DEMOGRAPHIC FACTORS AND THE DEMAND FOR DAIRY PRODUCTS IN CANADA: AN ECONOMIC ANALYSIS

A Thesis

Presented to

The Faculty of Graduate Studies

of

The University of Guelph

by

CRAIG MARTIN

In partial fulfilment of requirements

for the degree of

Doctor of Philosophy

July, 2011

ABSTRACT

DEMOGRAPHIC FACTORS AND THE DEMAND FOR DAIRY PRODUCTS IN CANADA: AN ECONOMIC ANALYSIS

Craig Martin
University of Guelph, 2011

Advisor:
Dr. Rakhal Sarker

Canada's population has experienced notable changes in birth rates, divorce rates, and immigration patterns over the past 50 years. These changes have had three major effects on the structure of the population: i) more but smaller households; ii) fewer children per household; and, iii) increasing number of households headed by foreign born persons arriving from a greater variety of home countries than in the past. How do changes in the characteristics of the Canadian population affect the consumption of dairy products? This is the central issue examined in this thesis.

The effects of the changes in the structure of the population of Canada were investigated for five dairy products: 1 Percent Fluid Milk, 2 Percent Fluid Milk, Butter, Cheddar Cheese and, Other Cheeses. The thesis incorporates demographic variables into a system of demand equations using the Linear Almost Ideal Demand System. The demand system is estimated using the Generalized Method of Moments estimator and data from the 1996 Canadian Food Expenditure Survey.

The model is used to test if age, ethnic origin, and the composition of the household affect the consumption of the five dairy products. The results show that the demographic characteristics of the household do influence the consumption of the

selected dairy products. However, the influence of the demographic factors is complex with at least one of the demographic factors influencing the consumption of each dairy product but no two dairy products being influenced by the same demographic factor in the same way. Also, no single demographic factor influenced the consumption of all dairy products in a consistent manner. The results also vary widely across geographic regions in Canada. While these results lead us to conclude that demographic variables do influence the consumption of dairy products in Canada they also demonstrate that attributing the changes in the consumption of dairy products to a single demographic factor, such as age or ethnic origin is simplistic and would likely lead to erroneous conclusions.

DEDICATION

This thesis is dedicated to my family.

First, I dedicate this thesis to my parents,

Willard and Karen Martin

for their unconditional love, limitless encouragement and continuous emotional support throughout my pursuit of higher studies leading to a doctoral degree in Agricultural Economics.

Second, I wish to dedicate this thesis to my daughter,

Natalie Hannah Martin

who took away all stress and strains of countless hours of hard work in this research and brought Sunshine even in a darkest day with a simple smile.

Finally, I dedicate this dissertation to my beautiful wife,

Nancy Martin

without whose loving care, unfailing support and encouragement this work would never have been completed.

I love you all.

ACKNOWLEDGEMENTS

I would like to thank the members of my thesis advisory committee Elliott Currie, Karl Meilke, Thanasis Stengos, Getu Hailu and especially my supervisor Rakhal Sarker for their thought comments, support and guidance in this work. I would also like to thank my internal examiner John Cranfield and my external examiner Michele Veeman for many helpful comments which led to notable improvements in this thesis. I would also like to thank Alan Ker for serving as the Chair of the Final Oral Examination. I would like to thank Margaret Franz for proofreading the early versions of this research. I would also like to gratefully acknowledge my employer, the Canadian Mennonite University in Winnipeg, Manitoba for giving me the support and time necessary to complete this dissertation.

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CHAPTER 1: INTRODUCTION

INTRODUCTION

The demand for goods and services in an economy is determined by the preferences of consumers. Since the characteristics of a population change over time due to changes in socioeconomic conditions and the environment, the demand for goods and services also change through time. In some instances, these changes are not entirely dependent on changes in widely known economic factors such as prices and income. Some non-economic factors may play an important role in this process. For example, the characteristics of a population may change over time due to changes in fertility, net migration or other factors. The attitude of the population may also change through time due to the availability of new information, research evidence and new knowledge. All these developments can cause significant changes in the demand for goods and services. Since in a developed economy, production of goods and services is guided by consumers' choices, it is important for producers to understand how the demand for various goods and services change over time because of changes in the characteristics of the population.

Three major structural characteristics of the Canadian population have changed during the last forty years. First, the Canadian population is getting older: the median age has increased from 25.5 years in 1966 to 37.5 years in 2001 (Statistics Canada, 2002a). Second, the ethnic make-up of the country is increasing in diversity. Canada, like any other country populated mostly through immigration, is ethnically a mixed society of immigrants coming from different continents. Two notable shifts in Canadian immigration have occurred since the 1970s. The first is a general increase in the number of immigrants entering the country. The second is related to the shift in the source of immigration. Prior to the 1970s, Europe was the main source of Canadian immigrants. However, since the 1970s, Canada's immigration has been shifting more toward Asian immigrants (Statistics Canada, 2003a). Due to these changes, the Canadian society is now the second most ethnically diverse society in the world[1] (Statistics Canada, 2003a). Finally, the household composition has also been changing in Canada. In 1981, 55 percent of all families were couples with children aged 24 and under living at home. However, by 2001 this fell to 44 percent of all families. During the same time period, couples with no children living at home increased from 34 percent to 41 percent (Statistics Canada, 2002b). Thus, while the total number of households is growing, the size of each household is declining in Canada (Statistics Canada, 2002b). How do the changes in the structure of the Canadian population affect the demand for goods and services produced in Canada?

A number of recent studies attempted to analyse the effects of ethnicity and other demographic factors on the demand for food in Canada and reported mixed results. For example, Quagrainie et al. (1998) and Hu et al. (2005) found that ethnicity and other demographic variables were statistically significant in the demand for meat products. However, Fortin (1995) found that, they were not significant for aggregate commodities. Popular news media in the agri-food sector raised concerns about changes in Canada's population mix and are eager to know how changes in demographic variables affect the demand for food (Agvision, 2006; DFO, 2004). In particular, the dairy sector has been concerned with changes in the ethnic make-up of Canada because dairy consumption varies significantly across different ethnic groups. At the 2004 annual meeting of the Dairy Farmers of Ontario (DFO) key issues related to meeting the demands of changing ethnic

[1] Australia is the most ethnically diverse nation according to the United Nation's measure of ethnic diversity which measures the percentage of foreign born individuals in the nations population.

groups were discussed at length (DFO, 2004). From a producer viewpoint, meeting the changing demand may lead to new marketing opportunities for milk and milk products and preserving consumers' and politicians' support for the supply management system (DFO, 2004). Growing concerns over the implications of changing ethnic diversity and demographic features of the Canadian population for the demand for dairy products and inconclusive results from the literature highlight the significance of this research.

ECONOMIC PROBLEM

If changes in the characteristics of the population in Canada result in changes in the demand for goods and services, they may have a significant bearing on the supply of various goods and services as well as on the overall resource allocation in Canada. In a competitive market, consumers are free to choose the goods and services they wish and able to consume. The suppliers need to read the market signals and adjust their production to fulfill the changing consumers' needs. As the suppliers attempt to meet the changing consumer preferences, the allocation of scarce resources changes over time. To improve resource allocation efficiency and to improve market opportunities over time, it is important for the suppliers to understand how changes in the population characteristics influence the demand for the goods and services they produce.

In recent years various commodity groups and people in academic and policy circles have been concerned about the effects of changes in demographic characteristics of the Canadian population on the demand for all food commodities in Canada. It is generally perceived that changes in demographic features are changing the demand for dairy products in Canada. Beyond this perception, however, there is no study to verify the nature and the extent of the effects of various demographic factors on the demand for specific dairy products in Canada. It is important for future growth and prosperity of the dairy sector in Canada to develop a good understanding of the effects of changes in demographic factors on the demand for dairy products. While this sector is currently protected under the supply management system, this could change in the future. A better understanding of the effects of ethnicity and other demographic factors on the demand for dairy products will help producers and processors make informed and efficient input choices.

RESEARCH PROBLEM

The central issue considered in this research is to investigate the effects of changes in ethnicity and other demographic factors on the demand for dairy products in Canada. The available literature does not offer a complete analysis of the demand for all dairy products produced and consumed in Canada which incorporates changes in ethnicity and other demographic variables. Kinnucan and Venkateswaran (1994) incorporated age and exposure to advertising in their study, but this only covered the consumption of fluid milk and orange juice in Ontario. They found that households with different characteristics responded differently to the same advertising campaign. Moschini and Moro (1993) in their analysis of food demand in Canada included a more complete list of dairy products. However, this list only includes fluid milk, butter, cheese and other dairy products. Also, this study did not take into account the effects of demographic factors on the demand for dairy products.

Gould (1997) investigated the demand for butter, margarine and butter-blends and found that a number of demographic factors, such as education, household size and ethnicity, influence household consumption choices of these dairy products. Moreover, this study was based on data from the United States and not on Canadian data. Since the market structures in Canada and the United States are different, extrapolating any information from this study to the Canadian context may be problematic. Lin et al. (2003) analysed the demand for fluid milk, cheese and other dairy products and concluded that the demand for all food will change with an older and more diverse population. However, two problems still persist. First, like Gould's (1997) study, the data used were from the United States and therefore, has similar problems. Second, Lin et al. (2003) did not use a demand system but used a single equation Tobit model in their analysis. In such a model, theoretical restrictions such as symmetry and adding-up cannot be imposed and so the results may not be consistent with the theory of consumer behaviour. These inadequacies also highlight the importance of this research.

This research proposes to use Canadian cross-sectional data for five dairy products. By using disaggregated data this research purports to explore the relationships between different dairy products in consumption and assess how those relationships are influenced by changes in ethnicity and other demographic variables.

PURPOSE AND OBJECTIVES

The purpose of this research is to incorporate ethnicity and other demographic variables into a demand system and use this to analyse the demand for selected dairy products in Canada. The specific objectives of this study are:

i. to identify whether ethnicity and other demographic factors are responsible for changes in the demand for dairy products;
ii. to incorporate ethnicity and other demographic variables into an existing demand system and use it to estimate the selected demand for dairy products in Canada;

iii. To examine the influence of ethnicity on the demand for dairy products in Canada;

iv. to derive policy implications of the results.

HYPOTHESIS

To achieve these objectives, a number of null hypothesis could be tested. Examples of some of the testable hypotheses stated in null form are:

- The age of a consumer does not influence the demand for dairy products.
- The ethnic origin of a consumer does not influence the demand for dairy products.
- The composition of a household does matter in determining the demand for dairy products.

SIGNIFICANCE OF THE STUDY

This study will contribute to the existing stock of knowledge in three significant ways. First, it will enhance our understanding of the effects of ethnicity and other demographic factors on the demand for dairy products in Canada.

The second contribution of this study involves the incorporation of ethnicity into a flexible demand system.

Finally, the results from this study can be used to develop a good understanding of the changes in demand for dairy products in Canada in the future with due attention to changes in ethnicity and other demographic factors in this country. This will represent the policy contribution of this study.

OUTLINE OF THE THESIS

This thesis is organized into eight chapters. Chapter 1 is an introduction to the research. It provides background information and presents the economic problem, research problem and the purpose and objectives.

Chapter 2 has two major parts. The first part introduces the changes in Canada's population since World War II. The second part discusses the changes in the consumption of dairy products in Canada between 1980 and 2004. This chapter sets the background that formed the rational for this research.

Chapter 3 also has two major parts. The first part reviews the current literature on food demand and the development of the current demand systems used in food demand analysis. The second part introduces the current literature on heterogeneous preferences and the methods used to incorporate demographic variables into a demand system. The synthesis of the literature in this chapter forms the basis of the analytical framework presented in Chapter 4.

Chapter 4 presents the analytical framework. It demonstrates alternative ways to incorporate demographic variables into an existing demand system and what are the consequences of alternative approaches for relevant elasticities. This chapter continues with a discussion of the data and econometric issues related to the estimation of the model.

Chapter 5 discusses the econometric results for Canada and the five regions. The chapter discusses the statistical significant variables in determining the demand for the various dairy products.

Chapter 6 performs policy simulations and discusses the policy implications of the results for the dairy sector with special emphasis on changing demographic structures in Canada.

Chapter 7 summarizes the main findings, highlights the key contributions, bring out the limitations and offers some concluding remarks.

CHAPTER 2: AN OVERVIEW OF THE CANADIAN DAIRY SECTOR AND POPULATION

INTRODUCTION

Canada has experienced a number of changes both economically and socially since World War II. Moving from a rural and agrarian base during the first part of the 20^{th} century to an urban and industrial society after World War II, Canadians now enjoy one of the highest standards of living in the world. Due to growing economic and political importance, Canada has achieved membership in the G-8 group of industrialized nations, the World Trade Organization (WTO), the Organization of Economic Cooperation and Development (OECD) and other major international economic organizations. Socially, Canada has been affected by changes in birth rates which have caused shifts in the age structure of population throughout the post-World War II period. Canada has also seen changes in its immigration pattern over the years which has resulted in significant ethnic diversity of its population. Other changes such as in life expectancy at birth and in the divorce rate have also caused changes to the Canadian society. All these changes may have contributed to changing production, consumption and trade of various agri-food commodities. It has been argued in recent years that changes in ethnicity and age distribution in the Canadian population are driving significant changes in the consumption of dairy products in Canada (DFO, 2004). The purpose of this chapter is to highlight major changes in both Canada's population and the consumption pattern of dairy products to contextualize the central theme of my research.

The first section highlights the changes in the pattern of consumption of fluid milk, cheese and other major dairy products in Canada. The second section focuses on the changes in the Canadian population. This section deals with changes in birth rates and changes in the pattern of immigration since World War II and how these changes may have influenced the consumption of dairy products in Canada. The concluding section of this chapter attempts to discern any relationship between trends in population changes and those in the consumption of dairy products in Canada.

CANADIAN DAIRY SECTOR

This section deals with two major topics: (i) the structure of the Canadian dairy sector and (ii) the pattern of major dairy products consumed in Canada.

Structure of the Canadian Dairy Sector

Since the late 1960s, the Canadian dairy sector has been tightly regulated through a system called "Supply Management". Under this system, milk producers are required to have production quotas to produce and market milk. The use of production quotas stabilizes the supply of raw milk in the market, while maintaining the price received by producers and paid by consumers at a higher level than it otherwise would have been. The system also requires all producers to sell their milk through the marketing board in each province. Thus, the entire supply of milk in Canada is regulated.

In order to maintain high prices under supply management, the Government of Canada imposed measures that restricted the importation of milk and dairy products into this country. Prior to 1995, the Canadian government utilized import quotas to limit imports of milk and dairy products. However, since the Uruguay Round Agreement on Agriculture in 1996, these import quotas have been replaced with tariff-rate-quotas and over-quota tariffs have been set at prohibitively high levels effectively limiting imports to the minimum access amount (Martin, 2002).

Table 2.1 Milk Classes

Class	Description
Class 1	Fluid milk and cream
Class 2	Ice cream, yogurt and food preparations such as pudding and infant formula
Class 3	Cheese
Class 4	Butter, milk powders, condensed milk and other related products
Class 5a	Cheese ingredients for further processing for domestic and export markets
Class 5b	All other dairy products for further processing for the domestic and export markets
Class 5c	Domestic and export activities of the confectionery sector
Class 5d	Specific negotiated exports including cheese under quota destined for US and UK markets, evaporated milk, whole milk powder and niche markets
Class 5e	Surplus removal

Source: Martin, 2002

Another feature of the milk marketing system introduced in the 1990s is a price class system (Table 2.1) where raw milk is priced to processors according to its end use. Though different types of end products from milk fetch different prices, the price received by producers is a blended price from milk sales allocated to different end uses with all producers receiving the same price regardless of the processors who bought their milk[2].

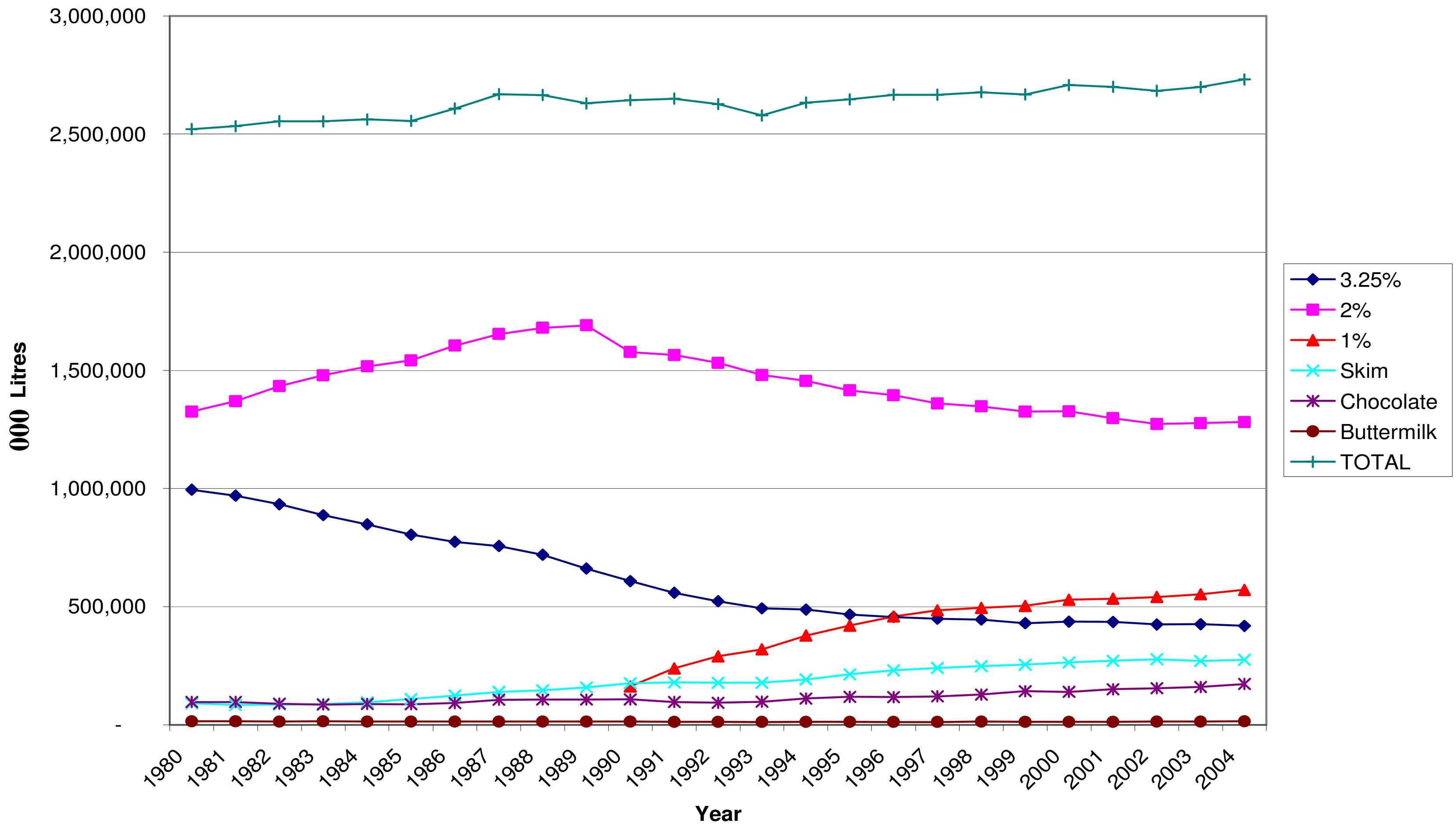
Consumption of Dairy Products in Canada

The consumption of dairy products in Canada has been subject to a number of changes in the last twenty-five years. This section focuses on the consumption patterns of various dairy products between 1980 and 2004.

Fluid milk generates the highest value for milk and is categorized as class 1. The fluid milk is divided into six individual products: milk of 3.25 percent butterfat, 2 percent butterfat and 1 percent butterfat as well as skimmed milk, chocolate milk and buttermilk. The total consumption of fluid milk in Canada has increased from 2.5 million litres in 1980 to 2.7 million litres in 2004 (Figure 2.1). The increasing trend in total fluid milk consumption, however, hides significant variations in the patterns of total consumption of six different types of fluid milk. For example, the consumption of 3.25 percent fluid milk has declined from 994 thousand litres in 1980 to 418 thousand litres in 2004 (Figure 2.1). The consumption of 2% milk rose from 1.3 million litres to 1.7 million litres in 1989, then decreased to 1.2 million litres in 2004 (Figure 2.1). The decline in the consumption of 2 percent fluid milk corresponds to the introduction of 1 percent milk in 1990 the consumption of which increased from 162 thousand litres in 1990 to 571 thousand litres by 2004 (Figure 2.1). Similar to 1 percent fluid milk, skim milk has seen an increase in total consumption from 91 thousand litres in 1980 to 275 thousand litres in 2004 (Figure 2.1). It has been suggested that these change in both total and per capita consumption are related to change in

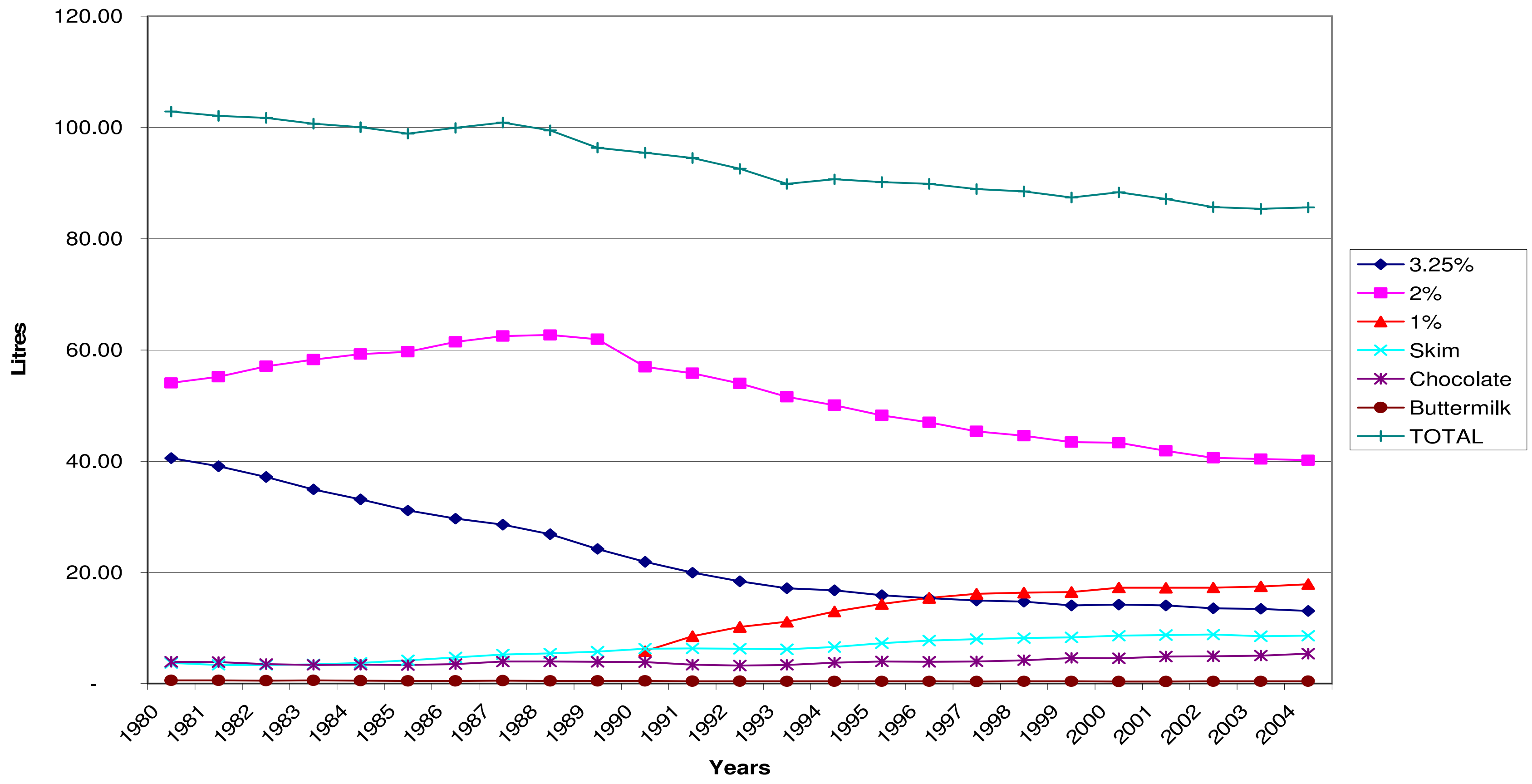
[2] The actual price producers receive per hl of milk can vary depending on component tests and quality penalties or bonuses.

Figure 2.1 Total Canadian Milk Consumption 1980-2004



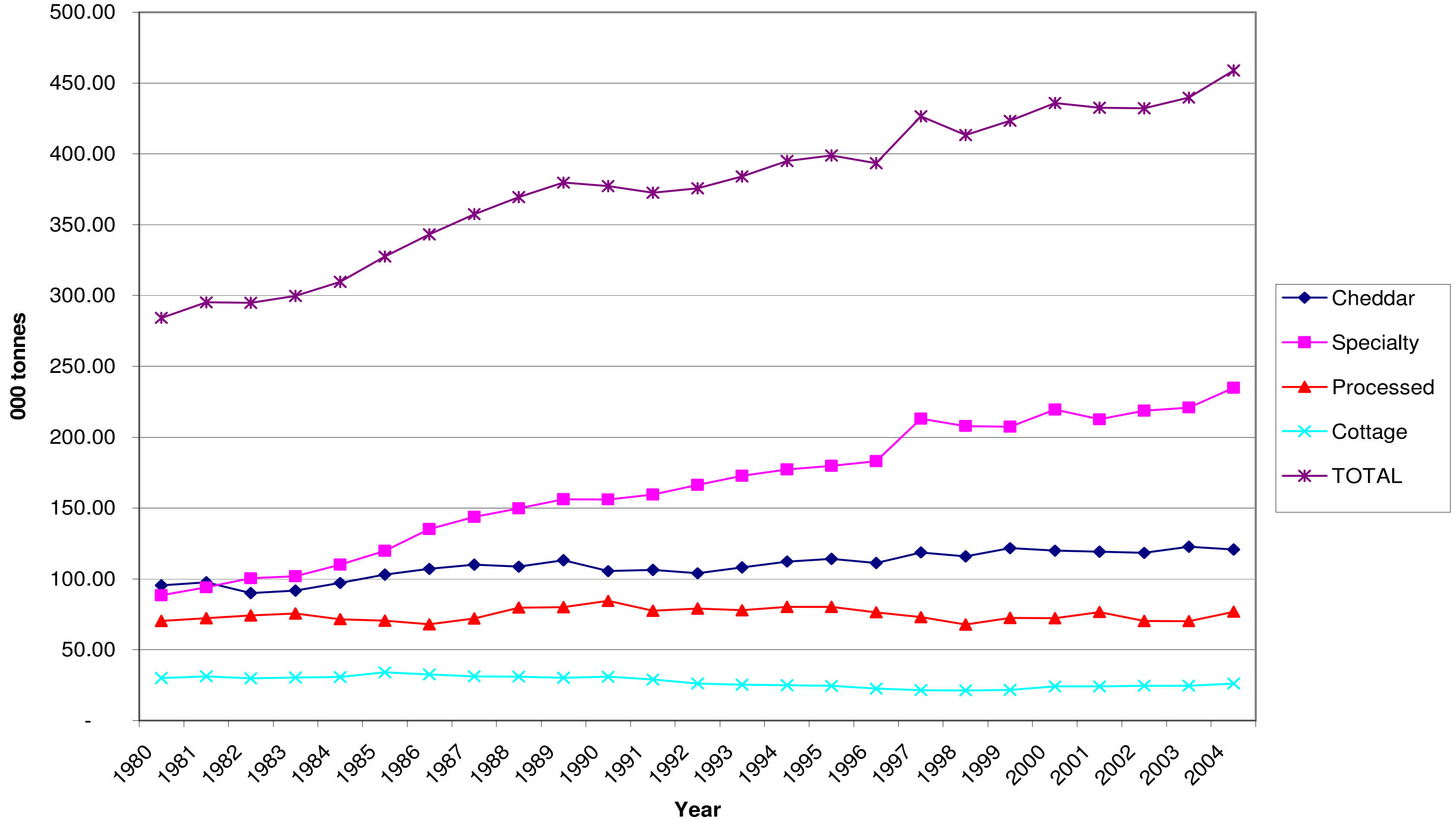
Sources: Statistics Canada Table 002-0010; CDIC, 2006

Figure 2.2 Canadian Per Capita Consumption of Milk 1980-2004



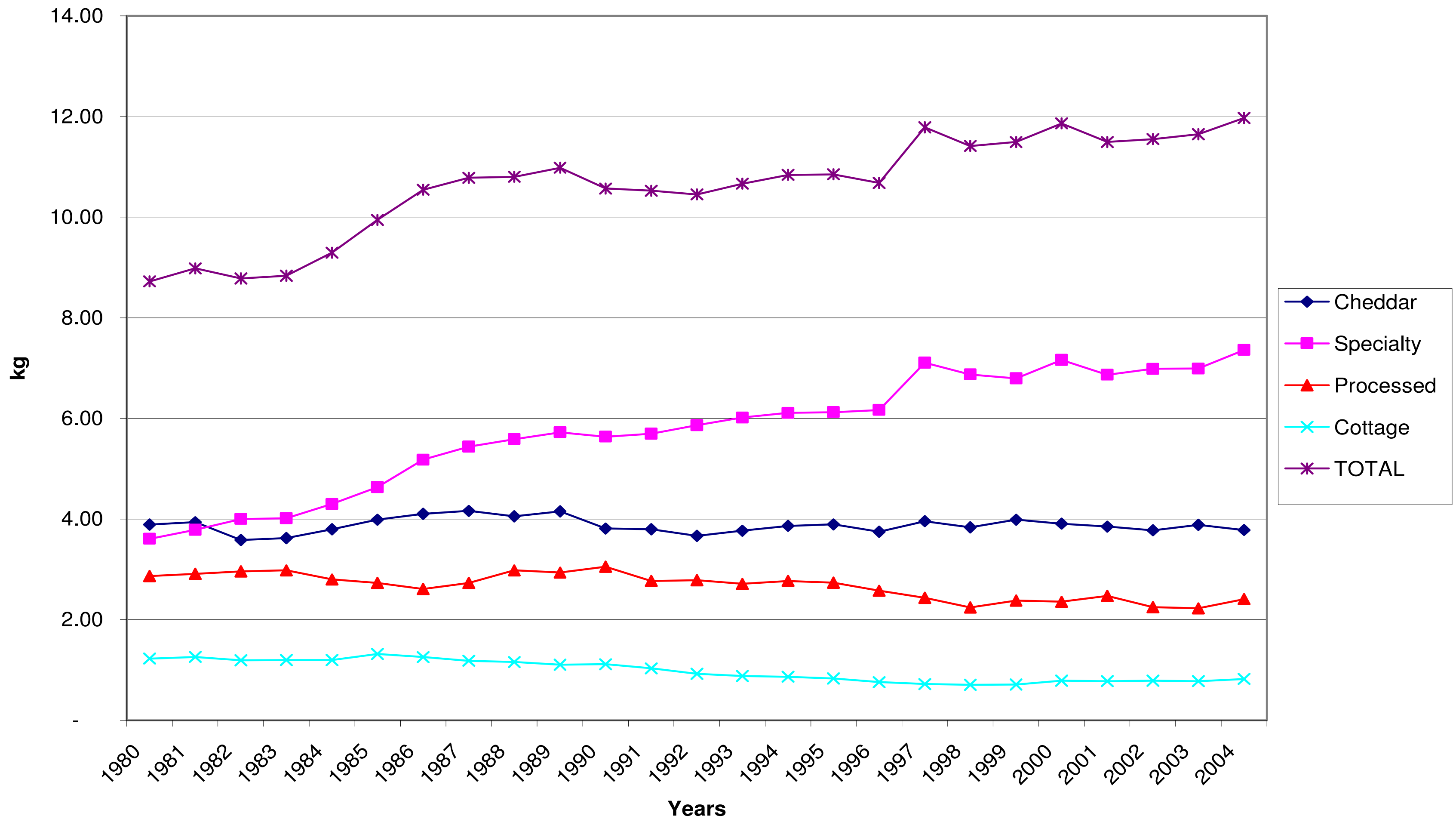
Sources: Statistics Canada Tables 002-0010 and 051-0005; CDIC, 2006

Figure 2.3 Total Canadian Consumption of Cheese 1980-2004



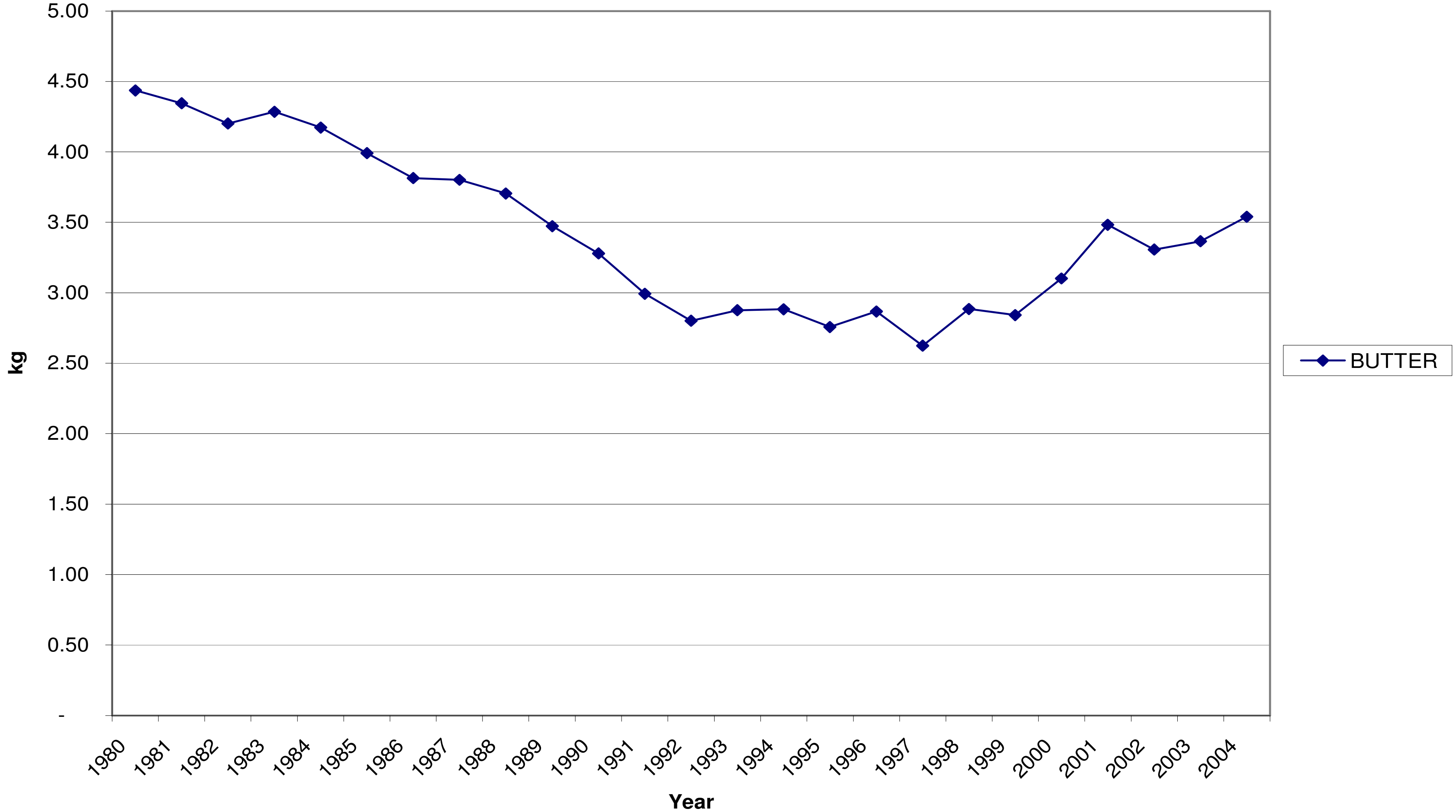
Sources: Statistics Canada Table 002-0010; CDIC, 2006

Figure 2.4 Canadian Per Capita Consumption of Cheese 1980-2004



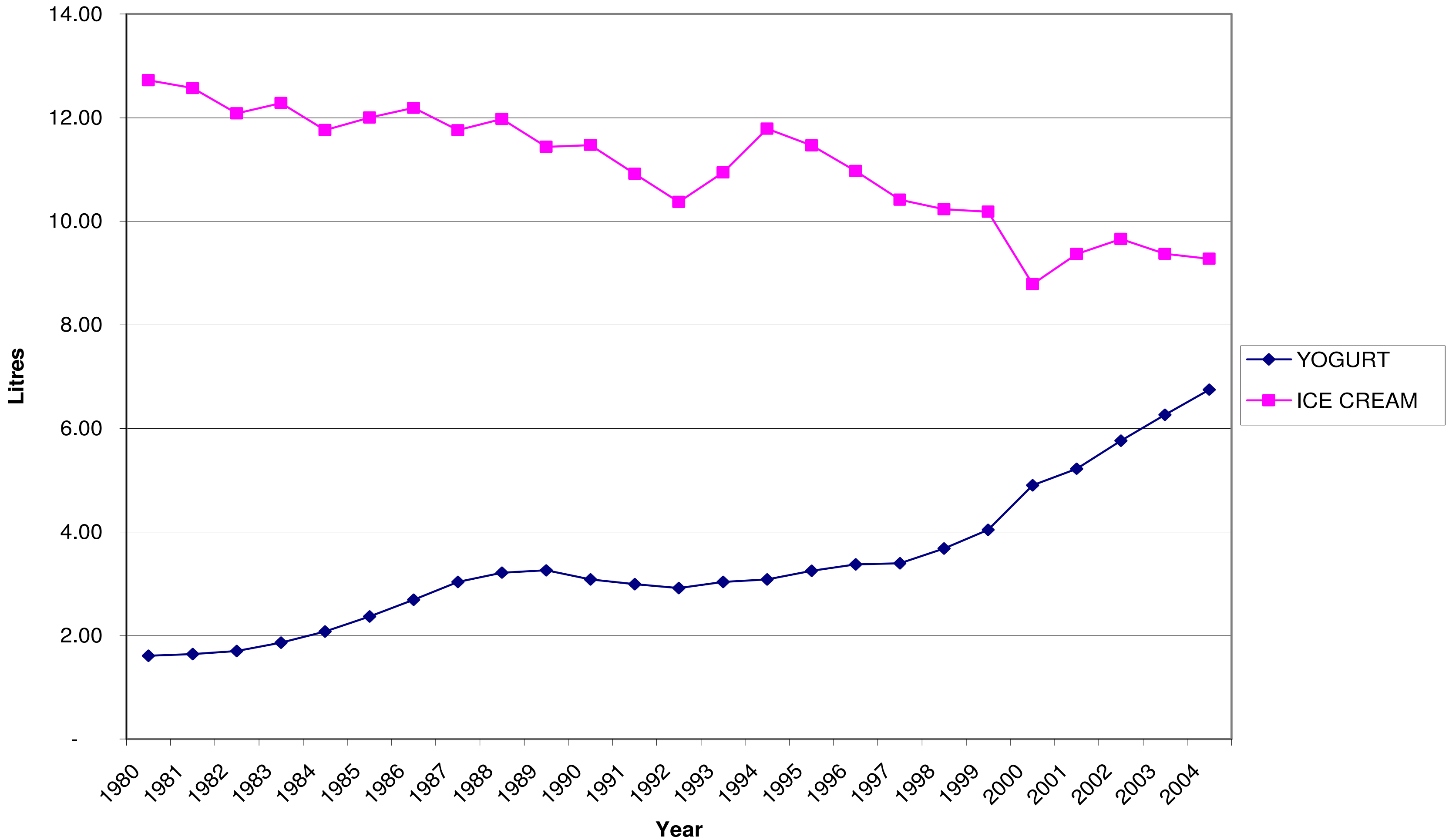
Sources: Statistics Canada Tables 002-0010 and 051-0005; CDIC, 2006

Figure 2.5 Canadian Per Caqpita Consumption of Butter 1980-2004



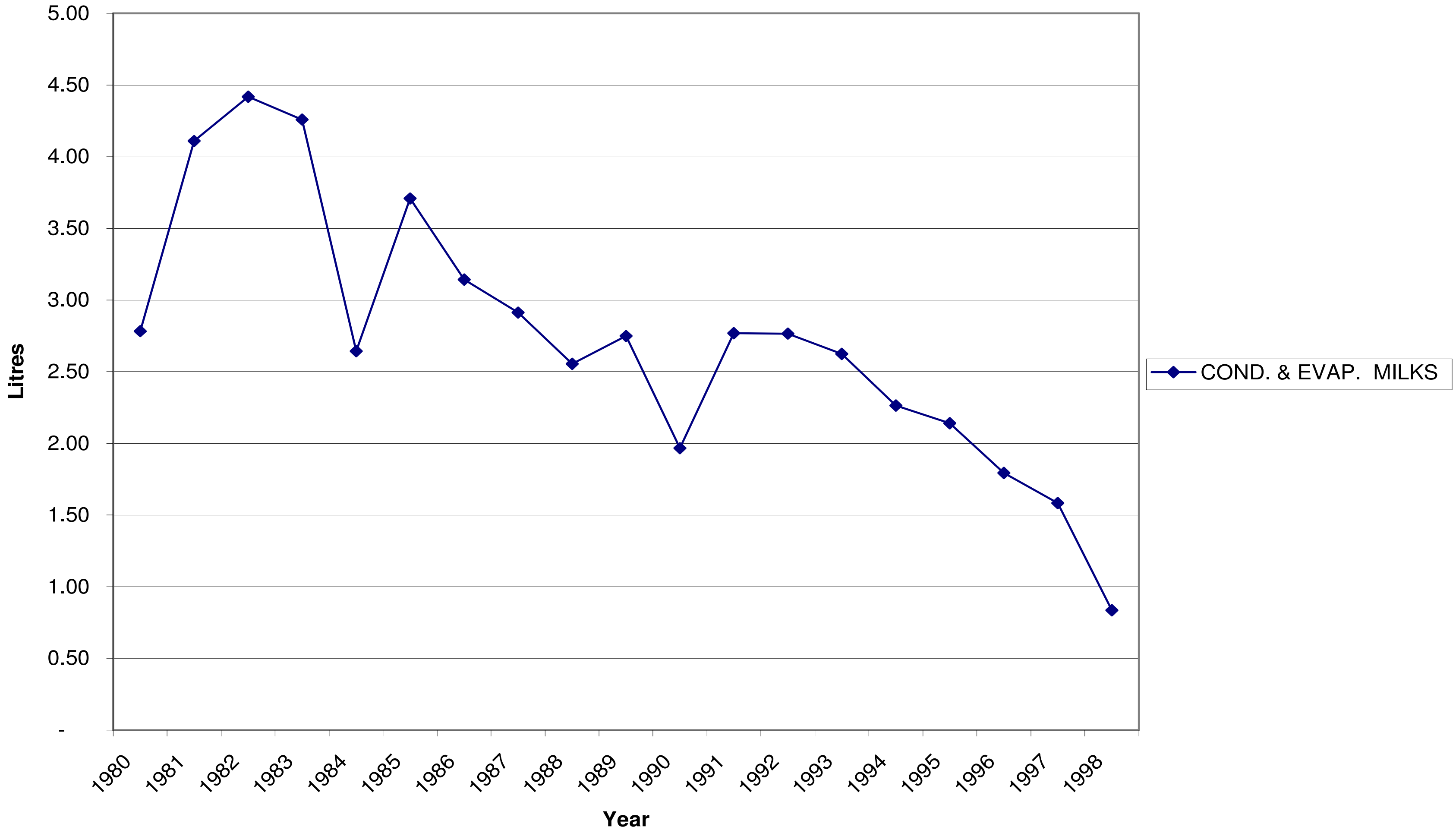
Sources: Statistics Canada Tables 002-0010 and 051-0005; CDIC, 2006

Figure 2.6 Canadian Per Capita Consumption of Yogurt and Ice Cream 1980-2004



Sources: Statistics Canada Tables 002-0010 and 051-0005; CDIC, 2006

Figure 2.7 Canadian Per Capita Consumption of Condensed and Evaporated Milks 1980-1998



Sources: Statistics Canada Tables 002-0010 and 051-0005; CDIC, 2006

preferences caused by the increase in the average age ofthe Canadian population, as an older population shifts from a higher fat diet to a lower fat diet (DFO, 2004).

While the total consumption of fluid milk has increased, it has done so at a rate less than the growth rate of the population. Therefore, the per capita consumption of fluid milk has declined from 103 litres per person in 1980 to 85 litres in 2004 (Figure 2.2). Again, there are considerable temporal variations in per capita consumption of six different types of fluid milk (Figure 2.2).

The consumption of other dairy products has also seen wide variations during the last 25 years. In the case of cheese, total consumption has increased from 284 thousand tonnes to 459 thousand tonnes between 1980 and 2004. The total consumption of cheddar, specialty and processed cheeses has increased since 1980; only the consumption of cottage cheese has decreased (Figure 2.3). Even though total consumption has increased for cheddar, specialty and processed cheeses, the per capita consumption has only increased for specialty cheeses while remaining relatively stable for the other two categories (Figure 2.4). The increase in the per capita consumption of specialty cheeses has been large enough to offset the decline in processed and cottage cheeses to cause the per capita consumption of all cheeses to increase (Figure 2.4).

The consumption of butter initially declined from 4.44 kg per person in 1980 to 2.62 kg per person in 1997 and then rose to 3.54 kg per person in 2004. (Figure 2.5) Meanwhile yogurt consumption increased steadily from 1.61 litres per person in 1980 to 6.75 litres in 2004 (Figure 2.6). Ice cream consumption declined from 12.72 litres per person in 1980 to 9.28 litres per person in 2004 (Figure 2.6). Other products experiencing a marked decline in consumption are evaporated milk and condensed milk.

The observed patterns of consumption over the last 25 years suggest that there is no consistent pattern of change in consumption for all dairy products. Some products have experienced growth in consumption while others experienced a decline. What factors might be driving these changes in the consumption of dairy products in Canada? This question is central to the economic research pursued in this study.

CANADIAN POPULATION

The first significant change in the Canadian population in the post-World War II era was a rapid change in birth rate. Compared with birth rates during the Depression and World War II, the post-World War II birth rate increased dramatically. The number of babies born during the Depression and World War II were 236,000 and 280,000 per year respectively (Statistics Canada, 2002a). This resulted in an annual average crude birth rate of 21.9 and 23.9 babies per 1000 people respectively. However, during the post-World War II baby boom, the number of babies born each year rose to 426,000 (Statistics Canada, 2002a). Thus, the average annual crude birth rate increased to 26.8 births per 1000 people. A second important feature of the baby boom is its duration. Where most population cohorts span between 5 and 10 years, the baby boom lasted from 1946 to 1965, a 20-year time period (Statistics Canada, 2002a). Thus, not only did the baby boom cause larger than normal number of births each year, it lasted longer than any other trend in births during the twentieth century, resulting in a very large population cohort that has had a significant effect on all aspects of the Canadian society.

