RURAL ECONOMY

Value-Added Meat: Measuring Past Successes and Predicting Future Winners

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Project Report

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Value Added Meats: Measuring Past Successes and Predicting Future Winners

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Abstract

Livestock industries are significantly affected by changes in consumer behaviour. In order to add value to meat and livestock production, many firms and farms are supporting the development of new products – these products can differ by credence attribute, by degree of processing and by marketing strategies. The literature suggests that one of the most important determinants of success in product innovation is an understanding of the market the product is introduced into. In this report consumer preferences for meat products, by animal species including minor meats, and by type of processing are examined. Responses to economic variables such as price, advertising and income are identified as are responses to food safety and meat related health issues. Interesting results include the fact that income elasticities of demand for meat products purchased at grocery stores are negative in this study and that own and cross price elasticities for certain meats, across processing levels for example, show strong substitutions. Thus introducing new meat products may not result in increased sales by animal species but may only result in substitution of one meat type product for another product of the same meat type.

Successful new product introductions or changes in product quality are shown, in this report, to be accompanied by significant marketing/advertising investment and, either by design or by serendipity, to have credence attributes in line with consumer's changing concerns. An example of this is the response in branded chicken sales, at the time of BSE in Canada, for a brand that could advertise itself as being 100% grain fed. Marketing strategies, such as working with the Health Check™ program of the Heart and Stroke Foundation of Canada are shown to have an impact on firm level sales (as well as on sales at the individual product level), a halo effect, that may be of importance in the firm's development of other value-added products.

Significant heterogeneity exists in consumer behaviour and it is important to recognize this heterogeneity in the development of value-added meat products. Added to the consumer heterogeneity, in general, is the heterogeneity in responses by meat type. What works for one sector, such as poultry, could be problematic in other sectors given differences in economic interrelationships reported in this study.

JEL Codes: D12, Q18

Keywords: meat, consumer behavior, value-added, strategic behaviour

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Value Added Meats: Measuring Past Successes and Predicting Future Winners

Background

The initial objective of the research was to empirically examine the success of value added products in the Canadian meat market. The meat industry is critical to the economic viability of Alberta. Recent animal disease and trade disputes have had serious repercussions for cattle and hog producers and processors. One strategy to reduce downturns in the industry is the development of new value added products, in the face of changing consumer health concerns, food safety issues (product recalls and disease outbreaks) and competition from non-meat alternatives. New and enhanced product development can only pay off for the Alberta meat industry if consumers actually prefer and are willing to pay for the new products developed and the price they are willing to pay is more than the costs of producing and marketing new value-added products.

The focus of this research project is to develop a profile of consumer preferences for meat products in the current grocery market (e.g. consumer preferences may be changing in response to animal diseases such as BSE, avian flu and H1N1 (in spite of the lack of a human health link)). Preferences will be modeled using existing market evidence on the consumer willingness to pay for product attributes (products are identified by species, type and amount of processing). Modeling and understanding consumer preferences for product attributes can rationalize new product development to include only those products with the highest potential payoffs. Trade-offs between process attributes (fresh, semi-processed, fully processed) and content attributes (e.g. CLA enriched) can be measured using data on existing grocery sales.

1. Using scanner data, model the existing/current consumer purchases of meat products by individual product, attribute and brand (including fresh,semi-processed and fully processed). This analysis can provide significant planning information to the scientists developing new products and product attributes such as traceability. Beef, pork, chicken and turkey products can all be examined. Revealed preference analysis for existing meat and animal products can provide hard estimates of consumer willingness to pay for value added attributes.

2. Using the data above (estimates of consumer response) provide baseline analysis of the economic potential of innovation within the meat industry.

