two-step estimators are asymptotically inefficient compared to Full Information Maximum Likelihood (FIML) estimation approach, which is computationally difficult to apply.

In panel data context, one has to allow for unobserved household heterogeneity and state dependence as there is an assumed relationship between current and prior period selection. Yet, in panel data, many estimators assume that selection bias is due to time invariant individual effect (Vella and Vebreek 1999). But such biases can be also operated through time varying individual effects (see Vella and Vebreek 1999 for more details).

Consider the following model where equation (a) is the primary equation while (b) is the reduced form equation based on selection rule. The censoring and selection rules are in equations (c) and (d).

$$y_{it}^{*} = m_1(x_{it}, z_{it}; \theta_1) + \mu_i + \eta_{it} \quad \text{(a)}$$

$$z_{it}^{*} = m_2(x_{it}, z_{i,t-1}; \theta_1) + \alpha_i + \upsilon_{it}, \quad \text{(b)}$$

$$z_{it} = h(z_{it}^{*}, \theta_3), \quad \text{(c)}$$

$$y_{it} = y_{it}^{*} \text{ if } g_i(z_{i1}, \ldots\ldots z_{iT}) = 0,$$

$$y_{it} = 0 (\text{unobserved}) \text{ if } g_i(z_{i1}, \ldots\ldots z_{iT}), \quad \text{(d)}$$

where i indexes households and t indexes time; y_{it} is the observed dependent variable and it is 1 if certain values of z_{it} are observed and 0 if certain values of z_{it} are unobserved; y_{it}^{*} is the corresponding latent variable ; Z_{it} is the vector of these exogenous factors; θ is vector of parameters relating Z_{it} to y_{it}. The equation's errors comprise random individual effects, μ_i and α_i and random individual specific time effects η_{it} and υ_i .

Unfortunately, inclusion of both time invariant individual effects and time variant individual effects complicate the model estimations in terms of correcting for selection bias (see Vella and Vebreek 1999 and Wooldridge 1995for more details). Wooldrige (1995) has introduced a fixed effect modelling method for testing and correcting for selection bias in linear unobserved components in panel data models by allowing unobserved components to be correlated with the observable explanatory variables. However, Wooldridge's method require a standard probit or Tobit regression for each time period followed by a multivariate linear regression, regardless of the time series properties of the errors. In this study context however, application of methods introduced by Vella and Vebreek (1999) or Wooldridge (1995) is complicated given the nature of restaurant categorization, the two levels of model estimations and system estimation with interactions. It is well known that selection models, with time

varying selection effects, have difficulties achieving convergence when estimated with maximum likelihood and other efficient estimators. For this reason, a practical solution here is to use a methodology, suggested by Heckman (1978), where selection bias that may arise due to time variant individual effects (effects of error components, η_{it} and v_i) are not taken into account.

To this end it is necessary to use a two-step modelling frame work that minimizes computational difficulties. Therefore, it is decided to use Heien and Wessll's estimation method extended to panel data context but without taking time specific individual effect into account. Moreover, in second stage estimation, Heien and Wessell's method facilitate use of a system of equations which may be suitable for analysing categorised restaurant purchases. In addition, as our focus is to identify relative differences in the impacts of factors considered rather than absolute values, Heien and Wessell's method seems adequate.

In the first stage, the decision to consume foods from different types of restaurants can be modeled as a dichotomous choice problem,

$y^*_{mht} = f(Z_{mht}, \gamma_{mt}) + U_{mht}$, and

$y_{mht} = 1$ if $y^*_{mht} > 0$

$y_{mht} = 0$ if $y^*_{mht} \leq 0$

where y_{mht} is the observed dependent variable and it is 1 if the h^{th} household consumes from m^{th} restaurant at time t and 0 if the household does not consumes from that particular restaurant type, y^*_{mht} is the corresponding latent variable which may depend on the exogenous factors such as advertising, habits, household's socio-demographic factors and other variables, Z_{mht} is the vector of these exogenous factors. γ_{mt} is vector of parameters relating Z_{mht} to y_{mht}, and U_{mht} is normally a distributed error term.

Then, given the assumption that U_{mht} is normally distributed, the probability that household *h* makes positive purchases from restaurant *m* in time *t* is represented as:

$$\text{Prob}\ (y_{mht}=1)=\phi(Z_{mht},\gamma_{mt})=\frac{1}{\sqrt{2\pi\sigma_{\alpha}^{2}}}\exp\left\{\frac{-\gamma,Z_{mht}^{2}}{2}\right\} \qquad (1)$$

where $\phi\,(Z_{mht},\gamma_{mt})$ is the cumulative normal distribution evaluated at (Z_{mht},γ_{mt}). Equation (1) can be specified for each restaurant type in the FAFH market and can be estimated with probit techniques (Ameniya 1981).

Next, for h^{th} household in the m^{th} restaurant type in time *t* (who may or may not consume foods from a particular restaurant), we calculate the inverse Mills ratio (R_{mht}). The inverse Mills ratio can be calculated from the above probit analysis and will be used as an additional variable to incorporate the censoring latent variables in the second stage estimation of the demand relations. From the maximum likelihood estimates in equation (1), R_{mht} for the household who consumes foods from a particular restaurant type is calculated as:

$$R_{mht}=\ \text{ɵ}(Z_{mht},\gamma_{mt})\ /\Theta\ (Z_{mht},\gamma_{mt})$$

where ɵ and Θ are the standard normal density and cumulative probability functions respectively. The inverse Mills ratio for households who do not consume any foods from a particular restaurant type is estimated as:

$$R_{mht}=\ \text{ɵ}(Z_{mht},\gamma_{mt})\ /\ (1-\Theta\ (Z_{mht},\gamma_{mt}))$$

For the second stage of analysis, an expenditure share equation introduced by Deaton and Muellbauer (1980, p.19), called the Working-Lesser model can be used. While there are many model specifications that can be used in food demand analysis, the Working-Lesser model has been identified as a suitable model for demand estimation of FAFH (Byrne and Capps 1996). Banks *et al.* (1997) also

found that the Working-Lesser model could not be rejected for food demand estimations. Recently, Browning and Collado (2007) have used the Engle curve form of the QAIDS (quadratic log formulation) in their study and found that none of the quadratic terms of log total expenditure were significant. Therefore, they have used a model similar to Working-Lesser, augmenting the QAIDS model. According to Deaton and Muellbauer (1980), in this specification, it is usually assumed that all households face identical prices so that explanation of behavioural differences is sought through differences in total expenditure and household characteristics. This assumption may be plausible for Canadian the FAFH market as a preliminary data collection of restaurant menu prices revealed that there are no actual price differences for menus in two major cities in Alberta and Ontario. In this research context, this assumption allows the viewing of household's expenditure on foods as value-weighted quantities (Stewart et al 2004). According to Stewart *et al.* (2004), viewing prices as weights for aggregating purchases in this way is consistent with classical demand theory. The model is specified as:

$$w_{mht}=\alpha_{mht}+\beta_m \log x_{ht} + \varepsilon_{mht} \qquad (2)$$

where w_{mht} is household *h*'s expenditure share in restaurant type *m*, and in time *t,* and x_{ht} denotes the total expenditure. α_{mht} and β_m may depend on household characteristics and other exogenous factors. Since there is no price variation, in this model, the required homogeneity of demand functions does not play any role. However, the adding up property is important and to fulfill that, it requires that $\sum w_{mh}=1$ and this could be satisfied provided that $\sum \alpha_{mh}=1$ and $\sum \beta_{mh}=0$. Equation (2) can be specified as follows to obtain the step two specifications, incorporating the inverse Mills ratio:

$$w_{mht}=\alpha_{mht}+\beta_m \log x_{ht} + \delta R_{mht} + \varepsilon_{mht} \qquad (3)$$

where w_{jit} is household i's budget share of commodity j in period t, and x_i denotes the total expenditures. The parameters α_{jit} and β_{jit} may depend upon household characteristics, like family composition, age, income and the regional differences. Model can be also extended to include restaurant advertising expenditure and a media index using translating approach (Pollack and Wales 1981). The random term ε_{jit} capture unobservable differences between households. Since the objective is to find evidence of changes in demand for FAFH, a dummy variable to capture the time of recipe change was used in each of the equations in the demand system. Various researchers have used dummy variables to capture activities of marketing agencies or an event such as introduction of government policy (Tansel 1993; Burton and Young 1996). In explicit modelling of structural change it is common to use dummy variables to account for seasonal changes in consumption (Moshini and Moro 1996).

4.5.2.2. Empirical Model

The theoretical framework and the model specification suggest estimation of the following equations;

$$ES_{jit} = f(\log TE_{it}, D_j, HHA_{it}, HHI_{it}, HHC_{it}, HFL_i, RG_{it},) \qquad (4)$$

where ES_{jit} is the i^{th} household's expenditure share on j^{th} restaurant (A&W, Harvey's, KFC, Wendy, other fast food restaurants, and all other restaurants) in period *t* (six years from March 2001 to February 2007- a year consisted of 12 months from March 1st to February 28th); TE_{it} is the deflated (by regional Consumer Price Index (CPI)), i^{th} household's total expenditure on FAFH in period *t;* D_j is the dummy variable to capture the time of recipe change in j^{th} restaurant ; HHI_{it} is the income of the households; HHA_{it} is the average age of the household head; Dichotomous variables were used to identify the regions where households live (RD_{it}) . For region variable, ten Canadian provinces were categorized into 5 main regions: West Coast, Prairie provinces, Ontario, Quebec, and Atlantic

Provinces. A dichotomous variable is also used for Household composition (HHC_{it}) and ethnic differences (HFL_{it}). For descriptive statistics on these variables, see Table 4.6.

Table 4- 6: Descriptive Statistics for the Sample in Part Two of the Study (March 2001 to February 2007)

Variable definition	***Variable name and sub-groups***	***Mean (March 2001-February 2002)***	***Mean (March 2002-February 2003)***	***Mean (March 2003-February 2004)***	***Mean (March 2004-February 2005)***	***Mean (March 2005-February 2006)***	***Mean (March 2005-February 2006)***
Dependent variables							
Expenditure shares							
A&W	**ES1**	0.05	0.05	0.04	0.05	0.03	0.06
Harvey's	**ES2**	0.02	0.02	0.02	0.01	0.01	0.01
KFC	**ES3**	0.06	0.04	0.05	0.05	0.06	0.04
Wendy's	**ES4**	0.03	0.03	0.03	0.03	0.03	0.03
Other Fast food Services	**ES5**	0.27	0.31	0.30	0.30	0.25	0.28
All other services	**ES6**	0.57	0.53	0.56	0.56	0.60	0.58
Independent variables							
Total FAFH expenditure (deflated)	TED	193.23	187.04	190.02	192.72	200.15	194.70
Restaurants' advertising expenditure (million $)	AD						
A&W	**AD1**	0.19	0.23	0.20	0.22	0.27	0.28
Harvey's	**AD2**	0.18	0.18	0.17	0.16	0.21	0.16
KFC	**AD3**	0.47	0.48	0.46	0.57	0.59	0.62
Wendy's	**AD4**	0.45	0.46	0.57	0.58	0.66	0.65
Other Full Services	**AD5**	5.20	5.04	5.24	5.49	5.94	6.30
All others	**AD6**	1.63	1.63	1.72	1.87	1.87	2.13
Annual income of household	HHI	39795	39754	39549	42397	42540	41434
Age of household head	HHA	51	52	53	54	55	56
Region	**RD**						
West Coast=1, otherwise=0	RD1	0.22	0.22	0.22	0.22	0.22	0.22
Prairie Provinces=1, otherwise=0	RD2	0.32	0.32	0.32	0.32	0.32	0.32
Ontario=1,otherwise=0	RD3	0.32	0.32	0.32	0.32	0.32	0.32
Quebec=1, otherwise=0	RD4	0.04	0.04	0.04	0.04	0.04	0.04
Atlantic Provinces=1, otherwise=0	RD5	0.10	0.10	0.10	0.10	0.10	0.10
Household composition	**HHC**						
Households without children	0	0.75	0.75	0.75	0.75	0.76	0.77
Households with children (<12 yrs)	1						
Household's first	**HFL**						

language							
English=1; otherwise=0	HFL1	0.84	0.84	0.84	0.84	0.84	0.84
French=1; otherwise=0	HFL2	0.04	0.04	0.04	0.04	0.04	0.04
Chinese=1;otherwise=0	HFL3	0.02	0.02	0.02	0.02	0.02	0.02
Other=1;otherwise=0	HFL4	0.10	0.10	0.10	0.10	0.10	0.10

Source: NPD CREST data

As indicated in Table 4.6, in the expenditure share variable, the highest share is attributed to 'all other services' category while the lowest share is attributed to Harvey's restaurants. 'All other services' category represents all the other restaurants which are largely specialized in providing full services, bars, retail food services and other services which do not categorised as fast food restaurants (NPD CREST data). The average total annual expenditure on FAFH by a household ranges from $187 to around $200. The other variable descriptions are comparable to the study sample in Table 4.3.