Table 2.2 Average Number of Births by Cohort

Cohort[1]	Year of Birth[1]	Age in 2005[1]	Average number of births per year Canada[1]	Birth Rate Canada[2, 3]	Birth Rate USA[2, 4]
Pre-WW1	Before 1914	92+	201,000	28.0	29.9
WW1	1914-1919	86-91	244,000	30.1	28.6
1920s	1920-1929	76-85	249,000	26.9	25.0
Depression	1930-1939	66-75	236,000	21.9	19.2
WW2	1940-1945	60-65	280,000	23.9	21.0
Baby boom	1946-1965	40-59	426,000	26.8	24.0
Baby bust	1966-1979	26-39	362,000	16.4	16.2
Children of the boomers	1980-1995	10-26	382,000	14.3	15.8
Children of the busters	1996 on	0-9	344,000	11.3	14.3

1 Statistics Canada, 2002a
2 Birth Rates are Average Crude Birth Rates for the period, which is calculated as number of births per 1000 people
3 Canadian birth rates were calculated from various Statistics Canada datasets
4 CDC, 2006

After the baby boom period, the birth rate in Canadian population dropped to about 362,000 births/year from 1966 to 1979 (Statistics Canada, 2002a). This reduction in the number of children born each year has been characterized as the "baby bust". The decline in total births and the larger population in the post-baby boom period led the average annual crude birth rate to decline to 16.4 births per 1000 people. Though the duration of the baby bust was shorter than that for the baby boom, it was longer than for the population cohorts that had preceded the baby boom. The result is that the baby bust cohort is significantly smaller than the baby boom cohort that preceded it. Where the baby boom saw a total number of 8.52 million babies born, the baby bust had only 5.068 million babies (Statistics Canada, 2002a). This "boom and bust" pattern means that goods and services demanded by the baby boom during certain periods of time could see a drop in demand as the boomers are replaced by the smaller number of busters (Foot, 1996).

Resulting from this boom-and-bust cycle between 1946 and 1979, from 1980 to the present we have seen two resulting echo population cohorts. The first of these echo cohorts happened between 1980 and 1995. This is the baby boom echo (Foot, 1996). As with the baby boom, the average number of annual births rose with the baby boom echo (Foot, 1996; Statistics Canada, 2002a). Between 1980 and 1995, the average number of annual births was 382,000 (Statistics Canada, 2002a). While this was an increase of 20,000 births per year over the baby bust cohort, there were 44,000 fewer births per year compared to their parents, the baby boomers (Statistics Canada, 2002a). During the baby boom period cohort the average annual birth rate declined to 14.3 births per 1000 people. The baby boom echo lasted for sixteen years, which was longer than the baby bust, but shorter than that of the baby boom. In sum, the baby boomers have not had as many children as their parents, and therefore, are not replacing themselves (Statistics Canada, 2002a).

The second echo started in 1996. This is the baby bust echo and represents the children of baby busters. Like their parents, the average number of annual births declined relative to the baby boom echo to 344,000 (Statistics Canada, 2002a). However, similar to the baby boom echo, the baby bust echo is less than their parents and the crude birth rate declined only to 11.3 births per 1000 people. The baby bust echo is expected to last for about fifteen years and end in 2010. (Statistics Canada, 2002a)

Other factors that have influenced the demographic structure of the Canadian population are life expectancy at birth and fertility rates. The life expectancy in Canada increased from 63 years to 77 years for men and from 66 years to 84 years for women (Statistics Canada, 2005).

The changes in the fertility rate followed an increasing trend after World War II until the late 1950s when the fertility rate peaked at just less than 4 children per woman (Verma et al., 1996). After the late 1950s, the trend in fertility rates sharply dropped until the early part of the 21^{st} century where it appears to have levelled off at about 1.5 children per woman (Verma et al., 1996).

The changes in these primary demographic statistics coupled with an increase in the divorce rate (Statistics Canada, 2002b) may have contributed in changes in the character of Canadian households. The percentage of households in which couples with children aged 24 and under living at home dropped from 55 percent in 1981 to 44 percent in 2001 (Statistics Canada, 2002b). This has happened at a time when the number of households in Canada increased from 10,852,050 in 1996 to 11,562,975 in 2001 (Statistics Canada, 2002b). Thus, there are more but smaller households in this country now than in the past.

Other results caused by changes in these primary demographic statistics are changes in the median age and the crude birth rate in Canada. The median age of the population initially decreased to 25.4 in 1966 and then increased to 37.6 years in 2001 (Statistics Canada, 2002a). The increasing trend in median age is expected to continue until 2011, when the median age is expected to stabilize (Statistics Canada, 2002a). The trend in crude birth rates in Canada during the 20^{th} century started relatively high at the beginning of the century at between 28 and 30 births per 1000 people. The birth rate declined during the 1920s and 1930s to 21.9 births per 1000 people. The crude birth rate rose during World War II and the post-war baby boom to around 27 births per 1000 people. Since then the crude birth has declined to 11.3 births per 1,000 people (Table 2.2).

The second major change in the Canadian population since World War II is in its ethnic diversity. This change is reflected in the structure of the immigrant portion of the Canadian population in 2001. Of the total Canadian population of 29 million in 2001, 5.4 million or 18.4 percent were born outside of Canada (Statistics Canada, 2003a). The nature of changes in Canadian immigration can be seen in the breakdown of the immigrant population in 2001 by period of entry and place of birth. Table 2.3 breaks down the immigrant population in 2001 by decade of immigration and region from which they immigrated. This table shows two major shifts in Canadian immigration patterns since World War II.

Table 2.3 Place of Birth by Period of Immigration, Canada, 2001

	Period of Immigration									
	Before 1961		1961-1970		1971-1980		1981-1990		1991-2001	
	Number	%	Number	%	Number	%	Number	%	Number	%
Total Immigration	894,465	100	745,565	100	936,275	100	1,041,495	100	1,830,680	100
United States	34,805	3.9	46,880	6.3	62,835	6.7	41,965	4.0	51,440	2.8
Europe	809,330	90.5	515,675	69.2	338,520	36.2	266,185	25.6	357,845	19.5
Asia	28,850	3.2	90,420	12.1	311,960	33.3	491,720	47.2	1,066,230	58.2
Africa	4,635	0.5	23,830	3.2	54,655	5.8	59,715	5.7	139,770	7.6
Caribbean, Central and South America	12,895	1.4	59,895	8.0	154,395	16.5	171,495	16.5	200,010	10.9
Oceania and other countries	3,950	0.4	8,865	1.2	13,910	1.5	10,415	1.0	15,385	0.8

Source: Statistics Canada, 2003a

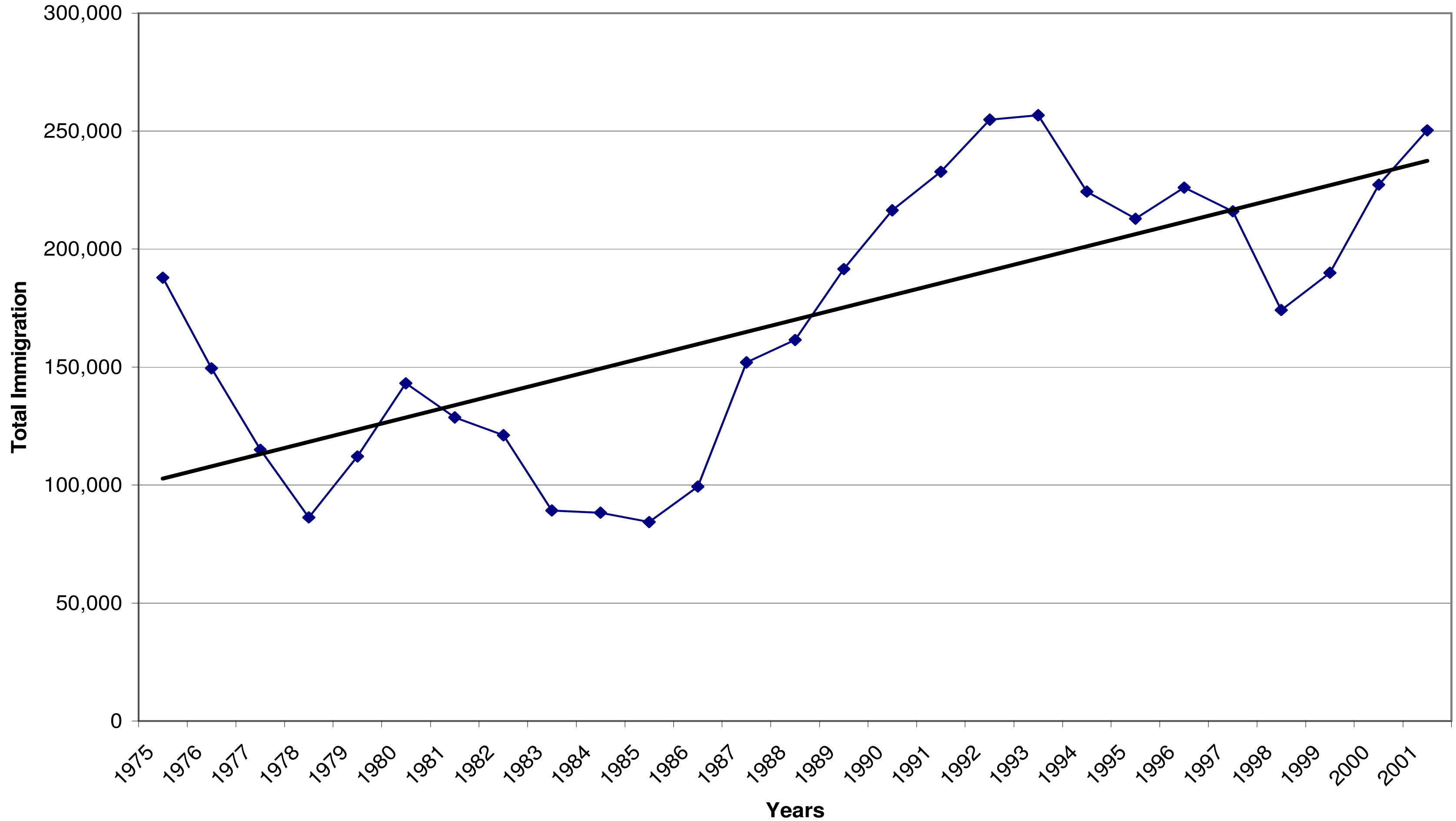
The first major shift in immigration has been the source of immigrants coming to Canada. Prior to 1961, about 90.5 percent of total immigrants were from Europe (Statistics Canada, 2003a). While European immigrants still dominate Canadian immigration, their share has fallen to 69.2 percent of total immigration since the 1960s. Asian immigrants represented only about 12.1 percent of total immigrants in Canada in the 1960s. The growth in Asian immigrants to Canada continued during the 1970s. Due to the declining number of European immigrants and rising Asian and African immigrants during the last three decades, the ethnic diversity of Canada has increased significantly (Statistics Canada, 2003a).

The second major shift in immigration since World War II is the total number of immigrants allowed to enter Canada each year. Since the mid 1970s, the annual number of immigrants has been increasing (Figure 2.8). This increasing immigration has resulted in the period 1990 to 2001 being the period with the highest sustained immigration into Canada since the western settlement period of 1903 to 1913 (Figure 2.2).

The combination of the two major shifts in immigration can be seen in the structure of the immigrant population in 2001. Due to these shifts in Canadian immigration Canada has changed from being a nation mainly of European descent to an ethnically diverse nation with people from many parts of the world.

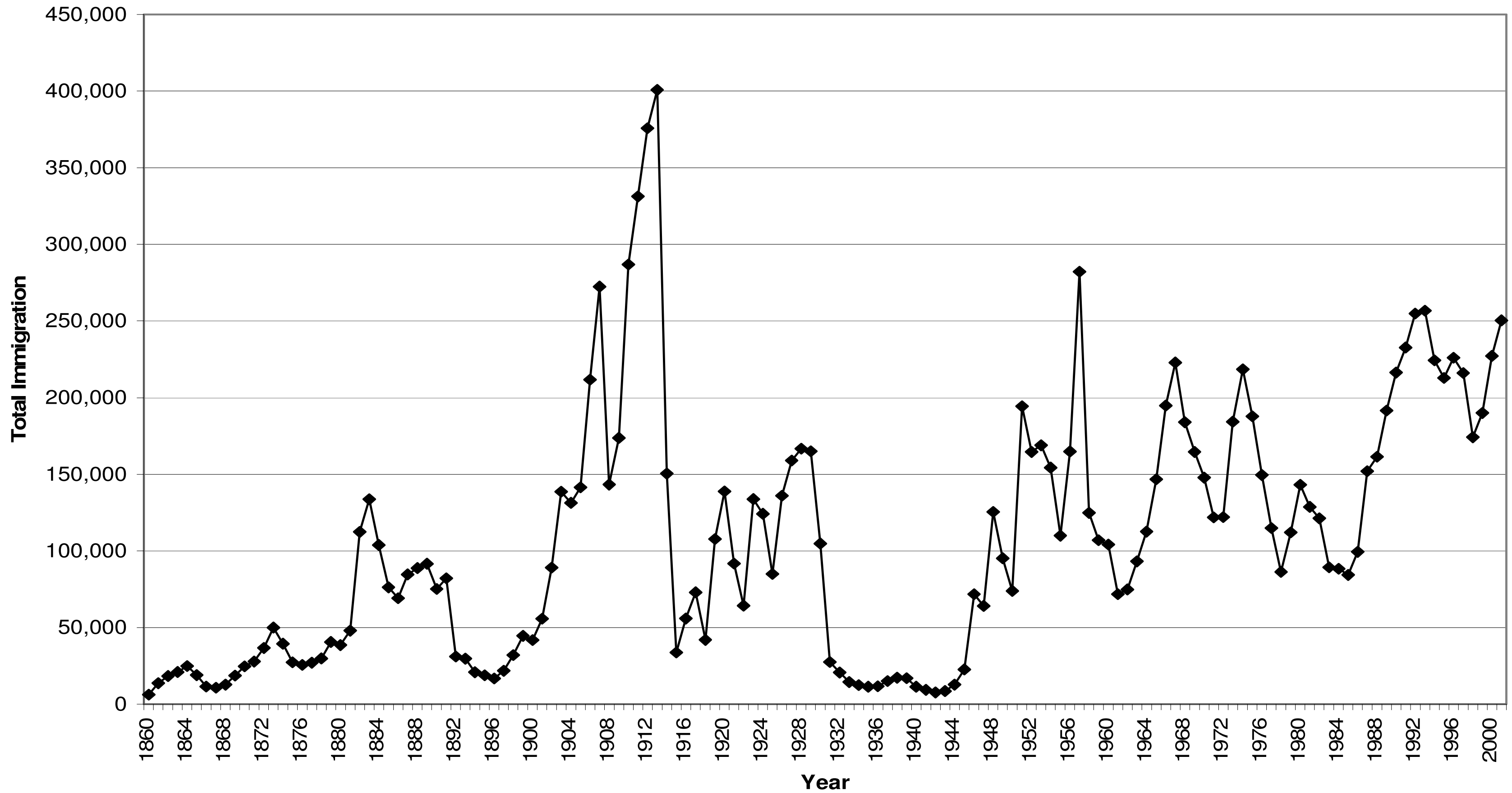
The question is, will the changes in the demographic structure of a population lead to changes in the demand for dairy products? For example, populations with high birth rates could expect high demand for products consumed by infants and young children than similar sized populations with a low birth rate. Likewise a population with a high percentage of older people will demand different goods and services than a population with a lower percentage of older people (Foot, 1996).

Figure 2.8 Canadian Immigration since 1975



Source: Strategic Policy, Planning and Research, 2002

Figure 2.9 Canadian Immigration since 1860



Source: Strategic Policy, Planning and Research, 2002

SUMMARY AND CONCLUSION

This chapter reviewed some notable changes in the demographic structure of Canada's population since the end of World War II. Major changes in the consumption of dairy products in Canada during the same period have also been reviewed. For example the decline in the consumption of 3.25 percent fat fluid milk corresponds to the increase in the median age, the decline in the birth rate and the increasing ethnic diversity of the Canadian population. It should also be noted that in the case of fluid milk, the decline in 3.25 percent fat milk was accompanied by an increase in the consumption of lower fat milk, initially 2 percent milk and later 1 percent milk when it became available. Therefore, the jury is still out on which of these or any other factors or combination of factors are causing these changes in the consumption of fluid milk in Canada.

Similar questions can also be raised about the changes in the consumption of cheese and other dairy products in Canada. Can these changes be attributable to changes in the ethnicity and/or other demographic factors in Canada? The following chapter focuses on a critical assessment of the existing literature related to this issue.

CHAPTER 3: DEMAND FOR FOOD: A CRITICAL ASSESSMENT OF AVAILABLE LITERATURE

INTRODUCTION

A system of demand for major dairy products need to be estimated in this study to assess the effects of changes in ethnicity and population demographics on the consumption of dairy products in Canada. This chapter, therefore, focuses on major developments in demand analysis to synthesize progress in this area. Special attention is devoted to empirical demand analysis focusing on food products and on initiatives to expand the basic framework so that habit formation and other non-economic variables can be incorporated in demand analysis. The objectives of this chapter are: (i) to highlight major developments in demand analysis; (ii) to provide a synoptic overview of who did what and how; (iii) to critically assess the findings of selected previous studies; and, (iv) to consider how this research may add value to the existing stock of knowledge in this area.

The rest of this chapter is organized as follows: (i) a review of the historical development of demand analysis with emphasis on demand systems, and (ii) a critical assessment of the literature that utilized demographic variables and their findings with regard to heterogeneous preferences in demand analysis.

CONSUMER CHOICE AND DEMAND ANALYSIS

The basic tenet of consumer choice analysis is to investigate if consumer demand for a good or a service is consistent with the demand theory. It involves an investigation of the impacts of prices, income and other relevant factors on observable demands for commodities, given a set of simplifying assumptions regarding consumers' behaviour and market conditions. The traditional approach to modelling consumer choices postulates that a consumer maximizes his/her preferences given the budget constraint. This simple theory generates powerful qualitative predictions for observed changes in demand for goods and services (Barten and Böhm, 1982).

The historical development in demand analysis has long been an area of interest to applied economists. Initial demand analysis focused on a single commodity and employed a single equation demand model to generate empirical results. It was soon realized that a single equation demand analysis may produce results inconsistent with demand theory due to its inability to incorporate cross-commodity effects and to verify symmetry, adding-up and other relevant properties of a theoretically relevant demand function.

The system approach to demand analysis was developed to address these inadequacies of a single equation approach. In this approach all relevant properties of demand could either be imposed or tested so that a theoretically consistent set of demand estimates could be obtained and used for policy analysis. Due to these advantages, applied demand analysis has become increasingly more reliant on the demand system approach (Moschini and Moro, 1993).

The demand system started from the initial work of Walras and Marshall who derived demand curves from utility functions (Blaug, 1996). However, a gap between theory and application was evident as applied demand analysis continued to rely on single equation models for the calculation of demand elasticities (Deaton and Muellbauer, 1980a). The integration of consumer choice theory and applied demand began with the work of Stone (1954). Stone (1954) distinguished his work from the previous demand studies by employing the theory of demand to define and modify the equations to be applied to the data (Deaton and Muellbauer, 1980a). Since the work of Stone, most of the developments in demand analysis have focused on improvements in the representation of the consumer's underlying preference function and relaxation of the assumption of a representative consumer. The predictions of demand theory have also been subjected to rigorous statistical analysis (Deaton and Muellbauer, 1980a). What follows next is a nontechnical overview of the developments in the four most popular demand systems used in empirical demand analysis.

Linear Expenditure System

The Linear Expenditure System was first introduced by Klein and Rubin (1947-1948) and derives its name from the fact that it is linear in both prices and expenditure (Pollak and Wales, 1992). The first application of the Linear Expenditure System was by Stone (1954) who focused on analyzing British demand for six major commodity groups[3] employing annual data from 1920 to 1938. The Linear Expenditure System is based on a specific utility function:

$$u = \sum_i \beta_i \ln(x_i - \gamma_i)$$

where $\sum_i \beta_i = 1$

(Samuelson, 1947-1948). This is known as the Stone-Geary utility function, where x_i is the total consumption of good i and γ_i is the minimum or subsistence level of consumption of good i. This utility function is defined as exhibiting preferences that are assumed to have strong or additive separability. The total utility in this case is the weighted sum of the

[3] The groups were: 1) meat, fish, dairy products and fats; 2) fruit and vegetables; 3) drink and tobacco; 4) household running expenses; 5) durable goods; and 6) other goods and services.

logarithm of the consumption above the subsistence level of consumption (Deaton and Muellbauer, 1980a; Pollak and Wales, 1992).

The standard utility maximization subject to a budget constraint yields the Marshallian demand functions such as,

$$x_i = \gamma_i = \frac{\beta_i}{p_i}(y - \sum_j p_j \gamma_j)$$

where

x_i is the quantity demanded of good i

p's are the prices

y is the total expenditure on the n goods

γ's are the subsistence level of consumptions.

Since the Linear Expenditure System is already a theoretically plausible demand system, the only restriction needed to impose adding-up, symmetry and homogeneity conditions is $\sum \beta_i = 1$ (Phlips, 1983). The negativity property implies that the direct substitution effects be less than zero or $\frac{\delta x_i}{\delta p_i} + x_i \frac{\delta x_i}{\delta y} < 0$. This is true only if $x_i > \gamma_i$ and $0 < \beta_i < 1$. Therefore, to be theoretically consistent the estimated demand system requires satisfaction of the following restrictions: (i) $0 < \beta_i < 1$; (ii) $\sum \beta_i = 1$; and (iii) $x_i > \gamma_i$. Since the Linear Expenditure System is linear in prices and total expenditure, it is easy to estimate this demand system using the Ordinary Least Squares (OLS). Due to its theoretical consistencies and the ease of empirical implementation, The Linear Expenditure System has been used in many studies over the years (eg. Goddard, 1983; Safyurtlu et al, 1986; Chang and Green, 1989; Moschini, 1991; Green et al, 1995; Park et al, 1996; McLaren et al, 2000).

Goddard (1983) used the Linear Expenditure System to study the demand for food at home and away from home in Canada. He used a two-stage budgeting procedure to allocate income first between savings and current expenditure. The current expenditure was further allocated between food at home, food away from home and non-food goods and services. He concluded that 86 percent of the supernumerary budget was allocated to non-food purchases, while the majority of food expenditures were pre-committed. Goddard's research suggests that food expenditures are largely pre-committed expenditures. This does not, however, indicate what factors determine the level of expenditures, whether pre-committed or supernumerary.

Although there are several advantages of using the Linear Expenditure System, there is also a problem associated with this method. While the restrictions of adding-up, symmetry and homogeneity are, easily imposed, the underlying functional form is highly restrictive. The Linear Expenditure System results in constant marginal budget shares over the full range of expenditures (Deaton and Muellbauer, 1980a; Cranfield et al., 2000). So the Stone-Geary utility function must be the exact functional form to represent consumer preferences. If this is not the case, the resulting demand estimates will contain misspecification errors and the resulting estimated values of the model would be incorrect (Piggott, 2003). Thus, the estimated elasticities would be incorrect and any forecasting or policy analysis based on these elasticities will be erroneous.

To address this problem associated with the Linear Expenditure System a flexible functional form is required. The first successful attempt along this line was the development of the Rotterdam Demand System by Barten (1964) and Theil (1965).

Rotterdam Model

The Rotterdam Model developed by A.P. Barten (1964) and Henry Theil (1965) attempted to address the problem associated with the Linear Expenditure System. The Rotterdam Model is very similar to the Linear Expenditure System although it focuses on the differentials of the logarithms (Deaton and Muellbauer, 1980a). If we totally differentiate the logarithmic form of the Linear Expenditure System, we get

$$d \ln x_i = e_i d \ln y + \sum_j e_{ij} d \ln p_j \, .$$

As with the Linear Expenditure System, it is relatively easy to impose and test the theoretical restrictions in the Rotterdam Model. Since the Rotterdam Model is linear in the derivative of the logarithm of income and prices, it can be estimated easily using standard linear regression methods.

The Rotterdam Model, as well as the Almost Ideal Demand System, have been widely used by agricultural economists (Alston and Chalfant, 1991). Although these models are quite similar in terms of their local flexibility, compatibility with the demand theory, data requirements, etc., they often lead to different results because of differences in the functional form of the demand systems (Alston and Chalfant, 1991). It is important to determine the correct functional form in demand analysis. Alstson and Chalfant (1991) compared the Rotterdam Model and the Almost Ideal Demand System for United States meat demand. They found that the Rotterdam Model was not rejected by their tests. Lee, Brown and Seale, Jr. (1994) also compared the Rotterdam Model and Almost Ideal Demand System for Taiwanese household consumption[4] and found that for their dataset, the Rotterdam Model was rejected. Alston and Chalfant (1991) compared four demand systems: double-log demand system, Linear Expenditure System, Almost Ideal Demand System and the Rotterdam Model, in testing for structural change in Canadian beef, pork and fish demand. They found no reason to prefer the Almost Ideal Demand System over the Rotterdam Model. Thus, there are instances where the Rotterdam Model represents the correct specification, its use improves the estimates and demand analysis. In other instances, the use of the Rotterdam Model could lead to misleading results.

Brown, Lee and Seale, Jr. (1995) and Moschini and Vassa (1993) used mixed demand systems based on the Rotterdam Model to study demand for oranges and beef and pork respectively. Mixed demand systems allow some commodities to have prices determined exogenously while others are determined endogenously. Moschini and Vassa (1993) used their mixed Rotterdam Model for Canadian meat demand. This allowed them to study beef and pork in a competitive market and chicken in a supply managed market in the same demand system. Brown, Lee and Seale, Jr. (1993) used a mixed demand system to study the demand for oranges in the United States and found that in this case the mixed demand system performed better than the traditional models. However, both of these studies still assumed that the Rotterdam or the inverse Rotterdam Model was the correct model in studying demand without formally testing for the suitability of the functional form.

A number of researchers attempted in the 1990s to increase the flexibility of the Rotterdam Model by incorporating demographic and socio-economic variables into the

[4] The consumption analysed was aggregated in the following categories Food, Clothing, Housing, Education, Medical Transportation and Miscellaneous

model. This allows the model to vary between economic agents and therefore, does not impose exactly the same restrictions on all agents in the economy. Brown (1994) and Nelson (1997) both incorporated demographic variables into the Rotterdam Model to study demand for fruit juices and alcoholic beverages respectively. Brown (1994) used four methods to incorporate demographics into the Rotterdam Model: scaling, translation, scaling-translation and Theil's approach. He found that the scaling-translation approach produced the best results when studying demand for grapefruit, orange and other juices in the United States. Nelson (1997) incorporated demographic factors into the Rotterdam Model by using demographic translation to study the demand for beer, wine and spirits in the United States. He concluded that the change in the age structure of the United States population was the main driver of the decline in alcohol consumption in the United States.

Even with the increased flexibility of the Rotterdam Model, its underlying structure remained problematic in empirical analysis as it generated, in some instances, incorrect budget shares and income flexibilities. The Rotterdam Model, like the Linear Expenditure System has an underlying utility function that has a directly additive structure (Phlips, 1983; Cranfield et al., 2000). As a result, the marginal budget shares are constant over the full range of the agent's income. Also the income flexibility is constant and equal to 1 over the full range of the agent's income. Consequently, the subsistence consumption is zero (i.e. $\gamma_1 = ... = \gamma_i = ... = \gamma_n = 0$) and therefore the utility function is $u = \sum \beta_i \ln x_i$ (Phlips, 1983). These results bring into question the universal acceptability of the Rotterdam Model for applied demand analysis, especially when the changes in income are large. However, the model still maintains its usefulness in testing theoretical restrictions of demand theory. The recognition of the restrictions of the Rotterdam Model provided impetus to the development of more flexible functional forms for demand analysis. These efforts led to the development of the Translog and Almost Ideal Demand Systems.

Translog Demand System

In an attempt to increase the flexibility of demand system analysis, the basic Translog Demand System was developed by Christensen, Jorgenson and Lau (1975). They intended to test demand theory in a manner that does not employ additivity or homotheticity as part of the maintained hypothesis. The second objective was to exploit the duality between prices and quantities in demand theory in order to find the indirect utility function (Christensen et al, 1975). By satisfying these two objectives, they were able to generate a flexible expenditure function which is consistent with utility maximization.

The Translog Demand System provides a second order approximation of an arbitrary twice differentiable utility function. This appeal has led a number of researchers to use the Translog Demand System (Green et al, 1995; Holt, 2002; Yen et al, 2003; Lewbel, 2003). Yen, Lin and Smallwood (2003) used the Translog Demand System to study food consumption by food stamp recipients in the United States. The flexibility of the Translog Demand System allowed them to adapt the model to incorporate censored data. They found that food stamp recipients respond differently to changes in price and subsidies than by other consumers.

The flexibility of the Translog Demand System also lends itself to be easily nested with other demand systems. Green, Hassan, and Johnson (1995) nested the Translog Demand System with five other demand systems: Linear Expenditure System, ADDILOG and three members of the Almost Ideal Demand System. They paired each combination to determine which demand system provided the best fit for Canadian data. They found that the Almost Ideal Demand System gave a better fit to these data than the other demand systems, including the Translog.

Although the Translog Demand System offered some improvements over the previous demand systems, it still has two major problems. First, it is assumed that consumer preferences are represented by a utility function of the general translog form. So, models estimated using the Translog Demand System are correct, if the underlying preference structure is truly represented by a translog utility function. Therefore, the Translog Demand System is still subject to functional choice errors (Piggott, 2003).

The number of parameters to be estimated increases significantly with the complexity of the functional form. In particular, the number of parameters that need to be estimated for a flexible functional form is greater than the number of parameters that need to be estimated for a non-flexible functional form for the same number of independent variables. Therefore, to estimate a flexible functional form model such as the Translog Demand System, a larger sample is needed than for the Linear Expenditure System. These problems aside, the Translog Demand System represents an important advancement in demand system analysis (Pollak and Wales, 1992).

Almost Ideal Demand System (AIDS)

The Almost Ideal Demand System developed by Deaton and Muellbauer (1980b) is comparable generally to the Rotterdam Model and Translog Demand Systems. However, the Almost Ideal Demand System has several advantages: it "gives an arbitrary first-order approximation of any demand system; it satisfies the axioms of consumer choice exactly; it aggregates perfectly over consumers without generating parallel linear Engel curves; it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters" (Deaton and Muellbauer, 1980b).

The starting point for the Almost Ideal Demand System is the semi-logarithmic model's underlying cost (expenditure) function. However, Deaton and Muellbauer (1980a, 1980b) added a quadratic form to allow for interaction between prices (Phlips, 1983) (see Appendix 1 for a complete derivation). However, only the adding-up restriction is automatically satisfied in an unrestricted estimation. This means that homogeneity and symmetry can be tested by imposing these restrictions (Deaton and Muellbauer, 1980a). These features of the Almost Ideal Demand System made it a popular choice in empirical demand analysis ever since it was introduced (eg. Goddard, 1983; Teklu and Johnson, 1988; Chang and Green, 1989; Wahl and Hayes, 1990; Reynolds and Goddard, 1991; Chen and Veeman, 1991; Kesavan et al, 1993; and many others). It has also led to the development of a family of demand systems related to the original Almost Ideal Demand System (McLaren et al, 1995; Eales and Unnevehr, 1994; Brown et al, 1995; Piggott, 2003).

Despite its enormous popularity, the Almost Ideal Demand System has two major pitfalls. It has the functional form problem, because a specific utility function underlies each of the Almost Ideal Demand System. Therefore, unless the functional form chosen for the Almost Ideal Demand System is correct, the estimated parameters will be erronious (Piggott, 2003). The second problem is related to the flexible functional form and the associated problems of estimation: the number of dependant variables must decrease to estimate a flexible functional form model rather than a non-flexible form model given the same data set (Pollak and Wales, 1992).

The preceding discussion on the development of demand systems for demand analysis has centred on increasing the extent of flexibility in the demand system in order to better estimate consumers' preferences. However, this flexibility has tended to focus on increasing the flexibility of the underlying utility function and has not been concerned with other assumptions of the models. All of the models presented thus far have assumed that the preferences of all consumers could be represented by a representative agent. The response of a consumer at the margin to changes in income is assumed to be identical (Antonelli, 1886; Gorman, 1953). This assumption has been relaxed in the literature through the inclusion of demographic and other non-economic variables in demand analysis.

The relaxation of the assumption of the representative agent means that the model is allowing the preferences of different households to differ. This means that preferences are no longer homogeneous but are heterogeneous in nature. The only specific source of heterogeneous preferences in the classic demand model is the households' income. However, there are other sources of heterogeneity in preferences that cannot be accounted for by income alone. For example, a person's ethnic background could influence his/her preference for food or dress while or a person's religion could prohibit the consumption of certain types of foods. Household structure could influence the household's consumption of certain products. For example, if the household contains a young child, goods and services needed by young children such as diapers, childcare, toys, etc. will be demanded in contrast to household without a child. Also households with older people may have different preferences than households with younger people. Including variables that describe non-economic demographic characteristics can allow the researcher to assess the importance of different characteristics and increase the general flexibility of the demand model and its forecasting ability.

DEMOGRAPHIC VARIABLES IN DEMAND ANALYSIS

The incorporation of demographic variables into demand analysis recognizes the fact that consumers and households tend to prefer different goods and services depending on the characteristics of their households. Such difference in consumption of different households is referred to as heterogeneous preferences. Consideration of heterogeneity differs from the traditional method of demand analysis which implicitly assumes homogeneous preferences and uses a representative agent model. In recent years a number of demand studies have attempted to incorporate heterogeneous preferences into their analysis. These studies can be divided into two general categories: single equation and demand system models. Single equation models have been used to analyse demand for a number of products in a number of countries. (These studies are summarized in Table 3.1) Hu et al. (2005) and Rigby and Barton (2005) both use mixed logit models with heterogeneous preferences to study the preferences for genetically modified food. Hu et al (2005) considered demand in Canada and Rigby and Barton (2005) focused on the United Kingdom respectively. Both studies found that consumer preferences were heterogeneous. However, neither study made an attempt to explain the causes of this heterogeneity.

Both Quagrainie et al (1998) and Dong et al (1998) assumed heterogeneous preferences and used single equation models to study the demand for meat products. Quagrainie et al (1998) studied demand for beef steak, pork cut and ground beef in western

Canada while Dong et al (1998) studied demand for beef steak and roasts in the United States. Quagrainie et al (1998) used a nested logit model while Dong et al (1998) used a single equation semi-log model. Quagrainie et al. (1998) found that socio-economic factors such as family size and age played a significant role in consumption. In particular, smaller households were found to have stronger preference for beef than larger households, while people over 40 years of age had lower preferences for all meats in the study. Dong et al (1998) also found that socio-economic factors played an important role in the demand for beef products in the United States. In this case, the age composition of the household was a statistically important factor in determining the demand for beef products. Single equation models have also been applied to study the demand for nutrient intake. Adelaja et al (1997) applied an Engel equation model to the demand for total fat, carbohydrates, cholesterol, vitamin A, vitamin C and calcium in the United States. Tiffin and Dawson (2002) applied a vector auto regression model to the demand for calories in Zimbabwe. Adelaja et al (1997) found statistically significant differences between households of different socio-economic background in the way they perceived health information and in their nutrient intake. Tiffin and Dawson (2002) found that price and income variables were inadequate to explain the demand for calories in Zimbabwe.

Kinnacan and Venkateswaran (1994) used a single equation model to study the demand for orange juice and milk in Ontario. They found heterogeneity in the response of consumers to advertising in the fluid milk market. All of the single equation studies reviewed show some degree of structural heterogeneity in a variety of markets. These results suggest that assumption of homogeneous preferences and the representative agent may not be valid in

Table 3.1 Single Equation Studies

Study	Commodities Studied	Sample, Data, Countries	Type of Model	Estimation Method	Restrictions Tested/Imposed	Major Findings
Kinnucan and Venkateswaran (1994)	milk and orange juice	quarterly data from 1973 to 1987 for Ontario	Cooley-Prescott model, return-to-normality and Stochastic Trend		none	Found differences in the response to advertising of different households.
Adelaja et al (1997)	total fat, carbohydrates, cholesterol, vitamin A, vitamin C and calcium	1991 Continuing Survey of Food Intake by Individuals and 1991 Diet and Health Knowledge Survey, USDA	Engel function, linear single equation	OLS and WLS	none	Found that there were differences between households of different socio-economic classes in the way they perceived health information.
Hu et al (2005)	bread with and without GMO	consumer survey in Canada Dec. 2002 to Jan. 2003	discrete choice; mixed logit, single equation	maximum likelihood	none	Found that consumers were heterogeneous in their preferences.
Quagrainie et al (1998)	beef steak, pork cut and ground beef	consumer survey in four western provinces	discrete choice; multinomial nested logit model, single equation	logit	imposed	Found that smaller households had stronger preferences for beef than larger households. They also found people over 40 had lower preferences for all meats.
Dong et al (1998)	beef steaks and roasts	1987-88 Nationwide Food Consumption Survey U.S.	semi-log, single equations	maximum likelihood	none	Found that socio-economic variables played a significant role in the demand for beef products.
Tiffin and Dawson (2002)	calories	annual data 1961-92 for Zimbabwe	vector autoregression model	OLS	none	Found that price and income were inadequate to explain the demand for calories.

some cases in which demographic variables alter the preferences of consumers.

The studies cited above found evidence that heterogeneity preferences affects the results of demand estimate, bringing into question predictions of the representative agent model in demand analysis. While informative, the single equation models are unable to ensure that the theoretical restrictions of adding-up, symmetry and negativity can be imposed or tested in the analysis (Deaton and Muellbauer, 1980a). Thus, economic theory played a minor role in these studies

The other class of studies incorporate heterogeneous preferences into a demand system. (These studies are summarized in Table 3.2) One of the early studies that applied this method to investigate for aggregate commodities such as food, shelter, transportation, etc. is Alessie and Kapteyn (1991). These authors incorporated heterogeneous preferences by making his/her subsistence expenditure a function of family size and habit formation through incorporating mean preserved budget shares. Alessie and Kapteyn (1991) used one period lagged demographic variables into the almost ideal demand system (AIDS) and found that the model with heterogeneous preferences better fit their data than did the model with homogeneous preferences and did not reject theoretical restrictions. They also found that the heterogeneous preference model had different properties than the standard model. In contrast, Fortin (1995) used the linear expenditure system to study consumption of aggregated commodities such as food, tobacco and alcohol, shelter, household operations, transportation and communication, clothing, personal services and miscellaneous non-durables and services in Canada. He concluded that the heterogeneity bias was small and insignificant during the period from 1978 to 1986. However, the use of the linear expenditure system in this study may have influenced the results.

It appears from the preceding that heterogeneity bias may be better identified with a more flexible demand system. Even without the functional form issue, it is possible that there are differences in the marginal response income changes at the sub-aggregate level. Thus, everyone could allocate the same portion of the increase in income to food but there could be differences in the type of food products each purchase. Consequently, there could be different marginal responses at the product level to an identical change in income. Such differences in the consumption of individual products is of interest in the agricultural sector in that these differences provide insights on commodities that are likely to grow or decline due to changes in economic and population characteristics. Some studies have attempted to use heterogeneous demand systems to study more disaggregated goods. For example, Kaabia et al. (2001) used a heterogeneous form of the Central Bureau of Statistics model[5] to study the consumption of beef, pork, poultry and fish in Spain using survey data from 1985 to 1997. They found that consumers responded differently to health information and that different levels of health information caused a change in consumer preferences. Nelson (1997) incorporated heterogeneous preferences into the Rotterdam Model to study the demand for alcohol in the United States. He found that change in the age structure of the population played a significant role in determining the demand for alcohol in the United States. Thus, most researchers have concluded that heterogeneous preferences played an important role in determining the demand for goods in different countries. These findings highlights the necessity to consider non-economic characteristics of the consumers and to use a flexible demand system for empirical demand analysis.

[5] The Central Bureau of Statistics model is derived by relaxing the constant budget share assumption of the absolute-price version of the Rotterdam Model.

Table 3.2 Demand System Studies

Study	Commodities Studied	Sample, Data, Countries	Type of Model	Estimation Method	Restrictions Tested/Imposed	Major Findings
Alessie and Kapteyn (1991)	food, housing, clothing/footwear, medical care, education/entertainment and transportation/other	survey data 1980-81 for Netherlands	AIDS	maximum-likelihood	none	Found that the model that incorporated heterogeneous preferences were statistical and preferred to a homogeneous model of the same functional form. They also found that the basic properties of the models were different.
Kaabia et al. (2001)	beef, pork, poultry and fish	survey data 1985-97 for Spain	Central Bureau of Statistics model	OLS	Imposed *adding-up *homogeneity *symmetry *negativity	Found households responded differently to health information. They also found that the presence of the information changed consumer preferences.
Fortin (1995)	food; tobacco and alcohol; shelter; household operations; transport and communication; clothing; personal services; and other	survey data 1978, 1982, 1984, 1986 for Canada	LES and QES	maximum-likelihood	none	Found that the heterogeneous bias was small and insignificant from 1978 to 1986. However goods were highly aggregated in this study.
Nelson (1997)	beer, wine and spirits	quarterly data 1974-90 for US	Rotterdam		Imposed *adding-up *homogeneity *symmetry Tested *negativity	Found that the age structure of the population played a significant role in the consumption of alcohol in the U.S.

SUMMARY

The major developments in the literature on demand theory and empirical demand analysis since World War II are reviewed in this chapter. It focused on different types of demand analysis for food products and for dairy products. Traditional demand analysis assumes homogeneous preference through the use of the representative agents. Attempts to relax the assumption of homogeneous preferences led to the inclusion of demographic variables into demand analysis. This process has produced mixed results so far, some studies found that preferences are heterogeneous while others found little or no evidence of heterogeneous preferences.

This thesis attempts to extend the literature by developing and estimating a demand system for selected dairy products in Canada at a disaggregate level. This approach allows us to test for heterogeneous preferences for different products.

Chapter 4 concentrates on the conceptual framework which utilizes developments in the theoretical and empirical demand analysis reviewed in this chapter.

CHAPTER 4: MODELLING THE EFFECTS OF DEMOGRAPHICS ON DEMAND

INTRODUCTION

This chapter focuses on the analytical framework used in this study. It also deals with econometric issues relevant for estimating a demand system using survey data and describes data employed in this study.

ANALYTICAL FRAMEWORK

A consumer faced with the choice of N goods to consume must have an implicit preference order for these goods to choose the quantity of each to be consumed. If consumer preferences are complete, reflexive, transitive, continuous and locally non-satiated they can be represented by a continuous and twice differentiable utility function (U) (Silberberg, 1990; Varian, 1992). The utility function can be expressed as

$$U^i = U^i(X^i) \tag{4.1}$$

where

$$X^i = (x_1^i, x_2^i, \ldots, x_N^i) \tag{4.2}$$

where x_j^i is the quantity consumed of the j^{th} good by the i^{th} consumer for all $j = 1 \; to \; N$. If the consumer also faces a budget constraint and the price vector for the N goods is $P = (P_1, P_2, \ldots, P_N)$ which cannot be changed by an individual, the consumer maximizes his/her utility as:

$$\max x_j^i = \{U^i = U^i(X^i)\} \text{ subject to } P^T X^i = M^i \tag{4.3}$$

where M^i is the income of the i^{th} consumer

P^T is the transpose of the price vector.

To solve the constrained utility maximization problem mathematically, a Lagrange function is formulated as follows:

$$L = U^i(X^i) + \lambda(M^i - P^T X^i) \tag{4.4}$$

where

λ is the Lagrange multiplier (this is commonly referred to as the marginal utility of income).

The first order conditions are:

$$\frac{\delta L}{\delta x_j^i} = 0 \Rightarrow \frac{\delta U^i}{\delta x_j^i} - \lambda^* p_j = 0 \text{ for all j = 1 to N} \tag{4.5}$$

$$\frac{\delta L}{\delta \lambda^*} = 0 \Rightarrow M^i - P^T X^i = 0 \tag{4.6}$$

If the functional form or the utility function is known, then the determinant of the Hessian matrix can be calculated. If the determinant of the Hessian matrix is non-zero, then the optimal solution to the Lagrange function can be derived as

$$X^{i*} = X^i(P, M^i) \tag{4.7}$$

$$\lambda^* = \lambda^*(P, M^i) \tag{4.8}$$

The optimal consumption vector X^{i*} is commonly known as the Marshallian demand function for the N goods by a particular consumer.[6]

[6] In order to ensure that the utility is maximized, the bordered Hessian matrix must be negative semi-definite.

Traditionally, aggregate demand for market goods has been derived through horizontal summation of all individual's demands for a good in the economy. Thus, the aggregate demand for good j is,

$$x_j(P, M) = \sum_{i=1}^{I} x_j^{i*}(P, M^i) \tag{4.9}$$

where

$$M = \sum_{i=1}^{I} M^i \tag{4.10}$$

An alternative form of expressing aggregate demand is by per capita aggregate demand. In this case, aggregate demand is the horizontal summation of individual demand divided by the number of individuals, so that:

$$\bar{x}_j(P, \overline{M}) = \frac{1}{I}\sum_{i=1}^{I} x_j^{i*}(P, M^i), \tag{4.11}$$

where:

$$\overline{M} = \frac{1}{I}\sum_{i=1}^{I} M^i \tag{4.12}$$

In order to aggregate individual demands as above, three sets of restrictions on individual demand need to be satisfied. First, good j is not a public good and there is no consumption externality (Deaton and Muellbauer, 1980a; Varian, 1992). Secondly, if income is optimally distributed, then relevant social utility functions can be constructed (Samuelson, 1956). The final restriction requires that individual demand must satisfy the following condition:

$$dx_j = \sum_{i=1}^{I} \frac{\alpha x_{ij}^*(P, M_i\ )}{\delta M_i} dM_i \ = 0 \tag{4.13}$$

This implies that a change in income distribution within the economy does not affect the aggregate demand for good j. In order for this condition to hold, $\sum_{i=1}^{I} dM^i$ must be equal to zero. This is only possible if the direct utility function of each individual consumer is either homothetic or quasi-linear such that the indirect utility function is of the Gorman form (Varian, 1996):

$$V^i(P, M^i) = V(P)M^i \tag{4.14}$$

or

$$V^i(P, M^i) = \Phi^i(P) + V(P)M^i \tag{4.15}$$

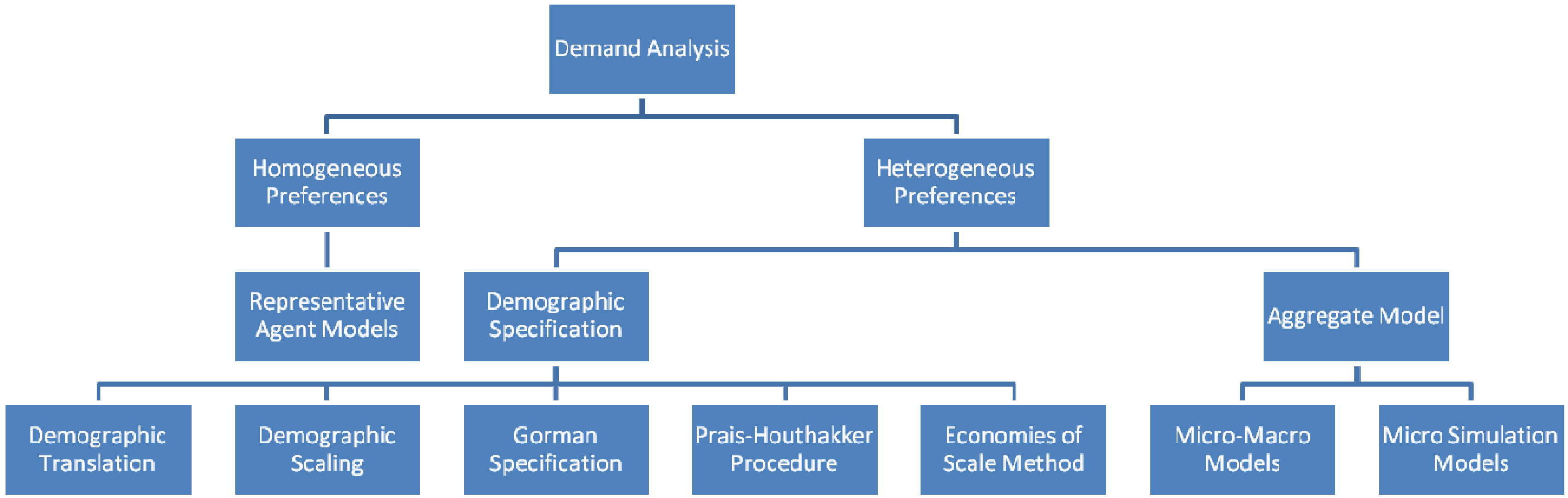
Woodland (1982) and Varian (1992), for example, show that if all consumers' indirect utility functions have one of the Gorman forms, then a single consumer can represent the economy. Therefore, the representative consumer maximizing his/her utility function subject to a budget constraint can obtain the aggregate demand. Consequently the theoretical restrictions of consumer theory, specifically the adding-up, symmetry, homogeneity and negativity, can be applied to market demand as well.