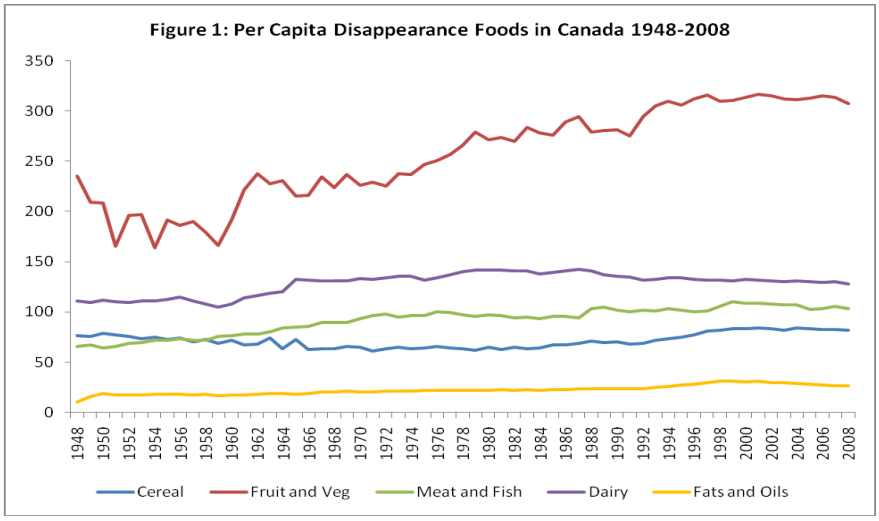
The livestock industry has been and still is a major contributor to the gross domestic income of Canada. Recently, the livestock industry has seen a disproportionate share of challenges with respect to consumers' perceptions; food safety concerns (domestically and internationally); transitions in environmental policy; changes in production practices and technology; and significant product innovation to encourage the continuing growth of consumption of chicken, perhaps at the expense of other meats. In recent years there has been a significant industry led/consumer oriented drive to put innovative value-added products on retail shelves. Value-added products provide consumers with a wider range of food products

that address concerns of food safety, nutrition, and quality. Many of these products contain credence attributes making it difficult, if not impossible, for consumers to detect the quality attributes and claims in pre-purchase and post purchase evaluations (Hoffman, 2000). In dealing with these challenges the meat industry must find ways to increase the engagement of consumers within the food chain and to provide effective avenues to aid consumers in their evaluation of products attributes and claims (Korthals, 2001). Industry supported initiatives must be undertaken to quantitatively and qualitatively assess the influence consumers' perceptions, beliefs, and attitudes have on product evaluation and purchasing decisions (Sunding et al., 2003). Recent outbreaks of animal transmitted diseases (BSE, avian flu and H1N1 virus); advancements in biotechnology and genetic engineering; and food borne illness scares (i.e. listeriosis, salmonella and E.coli bacteria) have helped to underscore consumer perceptions of food safety as one of the major challenges facing the livestock industry. Consumer perceptions of the perceived risks and dangers associated with livestock commodities has dominated debates concerning food safety issues (Myhr and Traavik, 2003). Increased general public awareness of the relationship between diet and lifestyle related diseases (i.e. obesity, cardiovascular disease, and cancer) have resulted in an increase consumer scrutiny of traditional nutritional aspects of food (i.e. fat, fibre, salt, and vitamin content) and nontraditional nutritional attributes of food (i.e. Omega-3 content) (Urala and Lahteenmaki, 2003).

Given this context of evolving consumer preferences the development of value-added meat products within the Canadian marketplace is not surprising. However there is little analysis of the successful product innovations and the characteristics of products and of consumers that make the products last beyond the short term in the marketplace.

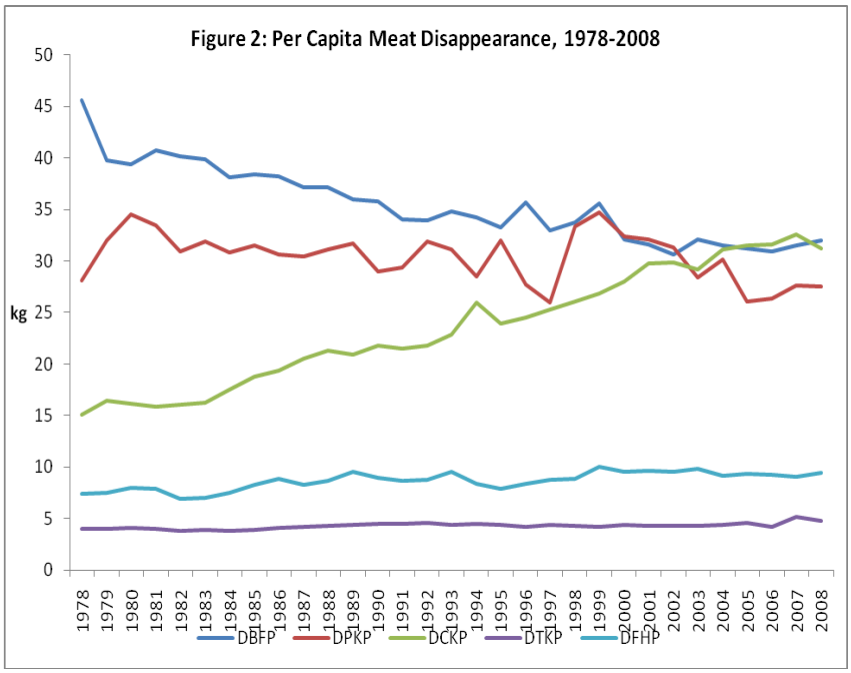
Overview of the meat market in Canada.