The demand for FAFH from different restaurants may be contemporaneously correlated through the error term. In this case Seemingly Unrelated Regression (SUR) estimates would be unbiased, asymptotically consistent, and efficient (Griffith *et al.* 1992). Therefore, the above equations were estimated as a system of equations using SUR. The model estimations are provided in Table 4.7 and 4.8.

Table 4- 7: Parameter Estimates for the Probit Model

Variable	***A&W***	***Harvey's***	***KFC***	***Wendy***	***Other Fast Foods***	***Other Full Service***
Intercept	0.201 (0.471)	-2.003** (0.741)	0.765 (0.503)	-0.114 (0.475)	2.790** (0.961)	-0.371 (1.143)
LTE (Deflated & log total expenditure)	0.116*** (0.033)	0.153*** (0..037)	0.232*** (0.033)	0.184*** (0.033)	0.389*** (0.082)	1.921*** (0.308)
AD (Advertising expenditure)	-0.987 (1.571)	-1.245 (3.319)	-0.391 (0.033)	0.635 (0.646)	-0.202 (0.156)	0.475 (0.578)

HHI (Household income)	-0.000006* (0.000003)	-0.000001 (0.000004)	-0.00001** (0.000003)	0.000007* (0.0000003)	-0.0000002 (0.000004)	0.000002 (0.000006)
HHA (Age of the household head)	-0.018*** (0.004)	0.011* (0.005)	-0.010* (0.004)	0.001 (0.005)	-0.859 (0.006)	-0.012 (0.009)
HHC (Household composition)	0.419** (0.149)	0.019 (0.186)	0.005 (0.145)	-0429 (0.148)	0.127 (0.218)	0.768* (0.296)
HHED (Household head's education)	0.221* (0.105)	0.103 (0.132)	-0.005 (0.108)	-0.568*** (0.128)	0.044 (0.148)	-0.199 (0.175)
Region						
RWC-West Coast	0.880*** (0.188)	-0.468* (0.265)	-0.817*** (0.188)	-0.737*** (0.194)	-0.472 (0.318)	0.118 (0.356)
RPP-Prairie Provinces	0.496** (0.178)	-0.129 (0.237)	-0.620*** (0.175)	-0.767*** (0.188)	-0.683* (0.298)	0.277 (0.322)
RON- Ontario	-0.638** (0.191)	0.377 (0.232)	-0.236 (0.174)	-0.341* (0.184)	-0.401 (0.310)	-0.039 (0.323)
RQB-Quebec	-0.355 (0.317)	0.915*** (0.320)	-0.432 (0.288)	-1.100 (0.333)	-0.883* (0.401)	-0.324 (0.509)
RAT- Atlantic Provinces						
Fraction of correct prediction	**70.62%**	**87.02%**	**67.75%**	**74.18%**	**90.98%**	**94.80%**

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

Table 4- 8: Parameter Estimates Using System Estimation

Variable	***A&W***	***Harvey's***	***KFC***	***Wendy***	***Other Fast Foods***	***Other Full Service***
Intercept	0.096** (0.024)	-0.015 (0.018)	0.106** (0.031)	0.037 (0.024)	0.527*** (0.061)	0.247** (0.075)
LTE (Deflated & log total expenditure)	-0.016*** (0.002)	-0.002 (0.002)	-0.027*** (0.004)	0.002 (0.003)	-0.031*** (0.008)	0.074*** (0.012)
AD (Advertising expenditure)	-0.708 (0.74)	0.023 (0.065)	0.016 (0.037)	0.035 (0.027)	-0.002 (0.006)	-0.002 (0.025)

D-dummy – to capture the time of recipe change	**0.028** (0.009)**	**-0.003 (0.005)**	**-0.0018* (0.008)**	**-0.003 (0.007)**		
HHI (Household income)	-0.0000005* (0.0000002)	0.0000001 (0.0000001)	-0.0000002 (0.0000002)	-0.00000003 (0.0000001)	0.0000007 (0.0000004)	0.000001** (0.0000006)
HHA (Age of the household head)	-0.0007* (0.0003)	0.0006** (0.0002)	0.00008 (0.0003)	0.00009 (0.0002)	-0.001 (0.0007)	0.001 (0.0009)
HHC (Household composition)	0.015 (0.010)	-0.004 (0.006)	-0.028* (0.011)	-0.020* (0.008)	0.083*** (0.022)	-0.121*** (0.027)
Region						
RWC-West Coast	0.052*** (0.13)	-0.006 (0.008)	-0.052*** (0.014)	-0.010 (0.011)	-0.054* (0.029)	0.072* (0.035)
RPP-Prairie Provinces	0.034** (0.013)	-0.00001 (0.007)	-0.052*** (0.014)	-0.023* (0.011)	-0.084** (0.028)	0.125*** (0.034)
RON- Ontario	-0.023* (0.13)	0.011 (0.008)	-0.004 (0.014)	-0.003 (0.011)	-0.041 (0.028)	0.061* (0.035)
RQB-Quebec	-0.014 (0.027)	0.083*** (0.016)	-0.019 (0.030)	-0.001 (0.023)	-0.060 (0.059)	0.013 (0.079)
RAT- Atlantic Provinces	Reference Group					
Ethnic differences						
HFL1- English speaking	Reference Group					
HFL2- French Speaking	-0.017 (0.024)	0.035* (0.014)	-0.004 (0.026)	-0.033* (0.019)	0.023 (0.051)	0.043 (0.062)
HFL3-Chinease Speaking	-0.020 (0.030)	-0.005 (0.018)	0.015 (0.033)	-0.032 (0.025)	-1.143* (0.064)	0.186*** (0.042)
HFL4-Other Language Speaking	0.030 (0.013)	-0.021** (0.007)	-0.034* (0.014)	-0.010 (0.010)	-0.016 (0.028)	0.052* (0.028)
ML (Mills ratio)	0.004 (0.001)	-0.016*** (0.002)	0.012*** (0.001)	0.001 (0.001)	-0.001 (0.188)	0.000005 (0.002)
R2	0.1707	0.0229	0.1992	0.0572	0.0717	0.1474

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

Source: Estimated by author

In these models analysis, in stage one, the probit estimations were used to describe the decisions to spend at a particular restaurant type and to obtain the inverse Mills ratio. These estimations were then used as additional variables to incorporate the censoring latent variables in the second stage of the estimation. Probit estimations of these models provide a measure of the impact of the selected independent variables on the probability of selecting particular restaurant type for households who have purchased from that restaurant category. As provided in Table 4.7, there are significant differences in the impact of selected variables on the probability of selecting different restaurant types analysed. The main objective of this analysis being the identification of structural change associated with restaurant recipe change, the model in the stage two is discussed in detail in the following section.

According to Table 4.8, the coefficient estimates for the dummy variables, which are used to model the time of TFA related recipe changes, provide evidence of changes in expenditure spending on selected restaurants. As shown in Table 4.8, A&W shows a higher expenditure share, after the change in the A&W recipes. In other words, with a reduction of TFAs in menu items, consumers have spent more on A&W foods. KFC's expenditure share is significantly lower after their recipe change, indicating that consumers spent less on KFC foods after a reduction in TFA content of their menu items. Expenditure share changes for Harvey's and Wendy's show negative but statistically insignificant effects. However, it should be noted that given the fact that analysis is based on yearly aggregated data, the times of recipe changes were captured as changes in specific years, instead of in specific months (Table 4.1). In addition, as the study sample consists of data only from March 2001 to February 2007, expenditure data for A&W and KFC after recipe changes are limited (A&W and KFC change their recipes in January 2007).

The effects of total FAFH expenditures on expenditure shares are significantly negative for A&W, KFC and other fast food restaurants while the coefficient for the of 'all other services' restaurant category is significantly positive. The

restaurant advertising expenditures do not show any significant impact on expenditure shares. The coefficient estimates for household income are significantly negative for A&W and significantly positive for 'all other services'. The household head's age variable shows a positive effect on Harvey's expenditure shares and a negative effect on A&W expenditure shares.

For household composition, region and ethnic diversity, dummy variables are used. With reference to the households who do not have children, the coefficient for households having children is significantly positive for other fast food services and significantly negative for KFC and Wendy's, and 'all other services'. These results indicate that the households with children tend to spend more on fast food type restaurants as compared to all other restaurant types. Regional dummy variables were estimated, holding the Atlantic Regions as the reference group. As compared to households in Atlantic Provinces, households in West Coast spend significantly more on A&W and 'all other services, and less on KFC and other fast foods; households in the Prairie provinces spend more on A&W and 'all other services' and less on KFC, Wendy's and other fast foods; households in Ontario spend more on 'all other services' and less on A&W; households in Quebec spend more on Harvey's. The ethnic differences were estimated using the households' first language as a variable. The majority English speaking households were used as the reference group. As compared to English speaking households, French speaking households spend more on Harvey's and less on Wendy's restaurants; Chinese speaking households spend more on 'all other services' and less on other fast foods; other language speakers spend more on 'all other services' and less on Harvey's and KFC.

The part two of this study provides evidence of changes in relative spending on different restaurants after recipe changes, indicating the possibility that consumers have changed their behaviour in response to TFA recipe changes. Among the restaurants that have changed recipes during the sample period, A&W has captured a higher expenditure share after their recipe changes while KFC showed

a lower expenditure share after their recipe changes although the time period after recipe change is very short.

4.5.3. Part 3: Changes in Dietary Quality with Behavioural Changes

With the finding that there is a structural change in FAFH expenditure patterns in part two of this paper, it is important to analyse the actual diet quality changes before and after recipe changes allowing for FAFH consumers' behavioural change. For the comparison of actual diet quality changes, household purchases are analysed. Since annual aggregate purchases do not differentiate between foods purchased before and after the actual recipe changes, households who have purchased foods, during the month of February in 2006 and 2007 were selected as the basis of comparison. This selection of households enables analysis of food purchase patterns and actual overall diet quality before and after recipe changes in A&W, KFC and Wendy's restaurants. Applying the above criterion, 236 households were selected from the original NPD data. Descriptive statistics for these 236 households are given in Table 4.9. The total expenditure and overall DQI for foods purchases for the month of February in 2006 and 2007 were calculated and compared for these 236 households (Table 4.10).

Table 4- 9: Descriptive Statistics of the Sample in the Part Three of the Study (236 Households in February 2002)

Variable definition	*Variable name and sub-groups*	*Mean Feb 2002*
Annual FAFH expenditure	TED	197.50
Annual income of household	HHI	43713
Age of household head	HHA	54
Region	**RD**	
West Coast=1, otherwise=0	RD1	0.29
Prairie Provinces=1, otherwise=0	RD2	0.19
Ontario=1,otherwise=0	RD3	0.33
Quebec=1, otherwise=0	RD4	0.14
Atlantic Provinces=1, otherwise=0	RD5	0.05
Household composition	**HHC**	
Households without children	0	0.20
Households with children (<12 yrs)	1	

Household's first language	**HFL**	
English=1; otherwise=0	HFL1	0.81
French=1; otherwise=0	HFL2	0.12
Chinese=1;otherwise=0	HFL3	0.00
Other=1;otherwise=0	HFL4	0.07

Source: Study sample

As indicated by the Table 4.9, average income of the households is about $43700.00. The average age of the household head is 54 years. Most of the households do not have children. The average total expenditure on FAFH in month of February is about $60.75. Unlike the samples in the part one and the part two of the study, the majority of households are from Ontario, followed by the West Coast. The representation of households from Prairie Provinces and Quebec are similar, while the lowest representation of households is from Atlantic Provinces. Compared to study samples in part one and two of the study, this sample also can be considered to be a representative sample of the Canadian population. Therefore, the analytical results can be generalized. Again, it should be noted that overly broad generalizations can be misleading when applied to populations that were not well represented by a sample. For an example, there could be response biases introduced by the persistent participants in longer panel data samples such as NPD sample.