The representative consumer approach to model aggregate demand has recently been criticized on several grounds. First, there is no direct relationship between individual and collective behaviour. In particular, individual utility maximization does not engender collective rationality (Kirman, 1992). Secondly, the representative agent's reaction to a change of a parameter in the model may not be the same as the aggregate reaction of all individuals they represent. Thus using such a model to analyse aggregate demand and the effects of policy changes could be erroneous (Kirman, 1992). Third, the preference ordering of the representative agent does not necessarily correspond to the preference ordering of all economic agents in a country. So the representative agent approach cannot be used to choose between two economic situations (Kirman, 1992). The fourth criticism relates to empirical testing as it is impossible to determine if a behavioural hypothesis is rejected because it does not hold or because of the additional hypothesis embedded in the model is being rejected. To address these issues, consumer demand models capable of incorporating heterogeneous preferences need to be developed and estimated.

How can we account for the heterogeneity of individual or household preferences in demand analysis? This could be done by expanding the framework through including non-price and non-income variables into the demand function. There are two alternative approaches: 1) Aggregate Demand and 2) Demographic Specification. The choice of between these two approaches depends on the type of data available and the functional form being used in the analysis.

The first method to accommodate heterogeneous preferences in demand analysis led to the development of the Aggregate Model Approach (Green, 1964). Under this approach, demand for a commodity is aggregated over individuals or households in the economy. This starts with a set of demand functions for each household or class of households. The aggregate demand function is created by finding the expected value of the individual demand functions. The resulting aggregate demand function measures the per capita demand within the economy. Consider for example, all households can be divided into two groups, small and large, that consumes the same goods, y_t, but differently. Assume also that each group of households differs in their consumption patterns in two ways. Small and large households can differ in the minimum amount of

Figure 4.1: Methods of Demand Analysis



each good they need to consume, i.e., their subsistence levels. In the demand function, the subsistence level for small and large households are $a_0(p_t)$ and $a_1(p_t)$ respectively. A second way to incorporate household consumption differences is through the marginal income effect, $b(p_t)$. Therefore, the marginal income effects for small and large households are $b_0(p_t)$ and $b_1(p_t)$ respectively. Given these differences in consumption pattern, the resulting demand functions can be written as,

$y_{it} = a_0(p_t) + b_0(p_t)M_{it}$ (4.16) for small households and

$y_{it} = a_1(p_t) + b_1(p_t)M_{it}$ (4.17) for large households.

Assuming that there are N_{0t} small households and N_{1t} large households and there are $N_t = N_{0t} + N_{1t}$ total households in the economy, the proportion of small and large households in the economy are $P_{0t} = N_{0t}/N_t$ and $N_{1t}/N_t = 1 - P_{0t}$ respecting. These proportions can be used to come up with an aggregate demand function such as,

$$\bar{y}_t = a_1(p_t) + [a_0(p_t) - a_1(p_t)]P_{0t} + b_0(p_t)P_{0t}\overline{M}_{0t} + b_1(p_t)(1 - P_{0t})\overline{M}_{1t} \qquad (4.18)$$

where

$$\overline{M}_{0t} = \frac{\sum_{ismall} M_{it}}{N_{0t}}$$

$$\overline{M}_{1t} = \frac{\sum_{il\arg e} M_{it}}{N_{1t}}$$

In this case, the aggregate demand function varies not only with changes in price and income, but also due to changes in the percentage of households in the economy that are small. Following this procedure, the heterogeneous nature of the economy can be analysed and the information pertaining to household demand for a community can be recovered since

$a_0(p_t)$, $a_1(p_t)$, $b_0(p_t)$ and $b_1(p_t)$ all can be estimated. The second approach known as Demographic Specification modifies an existing demand system by directly incorporating some non-price and non-income variables into the demand system. These non-price and non-income variables in demand analysis tend to be demographic variables that describe features of individuals or households in the data. There are five alternative means through which the demographic variables can be incorporated into a demand system: demographic translation, demographic scaling, Gorman specification, Paris-Houthakker procedure and economies of scale approach (Pollack and Wales, 1992).

Demographic translation replaces the original demand system

$$x_i = h_i(P, y) \tag{4.19}$$

by

$$h_i(P, y) = d_i + \bar{h}_i(P, y - \sum p_k d_k) \,. \tag{4.20}$$

Where the d's are translation parameters that depend on the demographic variables so that $d_i = D'(\eta)$ where η is the N-vector of demographic variables. Such a demographic translation allows the intercept of the demand function to be dependent on the demographic variables. Under this approach, changes in the demographic variables cause parallel shifts of the demand function. One limitation of demographic translation is that if the original demand system is theoretically plausible, there is no guarantee that the translated demand system would be theoretically plausible except when the d's are close to 0.

In demographic scaling, the original demand system is replaced with the following demand system,

$$h_i(P, y) = m_i \bar{h}_i(p_1 m_1, \ldots, p_n m_n, y) \tag{4.21}$$

where the m_i's are scaling parameters which depend on the demographic variables such that, $m_i = M^i(\eta)$. The corresponding direct and indirect utility functions are $U(x) = \overline{U}(\frac{x_1}{m_1},...,\frac{x_n}{m_n})$ and $\varphi(P, y) = \overline{\varphi}(p_1m_1,..., p_nm_n, y)$ respectively. Preferences incorporating demographic scaling into demand behaviour can be viewed in terms of both demographically scaled prices and quantities (Pollak and Wales, 1992; Brown, 1994). If the original demand system is theoretically plausible, then the scaled demand system would be theoretically plausible only if the m_i's are close to 1.

The Gorman specification replaces the original demand system with the following demand system,

$$h_i(P, y) = d_i + m_i\overline{h}_i(p_1m_1,..., p_nm_n, y - \sum p_kd_k) \tag{4.22}$$

where the d_i's and m_i's depend on the demographic variables. This offers a general specification for incorporating both demographic translation and scaling into a single specification. Since the Gorman specification combines both demographic translating and scaling, it inherits the limitations of both approaches. Thus, if the original demand system is theoretically plausible, then the new demand system with the Gorman specification would be theoretically plausible if the d's are close to 0 and the m's are close to 1 (Pollak and Wales, 1992).

The modified Prais-Houthakker procedure replaces the original demand system with

$$h_i(P, y) = s_ih_i(p, y / s_o) \tag{4.23}$$

where s_i is a scale specific for the i^{th} commodity and s_o is the income scale. S_i depends on the demographic variables while s_o is defined by the following budget constraint:

$$\sum p_ks_kh_k(P, y / s_o) = y \tag{4.24}$$

The income scale is a function of all price, expenditure and demographic variables so that

$$s_o = (p, y, s_1, \ldots, s_n)$$

If the left hand side of the budget constraint is an increasing function of y/s_o, then s_o is uniquely determined. This is guaranteed if there is no inferior good in the choice set. The modified Prais-Houthakker method only yields a theoretically plausible demand system if the original demand system corresponds to an additive direct utility function (Pollak and Wales, 1992).

The fifth method, known as the economies of scale consumption, does not require all demographic characteristics to have the same economies of scales. The main problem with economies of scale in consumption is related to estimation. The procedure adds an additional NxN parameters over a linear specification. The availability of data can limit the incorporation of economies of scale in consumption within an estimated demand system. To determine the most appropriate method of incorporating heterogeneity into a demand system model, it is necessary to test these with data in empirical models.

INVERSE AND DIRECT DEMAND SYSTEMS

Since the dairy sector is supply managed, it is important to describe its feature prior to the estimation of demand functions for dairy products in Canada. The traditional view of analyzing demand in markets that are supply managed is that the quantity is set exogenously and prices are adjusted through administration action, taking producer cost structure and market conditions into account. This would imply that an inverse demand function would be more appropriate. However, this would be the case if we were modelling the sector as a whole but since we are modelling individual households, which can purchase different quantities as price changes, the use of inverse demand functions may not be appropriate. In this case, we hypothesize that the individual consumer takes prices as given and can only adjust the amounts he/she purchases. Consequently individual consumers will act as if the market is competitive. Therefore, a direct demand function could describe the standard relationship between prices and quantities even for commodities that are produced under supply management.

EMPIRICAL MODEL

Three conditions must be considered in deciding which model is to be chosen and how it to be modified to accomplish the objectives of this research. First, the model needs to be flexible enough to represent consumer preferences. Secondly, we must be able to modify the basic model to incorporate demographic variables.

As noted earlier, demand system analysis is moving toward increasingly flexible demand systems. If we consider the early demand systems like the Linear Expenditure System (Stone, 1954) or the Rotterdam Model (Barten, 1964; Theil, 1965) we see that these models have the advantage of being relatively simple at incorporating demographic variables and are linear in variables. So, they can be easily estimated using linear estimation methods such as the Ordinary Least Square. However, these early models impose limitations on the choice of functional form of the underlying utility function. The restrictions on utility were the result of needing demand functions that could be estimated using linear regression methods. The result is that the underlying utility functions were additive in nature (Phlips, 1983). As a consequence, many of these models do not represent the underlying preference structure of surveyed households. Considering the size of the data set being used in this research[7] the advantages of the linear nature of these models is outweighed by the disadvantages of the restrictive nature of the underlying utility function and the problems associated with the misspecification of the functional form. Therefore, a more flexible model is sought for this research.

The relatively more highly flexible nested demand systems such as the Lewbel Demand System (Lewbel, 2003) and the Nested PIGLOG Demand System (Piggott, 2003) were not considered in this research because they are highly complex and require large dataset. It is also difficult to incorporate the demographic variables in these demand system. Thus, the advantages of increased flexibly in the model need to be weighed against the difficulties in incorporating demographic variables and estimating the expanded model. While highly flexible nested models address specification related issues, they pose significant problems that are beyond the scope of this research.[8]

For the purposes of this study what is needed is a demand system that is relatively flexible in its underlying utility function but remains relatively easy to incorporate the demographic variables and to estimate. In literature on the demand analysis for food we find two demand system models that fit these requirements. These are the Translog Demand System (Christensen et al., 1975) and the Almost Ideal demand System (AIDS) (Deaton and Muellbauer, 1980a and 1980b).[9] For this research, I will use the standard Almost Ideal Demand System and incorporate demographic variables into it using the Gorman specification described above.

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[7] See Chapter 4 for a full description of the data set.
[8] This is an area of further research that will be identified in Chapter 7.
[9] These two demand systems are almost always included in the nested demand systems.

Development of Almost Ideal Demand System with Demographics

The Almost Ideal Demand System can be derived from the Price Independent Generalized Logarithmic (PIGLOG) cost function, which allows an exact aggregation over consumers and the representation of market demands as if they were the outcome of decisions by a representative consumer (Deaton and Muellbauer, 1980a). The cost function c(u, P) is defined as

$$\ln c(u,P) = (1-u)\ln\{a(P)\} + u\ln\{b(P)\}$$

where

$$\ln\{a(P)\} = a_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2}\sum_k\sum_j \gamma_{kj}^* \ln P_k \ln P_j$$

$$\ln\{b(P)\} = \ln\{a(P)\} + \beta_0 \prod_k P_k^{\beta_k}$$

The model can be rewritten as

$$\ln c(u,P) = a_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2}\sum_k\sum_j \gamma_{kj}^* \ln P_k \ln P_j + u\beta_0 \prod_k P_k^{\beta_k} \qquad (4.25)$$

where α_i, β_i and γ_{ij}^* are parameters. From consumer duality, a utility maximizing consumer is exactly the same as a consumer who minimizes costs along the difference curve representing feasible maximum utility. Therefore, if we assume that the consumer maximizes utility, then c(u,P) = x where x is total expenditure. From equation (4.29) we get

$$\ln x = a_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2}\sum_k\sum_j \gamma_{kj}^* \ln P_k \ln P_j + u\beta_0 \prod_k P_k^{\beta_k} \qquad (4.26)$$

At this point, we can incorporate demographic variables into the expenditure function. Using the Gorman specification of incorporating demographic variables, we replace P_i with $P_i m_i(\rho)$ and x with $x - \sum_i P_i d_i(\rho)$ into the expenditure function (4.30) where ρ is vector of demographic variables. The resulting function is

$$\ln(x - \sum_i P_i d_i(\rho)) = a_0 + \sum_k \alpha_k \ln(P_k m_k(\rho)) + \frac{1}{2}\sum_k \sum_j \gamma_{kj}^{*} \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho)) + u\beta_0 \prod_k (P_k m_k(\rho))^{\beta_k} \quad (4.27)$$

where

$m_i(\rho) =$ the functional form that incorporates demographic variables by translation method

$d_i(\rho) =$ the functional form that incorporates demographic variables by the scaling method

We now solve equation (4.27) for x to obtain the expenditure function incorporating demographic variables.

$$x = e^{a_0 + \sum_k \alpha_k \ln(P_k m_k(\rho)) + \frac{1}{2}\sum_k \sum_j \gamma_{kj}^{*} \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho)) + u\beta_0 \prod_k (P_k m_k(\rho))^{\beta_k}} + \sum_j P_j d_j(\rho)) \quad (4.28)$$

This expenditure function with demographic variables can be used to derive the demand system.

The compensated demand equations can be generated from the expenditure function by invoking Shephard's Lemma. Thus, the Hisksian demand function for the ith commodity can be obtained from equation (4.28) as:

$$h_i^{*} = \frac{(\alpha_i + \sum_j \gamma_{ij} \ln(P_j m_j(\rho)) + u\beta_0 \beta_i \prod_k (P_k m_k(\rho))^{\beta_k})}{P_i} e^{a_0 + \sum_k \alpha_k \ln(P_k m_k(\rho)) + \frac{1}{2}\sum_k \sum_j \gamma_{kj}^{*} \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho)) + u\beta_0 \prod_k (P_k m_k(\rho))^{\beta_k}} + d_i(\rho) \quad (4.29)$$

where

$$\gamma_{ij} = \frac{1}{2}(\gamma_{ij}^{*} + \gamma_{ji}^{*})$$

The Marshallian demand function can be obtained by substituting the indirect utility function into the compensated budget share equation. The expenditure function (4.28) is inverted to obtain the indirect utility function:

$$u = \frac{\ln(x - \sum_i P_i d_i(\rho)) - a_0 - \sum_k \alpha_k \ln(P_k m_k(\rho)) - \frac{1}{2}\sum_k \sum_j \gamma_{kj}^* \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho))}{\beta_0 \prod_k (P_k m_k(\rho))^{\beta_k}} \tag{4.30}$$

Now substitute (4.30) into (4.29) to obtain the Marshallian demand equation

$$q_i = \frac{\alpha_i + \sum_j \gamma_{ij} \ln(P_j m_j(\rho)) + \beta_i \dfrac{\ln(x - \sum_j p_j d_j(\rho))}{\ln P}}{P_i} (x - \sum_j P_j d_j(\rho)) + d_i(\rho) \tag{4.31}$$

where

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln(P_k m_k(\rho)) + \frac{1}{2}\sum_k \sum_j \gamma_{kj}^* \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho)))$$

This gives us the basic demand equation, which can be used to get the budget share form of the demand system.

$$w_i = \frac{\alpha_i + \sum_j \gamma_{ij} \ln(P_j m_j(\rho)) + \beta_i \dfrac{\ln(x - \sum_j p_j d_j(\rho))}{\ln P}}{x} (x - \sum_j P_j d_j(\rho)) + \frac{P_i d_i(\rho)}{x} \tag{4.32}$$

where

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln(P_k m_k(\rho)) + \frac{1}{2}\sum_k \sum_j \gamma_{kj}^* \ln(P_k m_k(\rho)) \ln(P_j m_j(\rho)))$$

This is the traditional form of the Almost Ideal Demand System. The model has often been simplified even further by assuming that P can be approximated by a price index, P^*. The traditional index used in this simplification has been Stone's (1954) index where $\ln P^* = \sum w_j \ln P_j$ (Deaton and Muellbauer, 1980a). However, in the model developed below, P is not only a function of prices but also a function of the demographic variables. Therefore, the Stone index must also be a function of prices and demographic variables.

Thus, the Stone-like index for the model in 4.29 is $\ln P^* = \sum w_j \ln(P_j m_j(\rho))$. Therefore, if

$P \approx \phi P^*$ then

$$w_i = \frac{\alpha_i^* + \sum_j \gamma_{ij}^* \ln(P_j m_j(\rho)) + \beta_i \ln(x - \sum_j P_j d_j(\rho))}{x}(x - \sum_j P_j d_j(\rho)) + \frac{P_i d_i(\rho)}{x} \qquad (4.33)$$

where

$$\alpha_i^* = \alpha_i - \beta_i \ln \phi$$
$$\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$$

This is the general estimable form of the Almost Ideal Demand System with demographic variables. The model allows demographic variables to be incorporated in different ways through the choice of the functional forms of $m_i(\rho)$ and $d_i(\rho)$.

After augmenting the Almost Ideal Demand System with demographic variables two questions need to be addressed to foster better understanding of the modified Almost Ideal Demand System. First, what effect does the inclusion of demographic variables have on the general character of the demand system as this pertains to the intercept and slope of the underlying demand curves? Second, how does the inclusion of demographic variables affect the theoretical restrictions of adding-up, homogeneity, symmetry and negativity?

As mentioned previously the inclusion of demographic variables can affect the nature of the demand curve. However, the nature of the effect varies with the functional form chosen for the incorporation of demographic variables into the demand function. In the case where $m_i(\rho) = e^{\sum_r \varepsilon_{ir}\rho_r}$ and $d_i(\rho) = 0$ the impacts on the Almost Ideal Demand System are in the case of the intercept $\dfrac{\alpha_i^* + \sum_k \varepsilon_{ik}^* \rho_k}{P_i}$ and in the case of the slope $\dfrac{\partial^2 q_i}{\partial P_i \partial \rho_k} = -\dfrac{\varepsilon_{ik}^* x}{P_i^2}$. In both case, the presence of demographic variables will influence the nature of the demand function. In the case of the intercept, if $\sum_k \varepsilon^*_{ik}\rho_k > 0$, the intercept will increase; but if $\sum_k \varepsilon^*_{ik}\rho_k < 0$ the intercept will decrease. In the case of the slope of the demand function, if the demographic effect, ε^*_{ik}, is positive, the slope will decrease but this will increase if the demographic effect is negative. Therefore, the inclusion of demographic variables into the Almost Ideal Demand System can influence functional nature of both the intercept and the slope.

Having derived the Almost Ideal Demand System with demographic variables it is also important to derive the theoretical restrictions of adding-up, homogeneity, symmetry and negativity. These general restrictions allow us to carry out two possible actions in our analysis. First, we are able to test whether the demand system conforms to demand theory. Second, to impose the theoretical restrictions and force the demand system to conform to demand theory.

It should also be noted that, in the special case where $m_i(\rho) = 1$ and $d_i(\rho) = 0$ which would correspond to the case where preferences are homogeneous, the equation 4.33 would reduce to the traditional Almost Ideal Demand System. It should also be noted that $m_i(\rho)$ and $d_i(\rho)$ do not directly affect the coefficients in 4.32 or 4.33 and therefore, do not influence the general restrictions on their behaviour with regard to economic theory. This is because all prices and expenditures are adjusted identically in all demand equations within the system. Therefore, consumers will choose their consumption bundle based on their adjusted prices and not on the real prices in the market. If consumers' choices conform to economic theory, the coefficients on the adjusted prices and expenditure will act in a manner consistent with economic theory. However, the inclusion of the demographically adjusted Stone-like index in equation (4.33) means that some of the conditions under which the theoretical restrictions hold will change. This is important to consider in deriving the theoretical restrictions.

The first theoretical restriction is that a demand system must be homogeneous of degree zero in prices and income or total expenditure. This means if all prices and incomes are increased at the same rate that the resulting quantity demanded for all goods would remain unchanged. This restriction can be derived from Euler's theorem, which states that a if a function $z = \psi(x, y)$ is homogeneous of degree r then

$$x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = rz$$

In the case of demand functions, $q_1 = \phi_1(p_1, p_2, p_3, x)$, with homogeneity of degree zero we get

$$p_1\frac{\partial q_1}{\partial p_1} + p_2\frac{\partial q_1}{\partial p_2} + p_3\frac{\partial q_1}{\partial p_3} + x\frac{\partial q_1}{\partial x} = 0$$

This result can be generalized as

$$\sum_j p_j\frac{\partial q_i}{\partial p_j} + x\frac{\partial q_i}{\partial x} = 0$$

Dividing both sides of the generalized result by q_i gives price and income elasticities and the restriction can be rearranged as

$$\sum_j \frac{p_j}{q_i}\frac{\partial q_i}{\partial p_j} = -\frac{x}{q_i}\frac{\partial q_i}{\partial x}$$

For the demand system developed,

$$\sum_j \gamma_{ij} = 0$$

for 4.32 and

$$\sum_j \gamma_{ij}^* = -\beta_i$$

for 4.33.

The second theoretical restriction requires that the demand systems must add-up in that it must use up the household's income or total expenditure. This also means that if the household receives an additional amount of income it is allocated to the complete set of goods in the demand system so that the additional income is completely used. This restriction is derived from the HOD condition and the linear budget constraint

$$\sum_j p_j q_j (P, x) = x$$

In the case of the demand system derived above this means

$$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum_i \beta_i = 0$$

for 4.32 and

$$\sum_i \alpha_i^* = 1, \quad \sum_i \gamma_{ij}^* = 0, \quad \sum_i \beta_i = 0$$

for 4.33.

The final two theoretical restrictions are that demand systems must obey symmetry and negativity. These restrictions are known as the Slutsky condition as they can be derived from the Slutsky matrix. In the case of symmetry, the cross-price derivatives of the compensated or Hicksian demands are symmetrical. This is because the price derivatives of the compensated demand function are the second order derivatives of the expenditure function. According to Young's theorem, the cross-price derivatives of the compensated demands must be equal to each other.

$$\frac{\partial h_i^*}{\partial P_j} = \frac{\partial h_j^*}{\partial P_i}$$

The result for the Almost Ideal Demand System above is

$$\gamma_{ij} = \gamma_{ji}$$

for 4.32 and

$$\gamma_{ij}^* + \beta_i w_j = \gamma_{ji}^* + \beta_j w_i$$

for 4.33.

In the case of negativity the Almost Ideal Demand System has the same problem as other flexible functional forms in that negativity cannot be ensured by any restrictions on the parameters alone (Deaton and Muellbauer, 1980b). However, negativity can be checked for any estimation results by calculating the eigenvalues of the Slutsky matrix.

ECONOMETRIC ISSUES

Four econometric problems are generally encountered when dealing with survey data of the type used in this study. The first problem deals with the challenge of modelling quality. This is a relevant issue because consumers make decisions involving both the quantity and quality of what they consume.

Traditional demand system analysis uses large aggregate goods (Stone, 1954; Crawford et al., 2003). This raises the issue of quality choice. Aggregate goods allow both quality and price to vary. Therefore, consumer's choice of a particular quantity to be consumed is based on both quality and price and not just price. Also, price data are not often collected separately in household surveys. In general, household surveys record total expenditure on specific commodities and the total quantity consumed of those commodities. Unit values are then generated from these two variables and are used as a proxy for prices. If consumers are choosing quantity based on quality and price, the unit values become a function of expenditure, quantity and quality. Therefore, the unit value is a proxy for price and quality and, as a price proxy, the unit value needs to be corrected for quality. The quality correction is performed by setting up a regression where the unit value faced by the households is the dependant variable, and household characteristics and income are the independent variables (Cox and Wohlgenant, 1986; Deaton, 1997). The adjusted prices, P_i^* for the i^{th} household are assumed to eliminate the quality effects that the household characteristics have introduced. The "market price", P_i^* is equal to the intercept α plus the residual ε_i^* from the regression. These adjusted prices, P_i^* can be used in the demand system to enable the calculation of price elasticities or flexibilities to be used for the demand analysis.

As this study uses goods that are significantly more disaggregated then used in traditional demand analysis, these good are considered to be more homogeneous than other goods. Therefore, quality is a less significant problem for the demand analysis in this study.

The problem of zero expenditure in a survey data set is influenced by two factors. First, this may occur if the observation period of the survey is short. For example, if the data set uses one week observation periods, it is likely that a good may not have been purchased during this week, as opposed to the situation as longer observation periods, for example monthly, quarterly or annually. The second aspect is related to the level of disaggregation. It is more likely that zero expenditure will occur for a commodity if it was narrowly defined, for example hot dogs, than for broader commodity groups, for example all meat (Chen, 2000).

Following Thomas, three groups can be used to describe households with zero expenditure. The first group of households are those that would never purchase the food product no matter what the price is because of health concerns, religious beliefs or other reasons. These households can be excluded from the analysis since they would never be part of the market demand (Thomas, 1972). These types of households are classified as being in abstention.

The second group of households consists of infrequent buyers, for whom zero expenditures occur because of the short survey period. If the survey period had been extended, there would have been fewer zero expenditures. This type of zero expenditure is classified as infrequency (Thomas, 1972).

The third type of households with zero expenditure contains a group of potential buyers. These households do not purchase the good because of economic factors such as budget or price concerns. If economic factors change, such as an increase in income or a decrease in price, these households will start consuming the good. In a utility maximization framework, these households represent corner solutions (Thomas, 1972).

The net effect of the existence of zero expenditures is that the data set in limited or truncated to values greater than or equal to zero. In terms of econometrics this means that the data is not normally distributed and this will need to be dealt with in the estimation process.

The model will be regressed six times with different assumptions considered each time. The first regression will assume homogeneous preferences and will not correct for quality. This means that $m_i(\rho) = 1$, $d_i(\rho) = 0$ and the prices are the calculated unit values.

This is the simplest model and will represent a baseline of comparison for the other regressions of the model.

$$w_i = \alpha_i^* + \sum_j \gamma_{ij}^* \ln(P_j) + \beta_i \ln(x) \tag{4.34}$$

where

$$\alpha_i^* = \alpha_i - \beta_i \ln \phi$$
$$\gamma_{ij}^* = \gamma_{ij} - \beta_i w_i$$

The resulting function is the standard Almost Ideal Demand System.

The second version of the model will relax the assumption of homogeneous preferences but will not correct for quality. Thus the demographic variables will be included in the model by incorporating $m_i(\rho)$ and $d_i(\rho)$, but the price will be the calculated as unit values. By comparing the second regression with the first we will be able to assess the effects of relaxing the assumption of homogeneous preferences.

$$w_i = \frac{\alpha_i^* + \sum_j \gamma_{ij}^* \ln(P_j m_j(\rho)) + \beta_i \ln(x - \sum_j p_j d_j(\rho))}{x}(x - \sum_j P_j d_j(\rho)) + \frac{P_i d_i(\rho)}{x} \tag{4.35}$$

where

$$\alpha_i^* = \alpha_i - \beta_i \ln \phi$$
$$\gamma_{ij}^* = \gamma_{ij} - \beta_i w_i$$

Finally, in order to complete the second regression we need to assume a functional form for $m_i(\rho)$ and $d_i(\rho)$. Since any functional form for $d_i(\rho)$ will cause 4.35 to be highly non-linear and causing a problem for current econometric software to handle, the model to be usable we assume that $d_i(\rho) = 0$ for all dairy products. The functional form for $m_i(\rho)$ can be assumed such that the resulting function is linear in parameters. The simplest functional form that produces a final function that is linear is $m_i(\rho) = e^{\sum_r \varepsilon_{ir}\rho_r}$. The resulting functional form of the model is:

$$w_i = \alpha_i^* + \sum_k \varepsilon_{ik}^* \rho_k + \sum_j \gamma_{ij}^* \ln(P_j) + \beta_i \ln(x) \qquad (4.36)$$

where

$$\alpha_i^* = \alpha_i - \beta_i \ln \phi$$
$$\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$$
$$\varepsilon_{ik}^* = \sum_j (\gamma_{ij} - \beta_i w_j)\varepsilon_{jk}$$

The resulting function is the Generalized Almost Ideal Demand System.

This gives two versions of the model, 4.34 and 4.36, which can be estimated employing the data set described below. To examine regional variations, if any, in the demand for dairy products, the demand system will be estimated for Canada as a whole, and for five regions of Canada separately.

DATASET EVALUATIONS AND DESCRIPTION

Ideally a new dataset could have been collected specifically for the purpose of this research. However, the financial and time constraints encountered made this an impossible venture. Therefore, data relevant for this study were obtained from an existing food consumption survey conducted by Statistics Canada in 1996.

Summary of the Data

The 1996 Food Expenditure Survey covered 10,924 households across Canada throughout the year. Most households participated for two one-week periods. However, some households only participated in a single one-week period. About 10,902 households participated in the first week of the survey while 10,745 households participated in the second week. Thus, the data set consists of a total of 21,647 one-week surveys.

In the original dataset, both the geographic location and the household income were suppressed for some households. Since both of these variables are needed for the regression analysis, the observations that had either their geographic location or income suppressed were removed from the dataset. There were 52 observations that had their geographic location suppressed and 848 observations that had their incomes suppressed. Thus, 900 observations were removed from the dataset. In addition, 3,300 observations reported either zero food consumption for the week or zero consumption of all dairy products. Since a zero consumption of food or all dairy products in the given observation week is problematic for the calculation of unit values in the econometric analysis, these observations were removed. Therefore, out of 21,647 only 17,447 observations were usable for the analysis. The breakdown of these observations by province and quarter is given in Table 4.1. It should be noted that the survey was designed such that the number of households in each region is roughly proportional to the distribution of households in the Canadian population and this continues to hold in the data set.

The Food Expenditure Survey collected two types of data: (i) the expenditure and quantity purchased for each commodity; and (ii) household characteristics. The latter data were used to describe the structure and demographic characteristics of each household in this study. There are three general characteristics of the data set that needs to be taken into account when analysing the data. First, the data records household purchases of food in a given week. It does not record the actual food consumed within the household in a given week. As more durable foods, for example butter or cheeses, could have been purchased in presiding weeks and consumed during the week or food purchased during the week was consumed in latter weeks. The second consideration that needs to be taken into account is that it only records foods purchased for consumption within the household and not food consumed away from home[10]. This means that dairy products consumed outside the household are not included in the study. The third consideration is that processed foods that contain dairy products are recorded under processed foods and therefore, not included in the dairy products. So, this study will only looks at the direct purchase of dairy products for consumption at home for each household.

Table 4.2 lists variable name, description and average expenditure or quantity purchased for each dairy product. Households within the survey spent on average $10.30 per week on five dairy products considered in this study. The largest share of total expenditure was spent on 2 Percent Fluid Milk followed by Other Cheeses. In terms of quantity, 2 Percent Fluid Milk consumption was 4.1175 litres per week on average compared to only 1.4192 litres for 1 Percent Fluid Milk. In terms of industrial dairy products, Other Cheeses had the largest average quantity consumed at 375 grams per week compare with about 150 grams for both Butter and Cheddar Cheese.

The household characteristics were divided into two additional types of data. The first type of household characteristic data was created from the household characteristics information in the original dataset. The only dummy variable used in this research describes if the head of the household was born in Canada or outside of Canada. If one or more or the heads of the household was born outside Canada or the heads could all be born in Canada.

[10] Food consumed outside the household is recorded in its own category and is not part of the various foods purchased.

Table 4.3, below, shows that 17.6 percent of the households in the study were headed by at least one person born outside of Canada.

Table 4.1: Number of Surveys by Province and Quarter

Province	Number of Surveys	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Atlantic	4,032	1,007	1,085	982	958
Quebec	2,841	721	706	688	726
Ontario	4,396	1,065	1,169	1,097	1,065
Prairies	4,013	995	1,042	964	1,012
British Columbia	2,165	540	500	578	547
Total	17,447	4,328	4,502	4,309	4,308

Source: Statistics Canada, 1999

Table 4.2: Dairy Product Expenditure and Purchase Quantity Data

Variable Name	Description	Mean ($, L or kg)	Standard Deviation
F155E	Total Expenditure on Dairy Products	10.299	8.7899
F2E	Expenditure on Low-fat Milk (1%)	1.2366	3.0388
F4E	Expenditure on Low-fat Milk (2%)	3.5818	4.6946
F8E	Expenditure on Butter	0.87104	3.1698
F9E	Expenditure on Cheddar Cheese	1.4874	3.1573
F20E	Expenditure on Other Cheeses	3.1224	4.8495
F2Q	Quantity of Low-fat Milk (1%)	1.4192	4.3239
F4Q	Quantity of Low-fat Milk (2%)	4.1175	6.7266
F8Q	Quantity of Butter	0.15072	0.38713
F9Q	Quantity of Cheddar Cheese	0.15649	0.36479
F20Q	Quantity of Other Cheeses	0.37498	0.67721

Source: Statistics Canada, 1999

The second type of household characteristics measure the number of youth and children in the household, age of the reference person[11] and the educational level of the

[11] The reference person within the household is the person responsible for the purchasing of the food for the household.

reference person. Only the education level of the reference person had to be modified from the original dataset. It was converted from levels of education to years of education by using the method explained in Table 4.4. As shown in Table 4.5, the average number of youth within the household was 0.3 while the average number of children was 0.5. The average age of the reference person was 47.5 years and their average level of education was 12.9 years.

In addition to the household characteristics variable, there were other variables in the dataset. Some of these variables were used for reference purposes such as the household identification number, geographic location and the quarter in which the survey was done.[12] Quarterly dummy variables were used in the regression analysis to account for seasonality in consumption of selected dairy products.

Table 4.3: Household Characteristics Variables (Dummies)

Variable Name	**Description**	**Number of Observations with Value 1**	**Percentage of Observations with Value 1**
R3	If one of the heads of the household was born outside Canada takes the value 1 If the head(s) of the household was born in Canada takes the value 0	3,614	17.6

[12] These variables were used for sorting the data only and never directly entered the regression analysis.

Table 4.4: Conversion of Education Variable for Reference Person

Original Dataset		New Dataset Value
Variable Value	Description	
0	No spouse present in household	0
1	Less than 9 years of education	8
2	Some or completed secondary education	12
3	Some post-secondary education	14
4	Post-secondary non-university certificate or diploma	15
5	University degree	16

Table 4.5: Continuous Household Variables

Description	Data Range	Average
Number of youths 15 to 24 years	0 to 2	0.3
Number of children under 15 years	0 to 2	0.5
Reference person's age	24 to 80	47.5
Reference person's education	8 to 16	12.9

Source: Statistics Canada, 1999

Only six dairy products were frequently purchased. These are 1% Fluid Milk, 2% Fluid Milk, Butter, Cheddar Cheese, Processed Cheese and Other Cheeses. Of these six dairy products only four had strong purchase frequencies: 1 Percent Fluid Milk, 2 Percent Fluid Milk, Butter and Cheddar Cheese. The two marginal products are Processed Cheese and Other Cheeses.

In order not to delete information on Processed Cheese and Other Cheeses it was decided to merge Processed Cheese and Other Cheeses into a “new” "Other Cheeses" product which represented a more frequently purchased product. A significant issue with regard to merging Processed Cheese and Other Cheeses was with their prices, since it was found that the price of Processed Cheese and Other Cheeses were statistically different[13]. Therefore, it was necessary to create an index price for the "new" Other Cheeses merged product. The index price of the "new" Other Cheeses product was created using a quantity weighted average price. Thus, five dairy products analyzed in this research were selected.

Table 4.6: Representativeness of the 1996 Canadian Food Expenditure Survey

	Atlantic Canada	Quebec	Ontario	Prairies	British Columbia	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Head of Household Foreign Born	Number of Youth	Number of Children	Age of the Head of the Household	Education of the Head of the Household
Original Data Set	22.7	15.7	25.4	23.6	12.5	24.5	25.3	25.1	25.1	17.6	0.3	0.5	47.5	12.9
Study Data Set	23.3	17.1	24.3	22.3	12.9	23.9	25.7	25.3	25.0	19.2	0.4	0.6	47	13.1
1996 Census	8.04	24.5	37.8	16.6	13.1	25.0	25.0	25.0	25.0	21.8	0.5	0.7	46.9	13.2

How representative is the final data set used in this study to actual population in Canada? Table 4.6 summarizes the demographic variables and compares them with the 1996 Canadian Census results. In terms of the geographic distribution, we find that Atlantic Canada and the Prairies are over represented while Ontario, Quebec and British Columbia are underrepresented in both the original data set and the cleaned one used in this research.

[13] The means of Processed Cheese and Other Cheeses were tested using a Two-sample t Significance Test and rejected H_0: Mean of Processed Cheese = Mean of Other Cheese at a 99% confidence level.

However, there were very small difference between the original data set and the one used in this study. The observations are evenly distributed among four quarters in both data sets. In terms of the household characteristics both data sets are similar to the census data. Thus, the original data set and the data set used in this study are both representative of the Canadian population as a whole.

SUMMARY

An attempt is made in this chapter to present the analytical framework, the empirical model, describe data and discuss econometric method used to estimate the demand for five dairy products in Canada. The chapter deals with the theoretical conditions and shows that this research is consistent with the classical demand analysis. The problems associated with the use of the representative agent approach are highlighted and, different methods of relaxing the assumption of the representative agent are discussed. The Gorman specification is used to incorporate demographic variables into the Almost Ideal Demand System. Econometric issues relevant for demand analysis in this study and how these issues influence the analysis are also discussed. Finally, the data set used in this study is described and its representativeness to the Canadian population is assessed.

CHAPTER 5: DEMAND SYSTEM ESTIMATION AND THE RESULTS

INTRODUCTION

This chapter discusses the results obtained from the estimation of the demand system. The general results are presented first followed by the results for Canada and the regions of Ontario and Quebec[14]. Then the specific results for Canada, Quebec and Ontario are compared.

The general results discussed in this section are classified into two groups: i) the general results of the regression method; and, ii) empirical verification of the theoretical conditions of consumer demand. The initial estimation of the demand system invoked separability assumption and was done using the Seemingly Unrelated Regression method. The adding-up, homogeneity and symmetry conditions were imposed before estimating the demand system. The results for the Seemingly Unrelated Regression are placed in Appendix 2. While Seemingly Unrelated Regression method is generally used in the estimation of demand systems it requires that neither autocorrelation nor heteroskedasticity be present. Therefore it is necessary to test for both of these conditions after estimating the demand system.

Since the data set used in this study is cross sectional in nature, the test for autocorrelation was not necessary. However, the test for heteroskedasticity was performed by regression the square of the OLS residuals on the predicted dependent variable and a constant. The results revealed that except for Atlantic Canada, the regression residuals for all other regions considered in this research were heteroskedastic (Table 5.1). Since, the

[14] The results for Atlantic Canada, the Prairies and British Columbia are presented in Appendices 2 and 3.

standard errors are not normally distributed, generating statistical inferences based on the results are problematic (Greene, 2000; Hayashi, 2000; Wooldridge, 2002). Since statistical inference is an important aspect of this research, it is imperative to generate heteroskedasticity-corrected results.

Table 5.1: Heteroskedasticity Test Results

		Chi-Squared Test Statistic	P-Value
Canada	Without Demographics	35.560	0.00000
	With Demographics	229.262	0.00000
Atlantic Canada	Without Demographics	2.118	0.14556
	With Demographics	2.739	0.09796
Quebec	Without Demographics	260.762	0.00000
	With Demographics	280.285	0.00000
Ontario	Without Demographics	147.956	0.00000
	With Demographics	217.542	0.00000
Prairies	Without Demographics	11.446	0.00072
	With Demographics	15.419	0.00009
British Columbia	Without Demographics	72.643	0.00000
	With Demographics	93.009	0.00000

As the exact source of the heteroskedasticity is unknown, it is not possible to use the generalized least squares (GLS) or feasible generalized least square (FGLS). Therefore, I have chosen Generalized Method of Moments (GMM) for this study. The Generalized Method of Moments does not assume that the standard errors be normally distributed (Greene, 2000; Hayashi, 2000; Wooldridge, 2002). It essentially calculates the asymptotic variance-covariance matrix and the asymptotic distribution is normally distributed even if the actual distribution is not normal (Greene, 2000). This is helpful for performing valid statistical inferences.

The Generalized Method of Moments has other advantages as well. First, by choosing an appropriate weighting matrix, other estimation methods, such as, the Ordinary Least Squared, Weighted Least Squared, Generalized Least Squared, etc., can be nested within the Generalized Method of Moments (Greene, 2000; Hayashi, 2000; Wooldridge, 2002). Secondly, the weighting matrix can be chosen in such a way that it minimizes the asymptotic variance-covariance matrix. This can be done by iterating the Generalized Method of Moments process with a new weighting matrix each time until the minimum asymptotic covariance matrix is found (Wooldridge, 2002). The weighting matrix obtained through this iterative procedure minimizes the asymptotic var-covariance matrix and generates the most efficient estimates. In view of the above advantages, the GMM method has been employed in this research.

Note, however, the optimal weighting matrix which is at the core of efficient Generalized Method of Moments estimator is a function of the fourth moment. Often a very large sample size is required to obtain a reasonable estimate of the fourth moment. This was not an issue in this study as the data sets used are large.

Before estimating the model using GMM, one needs to select the type of weighting matrix to be used from a number of alternatives. The best matrix chosen for this research was the White's estimate of the weighting matrix as it did not require the use of a lag in the calculation of the weighting matrix.

The log-likelihood results presented in Table 5.2 can be used to assess the suitability of the model in two different ways. First, we can determine if imposing the theoretical conditions of homogeneity and symmetry[15] is supported by the data. Second, we can compare the suitability of incorporating demographic variables into the model.

In the case of the theoretical conditions, the likelihood ratio test[16] rejects the null hypothesis that the unrestricted and restricted models are the same in all cases. This implies that imposing the theoretical conditions are not supported by the data. However, the likelihood ratio tests are testing two different restricts. First, there are the imposed theoretical conditions. Second, there is the restriction of the functional form. It is possible that the likelihood ratio test is rejecting the functional form and not the theoretical conditions (Greene, 2000). The implication of these results is that the restricted model has a higher likelihood function value and therefore the restricted optimum is superior to the unrestricted. Therefore the model with the theoretical conditions imposed is the model that best fits the data (Moschini and Moro, 1993; Nelson, 1997).

The second set of tests that can be performed by the likelihood ratio test is to compare the model with and without demographic variables. In this cases the null hypothesis is that the demographic variable have no effect on the demand for dairy products. The test show that the model with demographic variables tended to be the more optimal. As a result this study will estimate the model with the theoretical conditions imposed and with and without demographic variables.

As before, the theoretical conditions of symmetry and homogeneity were imposed on the model before estimation. Since negativity cannot be imposed through restrictions of the

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[15] It should be noted that the theoretical condition of adding-up is imposed by the construction of the demand system and therefore is always imposed. This means it could not be tested independently.

[16] The likelihood ratio test is calculated as $\lambda = -2(\ln L_R - L_U)$

where

L_U is the unrestricted likelihood value

L_R is the restricted likelihood value

Table 5.2: Log-Likelihood Results for Canada and the Regions

	Unrestricted	Symmetry Imposed	Homogeneity Imposed	Symmetry & Homogeneity Imposed
Canada				
1st Stage				
No Demographic	0.0000	59.1803	138.5093	118.2742
Demographic	0.0000	60.7934	114.6728	97.0229
2nd Stage				
No Demographic	0.0000	78.5815	18.5319	94.8672
Demographic	0.0000	31.3691	21.1168	45.6156
Atlantic Canada				
1st Stage				
No Demographic	0.0000	33.0532	58.8711	84.9809
Demographic	0.0000	29.9281	88.5547	78.6497
2nd Stage				
No Demographic	0.0000	14.7638	10.7641	16.8247
Demographic	0.0000	16.4917	12.0142	18.5961
Quebec				
1st Stage				
No Demographic	0.0000	21.5366	32.5207	46.6362
Demographic	0.0000	23.9750	118.0753	41.7948
2nd Stage				
No Demographic	0.0000	10.3882	20.9027	28.8722
Demographic	0.0000	11.7468	22.8218	29.7611
Ontario				
1st Stage				
No Demographic	0.0000	44.8242	46.8674	88.8242
Demographic	0.0000	45.0564	38.2084	77.1261
2nd Stage				
No Demographic	0.0000	8.2477	12.9884	18.8122
Demographic	0.0000	12.8221	10.0050	20.0352
Prairies				
1st Stage				
No Demographic	0.0000	14.0243	33.8457	20.1431
Demographic	0.0000	14.7530	85.1309	16.3652
2nd Stage				
No Demographic	0.0000	10.9795	4.9452	13.3441
Demographic	0.0000	14.1037	7.3306	17.9337
British Columbia				
1st Stage				
No Demographic	0.0000	18.4312	19.7273	28.3427
Demographic	0.0000	17.8678	37.9203	29.0408
2nd Stage				
No Demographic	0.0000	15.3326	8.7728	24.8806
Demographic	0.0000	17.1770	10.0614	27.7523

Table 5.3: Eigenvalues for Canada and Regions

Region		Eigenvalues				
Canada	Without Demographic Variables	0.0000	-0.0419	-0.0486	-1.8779	-4.9497
	With Demographic Variables	0.0000	-0.0470	-0.0557	-2.2109	-5.0292
Atlantic Canada	Without Demographic Variables	0.0000	-0.0417	-0.0534	-1.5562	-3.8512
	With Demographic Variables	0.0000	-0.0405	-0.0537	-1.5202	-3.8893
Quebec	Without Demographic Variables	0.0000	-0.0398	-0.0484	-1.4339	-4.9615
	With Demographic Variables	0.0000	-0.0393	-0.0480	-1.3925	-4.8223
Ontario	Without Demographic Variables	0.0000	-0.0341	-0.0455	-0.0564	-5.5564
	With Demographic Variables	0.0000	-0.0317	-0.4587	-0.0560	-5.5058
Prairies	Without Demographic Variables	0.0000	-0.0450	-0.0578	-3.1714	-5.6710
	With Demographic Variables	0.0125	-0.0458	-0.0567	-2.8746	-4.3430
British Columbia	Without Demographic Variables	0.0000	-0.0469	-0.0621	-2.3324	-4.8665
	With Demographic Variables	0.0000	-0.0476	-0.0579	-2.2322	-4.8716

parameters of the model, it was verified after estimating the demand system. The necessary condition for negativity to hold requires that the own-price Hicksian substitution effects are negative. This condition was satisfied for Canada and for all regions. Note, however, the negative own-price Hicksian substitution effect is only a necessary condition. The sufficient condition requires that the matrix of the Hicksian substitution effects be at least negative semi-definite. This condition is satisfied if the eigenvalues of the Hicksian substitution effects are non-positive. Table 5.3 lists the resulting eigenvalues at the mean of the data set for Canada and the five regions considered in this study. The result is that negativity holds in all cases except the Prairie region when demographic variables are included in the model. However, when negativity was tested at all points in the data set, it did not hold. The eigenvalues in some cases were positive and in a few cases imaginary or complex eigenvalues. The result is that the model is only locally negative semi-definite. This means as the preditions move further from the mean they may not be consistent with economic theory.

CANADIAN RESULTS

The first model considered is that for Canada with and without demographic variables. The estimation results are presented in Tables 5.4 to 5.21. The estimation method assumed separability of the demand system and therefore was estimated in two-stages. The first stage estimated the budget allocation to four different groups, dairy group considered in this study, other dairy products, other food and non-food. The dairy group consisted of the expenditure on the five dairy products to be estimated in the second stage. The other dairy group is the expenditure on all other dairy products consumed in the household while the other food group is the expenditure on all food excluding dairy products. Finally, the non-food group is the household expenditure on all other goods and services. The second stage focused on the five dairy products in the dairy group, 1 Percent Fluid Milk, 2 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses. After the first and second stages of the estimation, conditional Marshallian and Hicksian elasticities were calculated for each stage. Then the unconditional Marshallian and Hicksian elasticities were derived following the procedure developed by Carpentier and Guyomard (2001)[17].