Canadian food consumers have an abundant opportunity to select among many different foods, this availability and evolving tastes and preferences have resulted in major shifts in food disappearance on a per capita basis over time. Since 1948, fruits and vegetables disappearance has dramatically increased, for example. Meat's role in overall food per capita disappearance is highlighted in Figure 1.



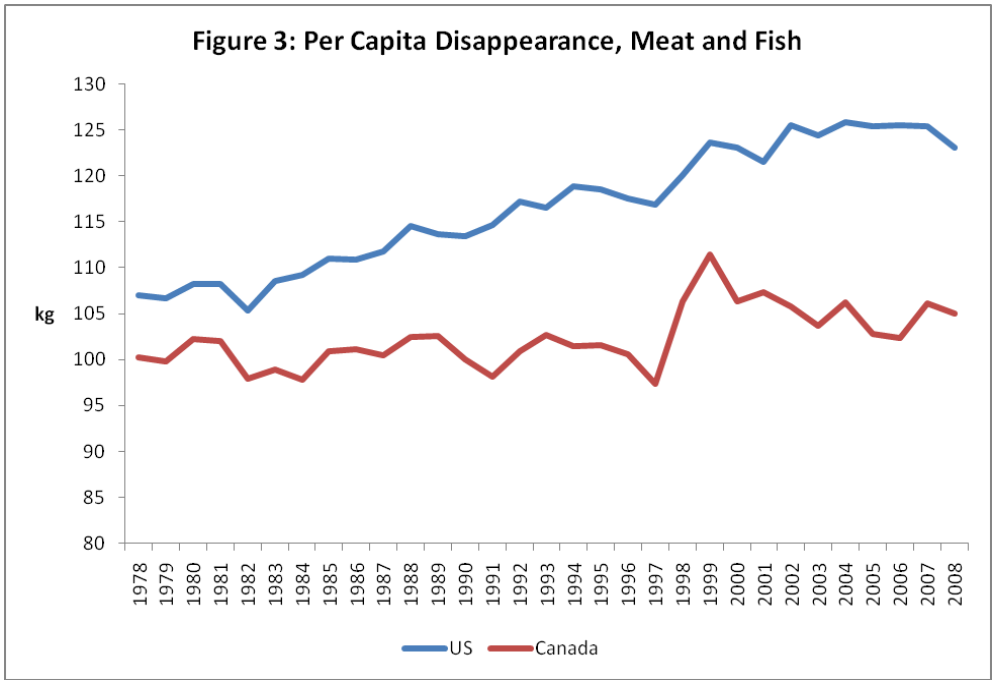
Source: Statistics Canada (disappearance and trade)

With a disaggregation of meat disappearance into different species it becomes clear that the relatively flat trend in per capita meat consumption is generated by relatively dramatic changes in individual meats consumed, decreases in beef consumption and increases in chicken consumption (Figure 2). Chicken disappearance has been on the increase since the 1980's. The chicken market benefited from increasing nutritional concerns about cholesterol since consumers tended to shift away from red meats towards 'white' meat in response to these widely publicized health concerns. Growth in chicken may also have been driven by the significantly higher number of processed chicken products available in the grocery store as compared to pork and beef products.



Source: Statistics Canada (disappearance and trade)
(DBFP=beef, DPKP=pork, DCKP=chicken, DTKP= turkey, DFHP=fish)

Canadian meat disappearance on a per capita basis remains significantly lower than that in the U.S. (Figure 3).