Table 4- 10: A comparison of Overall DQI and Total Expenditure of Selected Households- February 2002 and February 2007

	Feb 2002		Feb. 2003		Feb 2004		Feb 2005		Feb 2006		Feb 2007	
HHID	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses
2234*			**550**	**35.25**	**488**	**18.92**			**525**	**17.01**	**458**	**16.85**
4188					539	39.5	454	77.82	462	65	634	5
12421					419	100.3	455	100.96	354	99.35	359	33.64
16082*					**452**	**19.16**	**502**	**10.13**	**358**	**18.82**	**617**	**10.21**
18149*	**408**	**25.85**	**435**	**75.07**					**571**	**21.34**	**592**	**11.94**
20016*					**363**	**38.26**	**329**	**32.32**	**598**	**4.37**	**522**	**4.64**
22070	358	95	440	10.27	465	80.11			608	52	560	38.47
23498*	**446**	**65.25**			**567**	**135.75**	**506**	**137.74**	**468**	**68.25**	**543**	**72**
24056	416	14.4	706	2.25	403	21.72			647	55.53	483	4.95
26994			433	62.28			426	44	718	28	528	105
27063	438	155.1							523	127	508	87

27620*	**533**	**57.56**			**470**	**27.8**	**427**	**101.75**	**673**	**33.65**	**761**	**36.86**
29223*					**488**	**19.26**			**569**	**12.39**	**476**	**13.63**
30956	460	23.17	328	28.28					663	72.79	520	30.42
32267			271	76			356	38.72	437	8.43	377	19.87
33251*	**341**	**36.35**	**517**	**3.5**			**487**	**39.25**	**498**	**12.57**	**345**	**21.14**
33590	459	53			539	42.5	379	6	575	60.83	472	125.28
36099			557	182.11					665	18	460	91
36991			564	6.7					373	1.48	403	13.33
37171							371	81.05	460	164.7	517	67.1
37722			491	93.32	367	17.5			370	52.3	555	5.81
39704			487	95	432	40.74	371	95	422	122.6	573	50
41987			487	5.5	621	8	641	53.55	413	82.01	612	43
44681							407	45.19	630	20.6	437	32
44928*	**439**	**128.3**	**460**	**24.18**	**508**	**65.25**	**451**	**12.14**	**835**	**61.98**	**542**	**51.88**
45313			322	15					571	10.25	441	20.8
45887	405	138.73			384	204.85	512	259.49	541	180.46	525	243.98
47337							408	10.8	719	4.31	456	18.48
47764	354	50.34	491	3.43	445	100.63	405	133.65	384	53.2	473	24.14
50395									405	88.38	422	7.4
54542	597	89.58	412	48.98	376	167.14	679	101.2	718	2.8	447	170
54571	474	57	475	71	422	5.75			521	82.82	334	29
56148			507	36.18					534	24.1	520	10.13
58189*	**415**	**76.13**							**529**	**17.25**	**432**	**13.5**
58508	660	9.99	605	41.15					443	49.11	365	33.82
59981			342	166.1	467	74.02	450	97.37	372	159.67	300	39.41
64694	464	121.33							727	54.82	498	134.1
64818	613	9.98	370	24.5					529	5.23	377	61.84
67441							621	16.09	326	6	320	32.32
68398							395	26.6	400	157.99	408	340
70187*	**379**	**33.5**	**490**	**92.5**					**631**	**55.5**	**432**	**58.37**
70305	560	39.82					611	5.64	412	86.72	428	32.64
72154			385	17.6					432	20.75	716	35.44
74234	555	29.25							573	13.5	375	30.82
76545*	**430**	**24**	**559**	**11**	**635**	**40**	**642**	**25.03**	**451**	**5**	**516**	**14.5**
77983*	**486**	**26**	**358**	**30.18**	**554**	**55.71**			**737**	**6.23**	**452**	**12.7**
78051	534	80							618	28.92	545	45.5
78535	364	30.51	379	20.62	736	21.58			477	75.56	340	92.59
78553*									**433**	**42.77**	**301**	**46.37**
79686*							**464**	**22.2**	**737**	**13**	**342**	**21.23**
80864*			**423**	**76.28**					**443**	**57.58**	**418**	**65**
81655					441	176.38	417	67.37	258	108.35	470	64.73
82080	509	39.1					500	8.67	789	2.2	266	26.07
82229			457	79	296	77.36			439	30.87	287	190.61

82912*							**478**	**61.47**	**389**	**23.4**	**621**	**17.8**
83438	439	9.58							311	9.25	476	85.02
84010*	**446**	**25.62**	**369**	**13.9**			**471**	**117.93**	**600**	**54.65**	**483**	**53.31**
84024*	**586**	**2.65**	**459**	**4.11**	**461**	**3.41**			**739**	**3.3**	**806**	**1.32**
85063	361	351.62			426	72.68	486	130.85	371	127.98	629	59.84
85064	531	41.12	403	5.25	488	44.19	447	67.18	548	18.4	444	64.38
86013*			**508**	**16.4**			**473**	**22.5**	**456**	**40.2**	**645**	**39.98**
86431	670	71.61	436	75.87	459	92.72	489	130.22	444	45.59	822	8.4
86640	542	148.22							442	34.96	604	103.78
88389*									**469**	**32.62**	**704**	**38.51**
89447*					**401**	**197.9**			**331**	**17.24**	**427**	**10.8**
90505					583	25.57			594	25.75	532	116.94
93088			580	10.74					339	1.25	402	14
95432*			**477**	**33.28**					**451**	**24.11**	**528**	**24.53**
96662*	**560**	**21.86**			**408**	**57**	**740**	**97.87**	**367**	**30.22**	**356**	**26.47**
96690	497	25.91			419	23.92			512	3.41	710	28.15
97252					340	58.24	451	22.69	440	16.51	324	29.58
97359*	**473**	**44.87**							**433**	**149.2**	**372**	**144.6**
97484	521	76.36					455	75.12	618	27.7	413	105.31
97595	520	74.2							516	161.82	481	315.16
97720	554	36.24							321	51.41	438	13.73
97769									588	47.61	464	7
97816							395	11.56	450	5.8	436	33.88
98445*									**627**	**13.9**	**386**	**22.97**
99170*	**531**	**2.43**					**334**	**6**	**440**	**13.2**	**668**	**4.4**
100213					299	10.73			516	21.28	617	43.4
101544*	**542**	**60**	**201**	**55.15**					**343**	**37.63**	**368**	**29**
104054			633	156.54	552	15			510	35	591	79.16
104289					492	76.54			596	2.55	656	70.26
104473							494	9.1	543	8.11	742	30.13
104483			603	18.04	517	8.36	415	2.58	632	25.28	673	19.09
104663	482	46	533	104.72	447	62.43	429	116.26	366	281.81	382	43.59
105325*	**438**	**66.9**	**570**	**18.31**	**493**	**12.36**	**492**	**46.93**	**427**	**16.36**	**845**	**12.48**
107290	431	174.36	522	9.3	432	44.47			528	22.06	467	57.38
107566					531	36.1			418	74.92	617	11.51
108282	378	96.51	493	30.58					373	56.77	652	36.15
109272	429	162.9							388	16.2	699	110.11
116740*	**432**	**42.5**	**610**	**5.35**					**406**	**8.99**	**637**	**10.04**
117193	427	4.37	597	11.86			662	87.13	607	28.73	716	7.1
117566			557	19.41	577	4.2			573	7.19	525	35.86
118665	545	5.5					631	8.7	402	4.5	663	29.9
118732	556	107.17	500	134.05			510	104.45	326	98.07	517	266.92
118951					532	16.31	372	85.97	335	40.37	510	12.96

119848	541	158.23	412	285.29	471	123.15	423	297.62	454	28.79	443	246.11
122472			252	48	659	32	297	28.5	635	8	579	31
123294			538	42.23			405	50.08	474	79.88	407	67.55
123589*	**346**	**102**	**466**	**42**					**432**	**20**	**333**	**9.5**
124771*	**620**	**9**			**491**	**25**	**539**	**54.77**	**566**	**18.5**	**463**	**22.37**
125242			471	73.8	535	84.65			424	43.8	457	96.65
126850									521	30.48	381	76.68
127750	366	73.5	377	80	570	45			428	24.5	733	18
128109			358	12.67			365	80.63	475	18.23	520	54.13
128171*									**546**	**31.69**	**399**	**24.5**
129417	431	29.89					446	102.29	430	126.76	460	67.52
129643*									**427**	**1.2**	**703**	**2.75**
130644					652	37			690	86.6	535	27.45
133968			439	32.38	420	145.44			610	10.48	524	121.85
136119							390	129.59	459	90.16	418	42.75
136129	554	59.05							473	85	361	58.53
136553	418	22	402	2.25	453	35.39	496	12	556	77.16	511	61.29
136900			578	176	451	71	430	99	430	8.53	424	36.7
138588			542	104.56	440	48.71	379	154.16	443	91.5	450	141.28
141422									330	71.14	506	182.15
142277									666	15.99	424	87.87
142320			610	9	433	59.5			583	225.5	610	155.94
143749*	**508**	**25.2**	**369**	**13.5**	**627**	**23.63**	**453**	**19.08**	**717**	**17**	**531**	**17.99**
145026*	**674**	**1.7**	**416**	**6.5**					**486**	**4.15**	**520**	**2**
146828					465	10.4			572	53.78	658	9.68
147436			553	105	416	83.28			510	67.34	540	134.8
147797	350	31.89			335	86.48			491	68.14	425	233
148953	352	72.26	538	38.69			533	65.17	418	11.43	437	26.5
156082									343	80.72	581	110
157591	322	48.99			447	31.13	358	53	505	16	632	36.9
158268									442	72.96	556	24.85
158473	375	4.45	522	5.79			652	6.16	433	73.75	397	19.78
159197	342	98.45	481	178.1					502	415.37	301	267.38
162297*	**463**	**7**	**703**	**7.35**					**502**	**33**	**514**	**42**
168111			591	22.5	684	26	549	29	363	14	352	43
168469									478	23	613	11
170199			620	14.9	732	93.49			661	45.78	475	57.57
170330							574	19.21	523	59.25	559	106.15
171316*			**641**	**19.2**			**554**	**10**	**661**	**24.5**	**709**	**20**
182313	384	113.28	527	34.05					733	74.4	703	42.95
182398*							**502**	**8.97**	**635**	**15.96**	**457**	**19.47**
184171*			**512**	**40**	**404**	**20**	**728**	**12**	**374**	**18**	**470**	**20**
185567			456	190.48					633	98.98	565	60.03

186803			530	101.93	469	69.05	383	206.85	581	35.49	554	85
188551*	**456**	**22**	**467**	**156.34**					**463**	**55.41**	**484**	**49.15**
194871*									**439**	**14.55**	**502**	**14.08**
194912*					**574**	**81.8**			**408**	**78.66**	**541**	**80.47**
199469									630	4	535	92.49
200087*	**417**	**46.46**	**458**	**13.34**	**346**	**74.69**			**366**	**1.5**	**424**	**4.24**
200946			583	156.03					480	188.74	332	70.75
206521			**624**	**4.09**					**422**	**1.79**	**515**	**8.09**
207228							632	53.36	500	102.27	529	80.43
210463			566	71.35					480	35.44	621	68.79
210940					399	22.52			357	9.9	448	67.07
211170							320	92.6			800	8
211650*									**497**	**76**	**544**	**71.45**
214127							461	69.52	389	84.5	468	180.86
214276							362	125	537	89	327	114
216971									441	84.48	424	98.32
217213			458	53.48	679	13.65	423	22.73	391	36.65	540	48.1
217533			659	25			545	39.84	351	14.4	737	52.2
218508									309	112.6	390	93.5
219036									330	110	438	259
219322									426	139	699	120
220217							443	123.53	471	82.17	354	102.48
220568					552	22.7	507	39.15	414	30.2	392	54.48
224454					529	81.1			479	20	519	73.08
225246							550	112.29	510	32.53	438	12
225771*									**807**	**33.14**	**400**	**43.1**
233728			644	183.48	585	7.52			370	76.06	534	189.45
233927									382	16.93	388	45.79
234501					546	42.5	364	49	360	70.13	407	44.02
234929									241	25.35	487	1.47
236028									407	40	422	8.59
237185							652	42	443	8	419	82
237555*							**546**	**27.35**	**308**	**58**	**429**	**49.5**
238736*							**574**	**9.9**	**560**	**19.55**	**573**	**18.84**
241034							517	10.7	540	31.5	573	53
253554									318	83.32	618	29.46
300443*									**427**	**58.6**	**349**	**64.09**
300861*							**486.0**	**17.75**	**430**	**30**	**527**	**37.53**
301332							568.1	85.75	427	16	428	35
301383							522.3	42.03	425	23.98	566	34.44
301563							501.7	82.71	662	52.65	520	2.7
301962*							**437.3**	**34.26**	**531**	**24.92**	**557**	**22.73**
304689							283.0	27.8	572	53.29	506	11.03