Own-Price Effects

The results show that all own-price coefficients, Marshallian and Hicksian elasticities and Hicksian substitution effects are negative (Tables 5.4 to 5.21). The first-stage own-price elasticities, both Marshallian and Hicksian, are inelastic. The second-stage own-price

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[17] Unconditional elasticities were derived using the following formulas.
Income Elasticities

$$E_i = E_{(G)i}E_G$$

Marshallian Own-Price and Cross-Price Elasticities

$$e_{ij} = e_{(G)ij} + w_{(G)j}\left(\frac{1}{E_{(G)j}} + e_{GG}\right)E_{(G)i}E_{(G)j} + w_{(G)j}w_G E_G E_{(G)i}\left(E_{(G)j} - 1\right)$$

where

E_i *is the unconditional expenditure elasticity for good i*
$E_{(G)i}$ *is the estimated conditional expenditure elasticity*
E_G *is the expenditure elasticity for group G*
e_{ij} *is the unconditional price elasticity*
$e_{(G)ij}$ *is the estimated conditional price elasticity*
$w_{(G)j}$ *is the within − group expenditure share*
e_{GG} *is the own − price elasticity of goup G*
w_G *is the expenditure share of group G*

Hicksian Own-Price and Cross-Price Elasticities were derived from the Slutsky Equation.
For example in Atlantic Canada for 1 Percent Fluid Milk
Group Price Elasticity = -0.3381
Group Income Elasticity = 2.5484
Conditional Marshallian Own-Price Elasticity = -2.3195
Conditional Expenditure Elasticity = 1.2094
Unconditional Marshallian Own-Price Elasticity = -2.2319
Unconditional Income Elasticity = 3.0821

elasticities both Marshallian and Hicksian are elastic. This is as expected since the first stage allocate income to the aggregate groups which tends to be less elastic since any substitution between goods within the group does not affect the allocation to the group. In the second stage the allocation is to individual goods which tend to be more elastic then the group as a whole because there is now substitution between the different good.

In the second stage this means that the percentage decrease in the quantity consumed is larger than the percentage increase in price. An own-price elasticity with a magnitude greater than 1 normally indicates that the good is a luxury good however food is normally considered a necessity which means the magnitude of the own-price elasticity should be less than 1. There are several factors that could be driving these results. A factor that could be driving these results is the degree of substitution between various dairy products considered in this study. In most cases the dairy products are both gross and net substitutes of each other. So an increase in the price of one dairy relative to the other will induce consumers substitute the now relatively cheaper dairy products for the now relatively more expensive one. This increases the own-price effect and causes the elasticity to increase.

In comparing the second-stage Marshallian and Hicksian own-price elasticities (Table 5.8 to Table 5.9 and Table 5.18 to Table 5.19), we see that the Marshallian elasticise are large than the Hicksian elasticities in both of the cases, with and without demographic variables. This is expected because of the income effect removed from the latter.

The unconditional own-price Marshallian elasticities for the models with and without demographic variables were less elastic than the conditional own-price Marshallian elasticities (compare Tables 5.8 to 5.10 and Tables 5.18 to 5.20). In the case of the Hicksian elasticities the total own-price elasticities were more elastic then the conditional own-price own-price elasticities (compare Tables 5.9 to 5.11 and Tables 5.19 to 5.21). When the total Marshallian elasticities in the model with and without the demographic variables are compared, we see that the total Marshallian elasticities are more elastic in the model with demographic variables (Tables 5.10 to 5.20). Similar results are observed for the total Hicksian elasticities: the own-price elasticities are larger in absolute value in the model with demographic variables than in the model without (Table 5.11 and 5.21). Thus, once the non-economic differences of consumers' choices are taken into account, consumers become more price sensitive. Therefore, if we ignore differences in consumers, we are likely to understate the total own-price elasticity of demand for dairy products in Canada.

Table 5.4: First Stage Coefficients Without Demographic Variables: Canada

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0426	0.0128	-0.0007	-0.0011	-0.0109	0.0050
	0.0314	**0.0004**	**0.0002**	0.0010	**0.0015**	0.0061
Other Dairy	0.0387	-0.0007	0.0094	-0.0007	-0.0080	0.0028
	0.0242	**0.0002**	**0.0003**	0.0008	**0.0011**	0.0047
Other Food	0.8814	-0.0011	-0.0007	0.1557	-0.1538	-0.0997
	0.1312	0.0010	0.0008	**0.0050**	**0.0064**	**0.0259**
Non-Food	0.0372	-0.0109	-0.0080	-0.1538	0.1728	0.0920
	0.1808	**0.0015**	**0.0011**	**0.0064**	**0.0086**	**0.0356**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.5: First Stage Marshallian Elasticities Without Demographic Variables: Canada

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.2657 **0.0256**	-0.0440 **0.0173**	-0.1195 0.1218	-0.8601 **0.1961**	1.2894 **0.3556**
Other Dairy	-0.0637 **0.0261**	-0.2024 **0.0254**	-0.1020 0.1379	-0.8691 **0.2212**	1.2371 **0.4021**
Other Food	0.0032 0.0075	0.0026 0.0056	-0.0582 **0.0525**	-0.4081 **0.0761**	0.4604 **0.1399**
Non-Food	-0.0159 **0.0026**	-0.0116 **0.0019**	-0.2173 **0.0164**	-0.8722 **0.0248**	1.1170 **0.0453**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[18]

Table 5.6: First Stage Hicksian Elasticities Without Demographic Variables: Canada

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2435 **0.0205**	-0.0289 **0.0134**	0.1189 **0.0565**	0.1535 0.0842
Other Dairy	-0.0423 **0.0197**	-0.1878 **0.0221**	0.1267 **0.0641**	0.1035 0.0960
Other Food	0.0111 **0.0053**	0.0081 **0.0041**	0.0270 **0.0273**	-0.0461 0.0347
Non-Food	0.0034 0.0018	0.0015 0.0014	-0.0108 0.0081	0.0059 **0.0109**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[19]

[18] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

[19] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.7: Second Stage Coefficients Without Demographic Variables: Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2169 **0.0437**	-0.1577 **0.0137**	0.1179 **0.0078**	-0.0169 **0.0068**	0.0264 **0.0079**	0.0303 **0.0055**	0.0267 **0.0038**
2% Fluid Milk	0.6682 **0.0555**	0.1179 **0.0078**	-0.1869 **0.0139**	-0.0030 0.0058	0.0347 **0.0074**	0.0373 **0.0077**	-0.0522 **0.0056**
Butter	0.1725 **0.0312**	-0.0169 **0.0068**	-0.0030 0.0058	-0.0220 0.0135	0.0238 **0.0087**	0.0181 **0.0054**	-0.0140 **0.0035**
Cheddar Cheese	0.1600 **0.0368**	0.0264 **0.0079**	0.0347 **0.0074**	0.0238 **0.0087**	-0.1316 **0.0158**	0.0467 **0.0065**	0.0145 **0.0039**
Other Cheese	0.2161 **0.0461**	0.0303 **0.0055**	0.0373 **0.0077**	0.0181 **0.0054**	0.0467 **0.0065**	-0.1325 **0.0120**	0.0249 **0.0048**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Economically, these results tell us that individual households are more price-sensitive then the average or representative household commonly assumed in aggregate demand analysis.

Another finding is that the own-price elasticities are elastic and are statistically significant in both the model with and without demographic variables. This would suggest that a decrease in the own-price of dairy products would lead to an increase in total revenues at the retail level. However, it should be noted that this research only addresses the conditions at the retail level. The above statement of decreasing price will result in increasing revenues may not hold for the wholesale, processor or farm level. In order to determine the effect of a price change on the revenues of the wholesale, processor and farm levels of the value chain would require a detailed analysis of the structure of the value chain. This analysis is outside the purpose and objectives of this research.

Table 5.8: Second Stage Marshallian Elasticities Without Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.2634 **0.1090**	0.8542 **0.0566**	-0.1529 **0.0536**	0.1776 **0.0621**	0.1750 **0.0423**	1.2095 **0.0299**
2% Fluid Milk	0.3689 **0.0233**	-1.5013 **0.0405**	0.0059 0.0174	0.1242 **0.0225**	0.1568 **0.0236**	0.8455 **0.0166**
Butter	-0.1572 **0.0701**	0.0175 0.0555	-1.2146 0.1414	0.2676 **0.0906**	0.2319 **0.0550**	0.8548 **0.0364**
Cheddar Cheese	0.1765 **0.0564**	0.2147 **0.0505**	0.1615 **0.0628**	-1.9626 **0.1149**	0.3052 **0.0463**	1.1048 **0.0284**
Other Cheese	0.0906 0.0183	0.0965 0.0250	0.0525 0.0181	0.1444 0.0220	-1.4672 0.0408	1.0831 0.0160

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[20]

Table 5.9: Second Stage Hicksian Elasticities Without Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1092 **0.1077**	1.2627 **0.0609**	-0.0364 0.0535	0.3455 **0.0618**	0.5374 **0.0428**
2% Fluid Milk	0.4767 **0.0230**	-1.2157 **0.0412**	0.0873 **0.0172**	0.2416 **0.0220**	0.4102 **0.0229**
Butter	-0.0482 0.0709	0.3062 **0.0603**	-1.1323 **0.1400**	0.3862 **0.0907**	0.4880 **0.0559**
Cheddar Cheese	0.3173 **0.0567**	0.5878 **0.0536**	0.2679 **0.0629**	-1.8092 **0.1135**	0.6362 **0.0470**
Other Cheese	0.2287 **0.0182**	0.4623 **0.0258**	0.1568 **0.0180**	0.2948 **0.0218**	-1.1426 **0.0400**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[21]

[20] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.
[21] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.10: Total Marshallian Elasticities Without Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.1581	1.0466	-0.0974	0.2821	0.3959	1.5595
2% Fluid Milk	0.4889	-1.2809	0.0694	0.2434	0.4089	1.0902
Butter	-0.0375	0.2372	-1.1513	0.3864	0.4832	1.1022
Cheddar Cheese	0.2861	0.4151	0.2193	-1.8539	0.5351	1.4245
Other Cheese	0.2010	0.2986	0.1108	0.2540	-1.2354	1.3966

Table 5.11: Total Hicksian Elasticies Without Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1546	1.0528	-0.0697	0.4523	0.3959
2% Fluid Milk	0.4913	-1.2765	0.0888	0.3624	0.4089
Butter	-0.0351	0.2416	-1.1316	0.5067	0.4832
Cheddar Cheese	0.2892	0.4208	0.2447	-1.6984	0.5351
Other Cheese	0.2041	0.3042	0.1357	0.4064	-1.2354

Table 5.12: First Stage Price and Expenditure Coefficients With Demographic Variables: Canada

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0579 0.0314	0.0130 **0.0004**	-0.0006 **0.0002**	-0.0008 0.0010	-0.0116 **0.0014**	0.0022 0.0061
Other Dairy	0.0431 0.0238	-0.0006 **0.0002**	0.0094 **0.0003**	-0.0006 0.0007	-0.0082 **0.0011**	0.0020 0.0047
Other Food	0.8654 **0.1301**	-0.0008 0.0010	-0.0006 0.0007	0.1533 **0.0049**	-0.1519 **0.0063**	-0.0970 **0.0026**
Non-Food	0.0336 0.1796	-0.0116 **0.0014**	-0.0082 **0.0011**	-0.1519 **0.0063**	0.1716 **0.0085**	0.0928 **0.0353**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.13: First Stage Demographic Coefficients: Canada

	Atlantic Canada	Quebec	Prairies	British Columbia	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	-0.0004 0.0003	-0.0004 0.0003	-0.0002 0.0003	0.0007 0.0004	-0.0002 0.0003	-0.0001 0.0003	0.0002 0.0003	0.0004 0.0003	-0.0003 **0.0001**	-0.0003 **0.0001**	0.0000 0.0000	0.0000 0.0001
Other Dairy	0.0003 0.0002	-0.0004 0.0003	0.0000 0.0002	0.0001 0.0003	-0.0001 0.0002	0.0000 0.0002	0.0004 0.0002	0.0006 **0.0003**	-0.0002 **0.0001**	-0.0001 0.0001	0.0000 0.0000	-0.0001 0.0000
Other Food	-0.0018 0.0013	-0.0045 0.0013	-0.0025 0.0014	-0.0007 0.0015	0.0027 **0.0012**	0.0014 0.0012	0.0039 **0.0013**	0.0000 0.0011	-0.0032 **0.0006**	-0.0009 0.0006	0.0001 **0.0000**	-0.0002 0.0002
Non-Food	0.0019 0.0015	0.0053 **0.0015**	0.0028 0.0016	-0.0001 0.0017	-0.0024 0.0014	-0.0013 0.0013	-0.0046 **0.0015**	-0.0010 0.0013	0.0038 **0.0007**	0.0012 0.0007	-0.0001 **0.0000**	0.0003 0.0002

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.14: First Stage Marshallian Elasticities With Demographic Variables: Canada

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.2481	-0.0380	-0.0704	-0.7683	1.1247
	0.0257	**0.0171**	0.1214	**0.1955**	**0.3543**
Other Dairy	-0.0565	-0.2029	-0.0837	-0.8270	1.1700
	0.0257	**0.0248**	0.1358	**0.2178**	**0.3956**
Other Food	0.0046	0.0028	-0.0737	-0.4091	0.4753
	0.0074	0.0055	**0.0518**	**0.0757**	**0.1388**
Non-Food	-0.0167	-0.0118	-0.2150	-0.8746	1.1181
	0.0026	**0.0019**	**0.0162**	**0.0247**	**0.0449**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[22]

Table 5.15: First Stage Hicksian Elasticities With Demographic Variables: Canada

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2287	-0.0248	0.1375	0.1159
	0.0207	0.0133	**0.0563**	0.8383
Other Dairy	-0.0363	-0.1891	0.1326	0.0927
	0.0195	**0.0215**	**0.0632**	0.0943
Other Food	0.0128	0.0084	0.0142	-0.0355
	0.0053	**0.0040**	**0.0267**	0.0341
Non-Food	0.0025	0.0014	-0.0083	0.0044
	0.0018	0.0014	0.0080	**0.0108**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[23]

[22] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

[23] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.16: Second Stage Price and Expenditure Coefficients With Demographic Variables: Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2844 **0.0521**	-0.1698 **0.0151**	0.0916 **0.0070**	0.0125 0.0076	0.0338 **0.0087**	0.0319 **0.0058**	0.0166 **0.0042**
2% Fluid Milk	0.5155 **0.0638**	0.0916 **0.0070**	-0.2136 **0.0145**	0.0129 **0.0063**	0.0499 **0.0079**	0.0592 **0.0079**	-0.0445 **0.0059**
Butter	0.1036 **0.0322**	0.0125 0.0076	0.0129 **0.0063**	-0.0576 **0.0149**	0.0195 **0.0084**	0.0126 **0.0053**	-0.0002 0.0036
Cheddar Cheese	0.2552 **0.0423**	0.0338 **0.0087**	0.0499 **0.0079**	0.0195 **0.0084**	-0.1455 **0.0166**	0.0424 **0.0065**	0.0121 **0.0042**
Other Cheese	0.4101 **0.0531**	0.0319 **0.0058**	0.0592 **0.0079**	0.0126 **0.0053**	0.0424 **0.0065**	-0.1461 **0.0121**	0.0159 **0.0051**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Comparing the own-price elasticities of Canada to results from other studies is difficult since few studies looked at dairy products at this level of disaggregation using cross-sectional data. One study that examined dairy products at a similar level of disaggregation found Marshallian own-price elasticities for fluid milks of between -2.05 and-1.35 (Wang, 2005). While the results of this study are similar to those found in Wang (2005), there are a number of differences. While the purpose of this study is to investigate the effects of changing demographics on the demand for dairy products, Wang (2005) examined what influences the consumption of beverages. Another differences is that this study examined a set of dairy products while Wang (2005) examined only beverages including fluid milk.

Cross-Price Effects

The group cross-price effects in the first-stage estimation shows that all of the groups are gross substitutes. This means that an increase in the cost of one group causes a reduction

Table 5.17: Second Stage Demographic Coefficients: Canada

	Atlantic Canada	Quebec	Prairies	British Columbia	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	0.0275 **0.0083**	-0.0344 **0.0074**	0.0634 **0.0085**	0.0289 **0.0094**	0.0073 0.0077	-0.0119 0.0076	-0.0098 0.0077	-0.0246 **0.0069**	0.0027 0.0042	-0.0051 0.0038	0.0000 0.0002	0.0063 **0.0012**
2% Fluid Milk	0.0716 **0.0127**	-0.0573 **0.0122**	-0.0222 0.0118	-0.0316 **0.0138**	-0.0077 0.0112	-0.0004 0.0113	0.0026 0.0113	0.0115 0.0105	0.0208 **0.0061**	0.0348 **0.0056**	0.0012 **0.0003**	-0.0087 **0.0019**
Butter	-0.0385 **0.0073**	0.0096 0.0072	-0.0355 **0.0065**	0.0036 0.0081	-0.0048 0.0060	-0.0007 0.0062	0.0112 0.0063	0.0129 **0.0061**	-0.0089 **0.0030**	-0.0026 0.0029	0.0015 **0.0002**	-0.0026 **0.0011**
Cheddar Cheese	-0.0375 **0.0081**	-0.0062 0.0080	0.0137 0.0079	0.0294 **0.0095**	-0.0002 0.0075	-0.0060 0.0075	-0.0134 0.0074	-0.0326 **0.0066**	-0.0090 **0.0040**	-0.0106 **0.0037**	-0.0007 **0.0002**	0.0024 **0.0012**
Other Cheese	-0.0231 **0.0104**	0.0882 **0.0113**	-0.0194 0.0103	-0.0304 **0.0120**	0.0054 0.0098	0.0190 0.0100	0.0094 0.0099	0.0329 **0.0095**	-0.0057 0.0055	-0.0165 **0.0050**	-0.0021 **0.0003**	0.0025 0.0016

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

in the quantity consumed in all of the groups with total income fixed (Tables 5.5 and 5.14). The Hicksian elasticities show that the dairy group and other dairy are net compliments while the other food and non-food groups are net substitutes (Tables 5.5 and 5.14). Thus, as the cost of either the dairy group or other dairy products increase the quantity consumed in each group decreases and the consumption of other food and non-food commodities increase when the consumers are compensated for the change in relative income.

The second-stage cross-price effects indicate that all dairy products within the group are both gross and net substitutes in consumption. The only exceptions to this was 1 Percent Fluid Milk and Butter in the model without demographic variables as they appear not to be both gross and net substitutes.

The gross complimentary relationship of 1 Percent Fluid Milk and Butter disappeared with the addition of demographic variables and the relationship became that of both a gross and net substitutes. Thus, when we consider the demographic differences of households, the income or expenditure effect is reduced which turns Butter and 1 Percent Fluid Milk from compliments into substitutes. Similar to the own-price effect the addition of demographic variables caused changes to the coefficients of the prices of other dairy products, and it is these changes that caused the changes in cross-price elasticities. Note, however, the cross-price effects vary, considerably across dairy products considered in this study (Tables 5.8, 5.9, 5.18 and 5.19).

When considering the within group demand for 1 Percent Fluid Milk, 2 Percent Fluid Milk had the strongest gross (0.9) and net (1.3) substitution effects in the model without demographic variables followed by Other Cheeses (0.2 and 0.5) and Cheddar Cheese (0.2 and 0.3) (Tables 5.8 and 5.9). The results were similar in the model with demographic variables with 2 Percent Fluid Milk the strongest (0.7 and 1.1) followed by Cheddar Cheese (0.2 and 0.4) and Other Cheeses (0.2 and 0.5) and Butter was the weakest (Tables 5.18 and 5.19).

In the case of 2 Percent Fluid Milk, 1 Percent Fluid Milk (0.4 and 0.5, 0.3 and 0.4), Other Cheeses (0.3 and 0.5, 0.4 and 0.4) and Cheddar Cheese (0.2 and 0.3, 0.3 and 0.4) were the strongest gross and net substitutes in both models (Tables 5.8, 5.9, 5.18 and 5.19).

Butter's strongest gross substitute was Cheddar Cheese (0.3) in the model without demographic variables and (0.2) with demographic variables. Meanwhile 1 Percent Fluid Milk was the only moderate to weak gross substitutes in both models. In terms of the

Table 5.18: Second Stage Marshallian Elasticities With Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.3486 **0.1202**	0.6744 **0.0504**	0.0856 0.0596	0.2471 **0.0683**	0.2111 **0.0444**	1.1304 **0.0331**
2% Fluid Milk	0.2880 **0.0211**	-1.5879 **0.0426**	0.0510 **0.0190**	0.1659 **0.0237**	0.2147 **0.0240**	0.8683 **0.0174**
Butter	0.1302 0.0778	0.1350 **0.0608**	-1.5978 **0.1568**	0.2027 **0.0873**	0.1320 **0.0548**	0.9979 **0.0373**
Cheddar Cheese	0.2324 **0.0620**	0.3296 **0.0531**	0.1320 **0.0605**	-2.0605 **0.1213**	0.2790 **0.0465**	1.0875 **0.0303**
Other Cheese	0.0997 **0.0193**	0.1796 **0.0255**	0.0371 **0.0179**	0.1341 **0.0221**	-1.5035 **0.0414**	1.0531 **0.0171**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[24]

[24] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.19: Second Stage Hicksian Elasticities With Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.2045 **0.1187**	1.0562 **0.0551**	0.1944 **0.0598**	0.4041 **0.0682**	0.5498 **0.0451**
2% Fluid Milk	0.3987 **0.0208**	-1.2946 **0.0431**	0.1346 **0.0188**	0.2864 **0.0233**	0.4749 **0.0233**
Butter	0.2575 **0.0791**	0.4720 **0.0660**	-1.5018 **0.1551**	0.3413 **0.0873**	0.4310 **0.0554**
Cheddar Cheese	0.3711 **0.0626**	0.6969 **0.0566**	0.2367 **0.0606**	-1.9095 **0.1196**	0.6049 **0.0471**
Other Cheese	0.2340 **0.0192**	0.5353 **0.0263**	0.1385 **0.0178**	0.2802 **0.0218**	-1.1880 **0.0405**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[25]

Hicksian cross-price elasticities for Butter, Other Cheeses was the strongest net substitute in both models followed by 2 Percent Fluid Milk and Cheddar Cheese.

Both Cheddar Cheese and Other Cheeses have their strongest gross and net substitutes being each other and second strongest being 2 Percent Fluid Milk. Butter and 1 Percent Fluid Milk were the weakest gross and net substitutes for both cheeses. Thus, while the dairy products were all gross and net substitutes for each other, there are differences in the relative strength of their substitution effects which is expected because of the nature of end used of these products.

[25] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.20: Total Marshallian Elasticities With Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.2445	0.8844	0.1547	0.3560	0.4385	1.2714
2% Fluid Milk	0.4013	-1.3585	0.1263	0.2845	0.4625	0.9766
Butter	0.2390	0.3548	-1.5255	0.3166	0.3697	1.1224
Cheddar Cheese	0.3380	0.5428	0.2021	-1.9500	0.5098	1.2231
Other Cheese	0.2065	0.3954	0.1081	0.2458	-1.2701	1.1844

Table 5.21: Total Hicksian Elasticities With Demographic Variables: Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.2418	0.8895	0.1774	0.4948	0.4385
2% Fluid Milk	0.4035	-1.3546	0.1437	0.3911	0.4625
Butter	0.2415	0.3592	-1.5056	0.4391	0.3697
Cheddar Cheese	0.3407	0.5477	0.2239	-1.8165	0.5098
Other Cheese	0.2091	0.4001	0.1292	0.3751	-1.2701

The unconditional cross-price Marshallian elasticities were more elastic than the conditional cross-price Marshallian elasticities for both the model with and without demographic variables (Tables 5.8 and 5.10 and Tables 5.18 and 5.19). The unconditional Hicksian elasticities results were however, mixed. About one third of the unconditional Hicksian cross-price elasticities were more elastic than the conditional Hicksian cross-price elasticities the rest were more inelastic (Tables 5.9 and 5.11 and Tables 5.19 and 5.21). However, the change in the magnitude between the conditional and unconditional is relatively small for both the Marshallian and Hicksian cross-price elasticities.

Income and Expenditure Effects

The first-stage income effect produces elastic income elasticities for the Dairy Group (1.3 and 1.1), Other Dairy (1.2 and 1.2) and Non-food (1.1 and 1.1) in both models. Thus, as income rise the expenditure on the Dairy Group, Other Dairy and Non-Food increases proportionately more than the increase in income. The income elasticity of Other Food was inelastic (0.5 and 0.5) in both models (Table 5.5 and 5.14).

The second-stage expenditure elasticities show that all dairy products in this study are normal goods in models with and without demographic variables (Tables 5.8 and 5.18). However, only 2 Percent Fluid Milk and Butter were necessities with expenditure elasticities less than 1, in the model without demographic variables, 0.8 and 0.9 respectively. On the other hand, 1 Percent Fluid Milk, Cheddar Cheese and Other Cheeses were all luxury goods with expenditure elasticities great than 1 in the model without demographic variables, 1.2 and 1.1, and 1.1 respectively (Table 5.8). In the model with demographic variables only 2 Percent Fluid Milk had an expenditure elasticity less than 1 (0.9). 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheese all had expenditure elasticities greater than or approximately equal to 1, 1.1, 1.0, 1.1 and 1.1 respectively. This means as total expenditure on dairy products increases the percentage increase in the quantity consumed of 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses will be greater than the percentage increase in total expenditure. Meanwhile, the percentage increase in the consumption of 2 Percent Fluid Milk will be less than the percentage increase in total expenditure. The reverse is true in the case of a decrease in total expenditure. The net result is that 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses are more sensitive to changes in the total expenditure then 2 Percent Fluid Milks.

The implications of these results for dairy policy is that measures, excluding price changes, taken by the industry to encourage consumers to spend a greater proportion of their current incomes on dairy products than what they currently will have less effect on the consumption of 1 Percent and 2 Percent Fluid Milk. It is a different story for the consumption of 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses.

The total or unconditional income elasticities were all greater than or approximately equal to 1 in the models with and without demographic variables (Tables 5.10 and 5.20). The least elastic being 2 Percent Fluid Milk at 1.0 in the model with demographic variables (Table 5.20). The most elastic was 1 Percent Fluid Milk at 1.6 in the model without demographic variables (Table 5.10). Since all five dairy products have unconditional income elasticities larger than 1 all are luxury goods.

Seasonal Effects

The only difference between the two versions of the model is that, in the second model, seasonal, geographic and demographic variables are included. The inclusion of these variables allows differences in a household that are not related to prices or income to affect the consumption of dairy products. In the case of seasonal variables, their inclusion allows for households to vary the budget shares allocated to each dairy product throughout the year. In the case of dairy products it could be expected that during the holidays and special times of the year different dairy products might be preferred.

In the first-stage, significant seasonal effects were limited to the Second and Fourth Quarters for Other Food and the Fourth Quarter for Non-food (Table 5.13). In the case of Other Food, there was a statistically higher budget share in the Second and Fourth Quarters compared to the First Quarter. Non-food had a statistically lower budget share in the Fourth Quarter compared to the first three quarters of the year (Table 5.13).

In the second-stage estimation there were no statistically significant results and no seasonal effect in the budget share of the five dairy products. The result is the there is little seasonal effect in the consumption of dairy products.

Geographic Effects

These variables allow for differences in preference that are associated with the different regions in Canada. These differences can occur because of price and expenditure differences between the different regions. One of the possible causes of these differences is that in a country with such large geographic distances between the regions there can be cultural differences. A second possible cause of these differences is that, in Canada's early settlement, regions were settled by different ethnic groups. While these groups today would be defined as Canadians, not foreign born, there could be residual cultural differences that have persisted through the generations. Therefore, two households that would otherwise be identical could have different preference structures due to regional differences within the country.

The first-stage geographic effects were limited to Quebec. Quebec had a slightly higher budget share then the rest of the regions for the Non-food group otherwise there were no statistical differences between the budget shares across the regions.

While at the second-stage, the effects of seasonality were relatively limited, the geographic effects were not. Only the cases of Butter and Cheddar Cheese in Quebec, Cheddar Cheese and Other Cheeses in the Prairies, and Butter in British Columbia were we not able to reject the null hypothesis that the budget shares were the same as Ontario (Table 5.17). Therefore, most dairy products in the study have different budget shares in the five different geographic regions. This suggests that the five different regions should be treated separately in the analysis. Below I will discuss the results of the Canada as a whole model.[26]

The results for 1 Percent Fluid Milk show that Atlantic Canada, the Prairies and British Columbia have a statistically higher budget shares then Ontario while Quebec was statistically lower. This does not mean that the actual expenditure on or the quantity consumed of 1 Percent Fluid Milk is higher or lower than in Ontario; it is just that their percentage of the total expenditure is different. Therefore, we need to consider the total expenditure and price in each region before we can determine if the actual expenditure and quantity consumed are different. The expenditure on 1 Percent Fluid Milk ranged from $0.8879 in Quebec to $1.8939 in the Prairies. Relative to Ontario, the Prairies and British Columbia had a higher expenditure while Quebec had a lower expenditure. The level of expenditure for Atlantic Canada was similar to Ontario. Meanwhile, differences in the average price in each region means that the average quantity consumed ranged from 0.8916 litres in Quebec to 1.9435 litres in the Prairies. The quantity consumed in the Prairies and British Columbia was higher than Ontario and Quebec, and Atlantic Canada was less. The result is that there were differences in budget share, expenditure and quantity consumed of 1 Percent Fluid Milk in the five different regions of Canada.

For 2 Percent Fluid Milk, only Atlantic Canada has a statistically higher budget share than Ontario, with Quebec, the Prairies and British Columbia being statistically lower. Similar to the argument for 1 Percent Fluid Milk, the expenditure and quantity consumed of 2 Percent Fluid Milk is determined by the relationship between budget share, total expenditure

[26] I will discuss the results of the regional models later.

and price. In the case of 2 Percent Fluid Milk the range of expenditures was from $3.5808 in British Columbia to $4.488 in Atlantic Canada. The range of quantity consumed was from 3.3746 litres in British Columbia to 4.4833 litres in Ontario. Therefore, while there were budget shares and expenditures greater than and less than Ontario, Ontario had the greatest quantity consumed in any region in Canada.

In the case of Butter consumption, Atlantic Canada and the Prairies were statistically lower and Quebec and British Columbia were statistically the same as Ontario. As before, we need to consider each region's total expenditure and price before we can discuss each region's average expenditure and quantity consumed. The range of expenditures was from $0.5657 in Ontario to $1.1796 in Quebec. Meanwhile, the range of quantity consumed is from 0.0905 kg in Ontario to 0.1326 kg in Quebec. This means all of the regions had higher expenditures and quantity consumed of butter than Ontario.

Cheddar Cheese had Quebec, the Prairies and Ontario with the same budget share while Atlantic Canada was lower and British Columbia was higher. However, in terms of expenditure, Quebec and British Columbia had higher levels of expenditure than Ontario and the Prairies and Atlantic Canada were lower. Therefore, even though the Prairies had the same budget share, their actual expenditure was less than Ontario. The range of expenditure was from $1.0674 in Atlantic Canada to $1.4683 in British Columbia. In terms of quantity consumed British Columbia had the highest at 0.1347 kg and Atlantic Canada was the lowest at 0.1073 kg.

Finally, in the case of Other Cheeses, Ontario and the Prairies had the same budget shares while Quebec was higher and Atlantic Canada and British Columbia was lower. Like the other dairy products in the study the relationship of budget share does not necessarily indicate the relationship of expenditures and quantities consumed. The range of expenditure was from $2.3494 in British Columbia to $3.4927 in Quebec, with only Quebec having a higher level of expenditure than Ontario while the remaining regions were lower. The range of quantity consumed was from 0.2370 kg in British Columbia to 0.3503 kg in Quebec.

Given the different demographic structures in the five regions, it is reasonable to think that the preference structures of the representative consumer are going to be different. However, these differences are statistically significant and therefore we need to consider them separately in our analysis.

Demographic Effects

The central purpose of this research is to determine the effects of changes in the demographic structure of Canada's population on the demand for dairy products. This study includes five demographic variables: the household headed by a foreign born person, the number of youth, the number of children, and age and education of the person responsible for purchasing food in the household.

As discussed in Chapter 2, with the increase in immigration since the 1970s and the declining birth rate of Canadians, the number of persons living in Canada who were born outside Canada is increasing. It is therefore reasonable to ask what effect the changes the demographic will have in the structure of Canada's population on the consumption of dairy products. We studied this effect in the model by including a dummy variable, which is 0 if the Head(s) of the Household are born in Canada and 1 if they were born outside Canada. The result was that if the Head(s) of the Household were foreign-born, it had a positive effect on the budget shares of Butter and Other Cheeses, a negative effect on 1 Percent Fluid Milk and Cheddar Cheese and no effect on 2 Percent Fluid Milk (Table 5.17).

What this means is that, two identical households and facing identical markets except for the fact that the heads of one household were born in Canada and the second were born outside of Canada, will allocate their identical total expenditure on dairy products differently. We can now look at each dairy product individually and determine what effect the household being headed by foreign-born person(s) will have on budget share and consumption. We see that the foreign-born household will allocate about three percent less of its total expenditure to 1 Percent Fluid Milk than the Canadian-born household. Similarly, the foreign-born household will allocate about two percent less of its total expenditure to the consumption of Cheddar Cheeses compared with the Canadian-born household. The average monetary effect of foreign-born heads of the household is about -\$0.06 for 1 Percent Fluid Milk and about -\$0.04 for Cheddar Cheese per household per week (Table 5.22). This also means that, since total expenditure and prices are the same, the foreign-born household will consume less 1 Percent Fluid Milk and Cheddar Cheese than the Canadian-born household.

Conversely, the budget shares and the consumption of Butter and Other Cheeses increased if the heads of the household were foreign born. Other Cheeses budget share increased by about 3 percent and Butter increased by about 1 percent. Subsequently, the consumption of Other Cheeses and Butter is higher in the foreign-born household than in a Canadian-born household when both households have the same total expenditure in the same market. Are these results reasonable? In the case of Other Cheeses, since all cheese other than Cheddar Cheese are included in this group, we can expect that cheeses traditionally consumed in the household's country of origin would be included. Similarly, Butter, which includes ghee, is part of the traditional diets in several of the countries of origin of Canadian immigrants. This is especially true for the Indian sub-continent groups. Therefore, it is quite reasonable that households headed by foreign-born persons would have higher budget shares and consumption compared to similar households of Canadian-born persons. The average monetary effect of these increases in budget share is about \$0.03 for Butter and about \$0.05 for Other Cheeses (Table 5.22).

In the case of 2 Percent Fluid Milk we find that the heads of the household (foreign-born or not) has little effect on the budget share or consumption. The resulting average monetary effect is therefore relatively small, about \$0.02 per household per week (Table 5.22). This may indicate a meeting point of the two different households' preferences in that 2 Percent Fluid Milk is high enough in fat content to be similar enough to foreign-born persons' traditional diet that they will consume it and also meet the dietary preferences of Canadian-born persons.

The number of youth and the number of children within the household can be considered together because the effects on the budget share and consumption of all the dairy products were very similar. The number of youth had a positive influence on the budget share of 2 Percent Fluid Milk and a negative influence on Butter and Cheddar Cheese and no effect on 1 Percent Fluid Milk and Other Cheeses (Table 5.17). Meanwhile the number of children had a positive influence only on the budget share of 2 Percent Fluid Milk but a negative influence on the budget share for Cheddar Cheese and Other Cheeses and no influence on the budget share of 1 Percent Fluid Milk and Butter (Table 5.17). Again if we consider two households where the only difference is the number of youth within them we find that the household with the higher number of youth will have higher budget shares and levels of consumption for 2 Percent Fluid Milk and lower budget shares and levels of consumption for Butter and Cheddar Cheese and no difference for 1 Percent Fluid Milk and Other Cheeses. If the two households only differ in the number of children, then the budget share and level of consumption will be higher for 2 Percent Fluid Milk and the budget shares and levels of consumption will be lower for Butter, Cheddar Cheese and Other Cheeses. The number of children will have no effect on the budget share and level of consumption of 1 Percent Fluid Milk.

Table 5.22: Average Dollar Value Equivalents of the Effects of Demographic Variables

	Foreign Born[27]	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	-0.0584 **0.0015**	0.0661 **0.0014**	0.0289 **0.0005**	0.0472 **0.0003**	1.1828 **0.0088**
2% Fluid Milk	0.0196 **0.0015**	0.2003 **0.0014**	0.5154 **0.0005**	0.7074 **0.0003**	-2.2568 **0.0088**
Butter	0.0254 **0.0002**	-0.0570 **-0.0005**	-0.0563 **-0.0005**	0.5659 **0.0046**	-0.1224 **-0.0010**
Cheddar Cheese	-0.0390 **0.0010**	-0.1217 **0.0025**	-0.2425 **0.0039**	-0.4244 **0.0030**	0.5710 **0.0042**
Other Cheeses	0.0547 **0.0014**	-0.0877 **0.0018**	-0.2456 **0.0040**	-0.8960 **0.0064**	0.6254 **0.0047**

However, when we want to consider how the number of youth and children within the household is influencing the general consumption of dairy products in Canada, we need to consider the general trend in the number of youth and children within Canadian households. As discussed in Chapter 2 the number of youth and children per household is declining in Canada. What this does is reverse the effects of the number of youth and children as discussed above. Because of the decline in the number of youth and children in Canadian household there will be negative pressures on the consumption of 1 Percent and 2 Percent

[27] Dummy variable effect calculated using Halvorsen and Palmquist, 1980.

Fluid Milks and positive pressures on the consumption of Butter, Cheddar Cheese and Other Cheeses.

The implication of these results is that, given the current trend in family structures we can expect negative pressures and therefore, less consumption of 2 Percent Fluid Milk and higher consumption of Cheddar Cheese and Other Cheeses. Also future prospects of change in this area is limited because of two reasons: 1) the number of elderly households is expected to increase in the near future and these households do not normally have young children and youth in them; and 2) the current birth rate has bottomed out. While it may increase slightly in the future, it is expected to remain relatively low at below 11 births per 1000 women (Verna et al., 1996; Statistics Canada, 2009).

The resulting average monetary effects of the number of youth and children within the household was that there was a positive monetary effect for 1 Percent and 2 Percent Fluid Milks and a negative effect for Butter, Cheddar Cheese and Other Cheeses. In the case of the Number of Youth in the household we see the range of monetary effects from -$0.12 for Cheddar Cheese to $0.20 for 2 Percent Fluid Milk. In the Number of Children in the household we see the range of monetary effects from -$0.25 for Other Cheeses to $0.52 for 2 Percent Fluid Milk (Table 5.22).

The final two demographic variables are the age and education of the person within the household making the food purchase decisions. In the case of age there was a positive influence on the budget share of 2 Percent Fluid Milk and Butter. However, age had a negative influence on the budget share of Cheddar Cheese and Other Cheeses and no influence in the budget share of 1 Percent Fluid Milk (Table 5.17). While there are statistically significant positive and negative effects for age on the consumption of dairy products, it should be noted that none of these is large. The largest of these is for Other Cheeses with a decrease in budget share of only 0.21 percent. The average monetary effect of the Age of the Head of the Household ranged from -$0.90 for Other Cheeses to $0.71 for 2 Percent Fluid Milk (Table 5.22). Therefore, in reality the age of the person purchasing food within the household has little effect on the budget share and consumption of dairy products. It makes sense because the person purchasing the food within the household is taking into account the needs and preferences of others in the household and not just their own preferences and needs.

The implications for the industry are that the age of the person making the food purchases within the household is not the reason for most of the changes in the consumption of dairy products. Therefore, other changes in the demographic structure of Canada are likely to have caused the changes in the consumption of dairy products.

The level of education of the person purchasing food within the household has a positive influence on the budget share of 1 Percent Fluid Milk and Cheddar Cheese while it has a negative influence on the budget share of 2 Percent Fluid Milk and Butter and no influence on Other Cheese (Table 5.17). Again while the level of education of the person purchasing food within the household was statistically significant for all dairy products, none of the effects on budget share was very large. The largest effect on budget share by education was a decline in the budget share of 1.66 percent for an average increase of one grade of education for the head of the household. The average monetary effect of the Education of the Head of the Household ranged from -$2.26 for 2 Percent Fluid Milk to $1.18 for 1 Percent Fluid Milk (Table 5.22). The effect on the other dairy products is even smaller and therefore, one can question how much real effect the changes in education will have on the consumption of dairy products in Canada.

The general outcome is that demographic factors are influencing the consumption of dairy products in Canada but the influence is complex. The complexity arises from the fact that multiple factors are influencing budget share and resulting consumption decisions for each dairy product in different directions.

Regional Results

In the Canadian results presented above, statistical differences in budget shares were observed in different geographical regions of Canada. This implies differences in expenditure and quantity consumed. An alternative to including geographic dummy variables, which are limited in terms of how they can account for the regional differences in budget shares,[28] is to treat each region separately in the analysis and estimated a demand system for each region. By modelling each region separately one can allow variation in the demand functions that cannot be accounted for by simple geographic dummy variables. Therefore, I estimated separate demand systems for the selected dairy products for all five regions. This section reports the results for Ontario and Quebec which represents the largest regions in terms of consumption and production dairy products in Canada. The results pertaining to the other regions are exiled to Appendix 3.

The first-stage own-price elasticities for Quebec and Ontario were similar to the results from Canada as a whole with the only changes being in the magnitude of the elasticities. All of the first-stage own-price elasticities were negative and inelastic.

[28] In the case of this model the geographic dummy variables could only account for differences in the geographic variable in a linear functional form. More complex functional relationships could not be modelled.

The first-stage own-price effects for Ontario and Quebec were relatively similar to the result for Canada as a whole. The Marshallian and Hicksian own-price elasticities were negative and elastic in all cases. The only difference was in the magnitude of the first and second-stage own-price elasticities.

The Second-stage Marshallian own-price elasticities for Quebec had a smaller range than those from Canada. The range for Quebec was -1.1 to -3.0 in the model without demographic variables and -1.2 to -2.9, in the model with demographic variables (Tables 5.27 and75.32). There were only small variations in the Second-stage Marshallian own-price elasticities between the two models. However, the second-stage own-price elasticise in the model without demographic variables in the case of Quebec were more elastic than in the model with demographic variables. As with Canada, the Second-stage Hicksian own-price elasticities were less elastic than the Second-stage Marshallian own-price elasticities, which is consistent with economic theory for normal goods (compare Tables 5.27 and 5.28 and Tables 5.37 and 5.38).

Table 5.23: First Stage Coefficients Without Demographic Variables: Quebec

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.1020	0.0122	-0.0023	-0.0055	-0.0045	0.0333
	0.0871	**0.0010**	**0.0006**	0.0029	0.0042	**0.0170**
Other Dairy	-0.0526	-0.0023	0.0092	-0.0036	-0.0034	0.0202
	0.0652	**0.0006**	**0.0009**	0.0021	0.0031	0.0127
Other Food	0.2911	-0.0055	-0.0036	0.1382	-0.1291	0.0166
	0.3294	0.0029	0.0021	**0.0116**	**0.0162**	0.0643
Non-Food	0.8635	-0.0045	-0.0034	-0.1291	0.1369	-0.0701
	0.4727	0.0042	0.0031	**0.0162**	**0.0230**	0.0923

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.24: First Stage Marshallian Elasticities Without Demographic Variables: Quebec

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3665 **0.0667**	-0.1431 **0.0435**	-0.6257 0.3232	-1.6829 **0.5050**	2.8182 **0.9267**
Other Dairy	-0.2377 **0.0759**	-0.1835 **0.0861**	-0.6573 0.3947	-1.7550 **0.6265**	2.8334 **1.1481**
Other Food	-0.0321 0.0224	-0.0211 0.0155	-0.2478 **0.1281**	-0.7913 **0.1941**	1.0924 **0.3579**
Non-Food	-0.0040 0.0074	-0.0033 0.0052	-0.1473 **0.0413**	-0.7568 **0.0635**	0.9113 **0.1167**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[29]

Table 5.25: First Stage Hicksian Elasticities Without Demographic Variables: Quebec

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.3150 **0.0525**	-0.1120 **0.0339**	-0.1192 0.1575	0.5462 **0.2295**
Other Dairy	-0.1858 **0.0563**	-0.1522 **0.0782**	-0.1481 0.1910	0.4861 0.2834
Other Food	-0.0121 0.0160	-0.0091 0.0117	-0.0515 **0.0646**	0.0727 0.0900
Non-Food	0.0126 **0.0053**	0.0068 0.0040	0.0165 0.0205	-0.0359 **0.0290**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[30]

[29] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.
[30] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.26: Second Stage Coefficients Without Demographic Variables: Quebec

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2189	-0.1572	0.1011	0.0072	0.0325	0.0165	0.0188
	0.1058	**0.0331**	**0.0156**	0.0162	0.0205	0.0112	**0.0082**
2% Fluid Milk	0.2645	0.1011	-0.2044	0.0146	0.0309	0.0579	-0.0213
	0.1126	**0.0156**	**0.0322**	0.0149	0.0164	**0.0171**	0.0110
Butter	0.4136	0.0072	0.0146	-0.0188	0.0052	-0.0082	-0.0276
	0.0776	0.0162	0.0149	0.0303	0.0178	0.0142	**0.0082**
Cheddar Cheese	0.2414	0.0325	0.0309	0.0052	-0.1149	0.0463	0.0050
	0.0808	0.0205	0.0164	0.0178	**0.0370**	**0.0142**	0.0085
Other Cheese	0.2994	0.0165	0.0579	-0.0082	0.0463	-0.1125	0.0251
	0.1085	0.0112	**0.0171**	0.0142	**0.0142**	**0.0259**	0.0111

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Ontario's own-price elasticities follow the same general pattern as Canada. The Second-stage Marshallian own-price elasticities ranged from –1.1 to –2.8 in the model without demographic variables (Table 5.45) and –1.3 to –2.6 in the model with demographic variables (Table 5.55). There were only small variations in the own-price elasticities between the two models. The Hicksian own-price elasticities were less elastic than the Marshallian elasticities, which is consistent with economic theory of normal goods (compare Tables 5.45 to 5.46 and Tables 5.55 to 5.56).

Table 5.27: Second Stage Marshallian Elasticities Without Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.9937	1.1991	0.0620	0.3756	0.1204	1.2365
	0.4195	**0.1822**	0.2032	0.2566	0.1357	**0.1026**
2% Fluid Milk	0.3452	-1.6654	0.0574	0.1137	0.2208	0.9283
	0.0528	**0.1069**	0.0508	**0.0560**	**0.0589**	**0.0370**
Butter	0.0788	0.1914	-1.1302	0.0756	0.0162	0.7681
	0.1357	0.1198	0.2575	0.1499	0.1172	**0.0692**
Cheddar Cheese	0.2347	0.2154	0.0339	-1.8459	0.3255	1.0363
	0.1491	0.1135	0.1300	**0.2746**	**0.1008**	**0.0625**
Other Cheese	0.0395	0.1373	-0.0305	0.1167	-1.3314	1.0684
	0.0308	**0.0458**	0.0390	**0.0391**	**0.0713**	**0.0303**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[31]

While there were only small differences between the two models when we compared them within a region, there were notable differences when we compared elasticities between Ontario and Quebec. In the case of 1 Percent Fluid Milk, we see own-price elasticities of -2.8 in Ontario and -2.9 in Quebec. However, for 2 Percent Fluid Milk the range is -1.3 in Ontario and -1.7 in Quebec. In the case of Butter the range of own-price elasticities is -1.1 in Quebec and -1.1 in Ontario. On the other hand, Cheddar Cheese has a range of own-price elasticities of -1.8 in Quebec to -2.1 in Ontario. The range of own-price elasticities for Other Cheeses of -1.3 in Quebec to -1.3 in Ontario.