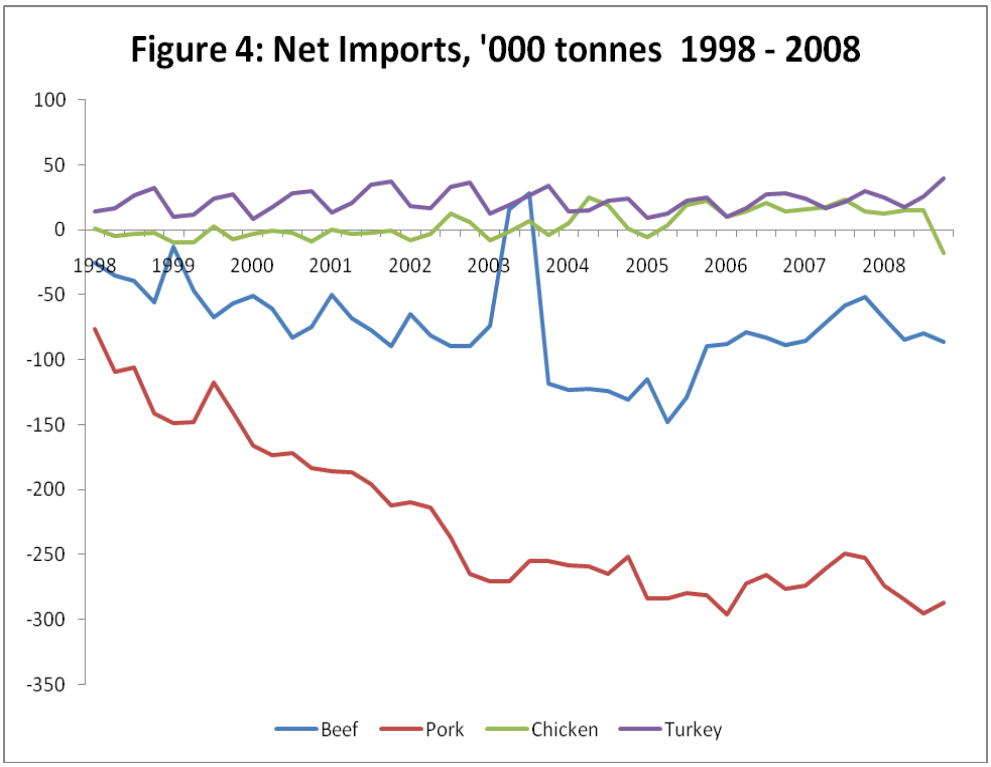


Source: Statistics Canada and USDA

Reasons for this major difference in meat consumption may be due to cultural differences between the two countries, relative prices of different meat products (at least until the mid 1990's poultry products were higher priced in Canada due to trade restrictions associated with supply management) and differing health concerns and risk perceptions across countries.

In Canada, meat has traditionally been sold in a number of forms: generic cuts (fresh or frozen), generic processed products (with some level of processing but usually requiring further cooking by consumer) and branded processed products (including as major Canadian meat processors, Olymel, Jane's, Flamingo and Schneiders (historically)). Recently one of the major national processors, a major Canadian meat processor, has been aggressively pursuing a strategy of 'branding' fresh and semi-processed products (Naturally Prime chicken, Prime Gourmet chicken and pork semi-processed products) based on production attributes (identification of type of feed) and identifying labels. Cargill has followed similar strategies with its promotion of Sterling Silver beef products across North America. Grocery store chains faced with the possibility of proliferation of branded fresh products, and the additional costs associated, must make decisions about pricing generic product, from whom to purchase it, whether to stock one or more brands, and what markups to assign. The proliferation of brands may affect stocking decisions on processed branded and generic products due to consumer substitution possibilities. Other processors in the meat industry are faced with making strategic decisions of whether to brand their product or continue providing store generic product.

Processors and retailers in the Canadian meat market must satisfy final consumers from domestic supply plus imports. However they are also increasingly concerned with satisfying the demands of international markets. Net import figures for each of the four major meats are shown in figure 4. The differences between the supply managed poultry markets and the export oriented beef and pork sectors are clearly identified in the figure. Particularly in the pork sector the growth in exports is dramatic over the past ten years. The US country of origin labelling (COOL) legislation and appreciation of the Canadian dollar have had very dramatic impacts on exports in the beef and pork sectors starting in 2009.



Source: Statistics Canada, International Trade Statistics

Research statement

The Canadian meat market has recently been facing significant changes, consolidation in Canadian processing and retailing, changing trade agreements, increasing imports and dramatically increasing exports, and evolving Canadian consumer preferences for different types of meat products. The research in this report attempts to provide an empirical assessment of many of these changes with a few examples of simulation modeling used to highlight the important of any measured relationships for industry strategy. Evolving consumer preferences within Canada will be measured using:

Canadian purchases of meat by product type (beef, pork, chicken, turkey, ham, bacon, veal, lamb), – linked to prices, advertising, media health and food safety coverage – using scanner data from 2000 to 2006.