306071		405.8	13	788	15.27	473	27
308255		353.5	55	596	101	427	74.5
308865				596	104.9	463	322.78
309128				438	175.91	368	6.5
313664		449.8	117.12	624	8.48	445	87.49
314440				310	55.69	585	77.5
315656		497.7	119.12	480	61.47	477	183.97
319284		418.6	103.19	371	55	638	6.09
319961				418	25.47	539	11
321898				518	26.3	563	140.68
321900				429	3.62	606	103
324186		514.7	112.81	250	56.5	467	73.5
324917*				**518**	**64**	**495**	**65**
326230		543.2	34.71	490	47.99	533	146.19
326540*		**418.7**	**30**	**598**	**32.26**	**574**	**25.37**
326613		618.6	307.82	709	22.3	663	111
327136				425	84	440	36
328411		454.9	10.98	546	97.52	662	24.6
328934*		**518.1**	**47.23**	**545**	**26.7**	**573**	**28.88**
329431				632	25	544	117.56
330654*				**634**	**24**	**733**	**16**
331559				262	20.17	585	9.57
332928				654	52.1	441	21.92
333546*		**515.6**	**44.75**	**632**	**5**	**587**	**12**
333714				423	76.01	601	100.07
334036		530.7	53.89	572	87.1	298	25.82
334192		482.0	65.95	611	137.48	357	86.91
334260		**483.9**	**41.42**	**482**	**5.65**	**539**	**6.98**
334801		432.4	52.5	521	88	872	30.95
334821*		**339.4**	**28.97**	**550**	**12.6**	**789**	**12.7**
336743				520	33.53	851	16.98
337129				678	15.41	535	29.5
337868		511.5	44.73	622	34.04	729	13.3
339271				543	20.97	806	7.27
340169				405	73.25	648	148.85
341200				364	97.38	507	50.97
341377		356.2	117.15	403	7.5	362	20.55
344350		428.1	174.08	342	142.05	479	46.85
344881				421	19.55	458	43
346324		359.7	45.3	472	769	452	25
349532*				**375**	**12.65**	**416**	**18.5**
354481				468	159.5	555	61.5
363066				524	195.5	550	71.01

364513									486	145.27	479	39.33
364859									607	85.6	369	29.5
365858									602	49	555	31
367089*									**468**	**33.5**	**716**	**43**
368205									376	84.25	374	37
369140									596	58.24	350	86.26
372553*									**558**	**10.25**	**755**	**18.37**
372800									451	27	391	159.35
373811									458	188	390	58.82

*Households with similar spending patterns during both February 2006 and February 2007

Source: Compiled by author

According to Table 4.10, there are large differences in overall DQI and total FAFH expenditure in February 2006 and February 2007. As the diet quality changes are affected by the total FAFH expenditure (some evidence was found in the part one of this study-see table 4.5), households with similar spending patterns were selected for the comparison. In the above sample, about 27% of the households (64 out of 236) show a similar spending pattern. Of these households about 60% (39 out of 64) show diet quality improvement (Table 4.11). However, 33 out of 39 households' diet quality improvements cannot be attributed to foods consumed from restaurants that changed recipes as these household have not purchased any foods from those restaurants during February 2007. The other six households have consumed foods from the restaurants that changed recipes as well as from the 'other restaurants' (see Table 4.12). For comparative purposes, earlier years' data is also provided in Table 4.12. Further analysis of recipes of their purchases (see Table 4.13) show that as household do not purchase similar menu items in two periods (February 2006 and February 2007) their diet quality improvement also cannot be directly attributed to the food consumption from restaurants that changed recipes.

Table 4- 11: Households Who Showed Diet Quality Improvements in February 2007 compared to February 2006

	Feb 2002		Feb. 2003		Feb 2004		Feb 2005		Feb 2006		Feb 2007	
HHID	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses	DQI	Expenses
16082					452	19.16	502	10.13	358	18.82	617	10.21

18149	408	25.85	435	75.07					571	21.34	592	11.94
23498	446	65.25			567	135.75	506	137.74	468	68.25	543	72.00
27620**	**533**	**57.56**			**470**	**27.8**	**427**	**101.75**	**673**	**33.65**	**761**	**36.86**
76545	430	24	559	11	635	40	642	25.03	451	5.00	516	14.50
82912							478	61.47	389	23.40	621	17.80
84024	586	2.65	459	4.11	461	3.41			739	3.30	806	1.32
86013**			**508**	**16.4**			**473**	**22.5**	**456**	**40.20**	**645**	**39.98**
88389									469	32.62	704	38.51
89447					401	197.9			331	17.24	427	10.8
95432			477	33.28					451	24.11	528	24.53
99170	531	2.43					334	6	440	13.20	668	4.40
101544	542	60	201	55.15					343	37.63	368	29.00
104483			603	18.04	517	8.36	415	2.58	632	25.28	673	19.09
105325	438	66.9	570	18.31	493	12.36	492	46.93	427	16.36	845	12.48
116740	432	42.5	610	5.35					406	8.99	637	10.04
127750	366	73.5	377	80	570	45			428	24.50	733	18.00
129643									427	1.20	703	2.75
145026**	**674**	**1.7**	**416**	**6.5**					**486**	**4.15**	**520**	**2.00**
162297	463	7	703	7.35					502	33.00	514	42.00
171316			641	19.2			554	10	661	24.50	709	20.00
184171			512	40	404	20	728	12	374	18.00	470	20.00
188551	456	22	467	156.34					463	55.41	484	49.15
194871									439	14.55	502	14.08
194912					574	81.8			408	78.66	541	80.47
200087	417	46.46	458	13.34	346	74.69			366	1.50	424	4.24
206521**			**624**	**4.09**					**422**	**1.79**	**515**	**8.09**
211650									497	76.00	544	71.45
237555							546	27.35	308	58.00	429	49.50
238736							574	9.9	560	19.55	573	18.84
300861							486.0	17.75	430	30.00	527	37.53
301962							437.3	34.26	531	24.92	557	22.73
328934							518.1	47.23	545	26.70	573	28.88
330654									634	24.00	733	16.00
334260							483.9	41.42	482	5.65	539	6.98
334821							339.4	28.97	550	12.60	789	12.70
349532**									**375**	**12.65**	**416**	**18.5**
367089**									**468**	**33.50**	**716**	**43.00**
372553									558	10.25	755	18.37

**Households purchased foods from restaurants that changed recipes (details are in Table 4.12)

Source: Compiled by author

Table 4- 12: The Households Who Had Shown Diet Quality Improvements and the Types of Restaurants That They Have Purchased Their Foods and Beverages

	year1		year2		year3		year4		year5		year6	
HHID	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant
16082					452	others	502	others	358	A&W/KFC	617	others
18149	408	others	435	others					571	others	592	others
23498	446	others			567	others	506	others	468	others	543	others
27620	**533**	**others**			**470**	**others**	**427**	**others/Wendy's**	**673**	**others**	**761**	**others/Harvey's**
76545	430	others	559	others	635	others	642	others	451	others	516	others
82912							478	others	389	others	621	others
84024	586	others	459	others	461	others			739	others	806	others
86013			**508**	**others/Harvey's**			**473**	**others**	**456**	**others/Harvey's**	**645**	**others/Wendy's**
88389									469	others	704	others
89447					401	others			331	others	427	others
95432			477	others					451	others	528	others
99170	531	others					334	others	440	others	668	others
101544	542	others	201	others					343	others	368	others
104483			603	others/Harvey's	517	others	415	others	632	others	673	others
105325	438	others	570	others/Wendy's	493	others	492	others/Wendy's	427	others/Wendy's	845	others
116740	432	others/A&W	610	others					406	others	637	others
127750	366	others	377	others/Wendy's	570	others			428	others	733	others
129643									427	others	703	others
145026	**674**	**others**	**416**	**others**					**486**	**A&W**	**520**	**A&W**
162297	463	others	703	others					502	others	514	others
171316			641	others			554	others	661	others	709	others
184171			512	others	404	others	728	others	374	others	470	others
188551	456	others	467	others					463	others	484	others
194871									439	others	502	others

194912					574	others			408	others	541	others
200087	417	others/Wendy's	458	others	346	others/Wendy's			366	others	424	others
206521			**624**	**others**					**422**	**others**	**515**	**others/KFC**
211650									497	others/KFC	544	others
237555							546	others	308	others	429	others
238736							574	others	560	others	573	others
300861							486.0	others	430	others	527	others
301962							437.3	others	531	others	557	others
328934							518.1	others	545	others	573	others
330654									634	others	733	others
334260							483.9	others	482	others	539	others
334821							339.4	others	550	others	789	others
349532									**375**	**others**	**416**	**others/A&W**
367089									**468**	**others/Wendy's**	**716**	**others/Wendy's**
372553									558	others	755	others

Source: Compiled by author

Table 4- 13: Details of Recipes Purchased by Households from Restaurants Which Changed Recipes

	year1		year2		year3		year4		year5		year6	
HHID	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant	DQI	Restaurant
27620	**533**	**others**			**470**	**others**	**427**	**others/Wendy's**	**673**	**others**	**761**	**others/Harvey's**
Details of recipes										Espresso, Cappuccino, Latte, Coffee with milk, poutine, French fries, chicken, soft drinks		Coffee with milk, chicken nuggets, donuts, poutine, subs, French fries/poutine, soft drinks
86013			**508**	**others/Harvey's**			**473**	**others**	**456**	**others/Harvey's**	**645**	**others/Wendy's**
Details of recipes										Hamburger, Salad, beer/ hamburger		coffee with milk, steak, fried fish, French fries/ hamburger, French fries, soft drinks
145026	**674**	**others**	**416**	**others**					**486**	**A&W**	**520**	**A&W**
Details of recipes										coffee with milk, cookies		cookies
206521			**624**	**others**					**422**	**others**	**515**	**others/KFC**
Details of recipes										Fried chicken sandwiches,		hamburgers/ Fried Chicken, French fries
349532									**375**	**others**	**416**	**others/A&W**
Details										grilled chicken		sushi/

of recipes										sandwiches, soft drinks		hamburger, soft drinks, French fries
367089									**468**	**others/Wendy's**	**716**	**others/Wendy's**
Details of recipes										tea, coffee, salads, French fries / salads main		ice cream, tea, bagel, French fries /hamburger, french fries, soft drinks

Source: Compiled by author

Despite the fact that there are no clear relationships between spending patterns, restaurant visits and DQI, the above observations indicate that given the consumers' behavioural changes in terms of taste, preferences or expenditure, restaurant recipe changes do not necessarily improve the overall diet quality of restaurant foods in the short term.

4.6. Conclusions

This study examined how some specific food industry changes on product formulations reducing TFAs could and have affected consumers overall diet quality in their demand for food away from home. Study objectives were achieved using three analyses.

From the first part of the analysis, it could be concluded that the restaurant recipe changes have the potential to improve overall diet quality of FAFH consumers, if, consumers can be assumed not to change their consumption behaviour significantly. Our results, in a similar way to the Trans Fat Task Force illustrate potential improvements in diet quality, even if only a small subset of restaurants changes recipes. It is worth noting that such recipe changes would potentially have a significantly positive effect on diet quality of households who have children as compared to households who do not have children through higher spending at chain restaurants. In addition, the higher the total FAFH spending, the household income and the age of the household head, the higher the diet quality improvements.

However, consumer behaviour is constantly changing. The second part of the analysis provides evidence of changes in relative spending on different restaurants after recipe changes, indicating that consumers have changed behaviour in response to TFA recipe changes. Among the restaurants that have changed recipes during the sample period, A&W has captured a higher expenditure share after recipe changes while KFC exhibited a lower expenditure share after their recipe changes.

Results of the third analysis provide some insights as to how the recipe changes have affected FAFH consumers' diet quality given the observed structural changes in the second part of the analysis. The analysis and comparison of DQI of selected households' food and beverage consumption during February 2006 and February 2007 provide some evidence that given the consumers' behavioural changes (taste, preferences or expenditure), restaurant recipe changes do not necessarily improve the overall diet quality of foods consumed from restaurants. Even though there are improvements in DQI of thirty nine households out of sixty four who have approximately similar expenditure patterns in February 2007 as compared to February 2006, there is no evidence that these DQI improvements are associated with recipe changes of A&W, KFC or Wendy's restaurants. Analysis of these particular household's purchasing patterns in February's of earlier year's shows enormous variability. When consumers' behaviour is fickle, assuming a positive diet quality response when certain restaurants voluntarily remove TFAs from some or all of their menu items may be unrealistic.