[31] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.28: Second Stage Hicksian Elasticities Without Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.8953 **0.4163**	1.5672 **0.1955**	0.2090 0.2035	0.5445 **0.2570**	0.5745 **0.1407**
2% Fluid Milk	0.4191 **0.0523**	-1.3891 **0.1081**	0.1678 **0.0502**	0.2405 **0.0552**	0.5617 **0.0576**
Butter	0.1400 0.1362	0.4201 **0.1256**	-1.0388 0.2546	0.1806 0.1499	0.2982 **0.1192**
Cheddar Cheese	0.3172 **0.1497**	0.5239 **0.1204**	0.1571 0.1305	-1.7043 **0.2710**	0.7061 **0.1038**
Other Cheese	0.1245 **0.0305**	0.4553 **0.0467**	0.0966 **0.0386**	0.2627 **0.0386**	-0.9391 0.0704

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[32]

Table 5.29: Total Marshallian Elasticities Without Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.9387	1.3488	0.1102	0.4533	0.3365	3.4848
2% Fluid Milk	0.4110	-1.4842	0.1164	0.2073	0.4809	2.6161
Butter	0.1503	0.3891	-1.0656	0.1776	0.2990	2.1647
Cheddar Cheese	0.2968	0.3856	0.0891	-1.7578	0.5701	2.9206
Other Cheese	0.1004	0.3042	0.0236	0.2032	-1.0913	3.0109

Table 5.30: Total Hicksian Elasticities Without Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.9336	1.3603	0.1847	0.8300	0.3365
2% Fluid Milk	0.4149	-1.4756	0.1722	0.4901	0.4809
Butter	0.1534	0.3962	-1.0194	0.4115	0.2990
Cheddar Cheese	0.3010	0.3952	0.1515	-1.4421	0.5701
Other Cheese	0.1048	0.3141	0.0879	0.5286	-1.0913

[32] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.31: First Stage Price and Expenditure Coefficients With Demographic Variables: Quebec

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.0463 0.0862	0.0132 **0.0010**	-0.0021 **0.0006**	-0.0040 0.0028	-0.0071 0.0042	0.2281 0.0167
Other Dairy	-0.0440 0.0616	-0.0021 **0.0006**	0.0090 **0.0007**	-0.0033 0.0020	-0.0036 0.0030	0.0182 0.0120
Other Food	0.3721 0.3183	-0.0040 0.0028	-0.0033 0.0020	0.1375 **0.0114**	-0.1301 **0.0159**	-0.0017 0.0622
Non-Food	0.7182 0.4566	-0.0071 0.0042	-0.0036 0.0030	-0.1301 **0.0159**	0.1407 **0.0224**	-0.2446 0.8925

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.32: First Stage Demographic Coefficients: Quebec

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	0.0006 0.0008	0.0004 0.0007	0.0003 0.0007	-0.0021 **0.0010**	-0.0006 0.0004	-0.0008 0.0004	0.0000 0.0000	0.0000 0.0001
Other Dairy	-0.0004 0.0005	-0.0002 0.0007	-0.0010 **0.0004**	0.0028 **0.0012**	-0.0005 **0.0002**	0.0001 0.0003	0.0000 0.0000	0.0000 0.0001
Other Food	-0.0015 0.0025	-0.0009 0.0023	-0.0080 **0.0023**	-0.0013 0.0030	-0.0043 **0.0014**	-0.0004 0.0012	0.0003 **0.0001**	0.0000 0.0004
Non-Food	0.0014 0.0031	0.0007 0.0029	0.0086 **0.0028**	0.0006 0.0041	0.0055 **0.0016**	0.0011 0.0015	-0.0003 **0.0001**	0.0000 0.0005

Table 5.33: First Stage Marshallian Elasticities With Demographic Variables: Quebec

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3007 **0.0693**	-0.1294 **0.0423**	-0.4445 0.3181	-1.3717 **0.4969**	2.2464 **0.9130**
Other Dairy	-0.2221 **0.0733**	-0.2013 **0.0712**	-0.5966 0.3788	-1.6281 **0.5956**	2.6481 **1.0904**
Other Food	-0.0223 0.0219	-0.0183 0.0150	-0.2334 **0.1249**	-0.7163 **0.1869**	0.9903 **0.3461**
Non-Food	-0.0080 0.0072	-0.0040 0.0049	-0.1556 **0.0402**	-0.7828 **0.0612**	0.9504 **0.1128**

Table 5.34: First Stage Hicksian Elasticities With Demographic Variables: Quebec

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2596 **0.0557**	-0.1047 **0.0330**	-0.0408 0.1550	0.4051 0.2269
Other Dairy	-0.1736 **0.0547**	-0.1721 **0.0636**	-0.1207 0.1848	0.4664 0.2688
Other Food	-0.0042 0.0158	-0.0074 0.0113	-0.0554 **0.0636**	0.0670 0.0882
Non-Food	0.0094 0.0052	0.0065 0.0037	0.0152 0.0200	-0.0311 **0.0283**

Table 5.35: Second Stage Price and Expenditure Coefficients With Demographic Variables: Quebec

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2309 0.1185	-0.1518 **0.0334**	0.0951 **0.0153**	0.0102 0.0159	0.0324 0.0204	0.0142 0.0113	0.0192 **0.0093**
2% Fluid Milk	0.3731 **0.1371**	0.0951 **0.0153**	-0.1962 **0.0331**	0.0155 0.0159	0.0271 0.0165	0.0585 **0.0174**	-0.0221 0.0126
Butter	0.2531 **0.0820**	0.0102 0.0159	0.0155 0.0159	-0.0234 0.0310	0.0028 0.0179	-0.0051 0.0144	-0.0099 0.0084
Cheddar Cheese	0.3178 **0.0939**	0.0324 0.0204	0.0271 0.0165	0.0028 0.0179	-0.1099 **0.0368**	0.0477 **0.0143**	-0.0036 0.0096
Other Cheese	0.2870 **0.1285**	0.0142 0.0113	0.0585 **0.0174**	-0.0051 0.0144	0.0477 **0.0143**	-0.1153 **0.0250**	0.0165 0.0125

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.36: Second Stage Demographic Coefficients: Quebec

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	-0.0115	-0.0164	-0.0124	-0.0049	0.0033	-0.0144	0.0000	0.0021
	0.0147	0.0146	0.0142	0.0173	0.0085	**0.0073**	0.0005	0.0022
2% Fluid Milk	-0.0208	0.0044	0.0045	0.0451	-0.0051	0.0109	-0.0011	-0.0036
	0.0232	0.0245	0.0237	0.0309	0.0123	0.0123	0.0008	0.0039
Butter	0.0106	-0.0043	-0.0054	-0.0401	-0.0082	0.0034	0.0019	-0.0065
	0.0153	0.0160	0.0147	**0.0151**	0.0072	0.0067	**0.0005**	**0.0025**
Cheddar Cheese	-0.0059	-0.0015	-0.0118	-0.0426	0.0181	0.0087	-0.0003	0.0001
	0.0165	0.0170	0.0161	**0.0173**	**0.0090**	0.0078	0.0005	0.0025
Other Cheese	0.0275	0.0178	0.0250	0.0425	-0.0082	-0.0086	-0.0005	0.0079
	0.0242	0.0247	0.0236	0.0313	0.0129	0.0123	0.0007	**0.0039**

Table 5.37: Second Stage Marshallian Elasticities With Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.9268	1.1231	0.0997	0.3736	0.0898	1.2406
	0.4228	**0.1782**	0.1984	0.2562	0.1363	**0.1163**
2% Fluid Milk	0.3254	-1.6370	0.0609	0.1011	0.2240	0.9256
	0.0519	**0.1107**	0.0540	0.0564	**0.0593**	**0.0422**
Butter	0.0925	0.1550	-1.1872	0.0353	-0.0124	0.9169
	0.1330	0.1285	0.2638	0.1502	0.1185	**0.0708**
Cheddar Cheese	0.2389	0.2060	0.0239	-1.8009	0.3584	0.9737
	0.1481	0.1128	0.1304	**0.2735**	**0.1007**	**0.0704**
Other Cheese	0.0350	0.1461	-0.0192	0.1236	-1.3304	1.0448
	0.0311	**0.0469**	0.0396	**0.0397**	**0.0689**	**0.0339**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[33]

[33] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.38: Second Stage Hicksian Elasticities With Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.8280	1.4924	0.2472	0.5431	0.5454
	0.4191	**0.1923**	0.1999	**0.2559**	**0.1416**
2% Fluid Milk	0.3991	-1.3615	0.1709	0.2276	0.5639
	0.0514	**0.1111**	**0.0534**	**0.0555**	**0.0584**
Butter	0.1655	0.4279	-1.0782	0.1606	0.3243
	0.1338	**0.1334**	0.2607	0.1502	**0.1208**
Cheddar Cheese	0.3164	0.4958	0.1397	-1.6678	0.7160
	0.1491	**0.1209**	0.1307	**0.2690**	**0.1050**
Other Cheese	0.1182	0.4571	0.1050	0.2664	-0.9467
	0.0307	**0.0473**	**0.0391**	**0.0391**	0.0682

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[34]

Table 5.39: Total Marshallian Elasticities With Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.8639	1.2947	0.1675	0.4568	0.3311	2.7870
2% Fluid Milk	0.3974	-1.4391	0.1392	0.1970	0.5015	2.0793
Butter	0.1648	0.3537	-1.1086	0.1315	0.2661	2.0597
Cheddar Cheese	0.3095	0.3999	0.1006	-1.7069	0.6304	2.1874
Other Cheese	0.1036	0.3341	0.0551	0.2147	-1.0665	2.3471

Table 5.40: Total Hicksian Elasticities With Demographic Variables: Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.8598	1.3038	0.2271	0.7580	0.3311
2% Fluid Milk	0.4004	-1.4322	0.1836	0.4217	0.5015
Butter	0.1678	0.3604	-1.0646	0.3541	0.2661
Cheddar Cheese	0.3126	0.4071	0.1474	-1.4705	0.6304
Other Cheese	0.1070	0.3418	0.1052	0.4684	-1.0665

[34] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

There were differences in the second-stage cross-price elasticities between Ontario and Quebec. In the case of Quebec those second-stage cross-price elasticities that were statistically significant were substitutes for both the Second-stage Marshallian and Hicksian cross-price elasticities. However, Quebec had a number of cross-price elasticities that were not statistically significant and these relationships were consistent between the models with and without demographic variables and for both the Second-stage Marshallian and Hicksian. For Quebec the cross-price elasticities that were not statistically significant were Butter and 1 percent Fluid Milk, Other Cheeses and 1 Percent Fluid Milk, Cheddar Cheese and Butter and Other Cheeses and Butter (Tables 5.27, 5.28, 5.37 and 5.38). The second-stage cross-price elasticities were statistically significant and net substitutes.

Ontario also has a more complex set of second-stage cross-price relationships. It was also different from Quebec in the sense that the statistically significant second-stage cross-price elasticities were different in the model without demographic variables compared to the model with demographic variables. In the model without demographic variables the statistically insignificant Second-stage Marshallian cross-price elasticities were for Butter and 1 Percent fluid Milk and Cheddar Cheese. However, in the case of the Second-stage Hicksian cross-price elasticities all of the cross-price elasticities were net substitutes. Meanwhile, in the model with demographic variables the statistically insignificant Second-stage Marshallian cross-price elasticities were Butter and 1 Percent Fluid Milk, Cheddar Cheese and Butter and Other Cheeses and Butter, while for the Second-stage Hicksian cross-price elasticities the only one that was statistically insignificant was the Butter and 1 Percent Fluid Milk. All other Second-stage Marshallian and Hicksian cross-price elasticities in the two models were positive statistically significant.

Table 5.41: First Stage Coefficients Without Demographic Variables: Ontario

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0674	0.0138	-0.0008	-0.0012	-0.0119	0.0004
	0.0343	**0.0006**	**0.0003**	0.0011	**0.0016**	0.0067
Other Dairy	0.0058	-0.0008	0.0080	-0.0016	-0.0056	0.0081
	0.0230	**0.0003**	**0.0003**	**0.0008**	**0.0011**	0.0045
Other Food	0.4592	-0.0012	-0.0016	0.1298	-0.1270	-0.0169
	0.1424	0.0011	**0.0008**	**0.0060**	**0.0072**	0.0282
Non-Food	0.4677	-0.0119	-0.0056	-0.1270	0.1445	0.0083
	0.1880	**0.0016**	**0.0011**	**0.0072**	0.0091	0.0372

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.42: First Stage Marshallian Elasticities Without Demographic Variables: Ontario

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.1337	-0.0488	-0.0774	-0.7667	1.0266
	0.0395	**0.0190**	0.1403	**0.2416**	**0.4221**
Other Dairy	-0.0892	-0.2175	-0.2971	-1.2006	1.8045
	0.0302	**0.0333**	0.1498	**0.2545**	**0.4450**
Other Food	-0.0053	-0.0087	-0.2111	-0.6745	0.8996
	0.0088	0.0060	**0.0627**	**0.0953**	**0.1679**
Non-Food	-0.0149	-0.0070	-0.1594	-0.8290	1.0103
	0.0026	**0.0018**	**0.0164**	**0.0264**	**0.0462**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[35]

[35] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.43: First Stage Hicksian Elasticities Without Demographic Variables: Ontario

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.1174 **0.0353**	-0.0384 **0.0157**	0.0953 0.0704	0.0605 0.1015
Other Dairy	-0.0605 **0.0247**	-0.1992 **0.0311**	0.0063 0.0762	0.2534 **0.1074**
Other Food	0.0090 0.0067	0.0004 0.0046	-0.0598 **0.0359**	0.0504 0.0427
Non-Food	0.0012 0.0020	0.0032 **0.0014**	0.0105 0.0089	-0.0149 **0.0113**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[36]

Table 5.44: Second Stage Coefficients Without Demographic Variables: Ontario

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.3856 **0.0880**	-0.1847 **0.0269**	0.0883 **0.0119**	-0.0009 0.0156	0.0612 **0.0165**	0.0362 **0.0103**	0.0294 **0.0070**
2% Fluid Milk	0.6267 **0.1116**	0.0883 **0.0119**	-0.1492 0.0284	-0.0151 0.0119	0.0464 **0.0145**	0.0296 **0.0149**	-0.0451 **0.0109**
Butter	0.2769 **0.0593**	-0.0009 0.0156	-0.0151 0.0119	-0.0184 0.0284	0.0246 0.0163	0.0098 0.0101	-0.0226 **0.0068**
Cheddar Cheese	0.1837 **0.0721**	0.0612 **0.0165**	0.0464 **0.0145**	0.0246 0.0163	-0.1514 **0.0315**	0.0192 0.0130	0.0228 **0.0075**
Other Cheese	0.2983 **0.0879**	0.0362 **0.0103**	0.0296 **0.0149**	0.0098 0.0101	0.0192 0.0130	-0.0948 **0.0229**	0.0155 0.0092

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[36] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.45: Second Stage Marshallian Elasticities Without Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.7555 **0.2540**	0.7288 **0.1005**	-0.0383 0.1456	0.5347 **0.1545**	0.2553 **0.0932**	1.2749 **0.0654**
2% Fluid Milk	0.2661 **0.0344**	-1.3811 **0.0755**	-0.0294 0.0346	0.1499 **0.0421**	0.1236 **0.0439**	0.8710 **0.0312**
Butter	0.0138 0.1438	-0.0675 0.1024	-1.1488 0.2685	0.2581 0.1523	0.1554 0.0935	0.7891 **0.0638**
Cheddar Cheese	0.4384 **0.1225**	0.2868 **0.1013**	0.1655 0.1213	-2.1527 **0.2378**	0.0919 0.0956	1.1700 **0.0559**
Other Cheese	0.1144 **0.0342**	0.0801 0.0476	0.0270 0.0335	0.0567 0.0435	-1.3295 **0.0777**	1.0514 **0.0303**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[37]

Table 5.46: Second Stage Hicksian Elasticities Without Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.6190 **0.2514**	1.1750 **0.1111**	0.0983 0.1459	0.7055 **0.1541**	0.6403 **0.0961**
2% Fluid Milk	0.3593 **0.0340**	-1.0763 0.0764	0.0638 0.0341	0.2665 **0.0414**	0.3866 **0.0426**
Butter	0.0982 0.1458	0.2086 0.1116	-1.0643 0.2656	0.3638 **0.1520**	0.3937 **0.0940**
Cheddar Cheese	0.5636 **0.1231**	0.6962 **0.1081**	0.2908 **0.1215**	-1.9959 **0.2350**	0.4452 **0.0970**
Other Cheese	0.2269 **0.0341**	0.4480 **0.0494**	0.1396 **0.0333**	0.1975 **0.0430**	-1.0120 0.0759

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[38]

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[37] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

[38] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.47: Total Marshallian Elasticities Without Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.6417	0.9807	0.0314	0.6652	0.5190	1.3089
2% Fluid Milk	0.3871	-1.1125	0.0449	0.2887	0.4043	0.8942
Butter	0.1362	0.2045	-1.0735	0.3986	0.4396	0.8101
Cheddar Cheese	0.5540	0.5431	0.2364	-2.0200	0.3601	1.2011
Other Cheese	0.2322	0.3412	0.0993	0.1918	-1.0564	1.0794

Table 5.48: Total Hicksian Elasticities Without Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.6394	0.9854	0.0549	0.8064	0.5190
2% Fluid Milk	0.3886	-1.1093	0.0610	0.3852	0.4043
Butter	0.1376	0.2074	-1.0589	0.4860	0.4396
Cheddar Cheese	0.5561	0.5473	0.2580	-1.8904	0.3601
Other Cheese	0.2340	0.3451	0.1187	0.3083	-1.0564

Table 5.49: First Stage Price and Expenditure Coefficients With Demographic Variables: Ontario

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0679 **0.0341**	0.0139 **0.0005**	-0.0008 **0.0002**	-0.0014 0.0011	-0.0118 **0.0016**	0.0003 0.0066
Other Dairy	0.0061 0.0225	-0.0008 **0.0002**	0.0080 **0.0003**	-0.0017 **0.0008**	-0.0055 **0.0011**	0.0082 0.0044
Other Food	0.4681 **0.1410**	-0.0014 0.0011	-0.0017 **0.0008**	0.1289 **0.0060**	-0.1258 **0.0071**	-0.0205 0.0280
Non-Food	0.4579 **0.1855**	-0.0118 **0.0016**	-0.0055 **0.0011**	-0.1258 **0.0071**	0.1431 **0.0090**	0.0119 0.0368

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.50: First Stage Demographic Coefficients: Ontario

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	0.0002 0.0005	0.0004 0.0006	-0.0002 0.0006	0.0001 0.0004	-0.0004 0.0003	-0.0004 0.0002	0.0000 0.0000	0.0000 0.0001
Other Dairy	-0.0003 0.0003	-0.0003 0.0003	0.0000 0.0004	0.0005 0.0003	-0.0001 0.0002	-0.0001 0.0002	0.0000 0.0000	-0.0001 0.0001
Other Food	-0.0003 0.0022	0.0023 0.0022	0.0023 0.0024	0.0012 0.0017	-0.0019 0.0011	0.0009 0.0012	0.0003 **0.0001**	-0.0007 0.0004
Non-Food	0.0004 0.0024	-0.0024 0.0025	-0.0021 0.0028	-0.0018 0.0019	0.0024 0.0013	-0.0004 0.0014	- 0.0003 **0.0001**	0.0008 0.0004

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.51: First Stage Marshallian Elasticities With Demographic Variables: Ontario

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.1262 **0.0386**	-0.0481 **0.0186**	-0.0883 0.1380	-0.7577 **0.2384**	1.0203 **0.4160**
Other Dairy	-0.0882 **0.0294**	-0.2156 **0.0329**	-0.3083 **0.1458**	-1.1990 **0.2483**	1.8111 **0.4335**
Other Food	-0.0061 0.0087	-0.0091 0.0058	-0.2134 **0.0620**	-0.6497 **0.0950**	0.8783 **0.1666**
Non-Food	-0.0149 **0.0026**	-0.0070 **0.0017**	-0.1586 **0.0162**	-0.8343 **0.0262**	1.0148 **0.0456**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[39]

[39] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.52: First Stage Hicksian Elasticities With Demographic Variables: Ontario

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.1100 **0.0344**	-0.0377 **0.0154**	0.0833 0.0692	0.0644 0.0996
Other Dairy	-0.0594 **0.0242**	-0.1973 **0.0308**	-0.0037 0.0742	0.2603 **0.1044**
Other Food	0.0079 0.0066	-0.0002 0.0045	-0.0657 **0.0355**	0.0580 0.0422
Non-Food	0.0013 0.0020	0.0033 **0.0013**	0.0121 0.0088	-0.0167 **0.0111**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[40]

Table 5.53: Second Stage Price and Expenditure Coefficients With Demographic Variables: Ontario

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.3630 **0.0960**	-0.1716 **0.0277**	0.0811 **0.0122**	0.0017 0.0158	0.0558 **0.0165**	0.0329 **0.0104**	0.0249 **0.0076**
2% Fluid Milk	0.7694 **0.1388**	0.0811 **0.0122**	-0.1351 **0.0272**	-0.0126 0.0123	0.0351 **0.0148**	0.0314 **0.0148**	-0.0526 **0.0123**
Butter	0.0314 0.0694	0.0017 0.0158	-0.0126 0.0123	-0.0311 0.0294	0.0319 0.0163	0.0101 0.0103	-0.0047 0.0072
Cheddar Cheese	0.0839 0.0899	0.0558 **0.0165**	0.0351 **0.0148**	0.0319 0.0163	-0.1398 **0.0324**	0.0170 0.0131	0.0245 **0.0087**
Other Cheese	0.4784 **0.1122**	0.0329 **0.0104**	0.0314 **0.0148**	0.0101 0.0103	0.0170 0.0131	-0.0914 **0.0225**	0.0079 0.0104

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[40] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.54: Second Stage Demographic Coefficients: Ontario

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	0.0202 0.0138	-0.0045 0.0133	0.0081 0.0143	-0.0080 0.0105	-0.0035 0.0075	-0.0113 0.0073	-0.0005 0.0004	0.0047 **0.0023**
2% Fluid Milk	0.0022 0.0226	0.0138 0.0233	-0.0216 0.0233	-0.0164 0.0177	0.0351 **0.0130**	0.0486 **0.0117**	0.0007 0.0007	-0.0094 **0.0038**
Butter	-0.0202 0.0127	-0.0054 0.0130	-0.0026 0.0135	0.0031 0.0099	-0.0119 0.0062	0.0026 0.0062	0.0023 **0.0004**	-0.0013 0.0022
Cheddar Cheese	0.0147 0.0145	-0.0077 0.0149	-0.0114 0.0146	-0.0391 **0.0108**	-0.0242 **0.0076**	-0.0172 **0.0077**	0.0000 0.0005	0.0060 **0.0025**
Other Cheese	-0.0169 0.0189	0.0038 0.0197	0.0275 0.0200	0.0603 **0.0156**	0.0045 0.0111	-0.0227 **0.0102**	-0.0025 **0.0006**	0.0000 0.0033

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table 5.55: Second Stage Marshallian Elasticities With Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.6280 **0.2615**	0.6765 **0.1037**	-0.0090 0.1476	0.4904 **0.1550**	0.2370 **0.0938**	1.2330 **0.0714**
2% Fluid Milk	0.2479 **0.0353**	-1.3334 **0.0774**	-0.0198 0.0355	0.1205 **0.0431**	0.1351 **0.0434**	0.8497 **0.0351**
Butter	0.0207 0.1458	-0.1018 0.1070	-1.2856 0.2779	0.3034 **0.1519**	0.1075 0.0948	0.9559 **0.0670**
Cheddar Cheese	0.3971 **0.1226**	0.1982 0.1042	0.2182 0.1211	-2.0680 **0.2454**	0.0716 0.0957	1.1828 **0.0647**
Other Cheese	0.1061 **0.0347**	0.0948 **0.0479**	0.0306 0.0342	0.0528 0.0441	-1.3105 **0.0760**	1.0262 **0.0345**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[41]

[41] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table 5.56: Second Stage Hicksian Elasticities With Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.4960	1.1080	0.1230	0.6556	0.6094
	0.2588	**0.1139**	0.1479	**0.1545**	**0.0974**
2% Fluid Milk	0.3389	-1.0361	0.0712	0.2343	0.3917
	0.0348	0.0777	**0.0351**	**0.0423**	**0.0422**
Butter	0.1230	0.2327	-1.1832	0.4314	0.3962
	0.1478	**0.1148**	0.2749	**0.1519**	**0.0958**
Cheddar Cheese	0.5237	0.6121	0.3449	-1.9096	0.4288
	0.1234	**0.1106**	**0.1214**	**0.2420**	**0.0979**
Other Cheese	0.2160	0.4539	0.1405	0.1902	-1.0006
	0.0345	**0.0489**	**0.0340**	**0.0434**	0.0744

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[42]

Table 5.57: Total Marshallian Elasticities With Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.5161	0.9265	0.0773	0.6247	0.4989	1.2580
2% Fluid Milk	0.3661	-1.0687	0.0715	0.2623	0.4119	0.8669
Butter	0.1371	0.1588	-1.1956	0.4431	0.3801	0.9753
Cheddar Cheese	0.5099	0.4501	0.3052	-1.9327	0.3354	1.2068
Other Cheese	0.2214	0.3527	0.1196	0.1911	-1.0406	1.0470

Table 5.58: Total Hicksian Elasticities With Demographic Variables: Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.5139	0.9310	0.1000	0.7605	0.4989
2% Fluid Milk	0.3676	-1.0657	0.0872	0.3559	0.4119
Butter	0.1388	0.1623	-1.1781	0.5484	0.3801
Cheddar Cheese	0.5119	0.4544	0.3269	-1.8025	0.3354
Other Cheese	0.2232	0.3565	0.1385	0.3041	-1.0406

[42] If the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

The second-stage expenditure elasticities in all cases were positive. So, all dairy products are normal goods. However, there were differences in the magnitude of the second-stage expenditure elasticities in different regions of Canada. The second-stage expenditure elasticities of dairy products in Quebec are also positive and significant. While the expenditure elasticities of 2 Percent Fluid Milk and Butter are less than 1 those of 1 Percent Fluid Milk, Cheddar Cheese and Other Cheeses are greater than 1 (Tables 5.27, 5.37, 5.45 and 5.55).

Ontario's second-stage expenditure elasticities were all positive in both models. The second-stage expenditure elasticities of 2 Percent Fluid Milk and Butter were less than 1 while for 1 Percent Fluid Milk, Cheddar Cheese and Other Cheeses were greater than 1. While the income elasticities of 1 Percent and 2 Percent Fluid Milk and Other Cheese decreased with the inclusion of demographic variables those for Butter and Cheddar Cheese increase with the inclusion of demographic variables (Tables 5.45 and 5.55)

In Quebec the foreign-born status of the head of the household had a negative effect on the Dairy Group and a positive effect on Other Dairy (Table 5.22). At the second-stage it had a negative influence on the consumption of Butter and Cheddar Cheese (Table 5.36). In Ontario, it has no statistically significant result at the first-stage. However, foreign-born person had a negative effect on Cheddar Cheese and a positive effect on Other Cheese consumption in Ontario at the Second Stage (Table 5.50).

The number of youth and children within the household also influences the consumption of dairy products differently in the various regions of Canada. In the case of Quebec, the number of children within the household has no statistically significant influence at the first-stage, but has a negative influence on the budget share of 1 Percent Fluid Milk at the second-stage (Table 5.32 and 5.36). The number of youth has a negative effect on Other Dairy and Other Food and a positive effect on Non-food at the first-stage. At the second-stage, the number of youth had a positive effect on Cheddar Cheese consumption. In Ontario the number of youth and children within the household has no effect at the first-stage. At the second-stage the number of youth and children had a positive influence on the consumption 2 Percent Fluid Milk and a negative influence on the consumption of Cheddar Cheese. The number of children also had a negative effect on Other Cheese (Tables 5.50 and 5.54).

The age of the Canadian population has been thought to be a significant factor in the changing consumption patterns of dairy products in Canada. In Quebec age had a positive effect on Other Food and a negative effect on Non-food. The only significant second-stage effect was for Butter in Quebec (Table 5.32 and 5.36). In Ontario, the age had a positive effect on Other Food and a negative effect on Non-food. At the second-stage, age had a positive effect on Butter but a negative effect on Other Cheese (Table 5.50 and 5.54).

The final demographic variable considered in this study is the level of education of the person purchasing food within the household. In Quebec, had no effect at the first-stage and had a positive effect on Other Cheese and a negative effect on Butter (Table 5.32 and 5.36). In Ontario, education had no effect at the first-stage and a positive effect on 1 Percent Fluid Milk and Cheddar Cheese and a negative effect on 2 Percent Fluid Milk (Table 5.50 and 5.54).

SUMMARY

This chapter discussed the econometric results for Canada, Ontario and Quebec. The econometric results obtained from the standard SUR estimator used in demand system estimation revealed that the residuals were heteroskedastic. As the source of heteroskedasticity in the model was unknown, the Generalized Method of Moments estimator was used to re-estimate the demand systems.

The dairy products considered in this study are both gross and net substitutes of the other dairy products. This implies that consumers at the retail level view all of the dairy products as close substitutes.

The inclusion of geographic, seasonal and demographic variables in the model influenced the size of the own-price and cross-price elasticities. In the case of own-price elasticities, the addition of geographic, seasonal and demographic variables made them more elastic. The responses of the cross-price elasticities to the addition of geographic, seasonal and demographic variables were mixed. Geographic variables were statistically significant for most of the dairy products but the effect of seasonality on the consumption of dairy products was limited. The influence of demographic variables on the consumption of dairy products is complex with no single variable found to be significant in all cases.

There are differences in the preference of consumers for selected dairy products in Ontario and Quebec. This is revealed in the statistical differences in the coefficients and elasticities. For example, when the household was headed by a foreign born person in Ontario was statistically significant for 1 Percent Fluid Milk and Other Cheeses and significant for 2 Percent Fluid Milk, Butter and Cheddar Cheese in Quebec. Other demographic variables had similar results when compared across the different regions in Canada.

Having estimated the demand system for selected dairy products in Canada, the results can be used to inform policy decisions. In Chapter 6, two different policy scenarios are presented and discussed.

CHAPTER 6: MODEL TESTING AND POLICY SIMULATIONS

INTRODUCTION

The purpose of this chapter is to perform policy simulations to investigate how the demand for selected dairy products will respond to changes in their prices and the structure of the Canadian population in the future. To this end, the model's predictive power is evaluated through a validation process. This is followed by an investigation of the model's responses to small changes in prices and other economic variables. The final set of simulations examine the responses of the demand for dairy products due to specific changes in the demographic variables in Canada.

The validation and policy analysis used the unconditional elasticities as these represent the best estimate of the true responses to changes in the variables. However, as seen in Chapter 5 the difference between the conditional and unconditional elasticities were small and as a result the difference in the results of the scenarios using the unconditional and conditional elasticities was less than the rounding error. This can be seen by comparing the results presented in Chapter 6 using unconditional elasticities and Appendix 5

BASELINE VALIDATION OF THE MODEL

The verification process is required to see if the model can accurately reproduce the means of the variables in the dataset. If the model is unable to reproduce the means, its reliability would be questionable. Also if the model cannot reproduce the expected outcomes at the mean value of the data set, then the results of the various scenarios, which are movements away from the optimum, would also be questionable.

Table 6.1: Dataset Means

Model	Prices					Expenditure	Foreign Born	Number of Children	Number of Teens	Age	Education
	1%	2%	Butter	Cheddar Cheese	Other Cheeses						
Canada	1.06	1.06	5.87	10.35	9.61	10.30	0.19	0.36	0.57	47.36	12.98
Atlantic Canada	1.26	1.27	5.52	9.95	9.26	10.00	0.08	0.35	0.61	47.31	12.78
Quebec	1.00	1.01	5.82	10.11	9.97	10.83	0.08	0.36	0.48	47.47	12.61
Ontario	1.03	0.99	6.25	10.48	9.59	10.78	0.30	0.36	0.58	47.49	13.13
Prairies	0.97	0.98	5.59	10.49	9.53	9.85	0.19	0.36	0.60	47.10	13.05
British Columbia	1.01	1.06	6.33	10.90	9.91	9.94	0.31	0.34	0.52	47.49	13.47

Table 6.2: Baseline Comparisons with Sample Means: Canada

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.1376	0.1378	0.0002	0.1688
2% Fluid Milk	0.3991	0.4010	0.0019	0.4717
Butter	0.0823	0.0828	0.0005	0.5504
Cheddar Cheese	0.1212	0.1192	-0.0019	-1.5917
Other Cheeses	0.2598	0.2592	-0.0006	-0.2473

Table 6.3: Baseline Comparisons with Sample Means: Atlantic Canada

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.1326	0.1326	0.0001	0.0413
2% Fluid Milk	0.4488	0.4514	0.0026	0.5761
Butter	0.0649	0.0646	-0.0003	-0.3991
Cheddar Cheese	0.1067	0.1058	-0.0009	-0.8720
Other Cheeses	0.2471	0.2456	-0.0015	-0.5903

Table 6.4: Baseline Comparisons with Sample Means: Quebec

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.0820	0.0867	0.0047	5.6975
2% Fluid Milk	0.3629	0.3407	-0.0222	-6.1168
Butter	0.1089	0.1126	0.0036	3.3452
Cheddar Cheese	0.1237	0.1248	0.0011	0.9069
Other Cheeses	0.3225	0.3353	0.0128	3.9551

Table 6.5: Baseline Comparisons with Sample Means: Ontario

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.1208	0.1200	-0.0008	-0.6860
2% Fluid Milk	0.4136	0.4160	0.0025	0.6013
Butter	0.0905	0.0904	-0.0002	-0.1753
Cheddar Cheese	0.1166	0.1144	-0.0021	-1.8384
Other Cheeses	0.2586	0.2592	0.0006	0.2473

Table 6.6: Baseline Comparisons with Sample Means: Prairies

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.1922	0.1948	0.0026	1.3405
2% Fluid Milk	0.3808	0.3921	0.0113	2.9730
Butter	0.0626	0.0638	0.0012	1.9689
Cheddar Cheese	0.1248	0.1185	-0.0063	-5.0533
Other Cheeses	0.2396	0.2308	-0.0088	-3.6811

Table 6.7: Baseline Comparisons with Sample Means: British Columbia

	Actual Budget Shares	Calculated Budget Shares	Error	Percentage Error
1% Fluid Milk	0.1582	0.1575	-0.0007	-0.4484
2% Fluid Milk	0.3602	0.3553	-0.0050	-1.3755
Butter	0.0975	0.0991	0.0016	1.6520
Cheddar Cheese	0.1477	0.1457	-0.0020	-1.3867
Other Cheeses	0.2363	0.2424	0.0061	2.5789

In order to verify the models, the mean values of all the exogenous variables (Table 6.1) are entered into each model. Then the calculated budget shares are compared to the actual budget shares. The results of the verification tests are summarized in Tables 6.2 to 6.7.

In the case of reproducing the actual data, the model tends to over predict the actual average weekly quantities consumed for the five dairy products. However, the predicted values produced in most cases are small in terms of both absolute error and percentage error. In the case of Canada the largest percentage error was for Cheddar at 1.59 percent below the observed mean value. The smallest percentage error was for 1 Percent Fluid Milk.

The five regions produced mixed results in their ability to predict the sample means. Atlantic Canada reproduced the actual result within plus or minus 1 percent. The largest percentage error for Atlantic Canada was for Cheddar Cheese at -0.87 percent. The smallest percentage error was for 1 Percent Fluid Milk at 0.04 percent. The model had relatively poorer results in predicting the actual means for Quebec. In this case the largest percentage error was for 2 Percent Fluid Milk at -6.12 percent. The smallest percentage error was for Cheddar Cheese at 0.91 percent.

The results for Ontario were similar to those for Canada in the general range of percentage errors. The largest percentage error in the case of Ontario was -1.84 percent for Cheddar Cheese. Meanwhile, the smallest percentage error was -0.18 percent for Butter. In the case of the Prairies the largest percentage error was -5.05 percent for Cheddar Cheese and the smallest was 1.34 percent for 1 Percent Fluid Milk. The model was better at reproducing the mean results for British Columbia than for the Prairies. In the case of British Columbia the largest percentage error was 2.58 percent for Other Cheeses and the smallest was -0.45 percent for 1 Percent Fluid Milk.

MODEL SENSITIVITY ANALYSIS

It is also necessary to understand how changes in both prices and demographic variables will affect the budget shares and demands for dairy products. We can compare the results of the various scenarios with the baseline results calculated above. We will discuss the results of four different scenarios. The four scenarios discuss the effects of shocking individual variables or a group of variables. The results of all four scenarios are summarized in Tables 6.8 to 6.13 below.

These results help us to understand how both budget shares and demands change when we change prices and demographic variables. However, the model only produces budget shares and therefore we need to understand the relationship between a change in budget share and the change in demand. In order to understand this relationship we need to take the total derivative of the budget share and solve for the change in demand. The result is as follows:

$$dw_i = \frac{\delta w_i}{\delta q_i} dq_i + \frac{\delta w_i}{\delta P_i} dP_i + \frac{\delta w_i}{\delta x} dx$$

$$r_{w_i} w_i = \frac{P_i}{x} r_{q_i} q_i + \frac{q_i}{x} r_{P_i} P_i - \frac{q_i P_i}{x^2} r_x x$$

$$r_{w_i} w_i = (r_{q_i} + r_{P_i} - r_x) w_i$$

$$r_{q_i} = r_{w_i} - r_{P_i} + r_x$$

where

r_{q_i} is the percentage change in quantity demanded
r_{w_i} is the percentage change in budget share
r_{P_i} is the percentage change in price
r_x is the percentage change in total expenditure

Since in the following scenarios, total expenditure is held constant r_x is zero. Specifically for r_{q_i} to be positive $r_{w_i} > r_{P_i}$ and the reverse is true if r_{q_i} is negative. Therefore, the change in the quantity demanded can be determined by knowing the change in price and the change in budget share.

In the first scenario we increase all dairy prices by 1 percent. The relatively small increase in the prices of all dairy products tested tells us how even small changes in the prices of all dairy products will influence the consumption of all dairy products. The second thing such a small change in prices tells us is the net elasticities of all dairy products when prices increase together. The third thing this small increase will tell us is the effect of dairy prices increasing at a rate greater than inflation, consumer price index, and therefore greater than all other goods and income or total expenditure (CDC, various; CRFA, various).

The results for Scenario 1 shows that in the case of Canada, we see increases in the budget share of 1 Percent and 2 Percent Fluid Milk but decreases in the budget share of Butter, Cheddar Cheeses and Other Cheeses. These net changes in budget share were all less than 1 percent and therefore the net effect was inelastic in all cases. The largest of these effects was the 0.6390 percent decline in the budget share of Cheddar Cheese. The smallest effect was the 0.2673 percent increase in the budget share of 1 Percent Fluid Milk. This means that changes in the real price of dairy products does have significant effects to the distribution of the budget shares in the case of Canada (Table 6.8).

In terms of consumption, an increase in the budget share with an increase in price does not necessarily mean an increase in quantity consumed. In order for consumption to increase the percentage increase in budget share must be greater than the percentage increase in the price of the dairy product. Therefore, in the case of Canada a uniform percentage increase in the price of dairy products that is greater than the rate of inflation will result in a decrease in the consumption of all dairy products. However, this decrease is not uniform. The decrease was less for 1 Percent and 2 Percent Fluid Milk as expected and was the greatest for Cheddar Cheese (Table 6.8).

In Atlantic Canada, the only the budget share that increased with the increase in the price of all dairy products was 2 Percent Fluid Milk. For all other dairy products the budget share declined. The smallest percentage change in budget share was for 1 Percent Fluid Milk while the largest was for Cheddar Cheese. However, all dairy saw declines in the quantity consumed as all the percentage change in budget share was less than 1 percent. The smallest percentage decline in consumption was for 2 Percent Fluid Milk while the largest decline was for Cheddar Cheese (Table 6.9).

Quebec, the Prairies and British Columbia had similar patterns of change in budget share with 1 Percent and 2 Percent Fluid Milk increasing in budget share while Butter, Cheddar Cheese and Other Cheeses decreased. The smallest percentage change was Butter in Quebec, the Prairies and British Columbia. The largest percentage change was Cheddar Cheese in all three regions. Even though the patterns were generally similar there were differences in magnitude. For example, even though Cheddar Cheese had the largest percentage change in all three regions, the percentage change ranged from -0.3177 percent in Quebec to -1.0080 percent in the Prairies. Again, in all cases the quantity consumed decreased as the percentage change in budget share was less than the percentage change in price (Tables 6.10, 6.12 and 6.13).

The pattern of the percentage change in budget shares in Ontario was different as only 1 Percent Fluid Milk experienced a reduction in its budget share while the budget shares for other dairy products increased. While in every other region and in Canada as a whole the increase in all prices caused declines in budget shares and quantity consumed for Butter, Cheddar Cheese and Other Cheeses, in Ontario they led to increased budget share. However, quantity consumed declined as the percentage increase in budget share was less than the percentage increase in price (Table 6.11). This is reasonable given the nature of substitution among the dairy products considered in this study. The positive cross-price effects and elasticities discussed in Chapter 5 play a key role in the net effect when all prices are increased. Another finding of this scenario is that price increases greater than the increase in general inflation, income or total expenditure, have a distributional effect on the consumption of dairy products in this study. What we see is that the budget shares of 1 Percent and 2 Percent Fluid Milk increase while the budget shares of Butter, Cheddar Cheese and Other Cheeses decline. The overall effect on the quantity consumed in this scenarios is negative for each dairy product. This suggests that if the price of dairy products increases faster than the rate of inflation, income or total expenditure the quantities of dairy products will continue to decline.

In the Second Scenario we examine the effect of a 1 percent increase in the mean number of households headed by a person not born in Canada. This attempts to explore the effect of Canada's increasing ethnic diversity on the demand for selected dairy products. In this scenario the change in the budget share is a direct effect of a change in the quantity consumed because both price and total expenditure are held constant. The results show that the net change in the consumption of dairy products is mixed. In the case of Canada, we see increases in the consumption of 2 Percent Fluid Milk, Butter and Other Cheeses while there are decreases in the consumption of 1 Percent Fluid Milk and Cheddar Cheese with the increase in the percentage of household headed by foreign-born persons. These changes, however, are very small.

In Atlantic Canada there were increases in the consumption of 2 Percent Fluid Milk, and Butter while there were decreases in 1 Percent Fluid Milk, Cheddar Cheese and Other

Cheeses. However, these changes are still very small. It seems that changes in the ethnic makeup of Canada is likely to have only a small effect on the consumption of dairy products in Atlantic Canada (Table 6.9).

The change in the number of households headed by foreign-born persons in Quebec saw increases in consumption for 2 Percent Fluid Milk and Other Cheeses and decreases in 1 Percent Fluid Milk, Butter and Cheddar Cheese. The magnitude of the percentage change was quite small in all cases. The largest percentage change was only 0.0375 percent for a 1 percent increase in households headed by foreign-born persons. This is also quite small compared with Ontario, the Prairies and British Columbia. Therefore, Atlantic Canada and Quebec's consumption of dairy products will be little affected by the changes in ethnic diversity as much as the other regions (Table 6.10).

The change in the number of household headed by foreign-born persons had its largest impact in Ontario. Ontario saw declines in the consumption of 1 Percent and 2 Percent Fluid Milk and Cheddar Cheese and increases in Butter and Other Cheeses. Also, Ontario's changes in consumption had the largest magnitudes in this scenario with –0.0705 percent for 1 Percent Fluid Milk and 0.0616 percent for Other Cheeses. Therefore, Ontario will see the greatest change in the consumption of dairy products due to changes in ethnic diversity, this in the province with the highest number of new immigrants to Canada, making these changes important to policy makers and the industry (Table 6.11).

The Prairies and British Columbia had similar results in general. These regions saw consumption increase for 2 Percent Fluid Milk, Butter and Other Cheeses with the increase in the percentage of households headed by foreign-born persons while consumption of 1 Percent Fluid Milk and Cheddar Cheese decreased. The difference in the two regions was the magnitude of the change in consumption. In most cases the percentage change in British Columbia was larger in magnitude than in the Prairies. The exception to this is Cheddar Cheese where the Prairies had a larger percentage change (Tables 6.12 and 6.13).

The effect of changes in the ethnic mix of Canada is likely to have some effect on the consumption of dairy products in Canada. However, this effect is different in the different regions of the country with Ontario having the largest effect and Atlantic Canada and Quebec the smallest.

In the third scenario we reduce the average number of children within the household by 1 percent to investigate the effects of the reduction in birth rate in Canada on the consumption of dairy products. The decline in the number of children within the household had both positive and negative effects on the consumption of various dairy products. In the case of Canada we saw a decline in the consumption of 1 Percent and 2 Percent Fluid Milks and increases in Butter, Cheddar Cheese and Other Cheeses. The largest percentage change was in Cheddar Cheese at 0.1519 percent with a 1 percent decrease in the number of children per household while the smallest was -0.0157 percent for 1 Percent Fluid Milk. The percentage changes in consumption caused by the changes in the average number of children per household are generally less than the changes caused by price increase but greater than the changes caused by the head of the household being foreign-born (Table 6.8).

In Atlantic Canada the decrease in the average number of children per household increases the consumption of 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses and only a decrease in the consumption of 2 Percent Fluid Milk. The largest percentage change is 0.0914 percent for Cheddar Cheese and the smallest is 0.0201 percent for Butter (Table 6.9).

In the case of Quebec, there is very little effect on the consumption of dairy products from reducing the average number of children per household. Even with the small effect, 1 Percent Fluid Milk, Cheddar Cheese and Other Cheeses did see increases in their consumption while 2 Percent Fluid Milk and Butter decreased. However, the largest percentage change was in 1 Percent Fluid Milk with only a 0.0390 percent increase and the smallest was for Butter with a -0.0010 percent decrease. The number of children within a household has little effect on the average consumption of dairy products in Quebec (Table 6.10).

Ontario saw the decline in the average number of children within the household increase the consumption of 1 Percent Fluid Milk, Butter, Cheddar Cheese and Other Cheeses and decreases only in 2 Percent Fluid Milk. The variation in percentage change was greater in Ontario then in Atlantic Canada and Quebec with the largest being 0.1788 percent for Cheddar Cheese and the smallest at 0.0058 percent for 1 Percent Fluid Milk. Therefore, the change in the average number of children per household will have a wider range of effects for Ontario (Table 6.11).