Canadian purchases of the four major meats by type of processing (fresh, semi-processed and fully processed) – linked to prices, advertising – using national scanner data over the period 2000-2007.

Canadian purchases of branded and other (non-branded) fresh chicken for a major Canadian brand – using national scanner data over the period 2000 to 2007.

Canadian purchases of beef and pork products from two major meat processing firms within Canada allowing for firms to change product quality, prices and advertising over time - using national scanner data over the period 2000 to 2007.

All of these measures of consumer preferences are new to the Canadian literature. In addition reference will be made to two minor studies that provide complementary information using Neilsen Homescan™ data, studies that examine different aspects of household purchases of meat under food safety incidents. The Homescan™ data is informed through an attitudinal survey of 5000 Homescan™ meat purchasers in 2008. For those particular households responses to food safety concerns are examined through looking at substitutions across the four major meat types and through substitutions across types of processing.

The changing structure of the Canadian meat market can be examined using a game theoretic model of pricing, advertising and quality interactions for firms producing beef and pork products. Actual data on how major firms play games is provided in the PhD thesis (unpublished) of Wenzhao Huang. The analysis provided in his thesis is highlighted by an examination of the potential impact of various proposed nutrition interventions (nutrition taxes, advertising restrictions) on the meat industry (characterized by two firms within the industry). Further details on this significant analysis are available from the authors on request.

Literature and Data Related to Development of Value-Added Products in Canada

The literature related to value-added meat is mostly descriptive in nature. The definitions of value-added are many and varied. Zhang (2010) and Zhang and Goddard (2010) have provided an extensive discussion of the myriad of different definitions of value-added meat products. Some variations in definition relate to niche marketing of production credence attributes while other classifications refer more formally to the level of further processing a product undergoes prior to sale to consumers. However in most cases the idea of adding value to primary products or to supply chains relates more broadly to product and/or process innovation. Some of the literature related to successful innovation in food markets is reviewed briefly below.

Harmsen et al. (2000) attempted to characterize the successful innovation strategies in food processing firms, firms operating in an industry that they describe as having "large numbers of new products introduced every year and needing innovation to succeed in an environment with competition and increasing market power, but having relatively low levels of spending on R&D" (page 153). They describe innovation strategies as either being product or process oriented. Product oriented innovation 'has to do with respect for the product manufactured an emphasis on objective product quality, even an emotional attachment to the products' (page 157). Process innovation on the other hand relates directly to the "optimisation of production units rather than products". "Process oriented companies tend to have strong links both up and down stream and increasing value-add might be attempted by integrating additional links of the food chain into the company not by trying to put more value into the products manufactured" (page 157). It is interesting to reflect that within the Canadian meat industry a company like Schneider's (various ownership over the past few years) has been associated with product excellence and not with vertical integration to the point where successive owners of the company have continued to rely on marketing content for Schneider's products which emphasize traditional quality.

Costa and Jongen (2006) in describing innovation in the European food industry also refer to the fact that there are many new food products introduced to the marketplace each year from an industry that spends relatively little on R&D. They go on to describe the industry however as 'conservative' in its innovations – "radically new products are rare especially when compared to the high number of products representing nil or an incremental level of novelty only that are introduced to the market every year" (page 457). However from their estimation, even if that has been the nature of the food product innovations found in many markets it is becoming clear that future success may need to come from different approaches.

In referring to the high level of failure associated with new product innovations (they estimate that 40 – 50% of new products are out of the market within one year), Costa and Jongen (2006) note that one issue impeding new food product development is the "slow rate of change in eating preferences and habits together with the consequent consumer aversion to too much novelty in food" (page 457). They advocate the necessity for the food industry to shift to a 'consumer led food product development" approach, something that their research shows is difficult for many food companies to adopt. Problems with the

adoption of a consumer focused food product development strategy include the lack of clear guidelines on how to identify opportunities at the beginning stages of a consumer driven strategy. Many food companies, from Costas and Jongen's research, do not have experience in acquiring information on markets, consumers and competitors which would allow them to identify opportunities for their particular companies. They also reference the difficulties some companies face in the interface between their marketing teams and their technology driven product development teams. Traditionally, communication between the two has not been as effective as it should be if product development is to be clearly consumer driven.