This study outcome yields some insights that can guide health policy programs in Canada. For an example, this study showed that food industry response through voluntary recipe changes could only be effective if there are no substantial changes in FAFH consumers' consumption behaviour. As well, we found evidence of structural change in FAFH consumers' expenditure patterns associated with the timing of recipe changes. Therefore, voluntary food industry response through changing recipes of selected popular menu items may not be very effective in improving the overall diet quality of FAFH consumers. The fact that the higher FAFH expenditure shares are attributed to the full service restaurants and other fast food restaurants, which may or may not have changed their recipes during this study period, indicates that there is a need to address the quality aspect of these restaurants' foods. However, a mandatory approach ensuring a low amount of unhealthy nutrients in basic ingredients of all foods and beverages will provide better quality diet in the FAFH market. This is only if the

new recipes do not result in an increase in other unhealthy ingredients. TFAs are only one, potentially negative component of individual prepared foods.

In our study we have only limited information on whether the other restaurants (other fast food restaurants, 'all other services' (full service restaurants and all other restaurants) have also changed their recipes. Some of the restaurants in these three categories are not chains and recipe changes to enhance diet quality would not receive any media coverage. A comprehensive survey of all restaurants is required to identify recipe changes for these restaurants. At the same time, over the time period analysed in this study, there are number of fast food, full service and other 'chain' restaurants that had not changed their recipes (These chains make up about 80% of FAFH expenditure for our sample in part two of the study- Table 6). Subsequent changes in their recipes would also contribute to an enhancement in diet quality.

4.5. Reference List

Ameniya, T. 1974. Multivariate Regression and Simultaneous Equation Models When the Dependent Variables are Truncated Normal. *Econometrica*. 42 : 999-1012

Andrews, D.W.K. 1993. Tests for Parameter Instability and Structural Change with Unknown Change Point. *Econometrica.* 61: 821-856.

Arellano, M. And S. Bond. 1991. Some Tests of Specification for Panel Data. *Review of Economic Studies*. 58:277-297

Arellano, M and O. Bover. 1995. Another Look at the Instrumental- Variable Estimation of Error-Component Models. *Journal of Econometrics*. 68:29-51

Ascherio,A., M.B.Katan, P.L.Zock, M.J.Stampfer, and W.C.Willett. 1999. Trans Fatty Acids and Coronary Heart Disease. *The New England Journal of Medicine.* 340, no. 25: 1994-98.

Astrup, A. 2006. The Trans Fatty Acid Story in Denmark. *Atherosclerosis Supplements*.7, no.2:43-46.

Atkins, F.J, W.A. Kerr, and D.B. McGivern. 1989. A Note on Structural Change in Canadian Beef Demand. *Canadian Journal of Agricultural Economics*. 37:513-524.

Banks, J., R.Blundell, and A. Lewbel. 1997. Quadratic Engel Curves and Consumer Demand. *Review of Economics and Statistics.* 79: 527-39.

Brown, R.L., J. Durbin, and J.M. Evans. 1975. Techniques for Testing the Consistency of Regression Relationships Over Time. *Journal of Royal Statistical Society*. 37:149-192.

Browning, M., and M.D. Collado. 2007. Habits and Heterogeneity in Demands: A Panel Data Analysis. *Journal of Applied Econometrics.* 22, no. 3: 625-40

Burton, M. P. and T. Young. 1996. The Impact of BSE on the Demand for Beef and Other Meats in Great Britain. *Applied Economics.* 28: 687-93.

Byrne, P. J., O. Capps. Jr., and A. Saha. 1996. Analysis of Food-Away-from-Home Expenditure Patterns for U.S. Households, 1982-89. *American Journal of Agricultural Economics,* 78, no. 3: 614-27.

Byrne, P. J., O. Capps. Jr., and A. Saha. 1998. Analysis of Quick Serve, Mid-Scale and Up-Scale FAFH Expenditure. *International Food and Agribusiness Management Review*. 1, no.1:51-72.

Chen, P. Y, and M.M. Veeman. 1991. An Almost Ideal Demand System Analysis for Meats with Habit Formation and Structural Change. *Canadian Journal of Agricultural Economic.* 39:223-235.

Chow, G.C. 1960. Test of Equality Between Sets of Coefficients in Two Linear Regressions. *Econometrica*. 28: 591-605.

Cox, D. R., J. D Skinner, B. R. Carruth, J. Moran III, and K. S. Houck. 1997. A Food Variety Index for Toddlers (VIT): Development and Application. *Journal of the American Dietetic Association.* 97: 1382-86.

CRFA. Canadian Restaurant and Food Service Association. 2006. "Monthly Food Service Monitor." Web page[accesses 2006]. Available at http://www.crfa.ca/research/statistics/monthly ffodservicemonitor/.

CSPI. Center for Science in the Public Interest. 2008. "Trans Fat". Web page [accessed 2008]. Available at http://www.cspinet.org/transfat/index.html.

CSPI. Center for Science in the Public Interest. 2008. "Most "Volunteers" in Restaurant Industry's Nutrition Information Program Stepped Back Two Paces". Web page [accessed 2008]. Available at http://cspi.cc/canada/pdf/twopacesback.pdf

Davis, C.G. 1997. The Logic of Testing Structural Change in Meat Demand: A Methodological Analysis and Appraisal. *American Journal of Agricultural Economics.* 79, no. 4: 1186-92.

Deaton, A., and J. Muellabauer. 1980. Economics and Consumer Behaviour. Cambridge: Cambridge University Press.

Deaton, A., and J. Muellabauer. 1980a. An Almost Ideal Demand System. *American Economic Review* 70: 312-26.

Drescher, L.S. 2007. "Healthy Food Diversity as a Concept of Dietary Quality – Measurement, Determinants of Consumer Demand, and Willingness to Pay." PhD Dissertation. University of Keil, Germany.

Drewnowski, A. 2005. Concept of a Nutritious Food: Toward A Nutrient Density Score. *American Journal of Clinical Nutrition.* 82, no. 4: 721-32.

Drewnowski, A. 2003. Fat and Sugar: An Economic Analysis. *The Journal of Nutrition*. 133:838S-840S.

Dufour, J.M. 1982. Recursive Stability Analysis of Linear Regression Relationships. *Journal of Econometrics*. 19:31-76.

Eales, J. S, and L. J. Unnevehr. 1988. Demand for Beef and Chicken Products: Separability and Structural Change. *American Journal of Agricultural Economics,* 70, no. 3: 521-32.

FDA. U.S. Food and Drug Administration. 2008. "Daily Values Encourage Healthy Diet." Web page, [accessed June 2008]. Available at http://www.fda.gov/FDAC/special/foodlabel/dvs.html.

FDA. U.S. Food and Drug Administration. 2008. "FDA Acts to Provide Better Information to Consumers on Trans Fat." Web page, [accessed June 2008]. Available at http://www.fda.gov/oc/initiative/transfat/bacgrounder/html.

Greene, W. 2003. Econometrics. New York: Prentice Hall.

Hansen R.G., B.W. Wyse, and A.W. Sorenson . 1979. Nutrition Quality Index of Food. Westport: CT: AVI Publishing Co.

Health Canada**.** 2003. "Consumer Perspectives on Healthy Eating, Summary of Quantitative Research" Web page, [accessed December 2007]. Available http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/reviewexamen/research-recherche-quantitative_e.html.

Health Canada. 2006. "Dietary Reference Intakes." Web page, [accessed May 2008]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/dri_tables-eng.pdf.

Health Canada. 2006. Impact of Modifying Trans Fat Content of Foods on Dietary Intake. Appendix 11. "TRANSforming the food supply, Report of the Trans Fat Task Force Submitted to the Minister of Health." Web page, [accessed December 2007]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf

Health Canada. 2006. Food Industry Perspective on Eliminating Trans Fats in Food Products. Appendix 12. TRANSforming the food supply, Report of the Trans Fat Task Force Submitted to the Minister of Health. Web page, [accessed December 2007]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf.

Health Canada. 2006. Methods and Opportunities for Reducing or Eliminating Trans Fats. Appendix 12. "TRANSforming the food supply, Report of the Trans Fat Task Force Submitted to the Minister of Health." Web page, [accessed December 2007]. Available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf

Health Canada. 2007. "Trans Fat Monitoring Program." Web page, [accessed January 2008]. Available at http://www.hc-sc.gc.ca/fn-an/nutrition/gras-trans-fats/tfa-age-eng.php.

Health Canada. 2008. Food and Nutrition: Food Labelling. Web page [accessed 2008]. Available at http://www.hc-sc.gc.ca/fn-an/pubs/label-etiquet/index-eng.php

Heckman, J. 1978. Dummy Endogenous Variables in a Simultaneous Equation System. *Econometrica.* 46: 931-59.

Heien, D., and C.R.Wessells. 1990. Demand Systems Estimation with Micro Data: A Censored Regression Approach. *Journal of Business & Economic Statistics.* 8, no. 3: 365-71.

Hunter, J.E., 2005. Dietary Levels of Trans-Fatty Acids: Basis for Health Concerns and Industry Efforts to Limit Use. *Nutrition Research*. 25, no.5:499-513.

Kant, A. K. 1996. Indexes of overall diet quality: A review. *Journal of the American Dietetic Association* 96: 785-91.

Kozup, J. C., E. H.Creyer, and S. Burton. 2003. Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items. *Journal of Marketing.* 67: 19-34.

Leth, T., H.G. Jensen, A.E. Mikkelsen, and A. Bysted. 2006. The Effect of the Regulation on *Trans* Fatty Acid Content in Danish Food. *Atherosclerosis Supplements.* 7: 53-56.

Maki, A. 1992. An Empirical Test of Homogeneity and Symmetry in a Demand System with Taste Change. *Structural Change and Economic Dynamics*. 3:167-176.

Moshini , G., and D. Moro. 1995. Structural Change and Demand Analysis: A Cursory Review. *European Review of Agricultural Economics.* 23, no. 3: 239-61.

Moshini, G., and K.D. Meilke. 1984. Parameter Stability and the US Demand for Beef. *Western Journal of Agricultural Economics.* 9: 271-282.

Moshini, G., and K.D. Meilke.1989. Modeling the Pattern of Structural Change in US Meat Demand. *American Journal of Agricultural Economics*. 71:253-261.

Mozaffarian, D., M.B.Katan, A .Ascherio, M.J. Stampfer, and W.C. Willett. 2006. Trans Fatty Acids and Cardiovascular Disease. *New England Journal of Medicine.* 354: 1601-13.

Murphy, S. P., J. A. Foote, L. R. Wilkens, P. P. Basitosis, A. Carlson, K. K. L. Yonemork, and M. White. 2006. Simple Measures of Dietary Variety are Associated with Improved Dietary Quality. *Journal of the American Dietetic Association.* 106: 425-29.

Nayga, R. M. Jr., 1996. Wife's Labor Force Participation and Family Expenditures for Prepared Food, Food Prepared at Home, and Food Away from Home. *Agricultural and Resource Economics Review.* 25, no. 2: 179-86.

NPD Group Inc. 2007. "Food Service: Consumer Tracking". Web page, [accessed 2007]. Available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html.

Oomen, C. M., M. C. Ocké, E. J.M .Feskens, M. J. van Erp-Baart, F. J Kok, and D. Kromhout. 2001. Association between Trans Fatty Acid Intake and 10-Year Risk of Coronary Heart Disease in the Zutphen Elderly Study: A Prospective Population-Based Study. *The Lancet* .357, no. 9258: 746-51.

Pollak, R.A. and T.J.Wales, 1981, Demographic Variables in Demand Analysis. *Econometrica.* 49:1533-1558.

Reynolds, A., and E. W. Goddard. 1993. Food Consumption Away From Home by Type of Facility and Type of Meal. *Canadian Journal of Agricultural Economics.* 42, no. 2: 225-30.

Schmit, T. D., D. Dong, C. Chung, H.M. Kaiser, and B.W. Gould. 2002. Identifying the Effects of Generic Advertising on the Household Demand for Fluid Milk and Cheese: A Two-Step Panel Data Approach. *Journal of Agricultural and Resource Economics.* 27, no. 1: 165-86.

Shonkwiler, J. S., and S.T.Yen. 1999. Two-Step Estimation of a Censored System of Equations. *American Journal of Agricultural Economics.* 81: 972-82.