Again the Prairies and British Columbia had similar patterns of change in the consumption of dairy products. A decrease in the average number of children per household increased the consumption of Butter, Cheddar Cheese and Other Cheeses and decreased the consumption of 1 Percent and 2 Percent Fluid Milk. However, again the magnitudes of the changes were different, with the Prairies having a larger percentage change for all dairy products than British Columbia. This means that the decline in the average number of children per household will have a greater effect on consumption than in British Columbia

Table 6.8: Model Sensitivity Results: Canada

Dairy Products	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.1378	0.1382	0.2673	0.1377	-0.0405	0.1378	-0.0157	0.1378	0.0330
2% Fluid Milk	0.4010	0.4024	0.3472	0.4010	0.0046	0.4006	-0.0960	0.4017	0.1815
Butter	0.0828	0.0826	-0.1999	0.0828	0.0287	0.0828	0.0507	0.0833	0.6717
Cheddar Cheese	0.1192	0.1185	-0.6390	0.1192	-0.0312	0.1194	0.1519	0.1188	-0.3583
Other Cheeses	0.2592	0.2584	-0.3214	0.2592	0.0196	0.2594	0.0708	0.2583	-0.3480

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

Table 6.9: Model Sensitivity Results: Atlantic Canada

Dairy Products	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.1326	0.1325	-0.0921	0.1326	-0.0066	0.1327	0.0238	0.1329	0.1657
2% Fluid Milk	0.4514	0.4521	0.1562	0.4514	0.0031	0.4512	-0.0449	0.4522	0.1788
Butter	0.0646	0.0645	-0.0988	0.0646	0.0340	0.0646	0.0201	0.0650	0.5825
Cheddar Cheese	0.1058	0.1055	-0.2486	0.1058	-0.0091	0.1059	0.0914	0.1055	-0.2987
Other Cheeses	0.2456	0.2453	-0.1043	0.2456	-0.0071	0.2457	0.0250	0.2445	-0.4426

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

Table 6.10: Model Sensitivity Results: Quebec

Dairy Product	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.0867	0.0868	0.2092	0.0867	-0.0058	0.0867	0.0390	0.0867	0.0558
2% Fluid Milk	0.3407	0.3417	0.2974	0.3407	0.0182	0.3405	-0.0335	0.3400	-0.1832
Butter	0.1126	0.1126	-0.0155	0.1125	-0.0220	0.1126	-0.0010	0.1133	0.6473
Cheddar Cheese	0.1248	0.1244	-0.3177	0.1248	-0.0375	0.1248	0.0104	0.1248	-0.0279
Other Cheeses	0.3353	0.3345	-0.2327	0.3353	0.0044	0.3354	0.0204	0.3352	-0.0352

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

Table 6.11: Model Sensitivity Results: Ontario

Dairy Product	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.1200	0.1189	-0.9505	0.1199	-0.0705	0.1200	0.0058	0.1199	-0.1148
2% Fluid Milk	0.4160	0.4163	0.0637	0.4160	-0.0173	0.4155	-0.1240	0.4166	0.1334
Butter	0.0904	0.0905	0.1212	0.0904	0.0398	0.0904	0.0515	0.0912	0.9451
Cheddar Cheese	0.1144	0.1149	0.4160	0.1144	-0.0342	0.1146	0.1788	0.1143	-0.0961
Other Cheeses	0.2592	0.2595	0.1120	0.2594	0.0616	0.2595	0.0994	0.2580	-0.4480

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

Table 6.12: Model Sensitivity Results: Prairies

Dairy Product	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.1948	0.1957	0.4733	0.1947	-0.0388	0.1946	-0.0779	0.1949	0.0679
2% Fluid Milk	0.3921	0.3940	0.4708	0.3921	0.0041	0.3914	-0.1704	0.3935	0.3586
Butter	0.0638	0.0637	-0.1308	0.0639	0.0475	0.0639	0.1427	0.0641	0.3638
Cheddar Cheese	0.1185	0.1173	-1.0080	0.1185	-0.0253	0.1188	0.2665	0.1177	-0.6854
Other Cheeses	0.2308	0.2293	-0.6456	0.2308	0.0255	0.2312	0.1789	0.2298	-0.4153

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

Table 6.13: Model Sensitivity Results; British Columbia

	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		Results	% Change	Results	% Change	Results	% Change	Results	% Change
1% Fluid Milk	0.1575	0.1581	0.3772	0.1573	-0.1250	0.1574	-0.0631	0.1576	0.0302
2% Fluid Milk	0.3553	0.3572	0.5425	0.3553	0.0143	0.3549	-0.1118	0.3563	0.3048
Butter	0.0991	0.0988	-0.3163	0.0992	0.0668	0.0991	0.0425	0.0999	0.7583
Cheddar Cheese	0.1457	0.1443	-0.9589	0.1457	-0.0036	0.1460	0.2390	0.1447	-0.6897
Other Cheeses	0.2424	0.2416	-0.3347	0.2425	0.0352	0.2425	0.0438	0.2416	-0.3619

Scenario 1: 1 percent increase in all dairy prices
Scenario 2: 1 percent increase in the mean number of households headed by foreign born person
Scenario 3: 1 percent decrease in the number of children
Scenario 4: 1 percent increase in the age of the head of the household

(Tables 6.12 and 6.13). Thus a decline in the average number of children per household will have a more mixed effect on the consumption of dairy products across Canada.

Scenario 4 looks at the increasing age of Canadians and its effect on the demand for dairy products. As the average age increases it is expected that the average age of the head of the household will also increase; therefore, this scenario will increase the age of the head of the household by 1 percent. The increase in the average age of the head of the household resulted in increased consumption of 1 Percent and 2 Percent Fluid Milks and Butter and declines in the consumption of Cheddar Cheese and Other Cheeses in the case of Canada. The largest percentage change in consumption was 0.6717 percent for Butter while the smallest was 0.0330 percent for 1 Percent Fluid Milk (Table 6.8).

One result in the preceding scenario runs counter to conventional thinking is for Other Cheeses which sees a decline in consumption with an increase in age. Speciality Cheeses, which are part of the Other Cheeses group, see increases in consumption attributed to increasing age of the population. There are three issues we need to consider in looking at these results. The first is that Other Cheeses is an aggregated good made up of Speciality Cheeses and Processed Cheese. Thus Other Cheeses in the model may not act exactly like Speciality Cheeses because of the influence of Processed Cheese in the aggregate good. The second issue is that there are other demographic trends that have a positive influence on the consumption of Other Cheeses that are trending with the age of the population. These are the decline in the number of children in the household and the increasing ethnic diversity of the population and other trends not tested for in this study. The third is that, even if per capita consumption of a good declines, total consumption can still increase if the decline in per capita consumption is less than the increase in population.

Atlantic Canada, the Prairies and British Columbia had similar patterns to Canada in that 1 Percent and 2 Percent Fluid Milks and Butter saw increases in consumption from the increase in age while Cheddar Cheeses and Other Cheeses declined. However, the magnitudes of the changes were different in the three regions. Atlantic Canada's largest percentage change was 0.5825 percent for Butter and its smallest was 0.1657 percent for 1 Percent Fluid Milk. Meanwhile, the Prairies' largest percentage change was -0.6854 percent for Cheddar Cheese and its smallest was 0.0679 percent for 1 Percent Fluid Milk. British Columbia's largest percentage change was 0.7583 percent for Butter and its smallest was 0.0302 percent for 1 Percent Fluid Milk. Therefore, even if the general pattern was the same there were differences in magnitude (Tables 6.9, 6.12 and 6.13).

The increase in age caused an increase in consumption of 1 Percent Fluid Milk and Butter and decreases in consumption of 2 Percent Fluid Milk, Cheddar Cheese and Other Cheeses in Quebec. The largest percentage change in Quebec was 0.6473 percent for Butter and the smallest was –0.0352 percent for Other Cheeses (Table 6.10).

In Ontario, the increase in the average age of the head of the household caused consumption of 2 Percent Fluid Milk and Butter to increase and 1 Percent Fluid Milk, Cheddar Cheese and Other Cheeses to decrease. The largest percentage change was for Butter at 0.9451 percent and the smallest was for Cheddar Cheese at -0.0961 percent (Table 6.11).

Thus, an increase in average age will lead to an increase in the consumption of Butter in all regions. However, changes in the age of the population will affect the consumption of other dairy products differently.

Policy Scenario Results

Having tested the model above, we are now ready to use the model to evaluate various real life policy scenarios. The first step in evaluating these policy scenarios is to develop a baseline that is used to compare the scenario results. The model estimated and discussed in Chapter 5 is used to develop the baseline over time (1996-2006). The geographic variables were calculated by determining the distribution of the population and setting the geographic variable to the proportion of the population in each region. The demographic variables were calculated from the household characteristics information and used the same method in Chapter 4 to convert the data when needed. Seasonal variables were set at 25 percent for each quarter. Having established the baseline we tested various pricing policies in order to recommend future pricing policies to the industry.

The results above indicate that the model for Canada as a whole better fits the data set and better reproduces the mean of the data set than do the regional models. A second issue is the availability of data to calculate the demographic variables at the sub-national level. Therefore we will only use the Canadian model for the policy analysis in this chapter.

Baseline Scenario

In the baseline scenario we set the geographic, seasonal and demographic variables to the values calculated from various Statistics Canada databases collected from the Canadian Censuses of 1996, 2001 and 2006. The years in between these census years were calculated using linear extrapolation. The geographic variables are the proportion, percentage, of households in each region. Quarterly variables are set at 25 percent for each quarter. The Head of the Household Foreign Born is set at the percentage of households headed by foreign born persons. The remaining demographic variables measure the average number of youth and children within the households and the average age and education of the head of the household. Table 6.14 lists the baseline values for these geographic, seasonal and demographic variables. The baseline holds prices and total expenditure on the dairy products constant at their 1996 levels, and therefore the baseline will reflect changes in budget share and consumption resulting from changes in the structure and distribution of Canada's population.

The general trend of the baseline for 1 Percent Fluid Milk is relatively flat from 1996 to 2006 (Table 6.15). When we compare these results with Figure 2.2 which shows the actual consumption of 1 Percent Fluid Milk we see that the general trends in both cases for the same time period are similar. The trend for 2 Percent Fluid Milk is a decline from 1996 to 2001 and flat to 2006 (Table 6.15). The trend for Butter is a steady increase in consumption from 1996 to 2006 (Table 6.15). This is consistent with the trend in consumption of Butter since 1996 (Figure 2.5). Cheddar Cheese had a small increase from 1996 to 2001 then it was relatively flat between 2001 and 2006 (Table 6.15). This is consistent with the trend in the consumption of Cheddar Cheese in Figure 2.4. The consumption of Other Cheeses initially increased from 1996 to 2001 and then showed a small decline such that consumption in 2006 was higher than in 1996 (Table 6.15). The initial increase is consistent with the combined consumption of Speciality Cheeses and Processed Cheese but the small decline in consumption is not consistent with the actual trend (Figure 2.4).

Table 6.14: Average of Geographic, Seasonal and Demographic Variables in the Baseline Projections

Variable	1996[1]	1997	1998	1999	2000	2001[1]	2002	2003	2004	2005	2006[1]
Atlantic Canada	0.0804	0.0793	0.0782	0.0774	0.0765	0.0755	0.0746	0.0740	0.0733	0.0724	0.0714
Quebec	0.2447	0.2432	0.2419	0.2409	0.2397	0.2384	0.2373	0.2366	0.2359	0.2351	0.2343
Prairies	0.1664	0.1667	0.1676	0.1681	0.1681	0.1679	0.1679	0.1679	0.1680	0.1685	0.1696
British Columbia	0.1308	0.1320	0.1321	0.1319	0.1316	0.1315	0.1312	0.1312	0.1314	0.1318	0.1323
Second Quarter	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Third Quarter	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Fourth Quarter	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Head of Household Foreign Born	0.2176	0.2187	0.2197	0.2208	0.2218	0.2229	0.2270	0.2310	0.2351	0.2391	0.2432
Number of Youth	0.5016	0.4983	0.4958	0.4955	0.4956	0.4970	0.4968	0.4952	0.4939	0.4925	0.4912
Number of Children	0.7483	0.7379	0.7265	0.7129	0.7000	0.6883	0.6766	0.6641	0.6518	0.6386	0.6261
Age of the Head of the Household	46.8851	47.0944	47.3036	47.5129	47.7221	47.9314	48.7138	49.4962	50.2787	51.0611	51.8435
Education of the Head of the Household	13.2447	13.2799	13.3151	13.3503	13.3855	13.4207	13.4328	13.4449	13.4569	13.4690	13.4811

Statistics Canada, various

1. 1996, 2001 and 2006 are from actual Canadian Census data. The year in between are linear extrapolations of the census data.

Table 6.15: Baseline Results for 1996 to 2006

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1295	0.9400	0.1298	0.9421	0.1301	0.9443	0.1304	0.9464	0.1307	0.9484	0.1307	0.9484
2% Fluid Milk	0.3965	2.9353	0.3954	2.9268	0.3942	2.9181	0.3930	2.9093	0.3919	2.9012	0.3910	2.8940
Butter	0.0893	0.1163	0.0897	0.1168	0.0900	0.1172	0.0903	0.1177	0.0907	0.1181	0.0910	0.1185
Cheddar Cheese	0.1189	0.0880	0.1194	0.0883	0.1198	0.0886	0.1202	0.0889	0.1206	0.0892	0.1209	0.0894
Other Cheeses	0.2657	0.2173	0.2658	0.2173	0.2659	0.2174	0.2660	0.2175	0.2662	0.2176	0.2662	0.2177

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1309	0.9504	0.1310	0.9506	0.1310	0.9506	0.1310	0.9507	0.1310	0.9510
2% Fluid Milk	0.3912	2.8959	0.3913	2.8969	0.3915	2.8978	0.3915	2.8979	0.3915	2.8982
Butter	0.0921	0.1199	0.0931	0.1213	0.0942	0.1227	0.0953	0.1241	0.0964	0.1255
Cheddar Cheese	0.1206	0.0892	0.1203	0.0890	0.1200	0.0888	0.1198	0.0886	0.1196	0.0885
Other Cheeses	0.2652	0.2168	0.2642	0.2161	0.2633	0.2153	0.2624	0.2145	0.2614	0.2137

Table 6.16: Baseline Total Consumption 1996 to 2006

Dairy Products	1996	1997	1998	1999	2000	2001	2002
1% Fluid Milk	390,987,696	396,820,069	402,725,663	408,622,102	414,476,186	419,480,702	425,516,950
2% Fluid Milk	1,220,923,179	1,232,810,738	1,244,544,435	1,256,151,958	1,267,960,027	1,280,075,959	1,296,624,390
Butter	48,377,244	49,191,399	49,994,562	50,798,450	51,610,259	52,423,687	53,684,114
Cheddar Cheese	36,583,546	37,188,715	37,791,745	38,391,476	38,980,007	39,553,483	39,926,461
Other Cheeses	90,377,543	91,542,149	92,724,639	93,925,333	95,116,013	96,283,646	97,085,510

Dairy Products	2003	2004	2005	2006
1% Fluid Milk	430,777,266	435,931,049	441,112,254	446,402,777
2% Fluid Milk	1,312,716,526	1,328,814,723	1,344,550,967	1,360,386,738
Butter	54,974,593	56,279,038	57,597,869	58,919,866
Cheddar Cheese	40,319,386	40,710,566	41,120,285	41,524,105
Other Cheeses	97,908,777	98,721,417	99,532,404	100,324,133

We conclude that the baseline is consistent with the actual consumption of the dairy products in Canada. This allows us to use the baseline as a point of comparison when evaluating various policy scenarios. The baseline also shows that demographic changes are influencing the consumption of dairy products even while prices and total expenditure are held constant.

The baseline effects on total consumption of dairy products can be seen by multiplying the weekly consumption per household by the number of households and 52 weeks. The resulting total consumption for Canada can be seen in Table 6.16. The increase in the number of households in Canada causes the consumption of all dairy products to increase in the baseline projections even in those products that are seeing a decline in the consumption per household. This means that the decline in the per household consumption must be less than the increase in the number of households in Canada.

Having established the baseline trends from 1996 to 2006 we can now shock the model with changes in policy and non-policy demographic changes to measure the effects of such changes on the consumption of dairy products in Canada. The following scenarios will include dairy pricing and advertising policies and non-dairy policies on immigration and the non-policy effect of an increase in the birth rate.

Policy Scenario 1: Increased Immigration

Immigration, birth rate, and population structure such as average age and education can also influence the consumption of dairy products. This scenario investigates the impact of changes to immigration policy in Canada and how those changes will impact the consumption of dairy products. One possible immigration policy for this period was proposed in the 1993 Liberal Red Book (Liberal Party of Canada) which set an immigration target of 1 percent of the population of Canada. This policy target has never been achieved since 1993, even during Liberal governments. Therefore, this scenario will consider what the impact on the consumption of dairy products would have been if this policy had been achieved in 1996 and after.

The impact of an expanded immigration policy on the population and number of households can be seen in Table 6.17. The population of Canada in 1996 would increase by an additional 68,164 people; however, the cumulative effect of this policy sees the population of Canada in 2006 increase by 901,990 people. A similar effect has happened to the number of households in Canada. Canada sees the number of households increase by 22,721 in 1996 but again the cumulative effect is an increase in the number of households by 300,663 in 2006.

These changes in the immigration policy also influenced the percentage of households headed by foreign-born persons. In 1996 the number of households headed by foreign-born persons increased from 1,740,552 to 1,763,274. The increase in the number of households headed by foreign-born persons by 2006 was up from 2,195,299 to 2,495,962. The change in the number of households headed by foreign-born persons also changes the percentage of households headed by foreign-born persons. The result is that the percentage of households headed by foreign-born persons increases such that in 1996 this is 21.98 percent of the total and by 2006 this is 26.76 percent.

Table 6.17: Effects on Total Population, Number of Households and Households Headed by Foreign-Born Persons

Year	Actual Population	Actual Immigration	Liberal Policy	Additional Immigration	New Population	Additional Households	Actual Households	New Total Households	Actual % Foreign Head	Actual Foreign Head	New Foreign Head	New % Foreign Head
1996	29610757	224857	293021	68164	29678921	22721	7998862	8021583	0.2176	1740552	1763274	0.2198
1997	29907172	194459	296108	101649	30076984	33883	8100344	8156948	0.2187	1771221	1827825	0.2241
1998	30157082	173194	299072	125878	30452772	41959	8201823	8300386	0.2197	1802105	1900668	0.2290
1999	30403878	205710	301571	95861	30795429	31954	8303303	8433820	0.2208	1833203	1963720	0.2328
2000	30689035	252527	304039	51512	31132098	17171	8404782	8552470	0.2218	1864517	2012204	0.2353
2001	31021251	256405	306890	50485	31514799	16828	8506264	8670780	0.2229	1896046	2060562	0.2376
2002	31372587	199170	310213	111043	31977178	37014	8610355	8811885	0.2270	1954206	2155736	0.2446
2003	31676077	239083	313726	74643	32355311	24881	8714448	8940859	0.2310	2013212	2239623	0.2505
2004	31995199	244578	316761	72183	32746615	24061	8818539	9069011	0.2351	2073062	2323534	0.2562
2005	32312077	254374	319952	65578	33129071	21859	8922632	9194963	0.2391	2133758	2406090	0.2617
2006	32649482	238125	323121	84996	33551472	28332	9026723	9327386	0.2432	2195299	2495962	0.2676

Table 6.18: Change in Immigration Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1294	0.9395	0.1296	0.9409	0.1298	0.9423	0.1300	0.9438	0.1303	0.9454	0.1303	0.9454
2% Fluid Milk	0.3966	2.9355	0.3954	2.9272	0.3943	2.9187	0.3931	2.9102	0.3921	2.9022	0.3911	2.8950
Butter	0.0893	0.1163	0.0897	0.1169	0.0901	0.1174	0.0905	0.1178	0.0908	0.1183	0.0912	0.1188
Cheddar Cheese	0.1189	0.0879	0.1193	0.0882	0.1196	0.0885	0.1200	0.0887	0.1203	0.0890	0.1206	0.0892
Other Cheeses	0.2658	0.2173	0.2659	0.2174	0.2661	0.2176	0.2664	0.2178	0.2665	0.2179	0.2666	0.2180

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1305	0.9472	0.1304	0.9468	0.1304	0.9464	0.1303	0.9462	0.1303	0.9462
2% Fluid Milk	0.3914	2.8972	0.3915	2.8983	0.3917	2.8993	0.3917	2.8995	0.3918	2.9000
Butter	0.0923	0.1202	0.0934	0.1216	0.0945	0.1231	0.0956	0.1245	0.0967	0.1259
Cheddar Cheese	0.1202	0.0889	0.1199	0.0887	0.1196	0.0885	0.1194	0.0883	0.1191	0.0881
Other Cheeses	0.2657	0.2172	0.2648	0.2165	0.2639	0.2158	0.2630	0.2150	0.2621	0.2143

Changes to the immigrant structure of the population does have an impact on both per household consumption and the total consumption of dairy products. In the case of per household consumption, the consumption of 1 Percent Fluid Milk became relatively constant at 0.94 litres/household/week between 1996 and 2006 and slightly less than 0.5 percent below the baseline per household consumption level (Table 6.18). In the case of 2 Percent Fluid Milk, per household consumption dropped from 2.93 litres/household/week to 2.90 litres/household/week by 2000 and then remained relatively constant until 2006 (Table 6.18). The pattern of per household consumption of 2 Percent Fluid Milk was relatively similar to the baseline pattern but at a level of per household consumption about 0.1 percent above the baseline. Therefore, the increase in immigration has a slight negative effect on the per household consumption on 1 Percent Fluid Milk but a slight positive effect on the per household consumption of 2 Percent Fluid Milk.

The effect of increased immigration on the per household consumption of industrial dairy products was rather mixed. The per household consumption of Butter increased from 0.1163 kg/household/week in 1996 to 0.1259 kg/household/week in 2006 (Table 6.18) and this level of consumption is only slightly higher than the baseline at about 0.3 percent (Table 6.15 to Table 6.18). The per household consumption of Cheddar Cheese was relatively stable at about 0.09 kg/household/week (Table 6.18) which is about 0.5 percent below the baseline per household level of consumption. Finally, the per household consumption of Other Cheeses increased from 0.2173 kg/household/week in 1996 to 0.2180 kg/household/week in 2001 and then declined to 0.2143 kg/household/week by 2006 (Table 6.18). The weekly per household level of consumption of Other Cheeses was higher by about 0.3 percent with the increase in immigration than in the baseline scenario. This means that the increase in

Table 6.19: Change in Immigration Total Consumption Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	391,898,578	0.23	399,096,059	0.57	406,701,190	0.99	413,902,384	1.29	420,468,005	1.45	426,284,542	1.62
2% Fluid Milk	1,224,458,208	0.29	1,241,591,936	0.71	1,259,789,930	1.22	1,276,279,831	1.60	1,290,673,025	1.79	1,305,314,590	1.97
Butter	48,529,897	0.32	49,573,045	0.78	50,661,268	1.33	51,684,093	1.74	52,615,637	1.95	53,547,155	2.14
Cheddar	36,673,920	0.25	37,414,887	0.61	38,187,301	1.05	38,917,452	1.37	39,577,396	1.53	40,221,063	1.69
Other Cheeses	90,654,786	0.31	92,232,885	0.75	93,927,709	1.30	95,519,110	1.70	96,920,035	1.90	98,293,400	2.09

Dairy Products	2002		2003		2004		2005		2006	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	434,016,563	2.00	440,193,253	2.19	446,328,460	2.39	452,393,008	2.56	458,909,920	2.80
2% Fluid Milk	1,327,559,030	2.39	1,347,477,733	2.65	1,367,278,088	2.89	1,386,368,523	3.11	1,406,555,184	3.39
Butter	55,074,134	2.59	56,552,103	2.87	58,041,720	3.13	59,533,414	3.36	61,077,381	3.66
Cheddar	40,742,264	2.04	41,234,275	2.27	41,720,889	2.48	42,217,461	2.67	42,733,828	2.91
Other Cheeses	99,537,681	2.53	100,653,527	2.80	101,746,546	3.06	102,809,453	3.29	103,928,395	3.59

% Δ = Percentage Change from Baseline

immigration had a small negative effect on the per household consumption of Cheddar Cheese but a small positive effect on the per household consumption of Butter and Other Cheeses.

The effect of an increase in immigration in Canada on the total consumption of dairy products was due to the changes in per household consumption and the increase in the number of households. The net effect of these two factors was that the total consumption of all dairy products increased but the increase was not uniform across all dairy products. The increase in the consumption of fluid milk was relatively constant increases in consumption. The increase in the total consumption of 1 Percent Fluid Milk was from 392 million litres in 1996 to 459 million litres in 2006. This is an increase of 0.2 percent in 1996 to 3 percent in 2006 above the baseline projects (Table 6.16 to Table 6.19). While the percentage increase above the baseline for 2 Percent Fluid Milk is the same as 1 Percent Fluid Milk, the increase in total consumption increased from 1.2 billion litres in 1996 to 1.4 billion litres in 2006 (Table 6.16 to Table 6.19). Therefore, the net effect of the increase in immigration is that fluid milk consumption would increase by about 3 percent by 2006.

The total consumption of industrial milk products also increases at a relatively steady rate from 1996 to 2006. However, the increase in the total consumption of Butter, Cheddar Cheese and Other Cheeses is not uniform across all of them. Butter and Other Cheeses see their total consumption increase such that by 2006 they were 4 percent above the baseline projections (Table 6.16 to Table 6.19). Meanwhile, the total consumption of Cheddar Cheese increased such that by 2006 it was only 3 percent above the baseline projection (Table 6.16

Table 6.20: Change in Immigration Total Consumption Results with Number of Households Held at Baseline

Dairy Products	1996		1997		1998		1999		2000		2001	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	390,788,518	-0.05	396,326,580	-0.12	401,871,794	-0.21	407,497,066	-0.28	413,207,188	-0.31	418,196,383	-0.31
2% Fluid Milk	1,220,989,905	0.01	1,232,976,058	0.01	1,244,830,485	0.02	1,256,528,850	0.03	1,268,385,146	0.03	1,280,548,053	0.04
Butter	48,392,435	0.03	49,229,038	0.08	50,059,688	0.13	50,884,259	0.17	51,707,049	0.19	52,531,172	0.21
Cheddar	36,570,040	-0.04	37,155,251	-0.09	37,733,844	-0.15	38,315,187	-0.20	38,893,957	-0.22	39,457,924	-0.24
Other Cheeses	90,398,005	0.02	91,592,846	0.06	92,812,359	0.09	94,040,910	0.12	95,246,380	0.14	96,428,419	0.15

Dairy Products	2002		2003		2004		2005		2006	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	424,090,486	-0.34	429,046,150	-0.40	434,001,557	-0.44	438,994,277	-0.48	444,117,202	-0.51
2% Fluid Milk	1,297,197,393	0.04	1,313,355,284	0.05	1,329,515,976	0.05	1,345,307,814	0.06	1,361,215,623	0.06
Butter	53,814,574	0.24	55,120,023	0.26	56,438,697	0.28	57,770,185	0.30	59,108,584	0.32
Cheddar	39,810,477	-0.29	40,190,091	-0.32	40,568,622	-0.35	40,967,087	-0.37	41,356,326	-0.40
Other Cheeses	97,261,227	0.18	98,104,658	0.20	98,936,463	0.22	99,764,498	0.23	100,578,318	0.25

% Δ = Percentage Change from Baseline

Table 6.21: Change in Immigration Total Consumption Results with Percentage of Foreign Born Held at Baseline

Dairy Products	1996		1997		1998		1999		2000		2001	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	392,098,323	0.28	399,592,996	0.70	407,565,320	1.20	415,045,104	1.57	421,759,301	1.76	427,593,701	1.93
2% Fluid Milk	1,224,391,293	0.28	1,241,425,460	0.70	1,259,500,443	1.20	1,275,897,015	1.57	1,290,240,435	1.76	1,304,833,366	1.93
Butter	48,514,662	0.28	49,535,142	0.70	50,595,359	1.20	51,596,934	1.57	52,517,147	1.76	53,437,592	1.93
Cheddar	36,687,464	0.28	37,448,585	0.70	38,245,898	1.20	38,994,939	1.57	39,664,958	1.76	40,318,470	1.93
Other Cheeses	90,634,266	0.28	92,181,833	0.70	93,838,935	1.20	95,401,716	1.57	96,787,378	1.76	98,145,828	1.93

Dairy Products	2002		2003		2004		2005		2006	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	435,476,414	2.34	441,969,344	2.60	448,312,756	2.84	454,575,628	3.05	461,271,623	3.33
2% Fluid Milk	1,326,972,616	2.34	1,346,822,380	2.60	1,366,556,918	2.84	1,385,588,576	3.05	1,405,698,690	3.33
Butter	54,940,621	2.34	56,402,895	2.60	57,877,526	2.84	59,355,838	3.05	60,882,378	3.33
Cheddar	40,860,963	2.34	41,366,929	2.60	41,866,865	2.84	42,375,334	3.05	42,907,195	3.33
Other Cheeses	99,357,851	2.34	100,452,557	2.60	101,525,392	2.84	102,570,274	3.05	103,665,743	3.33

% Δ = Percentage Change from Baseline

to Table 6.19). The resulting increase in total consumption of Butter was from 48.5 million kilograms in 1996 to 61.1 million kilograms in 2006 (Table 6.19). In the case of Cheddar Cheese the increase was from 36.7 million kilograms in 1996 to 42.7 million kilograms in 2006 (Table 6.19). Finally, the increase in the total consumption of Other Cheeses was from 90.7 million kilograms in 1996 to 103.9 million kilograms in 2006 (Table 6.19). Therefore, the increase in immigration to Canada increases the consumption of all industrial milk products in this study but the percentage increase would be greater for Butter and Other Cheeses than it was for Cheddar Cheese.

However, the change in the total consumption in this scenario is the net effect of two changes in the population: 1) the increase in the number of households headed by foreign born persons and; 2) the increase in the total number of households. In order to fully understand these effects in this scenario we need to understand each of these changes separately. Tables 6.20 and 6.21 present the results for each change individually. Table 6.20 presents the results from a change in the number of household headed by a foreign born person but holds the total number of households at the baseline levels. Table 6.21 presents the results from a change in the total number of households but holds the percentage of households headed by a foreign born person at the baseline levels. In comparing Tables 6.19, 6.20 and 6.21 we see that almost all of the change in total consumption is from the increase in the total number of households and not from the changing ethnic diversity. For example, Butter consumption in 2006 increased by 3.66 percent (Table 6.19) in this scenario, of this 3.66 percent increase 3.33 percent was from the increase in the number of households (Table 6.20) and only 0.32 percent was from the change in ethnic diversity (Table 6.21). This means while the change in ethnic diversity does have an effect on the consumption of dairy products it is relatively small compared to the change in the number of households and population.

Thus if the Government of Canada had achieved the immigration targets set out in the 1993 Liberal Red Book (Liberal Party of Canada, 1993) the total consumption of dairy products would have increased by between 3 and 4 percent annually by 2006. Secondly, an increase in immigration would be beneficial to the Canadian dairy industry. However, it should be noted that while the total consumption increases, they are not uniform and therefore there would require adjustments in the distribution of milk among the different dairy products.

Policy Scenario 2: Baby Boom

This scenario is not a true policy scenario in that it is not possible for either the government or the dairy industry to impose a policy that will increase the number of children born in a given year. However, changes in population due to changes in birth rate will affect the consumption of dairy products in Canada. It is also true that the crude birth rate in Canada has fluctuated through time. The crude birth rate was 30.1 during World War I, then fell to 21.9 during the Great Depression. The crude birth rate then rose again to the end of the Baby Boom in 1965 and has been falling ever since (Table 2.2). One possible scenario for the future crude birth rate in Canada is that as the Children of the Baby Boom or Baby Boom Echo start to have children the crude birth rate could rise. This would mean more children being born and therefore more children per household on average. While the expected increase in the crude birth rate from the Children of the Baby Boom having children is expected after 2006 and therefore outside the simulation period, we can still assess the impact of an increasing crude birth rate on the consumption of dairy products by increasing the crude birth rate from 1996 and 2006. This will give us an indication of the relative impact of an increase in the crude birth rate.

This scenario will hold the crude birth rate at 13 births per 1000 people. This is at a level about equal to the actual crude birth rate in 1996 but is about 2.5 birth per 1000 people higher than the crude birth rate in 2002 and 2003 (Table 6.22). The result of holding the crude birth at 13 births per 1000 people is that between 1996 and 2006 there would have been an additional 708,542 births. These additional births increase the average number of children per household but have no effect on the average number of youth as the additional children born after 1996 will not yet have reached the age of 15 to be considered youth. The effect on the average number of children per household can be seen in the increase from 0.7483, the actual crude birth rate, to 0.7490 births per 1000 people in 1996 (Table 6.22). The accumulative effect of the change in crude birth rate on the average number of children per household can be seen in the increase from 0.6261 to 0.7046 in 2006 (Table 6.22). Therefore, the additional births by 2006 add an additional 0.1 children per household.

The question now is what will be the effect of these additional children on the consumption of dairy products in Canada. To study the effects on the consumption of dairy products, we input the new average number of children into the model and investigate the results. Like in the previous scenarios, we will hold all other variables constant and look at the resulting changes in both per household and total consumption.

Table 6.22: Effects of Increased Crude Birth Rate on Number of Children per Households

Year	Actual Population	New Population	Actual Births	New Births	Additional Births	Actual Crude Birth Rate	New Crude Birth Rate	Number Of Households	Actual Number of Children	New Number of Children
1996	29610757	29610757	379242	384940	5698	12.8	13	7998862	0.7483	0.7490
1997	29907172	29912870	357097	388867	31770	11.9	13	8100344	0.7379	0.7426
1998	30157082	30194550	345475	392529	47054	11.5	13	8201823	0.7265	0.7368
1999	30403878	30488400	339277	396349	57072	11.2	13	8303303	0.7129	0.7299
2000	30689035	30830630	339024	400798	61774	11.0	13	8404782	0.7000	0.7242
2001	31021251	31224620	332343	405920	73577	10.7	13	8506264	0.6883	0.7208
2002	31372587	31649533	327487	411444	83957	10.4	13	8610355	0.6766	0.7185
2003	31676077	32036980	329757	416481	86724	10.4	13	8714448	0.6641	0.7154
2004	31995199	32442825	337074	421757	84683	10.5	13	8818539	0.6518	0.7122
2005	32312077	32844386	338612	426977	88365	10.5	13	8922632	0.6386	0.7081
2006	32649482	33270156	344644	432512	87868	10.6	13	9026723	0.6261	0.7046

Table 6.23: Change in Crude Birth Rate Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1295	0.9400	0.1298	0.9422	0.1301	0.9446	0.1304	0.9469	0.1307	0.9490	0.1307	0.9490
2% Fluid Milk	0.3966	2.9357	0.3957	2.9291	0.3949	2.9232	0.3942	2.9179	0.3936	2.9133	0.3932	2.9103
Butter	0.0893	0.1163	0.0896	0.1167	0.0899	0.1171	0.0902	0.1175	0.0905	0.1179	0.0908	0.1182
Cheddar Cheese	0.1189	0.0879	0.1192	0.0882	0.1195	0.0884	0.1197	0.0885	0.1198	0.0886	0.1199	0.0887
Other Cheeses	0.2657	0.2173	0.2656	0.2172	0.2656	0.2171	0.2655	0.2171	0.2654	0.2170	0.2652	0.2168

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1311	0.9513	0.1311	0.9518	0.1312	0.9521	0.1312	0.9524	0.1313	0.9530
2% Fluid Milk	0.3941	2.9170	0.3948	2.9226	0.3956	2.9281	0.3962	2.9328	0.3968	2.9376
Butter	0.0917	0.1195	0.0928	0.1208	0.0938	0.1221	0.0948	0.1235	0.0958	0.1248
Cheddar Cheese	0.1192	0.0882	0.1187	0.0878	0.1181	0.0874	0.1176	0.0870	0.1171	0.0866
Other Cheeses	0.2638	0.2157	0.2626	0.2147	0.2613	0.2137	0.2601	0.2127	0.2589	0.2117

The effect of a change in the crude birth rate had little effect on the consumption of dairy products in 1996 but the accumulative effect was larger by 2006. In the case of fluid milk products the pre household consumption of 1 Percent and 2 Percent Fluid Milk saw an increase by 2006. The per household consumption of 1 Percent Fluid Milk had increased to 0.9530 litres per household per week by 2006 (Table 6.23). This amount is 0.002 litres per household per week or 0.2 percent above the projected baseline (Table 6.15 to Table 6.23). A similar result was found for 2 Percent Fluid Milk where per household weekly consumption increased from 2.9357 litres per household per week in 1996 to 2.9376 litres per household per week in 2006. The increase in per household consumption increased 0.0004 litres per week or 0.01 percent above the baseline in 1996 but by 2006 the increase was 0.0394 litres per week or 0.02 percent (Table 6.15 to Table 6.23). Therefore the weekly per household consumption of 1 Percent and 2 Percent Fluid Milk increased relative to the baseline projects but were relatively stable between 1996 and 2006 (Table 6.23). The result is that the increase in the crude birth rate increases the already increasing per household consumption of 1 Percent Fluid Milk and reversed the declining per household consumption of 2 Percent Fluid Milk.

In terms of per household consumption of industrial milk products, the consumption of Butter, Cheddar Cheese and Other Cheeses declined relative to the baseline. The per household consumption of Butter increased from 0.1163 kilograms per household per week in 1996 to 0.1248 kilograms per household per week by 2006 (Table 6.23). However, this level of per household consumption is below the projected baseline from between 0 to 0.0007 kilograms per household per week or 0 to 0.6 percent (Table 6.15 to 6.23). The per household consumption of Cheddar Cheese was relatively stable at about 0.09 kilograms per household per week (Table 6.23). However, while the per household consumption was relatively stable it was at a level that is below the projected baseline by about 0.0016 kilograms per household per week or 2 percent (Table 6.15 to Table 6.23). The per household consumption of Other Cheeses was relatively stable from 1996 to 2001 and then declined to 2006. The per household consumption of Other Cheeses was below the baseline levels of consumption by 0 to 0.002 kilograms per week or 0 to 0.9 percent (Table 6.15 to Table 6.23). The result is that the increase in the crude birth rate will decrease the consumption of Butter, Cheddar Cheese and Other Cheeses.

In terms of per household consumption of dairy products an increase in the crude birth rate has a positive effect on the consumption of 1 Percent and 2 Percent Fluid Milk but a negative effect on the consumption of Butter, Cheddar Cheese and Other Cheeses. However, in terms of total consumption, the consumption of dairy products in Canada continued to increase from 1996 to 2006. While total consumption continued to increase, the rate of that increase differed across the dairy products. The rate of increase for 1 Percent and 2 Percent Fluid Milk was greater than the rate of increase in the baseline projects (Table 6.24). The increase in the consumption of 1 Percent Fluid Milk ranges from 820,600 to 904,283 litres or 0.002 to 0.2 percent above the baseline (Table 6.16 to Table 6.24). Similarly, the consumption of 2 Percent Fluid Milk increased at a rate greater than in the baseline. This can be seen in that the total consumption of 2 Percent Fluid Milk ranged from 148,707 to 18,492,148 litres or

Table 6.24: Change in Crude Birth Rate Total Consumption Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	390,995,902	0.00	396,874,028	0.01	402,847,386	0.03	408,826,017	0.05	414,769,064	0.07	419,777,117	0.07
2% Fluid Milk	1,221,071,886	0.01	1,233,788,614	0.08	1,246,750,372	0.18	1,259,847,414	0.29	1,273,267,719	0.42	1,287,303,929	0.56
Butter	48,374,392	-0.01	49,172,645	-0.04	49,952,255	-0.08	50,727,577	-0.14	51,508,466	-0.20	52,285,067	-0.26
Cheddar	36,576,557	-0.02	37,142,757	-0.12	37,688,070	-0.27	38,217,798	-0.45	38,730,557	-0.64	39,213,784	-0.86
Other Cheeses	90,369,710	-0.01	91,490,638	-0.06	92,608,440	-0.13	93,730,673	-0.21	94,836,427	-0.29	95,902,909	-0.40

Dairy Products	2002		2003		2004		2005		2006	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	425,920,670	0.09	431,303,298	0.12	436,583,392	0.15	441,887,900	0.18	447,307,060	0.20
2% Fluid Milk	1,306,043,540	0.73	1,324,399,067	0.89	1,342,707,388	1.05	1,360,749,858	1.20	1,378,878,886	1.36
Butter	53,503,471	-0.34	54,750,541	-0.41	56,012,600	-0.47	57,287,202	-0.54	58,565,218	-0.60
Cheddar	39,483,782	-1.11	39,770,332	-1.36	40,057,641	-1.60	40,358,972	-1.85	40,655,014	-2.09
Other Cheeses	96,589,350	-0.51	97,293,391	-0.63	97,989,613	-0.74	98,679,117	-0.86	99,350,047	-0.97

% Δ = Percentage Change from Baseline

0.01 to 0.01 percent above the baseline (Table 6.16 to Table 6.24). These results are consistent with the increase in per household consumption above.

Meanwhile the consumption of Butter, Cheddar Cheese and Other Cheeses also increased in spite of the fact that per household consumption of Cheddar Cheese and Other Cheeses actually declined and only the per household consumption of Butter increased. This means that the decline in the per household consumption of Cheddar Cheese and Other Cheeses was less than the increase in the number of households from 1996 to 2006. However, the increase in the consumption of Butter, Cheddar Cheese and Other Cheeses were all at a level which was less than the baseline consumption of these products.

In the case of Butter, while its total consumption still increased from 1996 to 2006, we find that the increase is at a level which is less than the baseline levels of consumption. This can be seen in that the total consumption of Butter ranged from 2,852 to 354,648 kilograms or 0.006 to 0.6 percent below the baseline (Table 6.16 to Table 6.24). Meanwhile the total consumption of Cheddar Cheese ranged from 6,989 to 869,091 kilograms or 0.02 to 2.1 percent below the baseline consumption (Table 6.16 to Table 6.24). Finally, the consumption of Other Cheeses ranged from 7,833 to 974,086 kilograms or 0.009 to 1.0 percent below the baseline consumption (Table 6.16 to Table 6.24). The general result is that the consumption of 1 Percent and 2 Percent Fluid Milk increased from 1996 to 2006 and at a rate greater than the baseline while consumption of Butter, Cheddar Cheese and Other Chesses increased in 1996 but at a rate less than the baseline. Overall the increase in the crude birth rate has a positive effect on the total consumption of 1 Percent Fluid Milk but a negative effect on the total consumption of Butter, Cheddar Cheese and Other Cheeses.

SUMMARY

In this chapter I tested the validity of the model estimated in Chapter 5 and investigated a set of scenarios to see how the model responds to those shocks. These prediction errors for Canada as a whole. However, there are notable variations across regions.

In terms of policy simulations, the influence of immigration policy and changes in birth rate have mixed effects on dairy consumption. An increase in the immigration rate caused the total consumption of all dairy products to increase but at different rates. Butter and Other Cheeses increased at a faster rate than 1 Percent and 2 Percent Fluid Milk and Cheddar Cheese. The increase in the number of children per household caused increases in the consumption of all dairy products but again different dairy products were affected differently. The consumption 1 Percent and 2 Percent Fluid Milk was positively affected by the increase in the number of children but the consumption of Butter, Cheddar Cheese and Other Cheeses were negatively affected.

It is evident that changes in birth rate causes complex changes in the consumption of dairy products in Canada. An increase in the birth rate cause increases in the consumption of 1 Percent and 2 Percent Fluid Milk and Cheddar Cheese and decreases for Butter and Other Cheeses. The largest impact was on the consumption of 2 Percent Fluid Milk. Changes in non-dairy policies and in the birth rate will affect the demand for dairy products in Canada.

CHAPTER 7: SUMMARY, RESEARCH CONTRIBUTIONS AND SUGGESTIONS FOR FUTURE RESEARCH

INTRODUCTION

The main purpose of this study was to incorporate ethnicity and other demographic variables into a demand system in order to study the effects of demographic changes on the demand for dairy products in Canada. In order to examine these changes in the consumption of dairy products, a set of demographic variables were incorporate into a demand system. The demographic variables were initially incorporated using the Gorman Specification into the Almost Ideal Demand System (AIDS) model framework. This resulted in the development of the Generalized Non-Linear Almost Ideal Demand System. However, due to limitation of econometrics and data a simplified version of the model, the Generalized Almost Ideal Demand System, was estimated.

The model was estimated for five dairy products in Canada and in five regions of the country. The model was then shocked to determine the effects of changes of various demographic and price variables included in the model to first determine the validity of the model. The model was then used to study the effects of changes in prices, total expenditure, immigration rates and birth rates on the consumption of dairy products in Canada from 1996 to 2006. These results were compared to a projected baseline that simulated the effects of actual changes in the structure of the population.

SUMMARY OF MAJOR FINDINGS

The major findings reported are consistent with the three objectives of this research. The initial objective of this research was to determine the demographic factors that influence the demand for dairy products in Canada and its five sub-regions. The second objective was to incorporate these demographic factors into a demand system for dairy products in Canada. The third area was the to assess derived policy implications of the model.

The demographic factors do influence the consumption of dairy products in Canada. Initial review of the literature on the demographic factors that have been found to influence the consumption of food in general along with intuitive thought created a short list of five demographic factors that might influence the consumption of dairy products. These demographic factors are: 1) if the household is headed by a foreign-born person; 2) number of youth in the household; 3) number of children in the household; 4) age of the head of the household; and 5) education of the head of the household.

Based on the econometric analysis it was determined that all five demographic factors included in this study played some role in determining the demand for dairy products in Canada and the five sub-regions. However, a single demographic factor did not influence the demand for all five dairy products. The results suggest that demographic factors do influence the consumption of dairy products in Canada and in five sub-regions in Canada but the relationship appears to be complex.

The second area of major findings of this study was the econometric results from the demand system estimated. The first of these findings was that the model and dataset were generally consistent with economic theory. The theoretical restrictions of symmetry, homogeneity and adding-up were imposed in the estimation process but the restriction of negativity still needed to be tested. The tests of negativity showed that the eigenvalues were negative semi-definite and therefore consistent with economic theory in eleven of the twelve models. The only model that was not consistent with economic theory was for the Prairies when demographic variables are included in the model.

Another major finding associated with the estimations were the differences in the own-price elasticities of dairy products in the models with and without demographic variables. The general result for Canada and the five sub-regions was that the magnitude of the own-price elasticities increased in the model with demographic variables relative to the model without demographic variables for both the Marshallian and Hicksian elasticities. Also associated with this finding was the fact that all of the own-price elasticities were found to be elastic at the retail level of the market.

The third set of econometric results was that the cross-price elasticities were both net and gross substitutes. Also the unconditional cross-price elasticities were more elastic then the conditional cross-price elasticities.

The fourth finding associated with the econometric results was the statistical significance of the demographic variables in the model. The result is that at least one demographic variable was statistically significant for each dairy product in both the first and second stages. However, the influence is stronger in the second stage then the first stage meaning that demographic variables influenced the choice of individual dairy products more then they influenced the consumption of dairy products as a whole. While the influence of demographic variables was statistically significant, their influence was less than the influence of dairy prices.

The results from policy simulations suggest that changes in immigration policy and birth rates would significantly affect the consumption of dairy products in Canada. However, under reasonable policy scenarios in these areas the total consumption of dairy products would continue to increase for the foreseeable future.

RESEARCH CONTRIBUTIONS

This research contributed in three areas: 1) analytical; 2) empirical; and 3) policy analysis.

In terms of analytical contributions, this research extended the body of knowledge by developing a more generalized method of incorporating demographic variables into the Almost Ideal Demand System. The result was the Generalized Non-Linear Almost Ideal Demand System. This demand system allows for both demographic scaling and translation simultaneously. The demand system also nests other demands such as the Generalized Almost Ideal Demand System which only allows for demographic scaling. While the model allows for a greater amount of flexibility in how demographic variables influence the demand for dairy products, it poses problems econometrically in that it is highly non-linear and therefore convergence is difficult. Related to this is that this research also gives us a better understanding as to how the inclusion of demographic variables influence the parameters of the demand equations in the Almost Ideal Demand System.

In terms of the empirical contributions, this study gave us a better understanding of the demographic factors that influence the demand for dairy products in Canada. It also highlighted the complexity of the relationship of each factor to the demand for the various dairy products. This can be seen in that there was no one single demographic factor that influenced all dairy products in Canada. Another empirical contribution of this research to the body of knowledge is a better understanding of the nature of price elasticities at the retail level of the supply chain. This retail level research showed that own-price elasticities were higher than generally thought. It also revealed the strong substitution effect.

In terms of the policy contribution, this research extended the body of knowledge by showing the complexity in which demographic variables influence the demand for dairy products. This means that reliance on one demographic factor such as age to explain shifts in the demand of dairy products is problematic for dairy policy and will ignore the more complex relationship that exists. The research also showed that the overriding factor that influences the consumption of dairy products is price; therefore price policy is more critical then changes in demographics in Canada in influencing dairy consumption.

MODEL LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

A number of limitations of this research need to be highlighted and the areas for further research need to be discussed. The areas of further research are in three general areas: 1) expansion of the model; and 2) theoretical issues in demand analysis.

The expansion of the model would include expansion in three ways: 1) the number of demographic variables; 2) the number of goods included in the model; and 3) the number of regions modelled.

The current model does not include all possible demographic factors that could influence the demand for dairy products. For example the current model only considers if the person the household was born in Canada or outside of Canada, it does not consider the country or region of origin of a foreign born head of a household. This is problematic in that it assumes that all foreign born persons that come to Canada have similar preference structures. The solution would be to include variables that not only consider if the head of the household is foreign born but also where that person was born and thereby allow for varying preference structures between the different cultural groups immigrating to Canada. This would allow an analysis of how changes in the sources of immigration, not just the amount of immigration, will affect the demand for dairy products.