In two related publications (Stewart- Knox et al., 2003 and Stewart-Knox and Mitchell (2003)) successful new food product innovations were assessed from detailed interviews with a number of companies. The success of the introduction of a reduced fat food product, introduced across food industry sectors, was assessed both qualitatively and quantitatively. This is an interesting study – from the focus on a single category of innovation to the ability to quantitatively assess success criteria (in this case success is identified by the firms themselves). Successful new product innovations were associated with sector (meat more successful than pastry but equally successful to dairy), communication with other experts, communication with retailers and manufacturer driven recipes, being a product that qualifies as reduced fat, having appropriate texture, seasonality (more seasonal the product the higher degree of failure), products planned by food technologists rather than defined by ill-defined 'trends' or by sources other than retailers, suppliers or research centres. At a more general level, Stewart-Knox and Mitchell (2003) identify success criteria for new product development as being actions taken during the concept phase, expertise employed throughout the product development process, outside consultation and thorough understanding of the market (page 63).

Canadian New Meat Product Developments at Retail

A brief description can be provided of some of the major retail product developments associated with the grocery sector in Canada. The majority of meat products sold in Canada are sold in fresh form. For the vast majority of these fresh products they are sold in unbranded form – in white styrofoam packages, undistinguishable by brand or by retailer in the category. This makes identifying new products introduced into the fresh segment difficult. One component of the fresh product sales that is growing is the retailer private label category (called in the Neilsen MarketTrack™ data Control Label). Although this segment of fresh market products is growing and undoubtedly growing differently across retailers, data restrictions on product release information do not allow researchers to identify these products by retailer, instead the products across retailers are aggregated into one category. The data on aggregate fresh market sales of meat[1], in the control label and other categories (will contain some branded products but the majority are

[1] Unless otherwise stated all data graphed in this report comes from Neilsen MarketTrack™ data purchased for this study.

unbranded) is provided in Figures 5 and 6. Although the quantity of Control Label fresh meat sold only reaches approximately 10% of the fresh meat category by the end of the 2006, the interesting thing is the dramatic growth in the category over the short six year period. In nominal terms the prices of Control Label fresh meats are uniformly higher than other fresh meat products across the entire sample period.

Figure 5: Comparison Meat Sales, Control Label and Other Meat
December 2000 to December 2006