Statistics Canada. 2007. "Survey of Household Spending and CANSIM II (table no. 203-0002)." Web page, [accessed January 2008]. Available at http://www.statcan. ca/cgi-bin/imdb/p2SV.pl?Function =getSurvey&SDDS=3508&lang =en&db =imdb&dbg=f&adm=8&dis=2 .

Statistics Canada. 2006. Food Services and Drinking Places, Summary Statistics by North American Industry Classification. CANSIM II (table no. 355-0005). Web page, [accessed 2006]. Available at http://www40.statcan.gc.ca/l01/cst01/serv26a-eng.htm.

Stender, S., and J. Dyerberg. 2004. The Influence of *Trans* Fatty Acids on Health. *Annals of Nutrition and Metabolism.* 48: 61-66.

Stender, S., J. Dyerberg, and A. Astrup. 2006. High Levels of Industrially Produced Trans Fat in Popular Fast Foods. A letter to the editor. *New England Journal of Medicine*. 354, no. 15:1650-1652.

Stewart, H., N. Blisard, S. Bhuyan, and R. M. Nayga, Jr. 2004. "The Demand for Food Away from Home: Full-Service or Fast Food?" *USDA-ERS Economic Research Report.* Report, no. 829.

Tansel, A. 1993. Cigarette Demand, Health Scares and Education in Turkey. *Applied Economics.* 25: 521-29.

Tauchman, H. 2005. Efficiency of Two-step Estimators for Censored System of Equations: Shonkwiler and Yen Reconsidered. *Applied Economics.* 37:367-374.

Thiele, S., G.B.M. Mensink, and R. Beitz. 2003. Determinants of Diet Quality. *Public Health Nutrition.* 7, no. 1: 29-37.

Vella, F. and M. Verbeek. 1999. Two-Step Estimation of Panel Data Models with Censored Endogeneous Variables and Selection Bias. *Journal of Econometrics.* 90: 239-263.

Wooldridge, J.M. 1995. Selection Correction for Panel Data Models Under Conditions Mean Independence Assumption. *Journal of Econometrics.*68: 115-132

Chapter 5: Summary Conclusions and Policy Recommendations

Consumption of FAFH is widely believed to be a contributing factor to the current obesity crisis and other diet related problems in North America. At present, in Canada, a number of issues related to FAFH consumption such as the relationship between obesity and fast foods, trans fats, sugar and salt content of restaurant foods, and restaurant advertising for children are being widely discussed. In these discussions, it is apparent that the interrelationships between FAFH, nutrition and diet related diseases are complex. Therefore, there are significant gaps in our knowledge. In this study, a number of important research questions related to FAFH consumption were studied in order to provide a detailed understanding of FAFH purchase trends, nutrient demand trends, factors affecting these trends and to provide some idea of the possible effectiveness of proposed policy interventions in the area.

5.1. Summary and Conclusion

In paper one of this study, a sample of Canadian FAFH purchases were analysed to examine the impact of industry advertising, households' habit forming preferences and socio-demographic and economic variables. Using a unique set of panel data, allowing for zero purchase observations, a two stage demand model was applied to two levels of purchasing decisions: the decision to select and expenditure on two broader categories of restaurants (limited services/fast foods and other/non fast foods services) and the decision to select and expenditure on different food specialities in each of the above two categories. Three models were estimated: one for the selection and expenditure decisions between two broader categories of FAFH, another for the selection and expenditure decisions among limited services/fast foods, and the other for the selection and expenditure decisions among other/non fast food restaurants.

The estimates of the effect of industry advertising, the presence of habit forming preferences and the effects of socio-economic and demographic factors revealed

some interesting details. This study provided preliminary results that suggest advertising may affect children's food consumption behaviour and therefore, the nutrition and health of their diet. Results of this study support the view that fast food advertising may have an impact on households with children and therefore, on nutrition and health of these household's diet. In other words, this study provides enough evidence to validate that there is causal link between advertising and higher consumption of limited service/fast food by households with children. In addition to supporting previous findings that FAFH is habit forming (Browning and Collado 2007), this study also provides additional information as to what categories of FAFH are habit forming. We found that at a more aggregated level, the other/non fast food category was habit forming and at a more disaggregated level, hamburger and coffee/donut specialities were habit forming within the limited service/fast food category and only family type specializations were habit forming within the other/non fast food category.

The analysis of socio-demographic and economic factors has provided useful information in the context of Canadian FAFH purchases. Interestingly, as opposed to the common finding that spending on limited services/fast foods is higher than that of other/non fast foods in other contexts, in Canada the trend shows relatively higher spending on other/non fast foods than on limited services/fast foods. Other than these findings, the effects of ethnic diversity and regional differences, the effects of other socio-demographic variables generally agree with the past studies of FAFH demand. However, the impact of these variables on food specialities within the two broader categories provides new information which could be used in policies related to diet and health, industry marketing and promotional activities. For examples, the results may be useful in designing and implementing nutrition education programs targeting FAFH consumption, and in designing and implementing market promotional activities for certain food specialities which show decreasing consumer spending.

The second study examined the demand for selected nutrients in FAFH to understand factors affecting nutrient intake in FAFH foods focusing on chain restaurants. Allowing for habit forming preferences, a demand model is specified for 13 nutrients. Nutrient densities were specified as a function of selected economic and socio-demographic characteristics lagged nutrient densities, advertising and a dummy variable to capture the possible impact of increasing availability of restaurant nutrition information to consumers. One of the caveats in nutrient demand studies is the measure of nutrient content of foods (Beatty *et al* 2007). Very often, studies have used per capita nutrient intake on a weight basis. When food intake data is available in the form of food groups and their quantities, calculation of nutrients using nutrition information sources is plausible. However, calculation of per capita nutrient intake on a weight basis is computationally difficult due to serving size differences in FAFH.

Among many measures of the nutrient content of foods, nutrition density measures are considered to be a promising tool (Drewnowski 2005), Since this standard is calculated using the number of calories as the basis, the resulting nutrient density ratio is independent of the serving size (Hansen 1979). Given a large variety of meal items and portion sizes in FAFH consumption, nutrient density can be considered to be a suitable proxy for nutrients in FAFH. To create nutrition data, first, all of the foods and beverage items purchased by households in the sample from chain restaurants for the selected period were identified. Second, the nutrient composition of each identified meal and beverage item were obtained from the restaurants' nutrition data collected by the author. Third, nutrient density, which measures the amount of nutrients for each 1000 calories, provided by each meal or beverage item was calculated and matched with the meal and beverage item purchases by the identified households. Finally, annual aggregate nutrient densities (for 13 nutrients) were calculated for each household in the sample and were used in the nutrient demand model based on an Engel function and estimated as a dynamic panel data model.

As no previous studies have been undertaken to examine nutrient demand in FAFH foods, there were no priori expectations as to how different socio-economic and demographic factors might affect different nutrient intakes. Study results provide interesting new information about nutrient consumption from chain restaurants in the FAFH market. It was found that household intake of some problematic nutrients such as saturated fat and cholesterol increases with household head income. Moreover, sugar intake is increasing with increasing household head age. Another important finding is the low level of vitamin A and iron intake of households with children as compared to households without children.

Further, we found evidence of habit forming preferences for certain nutrients, an impact of restaurant advertising and some significant variations in nutrient intake among ethnic groups and households in different regions. In addition, we expected that the agreement between Canadian Restaurant and Food Service Association and the main chain restaurants in Canada to make available nutrition information to consumers might have impacted households' food purchasing behaviour and nutrient intake. It is hypothesised that after February 2005, when the Canadian chain restaurants voluntarily started to provide their menu nutrition information through their web sites, leaflets and by various other means, households became more aware of the nutrient content of different FAFH food and beverage items and therefore, may have selected healthier menu options. Study results suggest that there are significant reductions in saturated fat, cholesterol, carbohydrate, sugar, protein, calcium and iron intake while there are significant increases in total fat, trans fats, sodium, fibre and vitamin A intake after the above agreement. One should expect that problematic nutrient intake might be reduced as households have more access to nutrition information. However, according to our results, households have not shown any concerns about purchasing items especially with high trans fat or sodium contents, which are considered very unhealthy nutrients. A media index was used to proxy the impact of households' general awareness of nutrition of foods and beverages

purchased from FAFH markets. Our results suggest that media index is correlated with lower saturated fat and protein intake while it has a positive relationship with to cholesterol, fibre, vitamin A, vitamin C and iron intake.

The parameter estimates for the variable which is used to capture availability of nutrition information and the media index both provide evidence that households have used nutrition information to reduce their intake of saturated fat and protein and to increase their intake of fibre and vitamin A. Our results do not provide evidence that households have used information to reduce trans fat intake despite the fact that trans fat has received wide media coverage recently.

The third study examined how some specific food industry changes in product formulations aimed at reducing TFAs could and have affected consumers' overall diet quality and their demand for food away from home. This study provides some indications of effectiveness of the current trans fat recommendations in Canada. Study objectives were achieved using three analyses.

From the first part of the analysis, whether restaurant recipe changes have the potential to improve overall diet quality of FAFH consumers is examined in the context that consumers are assumed not to change their consumption behaviour significantly from historical levels. Our results, in a similar way to the Trans Fat Task Force results illustrate potential improvements in diet quality, even if a small subset of restaurants changes recipes. It is worth noting that such recipe change would potentially have a significantly positive effect on the diet quality of households who have children as compared to households who do not have children. In addition, the higher the total FAFH spending, the household income and the age of the household head, the higher the diet quality improvements.

However, consumer behaviour is constantly changing. The second part of the analysis analysed whether there are behavioural changes in relative spending on different restaurants after recipe changes. Results provide a preliminary indication

that consumers have changed behaviour in response to TFA recipe changes. Among the restaurants that have changed recipes during the sample period, A&W has captured a higher expenditure share after its recipe changes while KFC has exhibited a lower expenditure share after their recipe changes. Therefore, the assumption (as above) that consumers will not change behaviour as recipe change is unrealistic.

Results of the third analysis provide some insights as to how the recipe changes have affected FAFH consumers' diet quality given the observed structural changes in the second part of the analysis. The analysis and comparison of diet quality index (DQI) of selected households' food and beverage consumption in February 2006 and February 2007 provides some evidence that given the consumers' behavioural changes (taste, preferences or expenditure), restaurant recipe changes do not necessarily improve the overall diet quality of these households. It is worth noting that in spite of the recommendations implemented in 2006, there is still evidence that not all restaurants have changed their recipes as of 2009. Given fixed behaviour, trans fat recipe changes can enhance diet quality. Accepting that consumers can change restaurants and change foods selected within restaurants, results in little evidence of diet quality improvements from the TF recipe changes in certain restaurants. This could be the evidence of the necessity of mandatory regulation.

In summary, this study is an empirical investigation of number of questions related to Canadian FAFH consumption: What is the structure of FAFH market in Canada? What are the households' FAFH purchasing patterns? What is the impact of advertising and habit forming preferences and socio-economic and demographic factors on FAFH purchases? What are the nutrition profiles of the most popular menu items of chain restaurants? What are the factors affecting nutrient demand in FAFH foods? What is the impact of some specific food industry changes on product formulations reducing TFAs could and have affected consumers overall diet quality and their demand for FAFH? In general, results

from the three independent studies provide useful information to fill some of the gaps in our knowledge of FAFH consumption, especially on health and nutrition with implications for public policy.

5.2. Policy Recommendations

Based on the findings in Chapter 2, there is evidence of a possible link between advertising and higher consumption of limited service/fast foods (at a more aggregated level) and of hamburger chains (at a more disaggregated level) by households with children. Findings in Chapter 3 show that the most frequently purchased menu items such as hamburgers, French fries and soft drinks are high in unhealthy nutrients. Since there is widespread speculation that exposure to food advertising may contribute to unhealthy food choices and weight gain, this finding sheds some light on the ongoing debate about whether and how commercial advertising of foods may contribute to the epidemic of obesity among children and adolescents and whether an advertising ban should be imposed to improve the quality of food purchased from the FAFH market. In addition, information on habit forming preferences for foods provided by certain categories of restaurants and the relationship with socio-economic and demographic factors can be used to design and implement educational programs to promote healthy eating. Since the impact of the above factors were measured at a more disaggregated level of restaurant classification which is different to restaurant classifications in other studies, the information can be used in FAFH industry marketing and promotions.

Findings in Chapter 3 such as the increasing intake of unhealthy nutrients (saturated fat, cholesterol and sugar) with increasing household income and age will negatively affect Canadians given the aging and income growth trends in Canada. The evidence that households with children chose foods which are low in important nutrients such as vitamin A and iron, and the expenditure elasticities for selected nutrients (in tax based policies) also can be used to design and implement policies to promote health and nutrition.