The second way that the model needs to be expanded is by increasing the number of goods within the model. The current model was limited to only five dairy products. The implicit assumption is that all substitution effects are limited to within this group of dairy products. However, it is likely that there are substitution effects between dairy products within the group and dairy products not in the model. It is also likely that there are substitution effects between dairy products and non-dairy products. The addition of additional products into the model could affect the own-price and cross-price elasticities of the current group of dairy as substitution and compliment effects are added to the demand system. As the addition of these new products help to explain the variations in the consumption of all dairy products.

The third area the model can be expanded is by increasing the number of regions within the model. The model currently contains two aggregate regions, Atlantic Canada and the Prairies, and assumes that preferences within these regions are relatively homogeneous. By splitting these regions into smaller regions, provinces, we will be smaller and more homogeneous populations. This would also mean that the model would be more consistent with the administration of supply management which is done at the provincial level especially for fluid milk products.

This research has investigated the role of household or demographic characteristics on the demand for dairy products in Canada. It found that these household or demographic characteristics do play a statistically significant role in determining the household's demand for dairy products. However, effect of these household and demographic characteristics on the demand for dairy products in Canada is complex in that they affect the demand in different ways for different dairy products. Overall as Canada's population changes over time, the demand for dairy products in Canada will also change in ways that cannot be accounted for by price and income changes alone.

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APPENDIX 1: DERIVATION OF THE ALMOST IDEAL DEMAND SYSTEM

The derivation of the Almost Ideal Demand System starts from a cost function defined by

$-\ln C = a(p) + ub(p)$ (1)

where

a(p) and b(p) are functions of prices

and u is the utility level.

Deaton and Muellbauer (1980a, 1980b) define

$$a(p) = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2}\sum_k \sum_l \gamma^*_{kl} \ln p_k \ln p_l \qquad (2)$$

$$b(p) = \beta_0 \prod_k p_k^{\beta_k} \qquad (3)$$

where

α, β, γ* are parameters

and p is price of the n goods.

Now substitute (2) and (3) into (1) to get

$$\ln C = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2}\sum_k \sum_l \gamma^*_{kl} \ln p_k \ln p_l + u\beta_0 \prod_k p_k^{b_k}\,. \ (4)$$

If we apply Shephard's Lemma, $\frac{\delta \ln C}{\delta \ln p_i} = s_i$, where s_i is the budget share, we get

$$s_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(x/P)$$

where

P is a price index defined by

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2}\sum_k \sum_l \gamma_{kl} \ln p_k \ln p_l$$

where

$$\gamma_{kl} = \frac{1}{2}(\gamma_{kl}^* + \gamma_{kl}^*) = \gamma_{lk}\,.$$

Theoretical restrictions for the Almost Ideal Demand System are:

Homogeneity $\sum_j \gamma_{ij} = 0$;

Adding-up $\sum_i \alpha_i = 0, \quad \sum_i \gamma_{ij} = 0, \quad \sum_i \beta_i = 0$;

Symmetry $\gamma_{ij} = \gamma_{ji}$;

Negativity $\gamma_{ii} < 0$.

These theoretical restrictions are for the case where there are no demographic variables incorporated into the model. The effects of incorporating demographic variables into the model on the theoretical restrictions is discussed in the following section. We will do this for the Generalized Almost Idea Demand System. This is because our assumptions of the functional forms of how the demographic variables enter the general model reduced it to the Generalized Almost Ideal Demand System.

This section therefore will prove the theoretical restrictions discussed in Chapter 4.7.4. The first theoretical restriction discussed in 4.7.4 is that demand systems must be homogeneous of degree zero in prices and income or total expenditure. Working from the standard AIDS theoretical restrictions

$$\sum_j \gamma_{ij} = 0 \tag{5}$$

we rearrange the relationship $\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$ to solve for $\gamma_{ij} = \gamma_{ij}^* + \beta_i w_j$ and substitute into A5.1.

$$\sum_j (\gamma_{ij}^* + \beta_i w_j) = 0$$
$$\sum_j \gamma_{ij}^* + \beta_i \sum_j w_j = 0$$
$$\because \sum_j w_j = 1$$
$$\therefore \sum_j \gamma_{ij}^* + \beta_i = 0$$

$$\sum_j \gamma_{ij}^* = -\beta_i \tag{6}$$

The second theoretical restriction is that demand systems must add-up in that they must use up the household's income or total expenditure. In the case of the demand system derived in 4.36 this means

$$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum_i \beta_i = 0$$

To get the relationships for 4.37 we need to rearrange $\alpha_i^* = \alpha_i - \beta_i \ln\phi$ and $\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$ and substitute the rearranged equations into the standard restrictions. The restriction $\sum_i \beta_i = 0$ is unaffected as β_i is not affected by the use of the Stone Index. However, α_i^* and γ_{ij}^* are affected by the use of the Stone Index and need to be solved. For α_i^* rearrange $\alpha_i^* = \alpha_i - \beta_i \ln\phi$ and substitute into $\sum_i \alpha_i = 1$

$$\sum_i \alpha_i = 1$$
$$\sum_i (\alpha_i^* + \beta_i \ln\phi) = 1$$
$$\sum_i \alpha_i^* + \sum_i \beta_i \ln\phi = 1$$
$$\sum_i \alpha_i^* + \ln\phi \sum_i \beta_i = 1$$
$$\because \sum_i \beta_i = 0$$

$$\therefore \sum_i \alpha_i^* = 1 \qquad (7)$$

For γ_{ij}^*, we rearrange $\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$ and substitute into $\sum_i \gamma_{ij} = 0$

$$\sum_i \gamma_{ij} = 0$$
$$\sum_i (\gamma_{ij}^* + \beta_i w_j) = 0$$
$$\sum_i \gamma_{ij}^* + \sum_i \beta_i w_j = 0$$
$$\sum_i \gamma_{ij}^* + w_j \sum_i \beta_i = 0$$
$$\because \sum_i \beta_i = 0$$

$$\therefore \sum_i \gamma_{ij}^* = 0 \qquad (8)$$

In the case of symmetry, the cross-price derivatives of the compensated or Hicksian demands are symmetric. This is because the price derivatives of the compensated demand function are the second order derivatives of the expenditure function. According to Young's theorem, the order of the double derivative does not matter and therefore the cross-price derivatives of the compensated demands must be equal.

$$\frac{\partial h_i^*}{\partial P_j} = \frac{\partial h_j^*}{\partial P_i}$$

The result for 4.36 is

$$\gamma_{ij} = \gamma_{ji}$$

To get the resulting symmetry conditions for equation 4.37 substitute $\gamma_{ij}^* = \gamma_{ij} - \beta_i w_j$ into $\gamma_{ij} = \gamma_{ji}$ to get:

$$\gamma_{ij}^* + \beta_i w_j = \gamma_{ji}^* + \beta_j w_i \tag{9}$$

The resulting theoretical restrictions are relatively straightforward except for $\sum_i \gamma_{ij}^* = 0$ and $\sum_j \gamma_{ij}^* = -\beta_i$ where the two relationships are normally expected to be the same. However, since the symmetry relationship is $\gamma_{ij}^* + \beta_i w_j = \gamma_{ji}^* + \beta_j w_i$ we can show that $\sum_i \gamma_{ij}^* = 0$ and $\sum_j \gamma_{ij}^* = -\beta_i$ are correct. Rearrange the symmetry condition to solve for γ_{ij}^* to get $\gamma_{ij}^* = \gamma_{ji}^* + \beta_j w_i - \beta_i w_j$. Now substitute γ_{ij}^* into $\sum_j \gamma_{ij}^* = -\beta_i$ and solve.

$$\sum_j \gamma_{ij}^* = -\beta_i$$
$$\sum_j (\gamma_{ji}^* + \beta_j w_i - \beta_i w_j) = -\beta_i$$
$$\sum_j \gamma_{ij}^* + \sum_j \beta_j w_i - \sum_j \beta_i w_j = -\beta_i$$
$$\sum_j \gamma_{ij}^* + w_i \sum_j \beta_j - \beta_i \sum_j w_j = -\beta_i$$
$$\because \sum_j \beta_j = 0$$
$$\because \sum_j w_j = 1$$
$$\therefore \sum_j \gamma_{ij}^* - \beta_i = -\beta_i$$
$$\therefore \sum_j \gamma_{ij}^* = 0$$

Therefore, the expected relationship is produced when the correct symmetry relationship is used in the functional relationship of the theoretical restrictions.

Elasticity Formulas

Marshallian Own-Price Elasticity

$$E_{ii}^{M} = \frac{\gamma_{ii}}{w_i} - \beta_i - 1$$

Marshallian Cross-Price Elasticity

$$E_{ij}^{M} = \frac{\gamma_{ij} - \beta_i w_j}{w_i}$$

Marshallian Income Elasticity

$$E_{ix} = \frac{\beta_i}{w_i} + 1$$

Hicksian Own-Price Elasticity

$$E_{ii}^{H} = \frac{\gamma_{ii}}{w_i} + w_i$$

Hicksian Cross-Price Elasticity

$$E_{ij}^{H} = \frac{\gamma_{ij}}{w_i} + w_j$$

APPENDIX 2: SEEMINGLY UNRELATED REGRESSION ECONOMETRIC RESULTS FOR ATLANTIC CANADA, PRAIRIES AND BRITISH COLUMBIA

Table A2.1 : Coefficients Without Demographic Variables (SUR): Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1% Fluid Milk	0.0103 0.4913	-0.1734 -15.2960	0.1175 14.8030	0.0026 0.3535	0.0391 4.8960	0.0383 5.3956	-0.0241 -8.3124
2% Fluid Milk	0.2449 11.8130	0.1226 14.9850	-0.1825 -16.4270	0.0179 2.9972	0.0659 9.5532	0.0836 10.9240	-0.1076 -27.8020
Butter	0.0843 5.4392	-0.0001 -0.0102	0.0071 1.2312	-0.0291 -2.8631	0.0100 1.2183	0.0073 1.2759	0.0049 2.3610
Cheddar Cheese	0.2870 14.9380	0.0295 3.6912	0.0333 4.9863	0.0065 0.7940	-0.1525 -13.6130	0.0341 5.1990	0.0492 20.3270
Other Cheeses	0.3736 20.3003	0.0213 2.9957	0.0247 3.3236	0.0021 0.3722	0.0375 5.6692	-0.1633 -17.9425	0.0777 24.1686

Table A2.2: Marshallian Elasticities Without Demographic Variables (SUR): Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.2601 233.9569	0.8539 219.1179	0.0188 0.1249	0.2845 23.9711	0.2784 29.1125	0.8245 69.0962
2% Fluid Milk	0.3073 224.5518	-1.4573 269.8393	0.0449 8.9830	0.1652 91.2645	0.2095 119.3334	0.7304 772.9530
Butter	-0.0009 0.0001	0.0865 1.5160	-1.3540 8.1973	0.1209 1.4842	0.0882 1.6279	1.0593 5.5741
Cheddar Cheese	0.2431 13.6247	0.2745 24.8631	0.0536 0.6304	-2.2585 185.3236	0.2815 27.0292	1.4058 413.1889
Other Cheeses	0.0821 8.9744	0.0949 11.0462	0.0082 0.1385	0.1442 32.1393	-1.6284 321.9329	1.2990 584.1193

Table A2.3: Price and Expenditure Coefficients With Demographic Variables (SUR): Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.2228	-0.2032	0.0914	0.0395	0.0628	0.0394	-0.0299
	-7.0441	-16.5230	11.2630	4.7235	7.0936	5.3887	-9.7870
2% Fluid Milk	0.2207	0.0961	-0.2088	0.0373	0.0906	0.1057	-0.1208
	6.3261	11.5200	-18.1580	5.9040	12.5450	13.4530	-29.7060
Butter	0.1487	0.0354	0.0224	-0.0747	0.0019	0.0028	0.0122
	6.2716	4.2419	3.6648	-6.5734	0.2221	0.4844	5.6162
Cheddar Cheese	0.4020	0.0513	0.0530	-0.0013	-0.1889	0.0285	0.0574
	14.2200	5.8063	7.5673	-0.1565	-15.9460	4.2946	22.4630
Other Cheeses	0.4515	0.0204	0.0419	-0.0007	0.0336	-0.1763	0.0811
	15.2567	2.7851	5.4674	-0.1220	5.0224	-19.0086	23.8622

Table A2.4: Demographic Coefficients (SUR): Canada

	Atlantic Canada	Quebec	Prairies	British Columbia	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	0.0326	-0.0453	0.0572	0.0153	0.0052	-0.0099	-0.0081	-0.0285	0.0127	0.0017	-0.0001	0.0089
	4.2323	-6.0012	8.2879	1.8474	0.7898	-1.4864	-1.2061	-4.5453	3.3082	0.4874	-0.2714	8.3474
2% Fluid Milk	0.0679	-0.0405	-0.0423	-0.0511	-0.0139	-0.0074	0.0038	0.0130	0.0329	0.0543	0.0012	-0.0137
	6.9744	-4.0458	-4.6307	-4.6517	-1.5728	-0.8348	0.4243	1.5573	6.4443	11.7240	4.7725	-9.6994
Butter	-0.0442	0.0145	-0.0313	0.0077	-0.0020	0.0030	0.0146	0.0115	-0.0104	-0.0048	0.0012	-0.0012
	-7.6502	2.7273	-6.3398	1.3327	-0.4252	0.6481	3.1124	2.6032	-3.8497	-1.9441	9.1821	-1.6137
Cheddar Cheese	-0.0415	-0.0059	0.0179	0.0404	-0.0006	-0.0047	-0.0139	-0.0243	-0.0190	-0.0227	-0.0006	0.0030
	-6.4133	-0.9389	3.0987	5.8801	-0.1160	-0.8514	-2.4906	-4.6601	-5.9504	-7.8480	-4.1481	3.4136
Other Cheeses	-0.0147	0.0772	-0.0015	-0.0123	0.0113	0.0191	0.0035	0.0283	-0.0163	-0.0286	-0.0017	0.0030
	-1.8043	9.1331	-0.1942	-1.6990	1.5147	2.5420	0.4683	4.0278	-3.7792	-7.3183	-8.0949	2.5365

Table A2.5: Marshallian Elasticities With Demographic Variables (SUR): Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.4768 273.0101	0.6643 126.8551	0.2872 22.3116	0.4565 50.3188	0.2862 29.0384	0.7825 95.7846
2% Fluid Milk	0.2407 132.7141	-1.5231 329.7078	0.0933 34.8573	0.2269 157.3731	0.2647 180.9912	0.6975 882.4497
Butter	0.4296 17.9935	0.2726 13.4308	-1.9075 43.2101	0.0231 0.0493	0.0340 0.2347	1.1482 31.5421
Cheddar Cheese	0.4233 33.7132	0.4377 57.2647	-0.0111 0.0245	-2.5589 254.2638	0.2353 18.4433	1.4737 504.5830
Other Cheeses	0.0787 7.7566	0.1613 29.8926	-0.0027 0.0149	0.1293 25.2248	-1.6787 361.3276	1.3120 569.4047

Table A2.6 : Coefficients Without Demographic Variables (SUR): Atlantic Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.1544 -3.2378	-0.2262 -8.5583	0.0739 4.4014	0.0295 1.7427	0.0359 1.9048	0.0756 4.7999	0.0113 1.8063
2% Fluid Milk	0.1386 3.2476	0.0863 4.9577	-0.2410 -9.8749	0.0312 2.6081	0.0684 4.7226	0.1109 6.6517	-0.0558 -6.4596
Butter	0.1215 3.6268	0.0300 1.7754	0.0266 2.3138	-0.1091 -4.9055	0.0232 1.3273	0.0271 2.3412	0.0022 0.5405
Cheddar Cheese	0.3135 7.3035	0.0344 1.8310	0.0531 3.8282	0.0221 1.2642	-0.1941 -7.7427	0.0637 4.6402	0.0208 4.1600
Other Cheeses	0.5808 15.1460	0.0755 4.7652	0.0874 5.4236	0.0263 2.2451	0.0666 4.7898	-0.2773 -14.2602	0.0215 3.1782

Table A2.7: Marshallian Elasticities Without Demographic Variables (SUR): Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.7057 73.2443	0.5570 19.3726	0.2227 3.0372	0.2711 3.6283	0.5699 23.0387	1.0849 3.2627
2% Fluid Milk	0.1923 24.5784	-1.5370 97.5137	0.0696 6.8024	0.1524 22.3032	0.2471 44.2446	0.8757 41.7261
Butter	0.4620 3.1520	0.4102 5.3539	-2.6827 24.0635	0.3580 1.7617	0.4184 5.4810	1.0342 0.2921
Cheddar Cheese	0.3223 3.3524	0.4976 14.6548	0.2071 1.5981	-2.8188 59.9500	0.5972 21.5318	1.1947 17.3056
Other Cheeses	0.3056 22.7068	0.3538 29.4154	0.1064 5.0404	0.2694 22.9421	-2.1225 203.3536	1.0871 10.1012

Table A2.8: Price and Expenditure Coefficients With Demographic Variables (SUR): Atlantic Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.2987 -4.9077	-0.2223 -8.4089	0.0750 4.4777	0.0288 1.7012	0.0371 1.9636	0.0703 4.4652	0.0111 1.6652
2% Fluid Milk	0.2030 2.9586	0.0878 5.0519	-0.2445 -10.0390	0.0312 2.6113	0.0709 4.8978	0.1136 6.8299	-0.0590 -6.4255
Butter	0.1129 2.7300	0.0287 1.7025	0.0246 2.1483	-0.1075 -4.8441	0.0203 1.1651	0.0278 2.4110	0.0060 1.3808
Cheddar Cheese	0.3446 6.5221	0.0350 1.8602	0.0535 3.8546	0.0194 1.1102	-0.1967 -7.8468	0.0641 4.6572	0.0248 4.6686
Other Cheeses	0.6382 11.2488	0.0708 4.4642	0.0913 5.6731	0.0282 2.4187	0.0684 4.9099	-0.2758 -14.2039	0.0171 2.3767

Table A2.9: Demographic Coefficients (SUR): Atlantic Canada

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	0.0270	0.0181	0.0164	-0.0112	-0.0114	-0.0046	0.0005	0.0096
	2.0506	1.2860	1.1726	-0.5981	-1.4025	-0.6358	1.2403	4.4142
2% Fluid Milk	-0.0485	-0.0650	-0.0211	0.0139	0.0264	0.0290	0.0014	-0.0102
	-2.5616	-3.3318	-1.0889	0.5380	2.3258	2.8572	2.5447	-3.4005
Butter	-0.0003	0.0160	0.0236	0.0295	0.0012	-0.0020	0.0008	-0.0036
	-0.0340	1.7704	2.6287	2.4626	0.2324	-0.4216	3.2086	-2.5937
Cheddar Cheese	-0.0022	-0.0028	-0.0340	-0.0106	-0.0114	-0.0150	-0.0006	0.0016
	-0.2080	-0.2564	-3.0695	-0.7170	-1.7726	-2.5921	-1.7780	0.9358
Other Cheeses	0.0240	0.0338	0.0151	-0.0217	-0.0047	-0.0074	-0.0022	0.0027
	1.5410	2.1899	0.9820	-1.0608	-0.5252	-0.9222	-4.9436	1.1227

Table A2.10: Marshallian Elasticities With Demographic Variables (SUR): Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.6764	0.5659	0.2169	0.2796	0.5306	1.0834
	70.7103	20.0495	2.8940	3.8559	19.9376	2.7728
2% Fluid Milk	0.1957	-1.5448	0.0694	0.1581	0.2531	0.8684
	25.5220	100.7897	6.8191	23.9889	46.6474	41.2870
Butter	0.3799	-1.6574	-0.6866	0.3134	0.4293	1.0925
	2.8984	4.6151	23.4655	1.3576	5.8129	1.9066
Cheddar Cheese	0.3276	0.5011	0.1814	-2.8430	0.6001	1.2328
	3.4604	14.8583	1.2326	61.5717	21.6897	21.7958
Other Cheeses	0.2866	0.3696	0.1142	0.2767	-2.1165	1.0694
	19.9292	32.1843	5.8499	24.1070	201.7512	5.6486

Table A2.11: Coefficients Without Demographic Variables (SUR): Quebec

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.0438	-0.1502	0.0912	0.0255	0.0547	-0.0046	-0.0165
	-0.7617	-5.1241	5.5238	1.1521	2.7667	-0.3284	-3.0675
2% Fluid Milk	0.1309	0.0946	-0.1998	0.0632	0.0759	0.0809	-0.1147
	2.5387	5.5871	-7.7957	3.8216	4.6000	4.4523	-13.5890
Butter	0.2618	0.0235	0.0501	-0.0310	-0.0169	-0.0275	0.0017
	5.3971	1.0652	3.1128	-1.0862	-0.8663	-1.9480	0.3204
Cheddar Cheese	0.3483	0.0496	0.0482	-0.0207	-0.1389	0.0248	0.0371
	7.0584	2.5070	2.9992	-1.0603	-5.6211	1.7138	6.6891
Other Cheeses	0.3028	-0.0175	0.0103	-0.0370	0.0253	-0.0735	0.0924
	6.8811	-1.2339	0.5824	-2.6079	1.7434	-3.3881	11.6180

Table A212: Marshallian Elasticities Without Demographic Variables (SUR): Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.8320	1.1118	0.3107	0.6671	-0.0567	0.7991
	26.2566	30.5124	1.3274	7.6546	0.1078	9.4098
2% Fluid Milk	0.2607	-1.5508	0.1743	0.2091	0.2228	0.6838
	31.2157	60.7730	14.6045	21.1604	19.8226	184.6482
Butter	0.2161	0.4601	-1.2845	-0.1553	-0.2521	1.0156
	1.1347	9.6895	1.1797	0.7505	3.7949	0.1027
Cheddar Cheese	0.4011	0.3900	-0.1677	-2.1232	0.2001	1.2997
	6.2853	8.9950	1.1242	31.5968	2.9370	44.7434
Other Cheeses	-0.0544	0.0320	-0.1146	0.0784	-1.2279	1.2866
	1.5224	0.3392	6.8010	3.0394	11.4794	134.9789

Table A2.13: Price and Expenditure Coefficients With Demographic Variables (SUR): Quebec

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.0942	-0.1514	0.0896	0.0270	0.0570	-0.0042	-0.0180
	-1.3822	-5.0765	5.3856	1.2090	2.8417	-0.2937	-3.1249
2% Fluid Milk	0.2649	0.0932	-0.1847	0.0581	0.0731	0.0840	-0.1237
	3.4467	5.4724	-7.1675	3.5140	4.4050	4.6180	-13.6490
Butter	0.2524	0.0243	0.0413	-0.0298	-0.0177	-0.0272	0.0091
	4.1795	1.0883	2.5630	-1.0454	-0.9062	-1.9366	1.6013
Cheddar Cheese	0.3360	0.0519	0.0452	-0.0203	-0.1377	0.0263	0.0346
	5.3777	2.5863	2.7896	-1.0405	-5.5323	1.8157	5.8173
Other Cheeses	0.2410	-0.0180	0.0086	-0.0349	0.0253	-0.0790	0.0981
	3.5038	-1.2651	0.4815	-2.4788	1.7451	-3.6442	11.4628

Table A2.14: Demographic Coefficients (SUR): Quebec

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	-0.0026	-0.0055	0.0108	-0.0146	0.0083	-0.0030	0.0001	0.0029
	-0.2075	-0.4406	0.8718	-0.9131	1.1533	-0.4385	0.3653	1.5546
2% Fluid Milk	-0.0326	-0.0288	-0.0267	0.0492	0.0182	0.0310	-0.0007	-0.0062
	-1.6543	-1.4640	-1.3650	1.9478	1.6033	2.8939	-1.1915	-2.0626
Butter	0.0025	-0.0062	-0.0006	-0.0220	-0.0110	-0.0007	0.0014	-0.0054
	0.2039	-0.5086	-0.0498	-1.4023	-1.5722	-0.0986	3.9897	-2.8815
Cheddar Cheese	-0.0030	0.0042	-0.0121	-0.0489	0.0076	0.0006	-0.0002	0.0017
	-0.2335	0.3240	-0.9393	-2.9487	1.0266	0.0842	-0.3980	0.8601
Other Cheeses	0.0357	0.0364	0.0286	0.0363	-0.0230	-0.0280	-0.0007	0.0069
	1.9052	1.9441	1.5352	1.5072	-2.1338	-2.7414	-1.3179	2.4150

Table A2.15: Marshallian Elasticities With Demographic Variables (SUR): Quebec

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.8467 25.7710	1.0931 29.0050	0.3296 1.4617	0.6948 8.0755	-0.0509 0.0863	0.7800 9.7648
2% Fluid Milk	0.2569 29.9472	-1.5091 51.3734	0.1601 12.3482	0.2015 19.4040	0.2316 21.3263	0.6590 186.2829
Butter	0.2233 1.1845	0.3793 6.5689	-1.2739 1.0929	-0.1624 0.8212	-0.2493 3.7505	1.0831 2.5641
Cheddar Cheese	0.4196 6.6888	0.3657 7.7816	-0.1645 1.0827	-2.1133 30.6068	0.2125 3.2967	1.2801 33.8415
Other Cheeses	-0.0559 1.6005	0.0265 0.2318	-0.1083 6.1446	0.0785 3.0453	-1.2449 13.2805	1.3040 131.3966

Table A2.16 : Coefficients Without Demographic Variables (SUR): Ontario

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.1911 -4.1668	-0.2266 -10.3540	0.0817 5.8862	0.0391 2.4042	0.0863 5.2803	0.0483 3.6501	-0.0289 -4.9704
2% Fluid Milk	0.1522 3.6537	0.0834 5.7289	-0.1890 -9.2136	0.0247 2.0718	0.1008 7.6796	0.0930 6.3548	-0.1130 -13.8350
Butter	0.1724 4.5502	0.0351 2.1625	0.0094 0.8342	-0.0496 -2.1010	-0.0110 -0.6381	0.0039 0.3441	0.0122 2.7129
Cheddar Cheese	0.4591 10.7660	0.0766 4.7003	0.0659 5.2876	-0.0143 -0.8295	-0.1969 -8.6869	0.0163 1.3070	0.0523 10.3380
Other Cheeses	0.4074 10.9987	0.0315 2.3687	0.0319 2.2824	0.0000 0.0039	0.0209 1.6546	-0.1616 -9.2220	0.0773 11.4613

Table A2.17: Marshallian Elasticities Without Demographic Variables (SUR): Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.8754 107.2049	0.6765 34.6470	0.3240 5.7801	0.7142 27.8812	0.3999 13.3235	0.7609 24.7050
2% Fluid Milk	0.2018 32.8207	-1.4570 84.8907	0.0598 4.2924	0.2436 58.9764	0.2250 40.3831	0.7269 191.4044
Butter	0.3873 4.6764	0.1044 0.6959	-1.5480 4.4142	-0.1213 0.4072	0.0430 0.1184	1.1346 7.3599
Cheddar Cheese	0.6572 22.0930	0.5657 27.9585	-0.1227 0.6881	-2.6895 75.4631	0.1402 1.7082	1.4490 106.8820
Other Cheeses	0.1218 5.6108	0.1232 5.2094	0.0002 0.0000	0.0807 2.7379	-1.6249 85.0453	1.2990 131.3623

Table A2.18: Price and Expenditure Coefficients With Demographic Variables (SUR): Ontario

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.2603 -4.4685	-0.2177 -9.9786	0.0830 5.9358	0.0377 2.3277	0.0826 5.0377	0.0476 3.6046	-0.0332 -5.4499
2% Fluid Milk	0.2924 4.4336	0.0849 5.8272	-0.1656 -8.0531	0.0205 1.7218	0.0923 7.0449	0.0975 6.6838	-0.1296 -15.2510
Butter	0.0646 1.3833	0.0323 2.0004	0.0005 0.0439	-0.0557 -2.3256	0.0021 0.1220	0.0007 0.0643	0.0200 4.3033
Cheddar Cheese	0.3683 6.8818	0.0715 4.3707	0.0526 4.1939	-0.0009 -0.0521	-0.1972 -8.5905	0.0145 1.1629	0.0595 11.2680
Other Cheeses	0.5350 9.4936	0.0289 2.1796	0.0295 2.1042	-0.0016 -0.1452	0.0202 1.6036	-0.1603 -9.1850	0.0833 11.7698

Table A2.19: Demographic Coefficients (SUR): Ontario

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	0.0069	-0.0081	-0.0071	-0.0231	0.0137	-0.0032	-0.0004	0.0088
	0.5558	-0.6381	-0.5617	-2.3872	1.9181	-0.4788	-1.1134	4.3590
2% Fluid Milk	0.0108	0.0150	-0.0002	-0.0116	0.0434	0.0663	0.0010	-0.0143
	0.6242	0.8520	-0.1005	-0.8565	4.0347	7.1841	1.9140	-5.0797
Butter	-0.0139	0.0021	0.0098	0.0073	-0.0162	-0.0037	0.0018	-0.0002
	-1.4963	0.2161	1.0238	1.0052	-3.0180	-0.7525	6.8447	-0.1170
Cheddar Cheese	0.0090	-0.0058	-0.0059	-0.0228	-0.0254	-0.0235	-0.0001	0.0067
	0.8412	-0.5232	-0.5353	-2.7322	-4.1185	-4.1306	-0.1809	3.8608
Other Cheeses	-0.0127	-0.0033	0.0033	0.0502	-0.0155	-0.0359	-0.0023	-0.0010
	-0.8724	-0.2197	0.2238	4.3976	-1.4761	-4.6196	-5.5591	-0.4264

Table A2.20: Marshallian Elasticities With Demographic Variables (SUR): Ontario

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.8015	0.6867	0.3123	0.6833	0.3939	0.7254
	-9.9786	5.9358	2.3277	5.0377	3.6046	29.7009
2% Fluid Milk	0.2053	-1.4005	0.0496	0.2233	0.2357	0.6867
	5.8272	-8.0531	1.7218	7.0449	6.6838	232.5874
Butter	0.3570	0.0055	-1.6150	0.0236	0.0080	1.2209
	2.0004	0.0019	5.4082	0.0149	0.0041	18.5180
Cheddar Cheese	0.6135	0.4517	-0.0078	-2.6921	0.1246	1.5103
	19.1034	17.5888	0.0027	73.7972	1.3523	126.9781
Other Cheeses	0.1119	0.1142	-0.0064	0.0781	-1.6199	1.3221
	4.7506	4.4276	0.0211	2.5717	84.3637	138.5281

Table A2.21 : Coefficients Without Demographic Variables (SUR): Prairies

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.0332 -0.5451	-0.2312 -7.6018	0.1305 5.9272	0.0403 2.3065	0.0481 2.3021	0.0620 3.3928	-0.0497 -7.5021
2% Fluid Milk	0.1150 2.0497	0.1349 6.0260	-0.2406 -8.2401	0.0373 2.6022	0.0809 4.4693	0.1089 5.8663	-0.1215 -15.5410
Butter	0.1740 4.1599	0.0371 2.1329	0.0295 2.1019	-0.0772 -3.3506	0.0000 -0.0023	0.1028 0.8206	0.0004 0.1027
Cheddar Cheese	0.3180 5.6512	0.0288 1.3830	0.0398 2.2415	-0.0043 -0.2285	-0.1761 -6.2233	0.0436 2.7174	0.0682 13.7200
Other Cheeses	0.4262 8.8390	0.0303 1.6500	0.0407 2.2137	0.0039 0.3121	0.0471 2.9104	-0.3173 -10.5015	0.1027 16.4419

Table A2.22: Marshallian Elasticities Without Demographic Variables (SUR): Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.2027 57.7869	0.6791 35.1313	0.2094 5.3199	0.2504 5.2996	0.3226 11.5111	0.7412 56.2819
2% Fluid Milk	0.3543 36.3126	-1.6317 67.8999	0.0979 6.7712	0.2126 19.9747	0.2861 34.4139	0.6808 241.5114
Butter	0.5920 4.5492	0.4715 4.4179	-2.2334 11.2266	-0.0007 0.0000	1.6424 0.6733	1.0063 0.0105
Cheddar Cheese	0.2309 1.9128	0.3191 5.0242	-0.0341 0.0522	-2.4110 38.7301	0.3491 7.3842	1.5460 188.2428
Other Cheeses	0.1266 2.7224	0.1699 4.9003	0.0165 0.0974	0.1965 8.4702	-2.3244 110.2821	1.4288 270.3367

Table A2.23: Price and Expenditure Coefficients With Demographic Variables (SUR): Prairies

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.1603 -2.0881	-0.2291 -7.5128	0.1354 6.1603	0.0431 2.4474	0.0450 2.1466	0.0655 3.5852	-0.0600 -8.5393
2% Fluid Milk	0.2641 3.3080	0.1388 6.2216	-0.2409 -8.3713	0.0325 2.2759	0.0858 4.7589	0.1203 6.5475	-0.1365 -16.7270
Butter	0.1031 2.0692	0.0381 2.1709	0.0215 1.5291	-0.0822 -3.4927	0.0075 0.3976	0.0085 0.6731	0.0066 1.6309
Cheddar Cheese	0.3483 5.2148	0.0230 1.1010	0.0400 2.2571	0.0036 0.1909	-0.1804 -6.3384	0.0382 2.3810	0.0755 14.3650
Other Cheeses	0.4448 6.7312	0.0291 1.5843	0.0440 2.4131	0.0029 0.2270	0.0420 2.5950	-0.2325 -10.8746	0.1144 17.3088

Table A2.24: Demographic Coefficients (SUR): Prairies

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	0.0013 0.0777	-0.0230 -1.3887	-0.0138 -0.8428	-0.0355 -2.3901	0.0323 3.4005	0.0115 1.3966	-0.0002 -0.4110	0.0113 4.2264
2% Fluid Milk	-0.0097 -0.5177	0.0154 0.8057	0.0367 1.9411	0.0168 0.9727	0.0375 3.3970	0.0808 8.4218	0.0022 4.1085	-0.0250 -8.0267
Butter	-0.0007 -0.0772	-0.0003 -0.0337	0.0141 1.5023	0.0145 1.7260	-0.0154 -2.8693	-0.0120 -2.5784	0.0005 2.0687	0.0027 1.7759
Cheddar Cheese	-0.0146 -1.2116	-0.0102 -0.8315	-0.0137 -1.1260	-0.0235 -2.1264	-0.0305 -4.3376	-0.0307 -5.0213	-0.0011 -3.2675	0.0045 2.2630
Other Cheeses	0.0238 1.5575	0.0181 1.1621	-0.0234 -1.5219	0.0277 1.9714	-0.0238 -2.6597	-0.0495 -6.3617	-0.0014 -3.2989	0.0065 2.5559

Table A2.25: Marshallian Elasticities With Demographic Variables (SUR): Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.1919 56.4425	0.7045 37.9492	0.2244 5.9898	0.2343 4.6079	0.3409 12.8533	0.6877 72.9190
2% Fluid Milk	0.3645 38.7079	-1.6326 70.0785	0.0855 5.1796	0.2253 22.6467	0.3159 42.8694	0.6414 279.7921
Butter	0.6088 4.7127	0.3432 2.3381	-2.3127 12.1993	0.1201 0.1581	0.1351 0.4531	1.1055 2.6598
Cheddar Cheese	0.1845 1.2121	0.3205 5.0945	0.0289 0.0365	-2.4452 40.1751	0.3063 5.6690	1.6050 206.3579
Other Cheeses	0.1216 2.5099	0.1837 5.8230	0.0120 0.0515	0.1755 6.7341	-1.9704 118.2570	1.4776 299.5956

Table A2.26: Coefficients Without Demographic Variables (SUR): British Columbia

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.0995 -1.4935	-0.1883 -5.8974	0.0750 3.2021	0.0539 2.3605	0.0821 3.4429	0.0162 0.8007	-0.0391 -4.7055
2% Fluid Milk	-0.0068 -0.1059	0.0861 3.6026	-0.2387 -7.2594	0.0815 4.0834	0.1435 6.5505	0.0861 3.9289	-0.1585 -15.2760
Butter	0.2880 5.1088	0.0470 2.0699	0.0589 3.0294	-0.1279 -3.7472	-0.0042 -0.1631	0.0064 0.3645	0.0198 3.1516
Cheddar Cheese	0.5352 8.1787	0.0623 2.6275	0.0882 4.1279	-0.0099 -0.3851	-0.2300 -6.6603	0.0007 0.0354	0.0887 12.3920
Other Cheeses	0.2833 5.1803	-0.0071 -0.3520	0.0166 0.7758	0.0024 0.1363	0.0085 0.4317	-0.1095 -4.2204	0.0891 10.1957

Table A2.27: Marshallian Elasticities Without Demographic Variables (SUR): British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.1899	0.4742	0.3408	0.5190	0.1026	0.7532
	34.7793	10.2533	5.5722	11.8537	0.6411	22.1414
2% Fluid Milk	0.2389	-1.6628	0.2263	0.3985	0.2391	0.5600
	12.9785	52.6995	16.6741	42.9088	15.4364	233.3590
Butter	0.4820	0.6046	-2.3122	-0.0430	0.0658	1.2029
	4.2847	9.1772	14.0415	0.0266	0.1329	9.9323
Cheddar Cheese	0.4220	0.5971	-0.0671	-2.5569	0.0047	1.6002
	6.9037	17.0397	0.1483	44.3592	0.0013	153.5542
Other Cheeses	-0.0300	0.0701	0.0102	0.0359	-1.4631	1.3770
	0.1239	0.6018	0.0186	0.1864	17.8121	103.9513

Table A2.28: Price and Expenditure Coefficients With Demographic Variables (SUR): British Columbia

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-0.1682	-0.1875	0.0825	0.0538	0.0806	0.0153	-0.0447
	-1.9299	-5.8800	3.5173	2.3640	3.3770	0.7564	-5.1735
2% Fluid Milk	0.1060	0.0934	-0.2285	0.0774	0.1418	0.0863	-0.1704
	1.0933	3.9136	-6.9460	3.8739	6.4687	3.9399	-15.8180
Butter	0.1506	0.0457	0.0522	-0.1220	-0.0012	0.0016	0.0237
	2.1334	2.0179	2.6737	-3.6068	-0.0467	0.0928	3.6348
Cheddar Cheese	0.6347	0.0585	0.0815	-0.0072	-0.2383	0.0079	0.0976
	7.7257	2.4640	3.8002	-0.2817	-6.9060	0.4010	13.0780
Other Cheeses	0.2769	-0.0101	0.0123	-0.0019	0.0171	-0.1111	0.0937
	3.3849	-0.4987	0.5713	-0.1084	0.8679	-4.2675	10.2093

Table A2.29: Demographic Coefficients (SUR): British Columbia

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age of Head of Household	Education of Head of Household
1 % Fluid Milk	-0.0214	-0.0481	-0.0686	-0.0555	0.0185	0.0128	-0.0005	0.0110
	-1.0282	-2.4289	-3.3989	-3.5559	1.6296	1.2299	-0.9173	3.1761
2% Fluid Milk	0.0226	0.0517	0.0523	0.0265	0.0463	0.0523	0.0015	-0.0175
	0.8703	2.0952	2.0898	1.3661	3.2812	4.0516	2.3472	-4.0603
Butter	0.0132	0.0004	0.0306	0.0238	-0.0117	-0.0022	0.0015	0.0027
	0.8447	0.0300	2.0296	2.0450	-1.3804	-0.2878	3.8885	1.0322
Cheddar Cheese	0.0079	-0.0133	-0.0052	-0.0128	-0.0252	-0.0420	-0.0015	-0.0008
	0.4408	-0.7818	-0.3008	-0.9569	-2.5843	-4.6996	-3.2266	-0.2613
Other Cheeses	-0.0222	0.0093	-0.0091	0.0180	-0.0279	-0.0209	-0.0011	0.0046
	-0.9980	0.4421	-0.4222	1.0815	-2.3037	-1.8830	-1.9971	1.2378

Table A2.30: Marshallian Elasticities With Demographic Variables (SUR): British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheeses	Total Expenditure
1 % Fluid Milk	-2.1848	0.5214	0.3399	0.5091	0.0968	0.7176
	34.5745	12.3712	5.5883	11.4043	0.5722	26.7651
2% Fluid Milk	0.2592	-1.6343	0.2148	0.3938	0.2395	0.5270
	15.3165	48.2471	15.0073	41.8434	15.5231	250.1985
Butter	0.4685	0.5356	-2.2517	-0.0122	0.0167	1.2432
	4.0721	7.1487	13.0092	0.0022	0.0086	13.2117
Cheddar Cheese	0.3961	0.5518	-0.0488	-2.6135	0.0534	1.6609
	6.0711	14.4416	0.0794	47.6930	0.1608	171.0212
Other Cheeses	-0.0426	0.0519	-0.0081	0.0725	-1.4702	1.3966
	0.2487	0.3264	0.0117	0.7533	18.2119	104.2305

APPENDIX 3: GENERALIZED METHOD OF MOMENTS ECONOMETRIC RESULTS FOR ATLANTIC CANADA, PRAIRIES AND BRITISH COLUMBIA

Table A3.1: First Stage Coefficients Without Demographic Variables: Atlantic Canada

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.0569	0.0120	-0.0016	-0.0048	-0.0057	0.0261
	0.0653	**0.0007**	**0.0005**	**0.0021**	0.0031	**0.0128**
Other Dairy	-0.0370	-0.0016	0.0101	-0.0031	-0.0054	0.0186
	0.0568	**0.0005**	**0.0006**	0.0018	**0.0027**	0.0111
Other Food	-0.0195	-0.0048	-0.0031	0.1141	-0.1062	0.0782
	0.2699	**0.0021**	0.0018	**0.0093**	**0.0129**	0.0529
Non-Food	1.1134	-0.0057	-0.0054	-0.1062	0.1173	-0.1228
	0.3862	0.0031	**0.0027**	**0.0129**	**0.0183**	0.0757

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.2: First Stage Marshallian Elasticities Without Demographic Variables: Atlantic Canada

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3428	-0.1096	-0.5600	-1.4702	2.4825
	0.0477	**0.0387**	**0.2597**	**0.3882**	**0.7255**
Other Dairy	-0.1344	-0.3027	-0.4779	-1.4068	2.3218
	0.0494	**0.0487**	0.2833	**0.4194**	**0.7879**
Other Food	-0.0317	-0.0216	-0.4910	-0.8579	1.4022
	0.0154	0.0131	**0.1003**	**0.1454**	**0.2724**
Non-Food	-0.0045	-0.0047	-0.1064	-0.7256	0.8413
	0.0056	0.0048	**0.0355**	**0.0522**	**0.0977**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[43]

[43] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.3: First Stage Hicksian Elasticities Without Demographic Variables: Atlantic Canada

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2991	-0.0747	-0.0775	0.4513
	0.0371	**0.0291**	0.1193	**0.1748**
Other Dairy	-0.0935	-0.2701	-0.0267	0.3903
	0.0365	**0.0402**	0.1310	**0.1927**
Other Food	-0.0070	-0.0019	-0.2185	0.2274
	0.0108	0.0095	**0.0480**	**0.0663**
Non-Food	0.0103	0.0071	0.0571	-0.0745
	0.0040	**0.0035**	**0.0166**	**0.0236**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[44]

Table A3.4: Second Stage Coefficients Without Demographic Variables: Atlantic Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2973	-0.1722	0.0985	0.0075	0.0317	0.0346	0.0295
	0.0874	**0.0285**	**0.0144**	0.0136	0.0163	**0.0128**	**0.0078**
2% Fluid Milk	0.4099	0.0985	-0.2846	0.0079	0.0825	0.0957	-0.0424
	0.1082	**0.0144**	**0.0293**	0.0122	**0.0147**	**0.0175**	**0.0117**
Butter	0.2054	0.0075	0.0079	-0.0445	0.0185	0.0107	-0.0129
	0.0529	0.0136	0.0122	0.0298	**0.0174**	0.0106	0.0068
Cheddar Cheese	0.3230	0.0317	0.0825	0.0185	-0.1889	0.0562	0.0059
	0.0637	0.0163	**0.0147**	**0.0174**	**0.0318**	**0.0122**	**0.0077**
Other Cheese	0.3590	0.0346	0.0957	0.0107	0.0562	-0.1972	0.0200
	0.0867	**0.0128**	**0.0175**	0.0106	**0.0122**	**0.0269**	**0.0097**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[44] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.5: Second Stage Marshallian Elasticities Without Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.4577 **0.2395**	0.7219 **0.1039**	0.0433 0.1129	0.2327 0.1355	0.2155 **0.1062**	1.2443 **0.0645**
2% Fluid Milk	0.2674 **0.0380**	-1.6923 **0.0727**	0.0289 0.0318	0.2265 **0.0387**	0.2790 **0.0472**	0.8905 **0.0301**
Butter	0.1164 0.1717	0.1654 0.1349	-1.5594 0.3865	0.2576 0.2233	0.1854 0.1369	0.8345 **0.0868**
Cheddar Cheese	0.2515 0.1308	0.6513 **0.1055**	0.1462 0.1414	-2.5387 **0.2617**	0.4422 **0.1001**	1.0475 **0.0628**
Other Cheese	0.1105 **0.0440**	0.3024 **0.0560**	0.0314 0.0364	0.1847 **0.0424**	-1.6976 **0.0955**	1.0687 **0.0332**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[45]

Table A3.6: Second Stage Hicksian Elasticities Without Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.3077 **0.2364**	1.2039 **0.1195**	0.1401 0.1129	0.3861 **0.1351**	0.5776 **0.1058**
2% Fluid Milk	0.3748 **0.0372**	-1.3474 **0.0756**	0.0982 **0.0314**	0.3362 **0.0379**	0.5382 **0.0451**
Butter	0.2171 0.1748	0.4886 **0.1562**	-1.4944 0.3832	0.3605 0.2236	0.4282 **0.1356**
Cheddar Cheese	0.3778 **0.1323**	1.0570 **0.1190**	0.2278 0.1413	-2.4096 **0.2584**	0.7471 **0.0993**
Other Cheese	0.2393 **0.0439**	0.7164 **0.0601**	0.1146 **0.0363**	0.3163 **0.0421**	-1.3866 **0.0926**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[46]

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[45] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.
[46] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.7: Total Marshallian Elasticities Without Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.3701	0.9174	0.0798	0.3071	0.3949	3.0891
2% Fluid Milk	0.3728	-1.4543	0.0735	0.3164	0.4959	2.2107
Butter	0.2246	0.4101	-1.5134	0.3500	0.4081	2.0718
Cheddar Cheese	0.3490	0.8704	0.1873	-2.4557	0.6425	2.6005
Other Cheese	0.2069	0.5190	0.0719	0.2667	-1.4996	2.6530

Table A3.8: Total Hicksian Elasticities Without Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.3635	0.9342	0.1266	0.6017	0.3949
2% Fluid Milk	0.3775	-1.4423	0.1070	0.5273	0.4959
Butter	0.2290	0.4213	-1.4821	0.5476	0.4081
Cheddar Cheese	0.3545	0.8846	0.2266	-2.2077	0.6425
Other Cheese	0.2126	0.5335	0.1121	0.5198	-1.4996

Table A3.9: First Stage Price and Expenditure Coefficients With Demographic Variables: Atlantic Canada

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.0721 0.0632	0.0121 **0.0006**	-0.0015 **0.0005**	-0.0049 **0.0020**	-0.0057 0.0030	0.0272 **0.0123**
Other Dairy	-0.0386 0.0546	-0.0015 **0.0005**	0.0101 **0.0006**	-0.0032 0.0018	-0.0053 **0.0026**	0.0191 0.0106
Other Food	-0.0356 0.2627	-0.0049 **0.0020**	-0.0032 0.0018	0.1140 **0.0091**	-0.1058 **0.0125**	0.0814 0.0514
Non-Food	1.1464 **0.3743**	-0.0057 0.0030	-0.0053 **0.0026**	-0.1058 **0.0125**	0.1168 **0.0176**	-0.1277 0.0732

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.10: First Stage Demographic Coefficients: Atlantic Canada