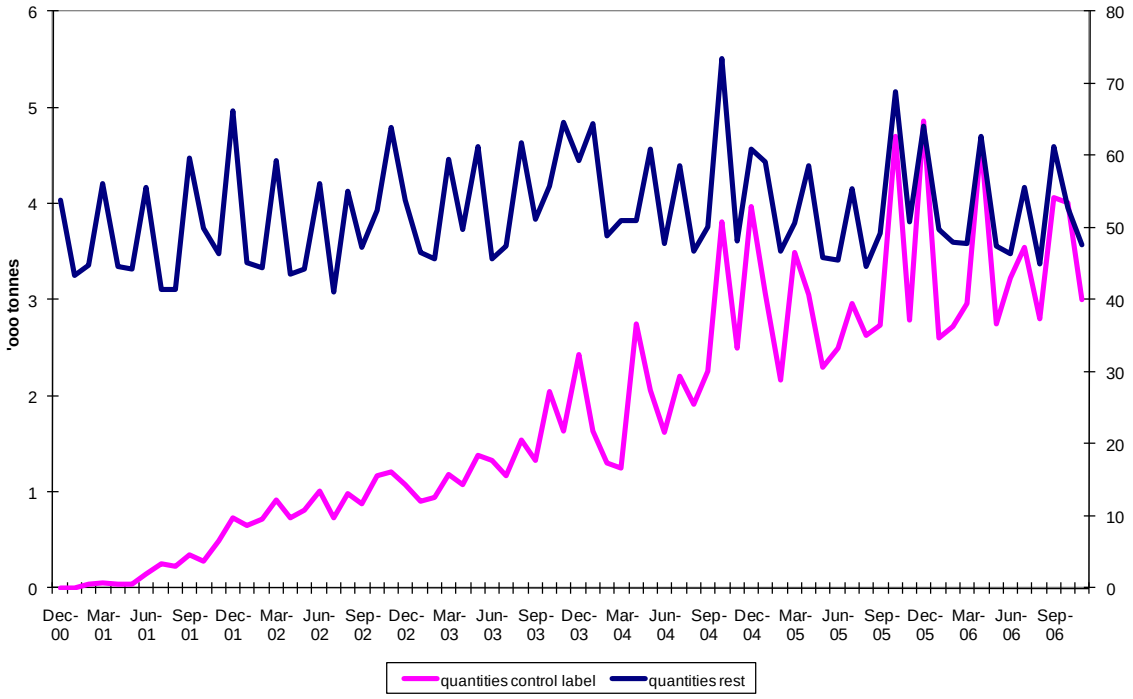
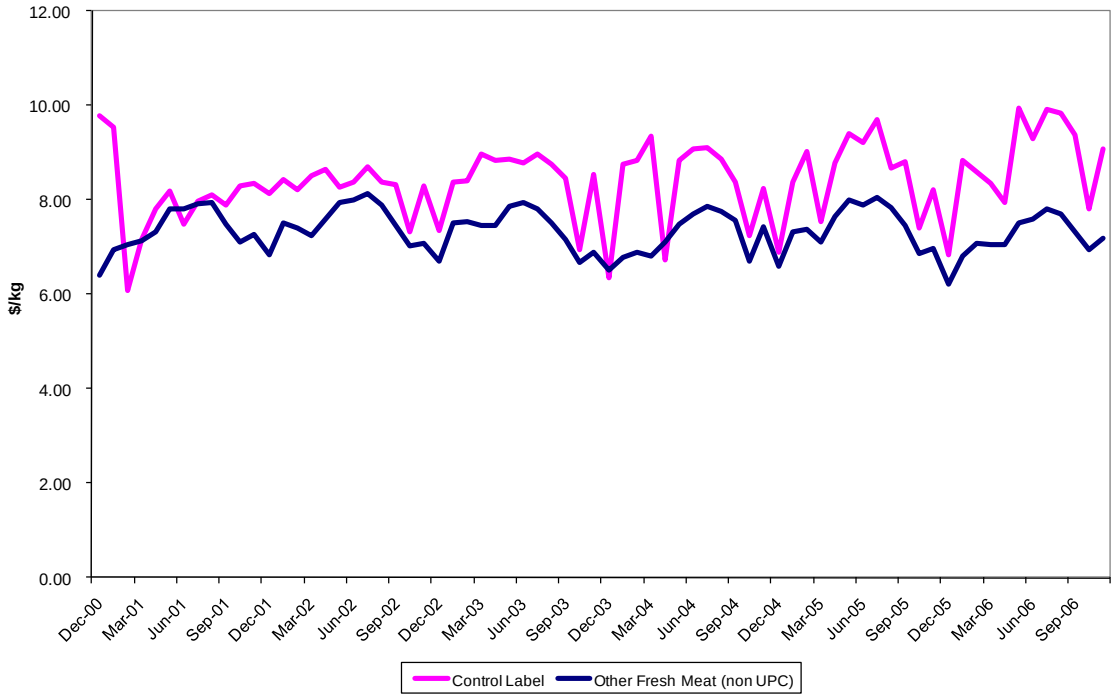


Figure 6: Comparison of Retail Prices Meat, Control Label and Other, December 2000 to December 2006



However more detail about the introduction of new meat products can be more clearly delineated in the frozen meat product category. First of all there are more meat products introduced in that category on a regular basis. Secondly the volume is large enough to be able to identify some differences across animal species categories. Data for two frozen meat product categories are provided in Table 1. For the category Frozen Boxed Meat the number of chicken products introduced dwarfs the number of introductions in any other animal species provided (seafood is not included in this table). Of the 190 new chicken products introduced over the six year period 18 of them failed and have disappeared from the marketplace. Notably the other meats have almost no new products introduced and accordingly have few failures. In the frozen meat category of steakettes (burgers etc.) beef product introductions dominate the category. In the beef steakettes/burger category there were 42 new products introduced and only three failures. For the failed products across these two categories the average length of time they appeared in the marketplace ranges from 13 to 29 weeks, significantly less than one year. This reflects the high costs of product development – a failure disappears very quickly and costs of product development are unlikely to be recouped. However except in certain specific categories, many of the meats, categorized by animal species, appear to have very little product development. Time series data of this sort would need to be much longer for an analyst to do significant regression analysis to determine the relative importance of economic variables such as price, advertising expenditure and product attributes on success or failure of new products in the fresh and frozen meat category.