The third study's findings suggest that the introduction of mandatory TFA legislation for all restaurants may be critical to improve diet quality in Canada. This study showed that food industry response through recipe changes could only be effective if there are no substantial changes in FAFH consumers' consumption behaviour. The evidence of structural change in FAFH consumers' expenditure patterns associated with the timing of recipe changes illustrated that voluntary food industry response through changing recipes of selected popular menu items may not be very effective in improving the overall diet quality of FAFH consumers. Consumers may substitute across products and restaurants resulting in overall dietary quality impacts which could be positive, negative or neutral.

This study provide insights to making decisions about health and nutrition related policies related to FAFH consumption by answering questions about why something should be done (e.g. finding that industry advertising may have an impact on households with children (paper1), findings that higher intake of some problematic nutrients with increasing income and older ages (paper 2) and finding that trans fat recipe change might have higher positive impact on the quality of food purchased by households with children (paper 3)), what should be done (e.g. an advertising ban, nutrition education and regulations) and, how it should be done (e.g. what factors to be consider in designing and implementing policy interventions) to promote healthy eating in FAFH market.

5.3. Future Research Recommendations/Limitations

One of the major limitations of this study which encompasses all three papers is lack of data on individual product prices of restaurant menu items. This limitation required us to explore the available modelling frameworks to find a suitable model which can account for this limitation. Even though this study has resulted in collection of price data for popular menu items from large chain restaurants in two major cities in Canada (Guelph-Toronto and Edmonton), the large number of menu items provided by the large number of chain and non chain restaurants and therefore, restaurant categorization adopted in the study did not allow us to make use of these data. While the emphasis of this study is on health and nutrition

aspects of FAFH consumption, a deeper analysis of price effects could have been useful in predicting economic implications of FAFH home purchases by estimating price elasticities.

Another limitation is the use of household purchases/ consumption instead of individual purchases/consumption. Even if 'purchase' and 'consumption' are not the same or synonymous, in all of the above three papers, household purchases were considered as household consumption and assumed that there are no plate waste or wastages. In addition, households' purchases/consumption, instead of individual's purchases/ consumption was the focus of dissertation given the nature of data. Therefore, household purchases or consumptions cannot be clearly ascribed to children/adults in households. Therefore, it is recommended to use individual level data in order to obtain information which is important in health and nutrition context.

In the chapter 1, the zero-censoring nature of categorical purchases, together with the lagged dependent variable (to capture habits) structure in panel format complicated the model estimation. After estimating the model in both types of estimations: as a system and as a single equation (as dynamic panel data model-AB), a comparable discussion of results were undertaken to provide an econometrically consistent estimate. In this model, the impact of advertising was found by looking at relationship between the impact of advertising on expenditure shares on certain restaurants and the positive effects of households with children on the expenditure shares of the same restaurant categories. Estimation of direct impact through interaction of advertising and household composition was not possible due to modeling complications. Therefore, further research should be done to properly quantify the advertising impact. In this chapter, the estimation of Mills ratio (latent variable) in all the expenditure share equations are significantly positive indicating that selection bias is quantitatively important. Therefore, other behaviour related variables such as attitudes and perceptions towards FAFH consumption should be included in the model estimation in future studies.

In chapter 3, despite the efforts to reduce the effects of endogenous variables and fixed effects through the AB model applications, there were some evidence of omitted variables explaining nutrient demand in chain restaurants in FAFH market. Some of the important omitted variables could be individual tastes, attitudes, perceptions, and individual product prices. In this study, given the modeling is done at the household level for nutrients, data collection on the above important variables were not facilitated. Therefore, future analysis of stated preference data with the above variables is recommended to obtain more in-depth information about individual nutrient intake in chain restaurants in FAFH market. Another limitation of this study is that model is estimated only for the chain restaurants in FAFH market and therefore, may not represent the demand for nutrients in the whole FAFH purchases. Unavailability of nutrition information for the menus offered by non chain restaurants prevented us from including non chain restaurants in the study.

For the study in chapter 4, we have only limited information on whether the other restaurants (other than 4 major chains – A&W, Harvey's, KFC and Wendy's) have also changed their recipes. Some of the restaurants in these other restaurants are not chains and recipe changes to enhance diet quality would not receive any media coverage. A comprehensive survey of all restaurants is required to identify recipe changes for these restaurants. At the same time, over the time period analysed in this study, there are number of fast food, full service and other 'chain' restaurants that had not changed their recipes. Subsequent changes in their recipes would also contribute to an enhancement in diet quality. Therefore, an analysis of purchase data for a longer period of time might provide more information on consumer reactions to restaurant recipe change. It is worth mentioning that some of the limitations due to small sample size could have been overcome by focusing on food products with recipe changes instead of focusing on restaurants that have changed recipes.

Appendix 1

Diet Quality Index construction

Method described in Thiele *et al* (2003) was used to develop the index. Thiele et al (2003) created a dietary quality index, which is a combination of two indices: a deficient index and a n excess index. For both deficient index and excess index higher value indicate a better dietary quality (Dresher,2007).

Construction of diet quality index

As mentioned above, there are two indices for this indicator: deficient index and excess index. For deficient index,

Single nutrient score is calculated using 'nutrient adequacy ratio' (NAR).

$$\text{NAR} = \frac{\text{nutrient intake}}{\text{RDA for nutrient}} \times 100$$

Here, the actual intake of nutrient is divided by the recommendation. If consumers' nutrient intake reaches more than 100% of the reference intake, the single nutrient deficient score is truncated at the maximum of 100 (minimum = 0). Therefore,

$$\text{single nutrient deficient score} = \frac{\text{actual intake of nutrient}}{\text{recommended intake of}} \times 100 = \text{NAR} \times 100$$

$$\text{deficient index} = \sum \text{NAR} \times 100$$

For the excess index, first single nutrient scores are calculated in the same way for deficient index. However, since nutrients at risk of excess intake are considered, high NAR values would indicate low dietary quality. In order to correct that adjusted NAR (aNAR) is calculated using following conditions.

$$\text{single nutrient excess score} = \frac{\text{actual intake of nutrient}}{\text{recommended intake of}} \times 100 = \text{NAR} \times 100$$

Conditions are:

if NAR < 100% then aNAR= NAR

if NAR >100% and < 200% then aNAR= 200-NAR

if NAR >200% then aNAR=0

$$\text{excess index} = \sum \text{aNARs}$$

According to Theile *et a*l (2004), the final dietary quality index is the summation of deficient index and the excess index. In this study nutrient density measures for nine nutrients (six nutrients: total fat, saturated fat, trans fat, cholesterol, sodium and sugar were used for excess index and three nutrients: protein, fibre and carbohydrate were used for deficient index). A score is calculated for each nutrient and summed up to obtain the dietary quality index.

Recommended dietary allowances provided by Health Canada for three nutrients: total fat, carbohydrate and protein and the recommended daily intake figures provided by FDA for five nutrients: saturate fat, cholesterol, sodium, fibre and sugar were used as reference intake. As there are no recommendations for TFA, the recommendation by Trans Fat Task Force was used in index construction.

Example 1: Calculation of the score of fibre (nutrient of the deficient index)

Recommended dietary intake	25g/2000 calories	
Intake of a person	16g/2000 calories	
Ratio	16/25 = 0.64	36% under reference
Score	(100-36) = 64	

Score is bounded between 0 and 100

Score 0: 0g/2000 calories

Score 100: 25g/2000 calories

Example 2: Calculation of the score of cholesterol (nutrient of the excess index)

Recommended dietary intake	max. 300mg /2000 calories	
Intake of a person	550mg/2000 calories	
Ratio	550/300 = 1.83	83.3% above reference
Score	(100 - 83.3) = 16.7	

Score is bounded between 0 and 100

Score 0: more than 600mg /2000 calories

Score 100: less than 300mg /2000 calories

Appendix 2: An example of calculation of DQI before and after recipe change for a selected household for the sample year 1 (March 2001 to February 2002)

Steps

1. First, household's purchase occasions were analysed and all the beverage and meal items ate identified. This selected household had 10 purchase occasions and meal and beverage items listed in column 3 were purchased from the corresponding restaurants listed in column 2.
2. Nutrition information for each of the meal and beverage item was taken from the restaurant nutrition data and USDA nutrition data collected. Nutrition density figures (amount of nutrients for 1000 calories) were then calculated and match with the each purchased food item as shown in the table.
3. Total aggregated nutrient density is calculated- step 3
4. Total aggregated nutrients for 2000 calories is then calculated, in order compare nutrient composition with recommended nutrient composition which is given for 2000 calories intake – step 4
5. Using recommended daily nutrients values (in raw), DQI is calculated according to the method outlined in Appendix 1.
6. Wendy restaurant changed their recipe and therefore nutrient values of Wendy's menu items has been changed in the following Table A-2 (after recipe change)

Table A-1: **Steps of calculating DQI before recipe change**

Purchase occasions	Restaurant Name	Meal and beverage items	Calories	Total Fat	Saturated Fat	Trans Fat	Cholesterol	Sodium	Carbohydrate	Fibre	Sugar	Protein
1	McDonald's	Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Chicken nuggets	1000.00	59.88	11.05	2.91	139.54	2156.99	60.47	1.16	1.16	53.49
		soft drinks-other flavours	1000.00	0.00	0.00	0.00	0.00	287.23	257.45	0.00	141.49	0.00
2	McDonald's	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		French fries	1000.00	49.57	19.13	6.09	52.17	817.40	124.35	8.70	0.87	10.43
		Cola	1000.00	5.41	0.00	0.00	0.00	108.11	258.38	0.00	241.89	1.89
3	McDonald's	Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
4	McDonald's	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
5	AIRWAY REST	Egg other	1000.00	42.11	7.89	1.20	488.72	1218.05	56.39	0.00	56.39	98.50
		Tea-Black hot	1000.00	0.00	2.00	0.00	0.00	3000.00	300.00	0.00	0.00	0.00
6	AIRWAY REST	Egg other	1000.00	42.11	7.89	1.20	488.72	1218.05	56.39	0.00	56.39	98.50
		Home fries	1000.00	66.21	15.11	12.75	0.00	1584.10	98.47	8.26	0.73	7.98
		Coffee-w/ milk	1000.00	63.75	36.54	2.50	264.43	283.66	93.28	0.00	93.28	17.12
7	McDonald's	Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Bread-other	1000.00	47.37	11.84	0.53	947.37	1907.89	84.21	6.58	10.53	57.89

8	McDonald’s	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Bread-other	1000.00	47.37	11.84	0.53	947.37	1907.89	84.21	6.58	10.53	57.89
9	WENDY'S	Cheese burger	1000.00	40.63	18.75	1.56	125.00	2562.50	106.25	3.13	21.88	53.13
		Baked/Stuffed potato	1000.00	9.68	5.65	0.32	24.19	137.10	203.23	22.58	12.90	25.81
10	WENDY'S	Bacon cheese burger	1000.00	54.21	22.43	2.34	168.22	2121.50	66.36	3.27	14.02	60.28
		Bacon cheese burger	1000.00	54.21	22.43	2.34	168.22	2121.50	66.36	3.27	14.02	60.28
		French fries	1000.00	48.33	8.33	11.94	0.00	972.22	131.11	11.67	0.00	10.56
	Annual aggregated nutrient consumption (step 3)		26000.01	1041.34	376.32	58.13	5186.77	46746.28	3057.41	134.84	871.69	1100.58
	Nutrient consumption for 2000 calories (step 4)		2000.00	80.10	28.95	4.47	398.98	3595.87	235.19	10.37	67.05	84.66
				720.92	28.95	4.47	398.98	3595.87	940.74	10.37	67.05	338.64
		Recommended daily average	2000	550	20	3.5	300	2400	1100	25	500	440
		Ratio		1.310771	1.4474	1.277558	1.3299404	1.498278	0.85522	0.414882	0.134106	0.769639
		Ratio adjusted		0.310771	0.4474	0.277558	0.3299404	0.498278	0.14478	0.585118	-0.865894	0.230361
		Percentage		31.07714	44.74002	27.75576	32.99404	49.8278	14.47799	58.51177	-86.58943	23.03606
		Excess/deficient Score		31.07714	44.74002	27.75576	32.99404	49.8278	14.47799	58.51177	100	23.03606
	DQI= summation of Excess/Deficient score		**382.42057**									