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	-0.0008	-0.0009	-0.0001	0.0006	-0.0007	-0.0004	0.0000	0.0001
	0.0005	0.0005	0.0005	0.0010	**0.0003**	0.0002	0.0000	0.0001
Other Dairy	-0.0008	-0.0001	0.0006	0.0004	-0.0006	0.0001	0.0000	-0.0001
	0.0005	0.0005	0.0006	0.0007	**0.0002**	0.0002	0.0000	0.0001
Other Food	-0.0053	-0.0071	-0.0045	-0.0014	-0.0016	-0.0006	0.0001	0.0000
	0.0022	**0.0022**	**0.0023**	0.0031	0.0012	0.0011	0.0001	0.0004
Non-Food	0.0069	0.0081	0.0040	0.0004	0.0029	0.0009	-0.0001	-0.0001
	0.0026	**0.0026**	0.0026	0.0038	**0.0013**	0.0013	0.0001	0.0004

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.11: First Stage Marshallian Elasticities With Demographic Variables: Atlantic Canada

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3381	-0.1083	-0.5813	-1.5207	2.5484
	0.0461	**0.0372**	**0.2498**	**0.3742**	**0.6979**
Other Dairy	-0.1323	-0.3023	-0.4942	-1.4283	2.3571
	0.0474	**0.0472**	0.2725	**0.4028**	**0.7561**
Other Food	-0.0328	-0.0225	-0.4948	-0.8687	1.4188
	0.0148	0.0127	**0.0976**	**0.1414**	**0.2646**
Non-Food	-0.0044	-0.0045	-0.1047	-0.7214	0.8350
	0.0054	0.0046	**0.0344**	**0.0506**	**0.0945**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[47]

[47] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.12: First Stage Hicksian Elasticities With Demographic Variables: Atlantic Canada

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2932 **0.0360**	-0.0725 **0.0281**	-0.0860 0.1148	0.4518 **0.1677**
Other Dairy	-0.0908 **0.0352**	-0.2692 **0.0392**	-0.0361 0.1263	0.3961 **0.1849**
Other Food	-0.0078 0.0104	-0.0026 0.0091	-0.2190 **0.0468**	0.2294 **0.0643**
Non-Food	0.0103 **0.0038**	0.0072 **0.0034**	0.0576 **0.0161**	-0.0751 **0.0228**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[48]

Table A3.13: Second Stage Price and Expenditure Coefficients With Demographic Variables: Atlantic Canada

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.3583 **0.0932**	-0.1561 **0.0302**	0.0944 **0.0149**	0.0078 0.0141	0.0281 0.0160	0.0258 **0.0131**	0.0253 **0.0086**
2% Fluid Milk	0.3135 **0.1170**	0.0944 **0.0149**	-0.2841 **0.0293**	0.0143 0.0122	0.0816 **0.0147**	0.0937 **0.0174**	-0.0403 **0.0126**
Butter	0.1496 **0.0563**	0.0078 0.0141	0.0143 0.0122	-0.0526 **0.0297**	0.0146 0.0170	0.0159 0.0110	-0.0040 0.0066
Cheddar Cheese	0.3421 **0.0706**	0.0281 0.0160	0.0816 **0.0147**	0.0146 0.0170	-0.1786 **0.0315**	0.0544 0.0124	0.0055 0.0081
Other Cheese	0.5531 **0.0948**	0.0258 **0.0131**	0.0937 **0.0174**	0.0159 0.0110	0.0544 0.0124	-0.1898 **0.0267**	0.0136 0.0105

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[48] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.14: Second Stage Demographic Coefficients: Atlantic Canada

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	0.0280 0.0151	0.0083 0.0152	0.0066 0.0153	-0.0294 0.0191	-0.0169 **0.0077**	-0.0030 0.0075	0.0005 0.0004	0.0079 **0.0025**
2% Fluid Milk	-0.0481 **0.0237**	-0.0581 **0.0241**	-0.0032 0.0246	0.0273 0.0298	0.0259 **0.0127**	0.0234 **0.0117**	0.0022 **0.0007**	-0.0023 0.0039
Butter	-0.0014 0.0106	0.0210 0.0118	0.0293 **0.0123**	0.0399 **0.0173**	0.0021 0.0059	-0.0013 0.0056	0.0009 **0.0004**	-0.0058 **0.0021**
Cheddar Cheese	-0.0034 0.0152	-0.0024 0.0151	-0.0384 **0.0141**	-0.0074 0.0180	-0.0024 0.0072	-0.0070 0.0072	-0.0005 0.0005	0.0010 0.0024
Other Cheese	0.0249 0.0198	0.0312 0.0204	0.0057 0.0202	-0.0304 0.0240	-0.0087 0.0107	-0.0121 0.0101	-0.0031 **0.0006**	-0.0007 0.0033

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.15: Second Stage Marshallian Elasticities With Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.3195 **0.2542**	0.7021 **0.1061**	0.0482 0.1169	0.2068 0.1333	0.1530 0.1080	1.2094 **0.0716**
2% Fluid Milk	0.2563 **0.0393**	-1.6932 **0.0726**	0.0450 0.0319	0.2236 **0.0390**	0.2722 **0.0471**	0.8960 **0.0325**
Butter	0.1061 0.1792	0.2038 0.1372	-1.6712 0.3843	0.1934 0.2180	0.2195 0.1412	0.9485 **0.0844**
Cheddar Cheese	0.2223 0.1287	0.6454 **0.1058**	0.1147 0.1378	-2.4550 **0.2592**	0.4282 **0.1004**	1.0444 **0.0657**
Other Cheese	0.0830 0.0452	0.3040 **0.0552**	0.0511 **0.3779**	0.1810 **0.0428**	-1.6657 **0.0952**	1.0466 **0.0362**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[49]

[49] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.16: Second Stage Hicksian Elasticities With Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1737	1.1705	0.1423	0.3559	0.5049
	0.2504	**0.1234**	0.1172	**0.1328**	**0.1088**
2% Fluid Milk	0.3644	-1.3461	0.1148	0.3340	0.5329
	0.0384	**0.0756**	**0.0314**	**0.0381**	**0.0448**
Butter	0.2204	0.5712	-1.5973	0.3102	0.4955
	0.1816	**0.1564**	0.3814	0.2180	**0.1408**
Cheddar Cheese	0.3482	1.0500	0.1960	-2.3263	0.7321
	0.1300	**0.1196**	0.1378	**0.2555**	**0.1003**
Other Cheese	0.2092	0.7094	0.1326	0.3100	-1.3612
	0.0451	**0.0597**	**0.0377**	**0.0425**	**0.0918**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[50]

Table A3.17: Total Marshallian Elasticities With Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.2319	0.9050	0.0916	0.2832	0.3338	3.0821
2% Fluid Milk	0.3590	-1.4528	0.0963	0.3135	0.4850	2.2834
Butter	0.2062	0.4378	-1.6212	0.2810	0.4270	2.4171
Cheddar Cheese	0.3178	0.8681	0.1623	-2.3715	0.6258	2.6614
Other Cheese	0.1784	0.5264	0.0986	0.2644	-1.4683	2.6672

[50] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.18: Total Hicksian Elasticities With Demographic Variables: Atlantic Canada

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.2254	0.9218	0.1382	0.5772	0.3338
2% Fluid Milk	0.3638	-1.4404	0.1309	0.5313	0.4850
Butter	0.2114	0.4510	-1.5846	0.5115	0.4270
Cheddar Cheese	0.3235	0.8826	0.2026	-2.1177	0.6258
Other Cheese	0.1841	0.5409	0.1390	0.5188	-1.4683

Table A3.19: First Stage Coefficients Without Demographic Variables: Prairies

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0320	0.0115	-0.0009	-0.0002	-0.0104	0.0063
	0.0727	**0.0008**	0.0006	0.0020	**0.0032**	0.0143
Other Dairy	0.0172	-0.0009	0.0087	-0.0006	-0.0072	0.0066
	0.0582	0.0006	**0.0006**	0.0017	**0.0026**	0.0114
Other Food	1.1958	-0.0002	-0.0016	0.1705	-0.1686	-0.1626
	0.2560	0.0020	0.0017	**0.0089**	**0.0118**	**0.0506**
Non-Food	-0.2450	-0.0104	-0.0061	-0.1697	0.1862	0.1498
	0.3731	**0.0032**	**0.0026**	**0.0118**	**0.0166**	**0.0736**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.20: First Stage Marshallian Elasticities Without Demographic Variables: Prairies

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3578	-0.0563	-0.0783	-0.8619	1.3544
	0.0552	0.0405	0.2697	0.4492	0.8068
Other Dairy	-0.0874	-0.2743	-0.1583	-1.0370	1.5570
	0.0626	**0.0559**	0.3248	0.5335	0.9610
Other Food	0.0140	0.0015	0.0510	-0.2190	0.1525
	0.0149	0.0116	**0.0954**	0.1456	0.2636
Non-Food	-0.0167	-0.0102	-0.2549	-0.9106	1.1924
	0.0057	**0.0044**	**0.0328**	0.0526	**0.0945**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[51]

[51] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.21: First Stage Hicksian Elasticities Without Demographic Variables: Prairies

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.3339	-0.0402	0.1816	0.1925
	0.0427	0.0314	0.1159	0.1802
Other Dairy	-0.0599	-0.2558	0.1405	0.1752
	0.0467	**0.0474**	0.1414	0.2170
Other Food	0.0167	0.0033	0.0802	-0.1003
	0.0107	0.0088	**0.0466**	0.0613
Non-Food	0.0044	0.0040	-0.0260	0.0177
	0.0041	0.0033	0.0151	**0.0214**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[52]

Table A3.22: Second Stage Coefficients Without Demographic Variables: Prairies

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.1439	-0.2313	0.1184	0.0224	0.0330	0.0574	0.0079
	0.1184	**0.0358**	**0.0188**	0.0151	0.0206	**0.0146**	0.0097
2% Fluid Milk	0.5957	0.1184	-0.2382	0.0172	0.0418	0.0608	-0.0567
	0.1322	**0.0188**	**0.0366**	0.0117	**0.0204**	**0.0189**	**0.0123**
Butter	0.1705	0.0224	0.0172	-0.1014	0.0327	0.0290	-0.0062
	0.0585	0.0151	0.0117	**0.0273**	**0.0162**	**0.0089**	0.0072
Cheddar Cheese	0.0778	0.0330	0.0418	0.0327	-0.1675	0.0599	0.0288
	0.0833	0.0206	**0.0204**	**0.0162**	**0.0391**	**0.0159**	**0.0085**
Other Cheese	0.2999	0.0574	0.0608	0.0290	0.0599	-0.2071	0.0262
	0.1033	**0.0146**	**0.0189**	**0.0089**	**0.0159**	**0.0302**	**0.0104**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[52] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.23: Second Stage Marshallian Elasticities Without Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.2907	0.6427	0.1208	0.1768	0.3066	1.0439
	0.2012	**0.0986**	0.0838	0.1143	**0.0812**	**0.0537**
2% Fluid Milk	0.4002	-1.6845	0.0672	0.1560	0.2375	0.8236
	0.0589	**0.1135**	0.0366	**0.0641**	**0.0599**	**0.0381**
Butter	0.3036	0.2479	-2.3030	0.4346	0.3970	0.9200
	0.1884	0.1375	**0.3567**	**0.2088**	**0.1172**	**0.0926**
Cheddar Cheese	0.1898	0.2219	0.2080	-2.1704	0.3543	1.1963
	0.1376	0.1339	0.1103	**0.2700**	**0.1073**	**0.0582**
Other Cheese	0.1922	0.1910	0.0985	0.2043	-1.7816	1.0955
	0.0532	**0.0670**	**0.0326**	**0.0586**	**0.1122**	**0.0380**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[53]

Table A3.24: Second Stage Hicksian Elasticities Without Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1025	0.9781	0.2017	0.3299	0.5928
	0.1984	**0.1042**	0.0839	**0.1142**	**0.0811**
2% Fluid Milk	0.5487	-1.4198	0.1310	0.2768	0.4633
	0.0585	**0.1138**	**0.0363**	**0.0635**	**0.0587**
Butter	0.4694	0.5435	-2.2318	0.5695	0.6493
	0.1953	**0.1506**	**0.3530**	**0.2090**	**0.1153**
Cheddar Cheese	0.4055	0.6064	0.3007	-1.9949	0.6824
	0.1404	**0.1392**	**0.1104**	**0.2664**	**0.1084**
Other Cheese	0.3897	0.5430	0.1834	0.3650	-1.4812
	0.0533	**0.0688**	**0.0326**	**0.0580**	**0.1100**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[54]

[53] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.
[54] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.25: Total Marshallian Elasticities Without Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.1726	0.8070	0.1653	0.2874	0.4954	1.4138
2% Fluid Milk	0.5331	-1.4989	0.1173	0.2803	0.4499	1.1155
Butter	0.4300	0.4242	-2.2554	0.5529	0.5991	1.2460
Cheddar Cheese	0.2977	0.3717	0.2486	-2.0692	0.5269	1.6203
Other Cheese	0.3069	0.3504	0.1417	0.3118	-1.5982	1.4837

Table A3.26: Total Hicksian Elasticities Without Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1681	0.8124	0.1863	0.4489	0.4954
2% Fluid Milk	0.5367	-1.4946	0.1339	0.4077	0.4499
Butter	0.4340	0.4289	-2.2369	0.6952	0.5991
Cheddar Cheese	0.3028	0.3779	0.2727	-1.8842	0.5269
Other Cheese	0.3116	0.3561	0.1637	0.4812	-1.5982

Table A3.27: First Stage Price and Expenditure Coefficients With Demographic Variables: Prairies

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.0724 0.0708	0.0118 **0.0007**	-0.0007 0.0005	0.0007 0.0020	-0.0119 **0.0031**	-0.0015 0.0140
Other Dairy	0.0434 0.0573	-0.0007 0.0005	0.0090 **0.0006**	0.0000 0.0017	-0.0084 **0.0025**	0.0015 0.0113
Other Food	1.2273 **0.2522**	0.0007 0.0020	0.0000 0.0017	0.1680 **0.0087**	-0.1688 **0.0116**	-0.1691 **0.0503**
Non-Food	-0.3431 0.3682	-0.0119 **0.0031**	-0.0084 **0.0025**	-0.1688 **0.0116**	0.1890 **0.0165**	0.1691 **0.0732**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.28: First Stage Demographic Coefficients: Prairies

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	0.0006 0.0006	0.0001 0.0005	0.0005 0.0005	0.0007 0.0006	0.0000 0.0003	-0.0001 0.0003	0.0000 0.0000	-0.0001 0.0001
Other Dairy	0.0005 0.0005	0.0005 0.0005	0.0006 0.0005	0.0002 0.0005	-0.0003 0.0002	-0.0003 0.0002	0.0000 0.0000	0.0000 0.0001
Other Food	-0.0051 0.0028	0.0030 0.0025	0.0054 **0.0026**	-0.0020 0.0023	-0.0034 **0.0014**	-0.0015 0.0013	0.0001 0.0001	-0.0005 0.0005
Non-Food	0.0040 0.0032	-0.0035 0.0029	-0.0065 **0.0030**	0.0011 0.0027	0.0037 **0.0016**	0.0018 0.0015	-0.0001 0.0001	0.0006 0.0005

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.29: First Stage Marshallian Elasticities With Demographic Variables: Prairies

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.3304 **0.0532**	-0.0360 0.0392	0.0583 0.2649	-0.6058 0.4393	0.9142 0.7886
Other Dairy	-0.0573 0.0608	-0.2425 **0.0565**	-0.0247 0.3219	-0.8031 0.5282	1.1272 0.9509
Other Food	0.0191 0.0148	0.0103 0.0116	0.0312 **0.0939**	-0.1907 0.1453	0.1326 0.2623
Non-Food	-0.0191 **0.0056**	-0.0133 **0.0043**	-0.2591 **0.0326**	-0.9262 **0.0524**	1.2172 **0.0941**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[55]

[55] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.30: First Stage Hicksian Elasticities With Demographic Variables: Prairies

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.3143	-0.0251	0.2365	0.1059
	0.0410	0.0303	**0.1146**	0.1761
Other Dairy	-0.0374	-0.2291	0.1950	0.0745
	0.0451	**0.0481**	0.1404	0.2145
Other Food	0.0215	0.0119	0.0571	-0.0874
	0.0106	0.0087	**0.0451**	0.0637
Non-Food	0.0024	0.0011	-0.0219	0.0213
	0.0040	0.0033	0.0149	**0.0212**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[56]

Table A3.31: Second Stage Price and Expenditure Coefficients With Demographic Variables: Prairies

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.1879	-0.2218	0.1153	0.0230	0.0276	0.0559	-0.0016
	0.1281	**0.0370**	**0.0188**	0.0151	0.0210	**0.0154**	0.0104
2% Fluid Milk	0.5870	0.1153	-0.2434	0.0093	0.0444	0.0744	-0.0451
	0.1416	**0.0188**	**0.0359**	0.0121	**0.0205**	**0.0183**	**0.0126**
Butter	0.0295	0.0230	0.0093	-0.0898	0.0342	0.0234	0.0009
	0.0635	0.0151	0.0121	0.0281	**0.0165**	**0.0092**	0.0080
Cheddar Cheese	0.1296	0.0276	0.0444	0.0342	-0.1629	0.0567	0.0262
	0.0969	0.0210	**0.0205**	**0.0165**	**0.0393**	**0.0161**	**0.0092**
Other Cheese	0.4417	0.0559	0.0744	0.0234	0.0567	-0.2103	0.0196
	0.1180	**0.0154**	**0.0183**	**0.0092**	**0.0161**	**0.0300**	0.0112

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[56] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.32: Second Stage Demographic Coefficients: Prairies

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	-0.0078 0.0198	-0.0276 0.1929	-0.0160 0.0198	-0.0289 0.0174	0.0214 0.0117	0.0059 0.0095	0.0007 0.0006	0.0095 **0.0031**
2% Fluid Milk	0.0104 0.0240	0.0308 0.0238	0.0212 0.0236	0.0398 0.0222	0.0222 0.0139	0.0586 **0.0121**	0.0020 **0.0007**	-0.0221 **0.0040**
Butter	-0.0091 0.0122	-0.0150 0.0123	0.0150 0.0130	0.0050 0.0117	-0.0161 **0.0062**	-0.0145 **0.0062**	0.0009 **0.0004**	0.0026 0.0024
Cheddar Cheese	-0.0133 0.0170	-0.0121 0.0171	-0.0090 0.0171	-0.0441 **0.0137**	-0.0191 **0.0094**	-0.0185 **0.0086**	-0.0013 **0.0005**	0.0048 0.0026
Other Cheese	0.0197 0.0212	0.0240 0.0212	-0.0113 0.0207	0.0281 0.0200	-0.0083 0.0124	-0.0315 **0.0108**	-0.0024 **0.0006**	0.0052 0.0035

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.33: Second Stage Marshallian Elasticities With Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.2285 **0.2079**	0.6424 **0.0988**	0.1281 0.0837	0.1545 0.1169	0.3125 **0.0857**	0.9910 **0.0578**
2% Fluid Milk	0.3840 **0.0592**	-1.7122 **0.1113**	0.0398 0.0379	0.1588 **0.0643**	0.2700 **0.0583**	0.8596 **0.0391**
Butter	0.2944 0.1882	0.1164 0.1427	-2.1610 **0.3671**	0.4399 **0.2130**	0.2985 **0.1195**	1.0118 **0.1038**
Cheddar Cheese	0.1560 0.1407	0.2453 0.1346	0.2193 0.1124	-2.1370 **0.2713**	0.3374 **0.1088**	1.1789 **0.0627**
Other Cheese	0.1909 **0.0560**	0.2483 **0.0653**	0.0797 **0.0337**	0.1963 **0.0592**	-1.7867 **0.1118**	1.0714 **0.0410**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[57]

[57] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.34: Second Stage Hicksian Elasticities With Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.0498 **0.2052**	0.9609 **0.1045**	0.2048 **0.0837**	0.2999 **0.1166**	0.5842 **0.0853**
2% Fluid Milk	0.5390 **0.0586**	-1.4360 **0.1116**	0.1064 **0.0375**	0.2849 **0.0637**	0.5057 **0.0571**
Butter	0.4769 **0.1948**	0.4415 **0.1557**	-2.0826 **0.3632**	0.5883 **0.2130**	0.5759 **0.1192**
Cheddar Cheese	0.3686 **0.1433**	0.6242 **0.1395**	0.3106 **0.1125**	-1.9640 **0.2678**	0.6607 **0.1095**
Other Cheese	0.3841 **0.0561**	0.5927 **0.0669**	0.1626 **0.0337**	0.3534 **0.0586**	-1.4929 **0.1096**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[58]

Table A3.35: Total Marshallian Elasticities With Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.1083	0.8275	0.1808	0.2712	0.5104	0.9059
2% Fluid Milk	0.5119	-1.5151	0.0959	0.2830	0.4806	0.7858
Butter	0.4133	0.2995	-2.1088	0.5554	0.4944	0.9250
Cheddar Cheese	0.2650	0.4130	0.2671	-2.0309	0.5172	1.0778
Other Cheese	0.3063	0.4260	0.1303	0.3084	-1.5965	0.9795

Table A3.36: Total Hicksian Elasticities With Demographic Variables: Prairies

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.1054	0.8309	0.1945	0.3747	0.5104
2% Fluid Milk	0.5144	-1.5121	0.1078	0.3727	0.4806
Butter	0.4163	0.3030	-2.0948	0.6610	0.4944
Cheddar Cheese	0.2685	0.4172	0.2834	-1.9078	0.5172
Other Cheese	0.3094	0.4297	0.1451	0.4203	-1.5965

[58] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.37: First Stage Coefficients Without Demographic Variables: British Columbia

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.1511 0.0850	0.0132 **0.0009**	0.0003 0.0006	0.0025 0.0027	-0.0161 **0.0040**	-0.0160 0.0166
Other Dairy	0.1128 0.0604	0.0003 0.0006	0.0093 **0.0006**	0.0017 0.0019	-0.0113 **0.0028**	-0.0119 0.0118
Other Food	0.8922 **0.3118**	0.0025 0.0027	0.0017 0.0019	0.1434 **0.0104**	-0.1475 **0.0144**	-0.1013 0.0614
Non-Food	-0.1560 0.4449	-0.0161 **0.0040**	-0.0113 **0.0028**	-0.1475 **0.0144**	0.1750 **0.0204**	0.1292 0.0875

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.38: First Stage Marshallian Elasticities Without Demographic Variables: British Columbia

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.2024 **0.0692**	0.0311 0.0449	0.3311 0.3506	-0.2132 0.5330	0.0532 0.9820
Other Dairy	0.0474 0.0675	-0.1775 **0.0571**	0.3468 0.3649	-0.1820 0.5551	-0.0346 1.0261
Other Food	0.0218 0.0192	0.0147 0.0133	-0.1589 **0.1136**	-0.3550 **0.1748**	0.4774 0.3171
Non-Food	-0.0235 **0.0069**	-0.0165 **0.0048**	-0.2219 **0.0400**	-0.9042 0.0619	1.1661 **0.1125**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[59]

[59] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.39: First Stage Hicksian Elasticities Without Demographic Variables: British Columbia

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2015 **0.0555**	0.0318 0.0349	0.3414 **0.1617**	-0.1718 0.2342
Other Dairy	0.0468 0.0515	-0.1779 **0.0483**	0.3401 **0.1674**	-0.2090 0.2467
Other Food	0.0299 **0.0141**	0.0202 **0.0993**	-0.0664 **0.0539**	0.0164 0.0744
Non-Food	-0.0037 0.0051	-0.0031 0.0036	0.0041 0.0185	0.0027 **0.0263**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[60]

Table A3.40: Second Stage Coefficients Without Demographic Variables: British Columbia

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.3247 **0.1236**	-0.1748 **0.0365**	0.0966 **0.0200**	0.0183 0.0194	0.0329 0.0193	0.0270 0.0143	0.0317 **0.0101**
2% Fluid Milk	0.5635 **0.1553**	0.0966 **0.0200**	-0.2358 **0.0434**	0.0418 **0.0196**	0.0567 **0.0247**	0.0408 0.0222	-0.0587 **0.0147**
Butter	0.2151 **0.0827**	0.0183 0.0194	0.0418 **0.0196**	-0.0989 **0.0448**	0.0187 0.0260	0.0201 0.0143	-0.0017 0.0100
Cheddar Cheese	0.4471 **0.1053**	0.0329 0.0193	0.0567 **0.0247**	0.0187 0.0260	-0.1506 **0.0467**	0.0424 0.0186	-0.0057 0.0113
Other Cheese	0.0989 0.1201	0.0270 0.0143	0.0408 0.0222	0.0201 0.0143	0.0424 0.0186	-0.1303 **0.0335**	0.0344 **0.0122**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[60] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.41: Second Stage Marshallian Elasticities Without Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.1905 **0.2458**	0.5757 **0.1260**	0.0980 0.1285	0.1832 0.1289	0.1232 0.0927	1.2104 **0.0667**
2% Fluid Milk	0.3437 **0.0652**	-1.7102 **0.1411**	0.1576 **0.0646**	0.2166 **0.0820**	0.1837 **0.0735**	0.8087 **0.0478**
Butter	0.1661 0.1683	0.3782 **0.1659**	-1.8826 **0.4055**	0.1694 0.2326	0.1842 0.1245	0.9846 **0.0894**
Cheddar Cheese	0.2039 0.1144	0.3533 **0.1442**	0.1166 0.1562	-1.9043 **0.2868**	0.2652 **0.1118**	0.9653 **0.0682**
Other Cheese	0.0823 0.0538	0.1140 0.0822	0.0615 0.0542	0.1383 0.0706	-1.5259 **0.1285**	1.1298 **0.0460**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[61]

Table A3.42: Second Stage Hicksian Elasticities Without Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.0079 **0.2423**	0.9469 **0.1324**	0.2333 0.1289	0.3836 **0.1283**	0.4441 **0.0947**
2% Fluid Milk	0.4656 **0.0651**	-1.4622 **0.1416**	0.2480 **0.0640**	0.3505 **0.0805**	0.3981 **0.0723**
Butter	0.3146 0.1738	0.6802 **0.1756**	-1.7725 0.4009	0.3324 0.2324	0.4453 **0.1277**
Cheddar Cheese	0.3495 **0.1169**	0.6494 **0.1492**	0.2246 0.1570	-1.7445 **0.2822**	0.5211 **0.1123**
Other Cheese	0.2526 **0.0538**	0.4605 **0.0836**	0.1878 **0.0539**	0.3253 **0.0701**	-1.2263 0.1262

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[62]

[61] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.
[62] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.43: Total Marshallian Elasticities Without Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.0526	0.7629	0.1811	0.3039	0.3494	0.0644
2% Fluid Milk	0.4964	-1.5029	0.2497	0.3502	0.4342	0.0431
Butter	0.3124	0.5768	-1.7944	0.2973	0.4241	0.0524
Cheddar Cheese	0.3508	0.5528	0.2052	-1.7757	0.5062	0.0514
Other Cheese	0.2231	0.3053	0.1464	0.2616	-1.2948	0.0601

Table A3.44: Total Hicksian Elasticities Without Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.0524	0.7631	0.1825	0.3122	0.3494
2% Fluid Milk	0.4965	-1.5027	0.2506	0.3558	0.4342
Butter	0.3125	0.5770	-1.7933	0.3041	0.4241
Cheddar Cheese	0.3510	0.5530	0.2063	-1.7691	0.5062
Other Cheese	0.2233	0.3055	0.1477	0.2693	-1.2948

Table A3.45: First Stage Price and Expenditure Coefficients With Demographic Variables: British Columbia

	Constant	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	0.1687 0.0892	0.0133 **0.0009**	0.0003 0.0006	0.0031 0.0029	-0.0166 **0.0041**	-0.0191 0.0174
Other Dairy	0.1193 **0.0607**	0.0003 0.0006	0.0092 **0.0005**	0.0019 0.0019	-0.0114 **0.0028**	-0.0130 0.0118
Other Food	0.9429 **0.3278**	0.0031 0.0029	0.0019 0.0019	0.1456 **0.0108**	-0.1506 **0.0150**	-0.1121 0.0643
Non-Food	-0.2309 0.4650	-0.0166 **0.0041**	-0.0114 **0.0028**	-0.1506 **0.0150**	0.1787 **0.0212**	0.1442 0.0912

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.46: First Stage Demographic Coefficients: British Columbia

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
Dairy Group	-0.0006 0.0009	-0.0004 0.0009	0.0003 0.0010	0.0002 0.0007	0.0001 0.0006	0.0000 0.0004	0.0000 0.0000	-0.0002 0.0003
Other Dairy	0.0005 0.0007	-0.0002 0.0006	0.0009 0.0006	0.0011 **0.0005**	-0.0002 0.0003	-0.0001 0.0003	0.0000 0.0000	-0.0002 0.0001
Other Food	0.0101 **0.0035**	0.0000 0.0033	0.0031 0.0039	-0.0015 0.0028	-0.0013 0.0016	-0.0006 0.0016	0.0000 0.0001	0.0004 0.0006
Non-Food	-0.0099 **0.0043**	0.0006 0.0041	-0.0043 0.0048	0.0002 0.0034	0.0014 0.0020	0.0006 0.0019	0.0000 0.0001	0.0000 0.0008

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.47: First Stage Marshallian Elasticities With Demographic Variables: British Columbia

	Dairy Group	Other Dairy	Other Food	Non-Food	Income
Dairy Group	-0.1988 **0.0702**	0.0300 0.0449	0.4009 0.3670	-0.1063 0.5584	-0.1258 1.0248
Other Dairy	0.0443 0.0671	-0.1832 **0.0557**	0.3869 0.3677	-0.1142 0.5585	-0.1339 1.0300
Other Food	0.0258 0.0202	0.0166 0.0135	-0.1366 **0.1186**	-0.3272 0.1832	0.4215 0.3320
Non-Food	-0.0245 **0.0072**	-0.0168 **0.0049**	-0.2295 **0.0417**	-0.9145 0.0646	1.1854 **0.1172**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[63]

[63] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.48: First Stage Hicksian Elasticities With Demographic Variables: British Columbia

	Dairy Group	Other Dairy	Other Food	Non-Food
Dairy Group	-0.2009 **0.0557**	0.0285 0.0347	0.3766 0.1697	-0.2042 0.2420
Other Dairy	0.0421 0.0512	-0.1847 **0.0470**	0.3610 **0.1694**	-0.2183 0.2466
Other Food	0.0329 **0.0148**	0.0214 **0.0100**	-0.0549 **0.0558**	0.0006 0.0774
Non-Food	-0.0044 0.0053	-0.0032 0.0036	0.0002 0.0193	0.0075 **0.0272**

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[64]

Table A3.49: Second Stage Price and Expenditure Coefficients With Demographic Variables: British Columbia

	Constant	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-0.2431 0.1405	-0.1692 **0.0384**	0.1005 **0.0206**	0.0167 0.0193	0.0234 0.0197	0.0285 0.0149	0.0219 0.0112
2% Fluid Milk	0.5272 **0.1783**	0.1005 **0.0206**	-0.2368 **0.0428**	0.0422 **0.0210**	0.0504 **0.0246**	0.0437 **0.0219**	-0.0492 **0.0157**
Butter	0.0203 0.0900	0.0167 0.0193	0.0422 **0.0210**	-0.0926 **0.0466**	0.0165 0.0260	0.0171 0.0144	0.0090 0.0102
Cheddar Cheese	0.5362 **0.1264**	0.0234 0.0197	0.0504 **0.0246**	0.0165 0.0260	-0.1304 **0.0468**	0.0401 **0.0196**	-0.0133 0.0121
Other Cheese	0.1593 **0.1420**	0.0285 0.0149	0.0437 **0.0219**	0.0171 0.0144	0.0401 **0.0196**	-0.1295 **0.0339**	0.0316 **0.0137**

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

[64] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.50: Second Stage Demographic Coefficients: British Columbia

	Second Quarter	Third Quarter	Fourth Quarter	Foreign Born	Number of Youth	Number of Children	Age	Education
1% Fluid Milk	-0.0109	-0.0341	-0.0703	-0.5710	0.0167	0.0001	-0.0006	0.0078
	0.0252	0.0229	**0.0228**	**0.0166**	0.0126	0.0114	0.0007	**0.0033**
2% Fluid Milk	0.0441	0.0279	0.0332	-0.0051	0.0210	0.0182	0.0018	-0.0129
	0.0339	0.0321	0.0324	0.0253	0.0174	0.0157	**0.0009**	**0.0059**
Butter	0.0105	0.0025	0.0254	0.0476	-0.0116	0.0016	0.0017	-0.0007
	0.0199	0.0185	0.0198	**0.0163**	0.0085	0.0089	**0.0005**	**0.0038**
Cheddar Cheese	-0.0002	0.0021	0.0239	-0.0120	-0.0101	-0.0163	-0.0017	0.0024
	0.2287	0.0215	0.0223	0.0170	0.0117	0.0110	**0.0006**	0.0039
Other Cheese	-0.0435	0.0015	-0.0123	0.5405	-0.0161	-0.0036	-0.0012	0.0034
	0.0299	0.0286	0.0286	0.0225	0.0154	0.0145	0.0008	0.0047

Coefficients and Constant above with Standard Error Below
Standard Error bold if H_0: Coefficient =0 is rejected at a 95% confidence level

Table A3.51: Second Stage Marshallian Elasticities With Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Expenditure
1% Fluid Milk	-2.1436	0.6219	0.0947	0.1312	0.1508	1.1451
	0.2580	**0.1315**	0.1277	0.1310	0.0980	**0.0745**
2% Fluid Milk	0.3519	-1.7229	0.1556	0.1907	0.1850	0.8397
	0.0671	**0.1396**	**0.0689**	**0.0816**	**0.0726**	**0.0511**
Butter	0.1374	0.3528	-1.8373	0.1344	0.1318	1.0809
	0.1673	**0.1778**	**0.4212**	0.2317	0.1256	**0.0912**
Cheddar Cheese	0.1536	0.3290	0.1088	-1.7744	0.2636	0.9194
	0.1165	**0.1438**	0.1562	**0.2874**	**0.1179**	**0.0731**
Other Cheese	0.0897	0.1283	0.0513	0.1315	-1.5199	1.1191
	0.0565	0.0816	0.0547	0.0745	**0.1299**	**0.0516**

Calculated Marshallian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[65]

[65] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.52: Second Stage Hicksian Elasticities With Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-1.9709	0.9731	0.2228	0.3207	0.4543
	0.2549	**0.1366**	0.1281	**0.1304**	**0.0991**
2% Fluid Milk	0.4785	-1.4654	0.2495	0.3297	0.4076
	0.0672	**0.1396**	**0.0684**	**0.0801**	**0.0714**
Butter	0.3004	0.6843	-1.7164	0.3133	0.4184
	0.1727	**0.1876**	0.4163	0.2323	**0.1286**
Cheddar Cheese	0.2922	0.6109	0.2117	-1.6222	0.5074
	0.1188	**0.1485**	0.1570	**0.2828**	**0.1182**
Other Cheese	0.2585	0.4715	0.1765	0.3168	-1.2232
	0.0564	**0.0826**	**0.0543**	**0.0738**	0.1278

Calculated Hicksian Elasticities Above with Standard Error Below
Standard Error bold if H_0: Own-Price Elasticity = -1 or Cross-Price Elasticity = 0 is rejected at a 95% confidence level[66]

Table A3.53: Total Marshallian Elasticities With Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese	Income
1% Fluid Milk	-2.0103	0.8209	0.1881	0.2488	0.3799	-0.1441
2% Fluid Milk	0.4957	-1.5083	0.2563	0.3175	0.4321	-0.1057
Butter	0.2730	0.5551	-1.7424	0.2539	0.3647	-0.1360
Cheddar Cheese	0.2947	0.5395	0.2076	-1.6500	0.5060	-0.1157
Other Cheese	0.2239	0.3286	0.1453	0.2499	-1.2893	-0.1408

[66] By test if the Own-Price Elasticity is equal to -1, we can determine confidence that a good is a luxury (magnitude greater than 1) or a necessity (magnitude less than 1) when we can reject H_0. Similar by test if the Cross-Price Elasticity is equal to 0, we can determine with confidence if the good is a substitute (greater than 0) or a compliment (less than 0) when H_0 is rejected.

Table A3.54: Total Hicksian Elasticities With Demographic Variables: British Columbia

	1% Fluid Milk	2% Fluid Milk	Butter	Cheddar Cheese	Other Cheese
1% Fluid Milk	-2.0106	0.8204	0.1849	0.2302	0.3799
2% Fluid Milk	0.4954	-1.5086	0.2540	0.3039	0.4321
Butter	0.2726	0.5547	-1.7454	0.2364	0.3647
Cheddar Cheese	0.2944	0.5391	0.2051	-1.6649	0.5060
Other Cheese	0.2235	0.3281	0.1423	0.2318	-1.2893

APPENDIX 4: PROBLEMS WITH THE FOOD EXPENDITURE SURVEY

In the case of the expenditure and quantity purchased data, the original Food Expenditure Survey dataset had three major problems that need to be addressed in order to create a dataset suitable for empirical analysis. The first problem was associated with how the original dataset exported the expenditure and quantity purchased data. The format was to list all commodities in the same column with expenditure and quantity purchased in the two adjacent columns. The resulting structure was that the first household food purchases in week 1 were listed first and followed by their week 2 purchases. This pattern was then repeated for each subsequent household. The solution to the problem was to export each commodity separately in twenty-one separate files for dairy products. The resulting files listed household 1, week 1 purchases of the particular commodity followed by its week 2 purchases and then subsequently by household 2 and so on. In this way we were able solve the problem of listing all the commodities in a single column.

The second problem associated with the original dataset was that each individual purchase of a food commodity made by an individual household in a given week was listed separately. Since this research needed the total expenditure and quantity purchased for the week, these separate purchases needed to be summed and the totals entered as the new expenditure and quantity purchased for the week. This required the development of a computerized method that allowed households with multiple purchase, with no limit on the number of purchases, to be summed and allow households with single purchases to be unaffected by the process. After completing this process the dataset now only had one expenditure and quantity purchased for each household in each week.

The third and final problem was that the exported and summed commodity files only listed those households that had a positive, non-zero quantity purchased.[67] This meant that the missing households had to be added to the exported files with zero expenditure and quantity purchased added to the data files before the commodity files could be merged with the household characteristics data file created above to create the final dataset.

All three of these problems were compounded by the fact that there are 21,647 one-week household observations that need to be matched. Thus, a large number of calculations had to be preformed and this put a significant demand on computer power to complete these calculations and forced many of them to be completed in small batches.

[67] There are some cases where the quantity purchase is a positive, non-zero value and the expenditure is zero. These are the cases where the household either used a food bank or food was given to them or alternatively these could be errors in the data recording.

APPENDIX 5: POLICY SCENARIO RESULTS USING CONDITIONAL ELASTICITIES

Table A5.1: Baseline Results for 1996 to 2006

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1295	0.9400	0.1298	0.9421	0.1301	0.9443	0.1304	0.9464	0.1307	0.9484	0.1307	0.9484
2% Fluid Milk	0.3965	2.9353	0.3954	2.9268	0.3942	2.9181	0.3930	2.9093	0.3919	2.9012	0.3910	2.8940
Butter	0.0893	0.1163	0.0897	0.1168	0.0900	0.1172	0.0903	0.1177	0.0907	0.1181	0.0910	0.1185
Cheddar Cheese	0.1189	0.0880	0.1194	0.0883	0.1198	0.0886	0.1202	0.0889	0.1206	0.0892	0.1209	0.0894
Other Cheeses	0.2657	0.2173	0.2658	0.2173	0.2659	0.2174	0.2660	0.2175	0.2662	0.2176	0.2662	0.2177

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1309	0.9504	0.1310	0.9506	0.1310	0.9506	0.1310	0.9507	0.1310	0.9510
2% Fluid Milk	0.3912	2.8959	0.3913	2.8969	0.3915	2.8978	0.3915	2.8979	0.3915	2.8982
Butter	0.0921	0.1199	0.0931	0.1213	0.0942	0.1227	0.0953	0.1241	0.0964	0.1255
Cheddar Cheese	0.1206	0.0892	0.1203	0.0890	0.1200	0.0888	0.1198	0.0886	0.1196	0.0885
Other Cheeses	0.2652	0.2168	0.2642	0.2161	0.2633	0.2153	0.2624	0.2145	0.2614	0.2137

Table A5.2: Baseline Total Consumption 1996 to 2006

Dairy Products	1996	1997	1998	1999	2000	2001	2002
1% Fluid Milk	390,987,696	396,820,069	402,725,663	408,622,102	414,476,186	419,480,702	425,516,950
2% Fluid Milk	1,220,923,179	1,232,810,738	1,244,544,435	1,256,151,958	1,267,960,027	1,280,075,959	1,296,624,390
Butter	48,377,244	49,191,399	49,994,562	50,798,450	51,610,259	52,423,687	53,684,114
Cheddar Cheese	36,583,546	37,188,715	37,791,745	38,391,476	38,980,007	39,553,483	39,926,461
Other Cheeses	90,377,543	91,542,149	92,724,639	93,925,333	95,116,013	96,283,646	97,085,510

Dairy Products	2003	2004	2005	2006
1% Fluid Milk	430,777,266	435,931,049	441,112,254	446,402,777
2% Fluid Milk	1,312,716,526	1,328,814,723	1,344,550,967	1,360,386,738
Butter	54,974,593	56,279,038	57,597,869	58,919,866
Cheddar Cheese	40,319,386	40,710,566	41,120,285	41,524,105
Other Cheeses	97,908,777	98,721,417	99,532,404	100,324,133

Table A5.3: Change in Immigration Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1294	0.9395	0.1296	0.9409	0.1298	0.9423	0.1300	0.9438	0.1303	0.9454	0.1303	0.9454
2% Fluid Milk	0.3966	2.9355	0.3954	2.9272	0.3943	2.9187	0.3931	2.9102	0.3921	2.9022	0.3911	2.8950
Butter	0.0893	0.1163	0.0897	0.1169	0.0901	0.1174	0.0905	0.1178	0.0908	0.1183	0.0912	0.1188
Cheddar Cheese	0.1189	0.0879	0.1193	0.0882	0.1196	0.0885	0.1200	0.0887	0.1203	0.0890	0.1206	0.0892
Other Cheeses	0.2658	0.2173	0.2659	0.2174	0.2661	0.2176	0.2664	0.2178	0.2665	0.2179	0.2666	0.2180

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1305	0.9472	0.1304	0.9468	0.1304	0.9464	0.1303	0.9462	0.1303	0.9462
2% Fluid Milk	0.3914	2.8972	0.3915	2.8983	0.3917	2.8993	0.3917	2.8995	0.3918	2.9000
Butter	0.0923	0.1202	0.0934	0.1216	0.0945	0.1231	0.0956	0.1245	0.0967	0.1259
Cheddar Cheese	0.1202	0.0889	0.1199	0.0887	0.1196	0.0885	0.1194	0.0883	0.1191	0.0881
Other Cheeses	0.2657	0.2172	0.2648	0.2165	0.2639	0.2158	0.2630	0.2150	0.2621	0.2143

Table A5.4: Change in Immigration Total Consumption Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	391,898,578	0.23	399,096,059	0.57	406,701,190	0.99	413,902,384	1.29	420,468,005	1.45	426,284,542	1.62
2% Fluid Milk	1,224,458,208	0.29	1,241,591,936	0.71	1,259,789,930	1.22	1,276,279,831	1.60	1,290,673,025	1.79	1,305,314,590	1.97
Butter	48,529,897	0.32	49,573,045	0.78	50,661,268	1.33	51,684,093	1.74	52,615,637	1.95	53,547,155	2.14
Cheddar	36,673,920	0.25	37,414,887	0.61	38,187,301	1.05	38,917,452	1.37	39,577,396	1.53	40,221,063	1.69
Other Cheeses	90,654,786	0.31	92,232,885	0.75	93,927,709	1.30	95,519,110	1.70	96,920,035	1.90	98,293,400	2.09

Dairy Products	2002		2003		2004		2005		2006	
	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	434,016,563	2.00	440,193,253	2.19	446,328,460	2.39	452,393,008	2.56	458,909,920	2.80
2% Fluid Milk	1,327,559,030	2.39	1,347,477,733	2.65	1,367,278,088	2.89	1,386,368,523	3.11	1,406,555,184	3.39
Butter	55,074,134	2.59	56,552,103	2.87	58,041,720	3.13	59,533,414	3.36	61,077,381	3.66
Cheddar	40,742,264	2.04	41,234,275	2.27	41,720,889	2.48	42,217,461	2.67	42,733,828	2.91
Other Cheeses	99,537,681	2.53	100,653,527	2.80	101,746,546	3.06	102,809,453	3.29	103,928,395	3.59

% Δ = Percentage Change from Baseline

Table A5.5: Change in Crude Birth Rate Results

Dairy Products	1996		1997		1998		1999		2000		2001	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1295	0.9400	0.1298	0.9422	0.1301	0.9446	0.1304	0.9469	0.1307	0.9490	0.1307	0.9490
2% Fluid Milk	0.3966	2.9357	0.3957	2.9291	0.3949	2.9232	0.3942	2.9179	0.3936	2.9133	0.3932	2.9103
Butter	0.0893	0.1163	0.0896	0.1167	0.0899	0.1171	0.0902	0.1175	0.0905	0.1179	0.0908	0.1182
Cheddar Cheese	0.1189	0.0879	0.1192	0.0882	0.1195	0.0884	0.1197	0.0885	0.1198	0.0886	0.1199	0.0887
Other Cheeses	0.2657	0.2173	0.2656	0.2172	0.2656	0.2171	0.2655	0.2171	0.2654	0.2170	0.2652	0.2168

Dairy Products	2002		2003		2004		2005		2006	
	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity	Budget Share	Quantity
1% Fluid Milk	0.1311	0.9513	0.1311	0.9518	0.1312	0.9521	0.1312	0.9524	0.1313	0.9530
2% Fluid Milk	0.3941	2.9170	0.3948	2.9226	0.3956	2.9281	0.3962	2.9328	0.3968	2.9376
Butter	0.0917	0.1195	0.0928	0.1208	0.0938	0.1221	0.0948	0.1235	0.0958	0.1248
Cheddar Cheese	0.1192	0.0882	0.1187	0.0878	0.1181	0.0874	0.1176	0.0870	0.1171	0.0866
Other Cheeses	0.2638	0.2157	0.2626	0.2147	0.2613	0.2137	0.2601	0.2127	0.2589	0.2117

Table A5.6: Change in Crude Birth Rate Total Consumption Results

	1996		1997		1998		1999		2000		2001	
Dairy Products	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	390,995,902	0.00	396,874,028	0.01	402,847,386	0.03	408,826,017	0.05	414,769,064	0.07	419,777,117	0.07
2% Fluid Milk	1,221,071,886	0.01	1,233,788,614	0.08	1,246,750,372	0.18	1,259,847,414	0.29	1,273,267,719	0.42	1,287,303,929	0.56
Butter	48,374,392	-0.01	49,172,645	-0.04	49,952,255	-0.08	50,727,577	-0.14	51,508,466	-0.20	52,285,067	-0.26
Cheddar	36,576,557	-0.02	37,142,757	-0.12	37,688,070	-0.27	38,217,798	-0.45	38,730,557	-0.64	39,213,784	-0.86
Other Cheeses	90,369,710	-0.01	91,490,638	-0.06	92,608,440	-0.13	93,730,673	-0.21	94,836,427	-0.29	95,902,909	-0.40

	2002		2003		2004		2005		2006	
Dairy Products	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ	Quantity	% Δ
1% Fluid Milk	425,920,670	0.09	431,303,298	0.12	436,583,392	0.15	441,887,900	0.18	447,307,060	0.20
2% Fluid Milk	1,306,043,540	0.73	1,324,399,067	0.89	1,342,707,388	1.05	1,360,749,858	1.20	1,378,878,886	1.36
Butter	53,503,471	-0.34	54,750,541	-0.41	56,012,600	-0.47	57,287,202	-0.54	58,565,218	-0.60
Cheddar	39,483,782	-1.11	39,770,332	-1.36	40,057,641	-1.60	40,358,972	-1.85	40,655,014	-2.09
Other Cheeses	96,589,350	-0.51	97,293,391	-0.63	97,989,613	-0.74	98,679,117	-0.86	99,350,047	-0.97

% Δ = Percentage Change from Baseline