Step A-2: Steps of calculating DQI after recipe change

Purchase occasions	Restaurant Name	Meal and beverage items	Calories	Total Fat	Saturated Fat	Trans Fat	Cholesterol	Sodium	Carbohydrate	Fibre	Sugar	Protein
1	McDonald's	Cheese burger										
		Chicken nuggets										
		soft drinks-other flavours	1000.00	0.00	0.00	0.00	0.00	287.23	257.45	0.00	141.49	0.00
2	McDonald's	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		French fries	1000.00	49.57	19.13	6.09	52.17	817.40	124.35	8.70	0.87	10.43
		Cola	1000.00	5.41	0.00	0.00	0.00	108.11	258.38	0.00	241.89	1.89
3	McDonald's	Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
4	McDonald's	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
5	AIRWAY REST	Egg other	1000.00	42.11	7.89	1.20	488.72	1218.05	56.39	0.00	56.39	98.50
		Tea-Black hot	1000.00	0.00	2.00	0.00	0.00	3000.00	300.00	0.00	0.00	0.00
6	AIRWAY REST	Egg other	1000.00	42.11	7.89	1.20	488.72	1218.05	56.39	0.00	56.39	98.50
		Home fries	1000.00	66.21	15.11	12.75	0.00	1584.10	98.47	8.26	0.73	7.98
		Coffee-w/ milk	1000.00	63.75	36.54	2.50	264.43	283.66	93.28	0.00	93.28	17.12
7	McDonald's	Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Cheese burger	1000.00	40.00	16.67	1.33	116.67	2500.00	110.00	6.67	23.33	50.00
		Bread-other	1000.00	47.37	11.84	0.53	947.37	1907.89	84.21	6.58	10.53	57.89
8	McDonald's	Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Hamburger	1000.00	42.11	18.42	1.05	157.89	2368.42	92.11	5.26	15.79	47.37
		Bread-other	1000.00	47.37	11.84	0.53	947.37	1907.89	84.21	6.58	10.53	57.89
9	WENDY'S	Cheese burger	1000.00	41.42	17.16	1.48	124.26	2378.70	104.73	4.14	22.49	51.48
		Baked/Stuffed potato	1000.00	6.78	4.24	0.23	16.95	135.59	210.17	23.73	11.86	27.12
10	WENDY'S	Bacon cheese burger	1000.00	45.95	18.92	1.35	135.14	2027.03	91.89	5.41	16.22	51.35
		Bacon cheese burger	1000.00	45.95	18.92	1.35	135.14	2027.03	91.89	5.41	16.22	51.35
		French fries	1000.00	48.28	7.33	2.16	0.00	1017.24	125.86	12.07	0.00	13.79
	Annual aggregated nutrient consumption (step 3)		26000.00	1022.66	365.30	46.19	5112.61	46417.06	3108.66	141.67	875.65	1085.63

Nutrient consumption for 2000 calories (step 4)	2000		78.665815	28.099865	3.5533549	393.27734	3570.542367	239.12797	10.897922	67.357963	83.510032
			707.99233	28.099865	3.5533549	393.27734	3570.542367	956.51189	10.897922	67.357963	334.04013
Recommended daily average	2000		550	20	3.5	300	2400	1100	25	500	440
Ratio			1.2872588	1.4049932	1.0152443	1.3109245	1.487725986	0.8695563	0.4359169	0.1347159	0.7591821
Ratio adjusted			0.2872588	0.4049932	0.0152443	0.3109245	0.487725986	-0.1304437	-0.5640831	-0.865284	-0.240817
Percentage			28.72588	40.499323	1.5244259	31.092445	48.77259864	-13.04437	-56.40831	-86.5284	-24.0817
Excess/deficient Score			28.725879	40.499323	1.5244259	31.092445	48.77259864	100	100	100	100
DQI= summation of Excess/Deficient score		**550.61**									

Appendix 3: DQI at the beginning and at hypothetical scenario for 122 households for the period of March 2001 to February 2005

	year 1 (March 2001-February 2002)			year 2 (March 2002-February 2003)			year 3 (March 2003-February 2004)			year 4 (March 2004-February 2005)			
HHID	DQI Beginning	DQI Hypothetical	change	DQI Beginning	DQI Hypothetical	change	DQI Beginning	DQI Hypothetical	change	DQI Beginning	DQI Hypothetical	change	DQI average change
1	631	736	105	618	618	0	623	623	0	575	676	102	52
2	574	612	38	589	679	90	541	623	82	616	625	10	55
3	649	679	30	592	592	0	656	686	29	624	625	2	15
4	646	700	54	589	695	105	639	690	51	580	632	52	65
5	648	668	20	467	491	25	563	672	109	542	542	0	38
6	671	694	23	695	695	0	610	671	61	717	719	1	21
7	533	638	104	598	706	108	551	656	105	636	636	0	79
8	628	627	-1	666	665	0	667	666	0	642	642	0	0
9	432	432	0	453	453	0	692	675	-16	619	672	53	9
10	705	758	53	838	838	0	687	754	67	726	773	47	42
11	674	676	2	672	674	2	636	637	1	479	479	0	1
12	546	620	74	539	551	12	562	562	0	557	561	3	22
13	514	633	119	642	642	0	671	671	0	507	516	9	32
14	586	598	11	562	596	35	544	583	39	724	724	0	21
15	619	683	64	646	659	14	681	703	21	616	649	34	33
16	651	652	1	624	626	1	589	606	16	735	760	25	11
17	579	579	0	601	601	0	587	587	0	597	597	0	0
18	645	688	43	600	654	55	621	676	55	635	667	32	46
19	519	561	42	717	727	10	485	522	37	528	528	0	22
20	757	757	0	639	640	1	558	558	0	544	544	1	1
21	622	622	0	648	647	0	575	573	-2	621	620	-1	-1
22	780	780	0	705	705	0	656	763	106	673	775	102	52
23	634	652	18	679	679	0	619	619	0	678	678	0	5
24	521	633	112	584	617	32	593	704	111	526	587	61	79
25	620	621	1	624	622	-2	655	655	0	607	607	0	0
26	641	675	34	597	677	80	620	710	90	594	677	84	72
27	669	677	8	612	609	-3	559	556	-3	644	643	-1	0
28	683	684	2	528	636	107	471	509	38	467	516	50	49
29	751	751	0	743	743	0	450	585	135	627	627	0	34

30	512	512	0	482	578	96	543	599	55	547	547	0	38
31	670	686	16	667	667	0	558	559	0	773	773	0	4
32	595	703	108	606	704	97	641	686	45	767	767	0	63
33	664	667	3	606	657	50	740	748	8	711	712	2	16
34	686	721	35	740	740	0	661	724	63	602	651	49	37
35	639	660	21	582	588	7	655	655	0	727	749	22	13
36	706	706	0	752	752	0	760	760	0	708	715	6	2
37	590	669	79	624	728	105	570	650	80	617	724	107	93
38	607	710	103	590	590	0	483	483	0	551	629	78	45
39	702	702	0	701	701	0	699	699	0	701	701	0	0
40	496	500	5	421	421	0	572	576	4	460	465	5	3
41	649	654	5	713	713	0	733	740	6	692	712	20	8
42	622	691	69	639	677	38	634	669	34	609	609	0	35
43	516	516	0	787	787	0	516	516	0	787	787	0	0
44	687	701	14	703	716	12	654	707	53	715	716	1	20
45	596	597	1	658	683	25	631	631	0	679	781	102	32
46	683	698	15	736	769	33	772	772	0	603	707	104	38
47	601	635	35	619	675	56	702	702	0	662	662	0	23
48	736	736	0	643	683	40	645	654	9	659	669	10	15
49	661	684	23	642	642	0	638	639	1	540	540	1	6
50	655	735	80	646	733	86	633	713	81	639	712	73	80
51	668	691	23	427	471	43	649	678	29	556	660	104	50
52	695	796	101	638	638	0	614	722	108	601	712	111	80
53	685	685	0	636	636	0	665	665	0	645	645	0	0
54	728	728	0	651	651	0	758	758	0	740	740	0	0
55	686	719	32	694	721	27	616	637	21	586	685	99	45
56	593	640	48	617	642	25	651	651	0	522	536	15	22
57	599	602	2	547	561	14	586	592	6	615	644	29	13
58	610	635	25	654	665	11	663	711	48	623	706	84	42
59	647	706	59	710	784	74	740	780	40	701	744	43	54
60	541	546	5	671	684	13	602	606	4	551	575	23	11
61	760	760	0	720	721	2	639	656	18	682	682	0	5
62	707	744	37	581	656	76	572	572	0	520	520	0	28

63	765	763	-2	752	754	2	736	737	1	672	672	0	0
64	569	670	101	587	619	32	654	710	57	597	624	26	54
65	689	689	0	609	714	105	653	654	1	506	518	11	29
66	682	682	0	611	630	19	660	660	0	511	511	0	5
67	773	773	0	737	737	0	558	625	67	563	619	56	31
68	657	657	0	664	666	1	568	569	1	640	640	0	1
69	750	759	9	776	776	0	617	723	106	780	780	0	29
70	600	600	0	520	519	-1	627	641	14	610	613	3	4
71	681	734	53	611	648	37	644	701	57	636	685	49	49
72	749	750	1	681	682	1	743	743	0	553	554	1	1
73	690	735	45	667	689	21	679	679	0	667	667	0	17
74	691	723	32	741	755	14	715	802	87	624	734	110	61
75	585	674	89	766	766	0	572	598	26	723	723	0	29
76	703	703	0	673	674	0	647	656	10	570	611	42	13
77	597	597	0	625	625	0	715	716	1	649	649	0	0
78	394	404	10	433	462	30	501	522	21	424	425	1	15
79	729	729	0	711	711	0	734	734	0	718	734	16	4
80	600	600	0	570	577	7	666	666	0	668	668	0	2
81	510	608	98	596	617	21	614	660	46	762	762	0	41
82	544	544	0	649	650	1	753	753	0	742	742	0	0
83	617	666	48	701	710	9	585	687	102	711	769	58	54
84	736	738	1	700	700	0	725	727	2	688	687	-1	1
85	667	667	0	616	660	44	649	658	8	709	709	0	13
86	660	715	54	633	640	7	670	670	0	704	704	0	15
87	731	731	0	732	764	32	538	538	0	761	762	2	8
88	698	698	0	687	699	12	583	617	34	693	693	0	11
89	675	743	68	665	665	0	625	625	0	718	718	0	17
90	570	683	113	579	682	103	640	640	0	483	483	0	54
91	646	686	39	664	691	27	645	666	21	639	739	100	47
92	598	598	0	644	660	16	610	633	22	629	720	91	32
93	654	654	0	635	687	53	571	680	109	537	655	118	70
94	667	748	81	612	690	77	635	665	30	695	746	52	60
95	598	712	114	510	611	102	583	703	120	536	640	104	110

96	554	617	63	580	580	0	746	746	0	696	696	0	16
97	541	649	108	586	683	97	730	754	25	682	683	1	58
98	741	741	0	773	773	0	733	733	0	456	549	93	23
99	730	729	-1	730	729	-1	743	743	0	743	743	0	-1
100	606	715	109	656	762	105	676	676	0	631	673	42	64
101	621	718	97	600	626	26	595	654	59	518	564	46	57
102	660	660	0	617	732	115	526	590	64	751	751	0	45
103	582	681	99	589	602	13	616	652	36	621	664	43	48
104	653	719	66	741	742	1	644	643	-1	557	557	0	16
105	583	687	104	720	733	13	694	694	0	745	745	0	29
106	512	640	128	491	624	133	467	607	140	593	704	111	128
107	665	664	-1	650	673	23	543	543	0	645	657	12	9
108	657	657	0	624	710	86	643	691	48	692	692	0	33
109	566	570	4	640	666	26	747	751	4	716	715	-1	8
110	419	419	0	601	602	1	487	487	0	535	548	13	4
111	603	603	0	525	597	72	572	572	0	613	613	0	18
112	697	699	2	586	692	106	597	677	81	532	648	115	76
113	727	729	2	738	738	0	577	688	111	620	731	111	56
114	443	443	0	457	458	1	495	495	0	433	471	38	10
115	565	587	22	615	637	22	503	503	0	456	515	59	26
116	625	714	89	638	744	106	632	740	107	758	764	6	77
117	532	554	21	592	639	46	587	654	67	568	635	66	50
118	671	692	21	622	622	0	494	494	0	665	712	47	17
119	682	740	58	607	698	91	720	759	39	687	741	53	61
120	731	757	26	646	645	-1	618	717	99	638	638	0	31
121	572	572	0	497	543	46	599	668	69	598	700	102	54
122	706	738	32	693	741	48	643	643	0	639	639	0	20