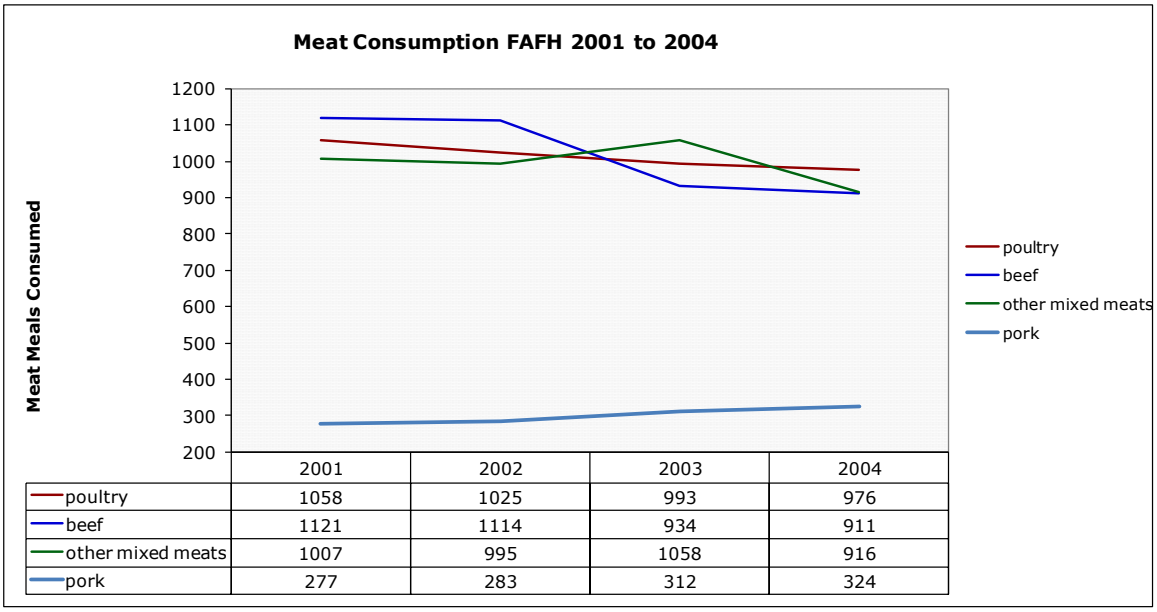
Table 1: Statistical Summary of New Frozen Meat Products Introduced 2001-2006					
FROZEN BOXED MEAT			**STEAKETTES**		
CHICKEN			PORK		
# of Products Listed	682.00		# of Products Listed	12.00	
# of Products with Data	467.00		# of Products with Data	11.00	
# of Products Introduced	190.00		# of Products Introduced	7.00	
Avg Length of CHICKEN Product AP	44.98	weeks	Avg Length of Pork Product AP	52.55	weeks
Avg Length of CHICKEN Product Intro*	34.63	weeks	Avg Length of Pork Product Intro	43.86	weeks
# Still on Market of Introduced	172.00		#still on market of introduced	6.00	
Failed Products	18.00		Failed Products	1.00	
Average Length of Failed CHICKEN Products	13.61		Average Length of failed PORK products	29.00	weeks
PORK			TURKEY		
# of Products Listed	10.00		# of Products Listed	2.00	
# of Products with Data	9.00		# of Products with Data	2.00	
# of Products Introduced	4.00		# of Products Introduced	1.00	
Avg Length of PORK Product AP	42.67	weeks	Avg Length of TURKEY Product AP	34.00	weeks
Avg Length of PORK Product Intro*	37.50	weeks	Avg Length of TURKEY Product Intro*	28.00	weeks
# Still on Market of Introduced	4.00		#still on market of introduced	1.00	
Failed Products	0.00		Failed Products	0.00	
Average Length of Failed PORK Products	0.00		Average Length of failed TURKEY products	0.00	
TURKEY			BEEF		
# of Products Listed	36.00		# of Products Listed	124.00	
# of Products with Data	30.00		# of Products with Data	94.00	
# of Products Introduced	14.00		# of Products Introduced	42.00	
Avg Length of TURKEY Product AP	38.47	weeks	Avg Length of BEEF Product AP	47.65	weeks
Avg Length of TURKEY Product Intro*	31.64	weeks	Avg Length of BEEF Product Intro	29.26	weeks
# Still on Market of Introduced	13.00		#still on market of introduced	39.00	
Failed Products	1.00		Failed Products	3.00	
Average Length of Failed TURKEY Products	16.00		Average Length of failed BEEF products	20.33	weeks
BEEF			BUFFALO		
# of Products Listed	8.00		# of Products Listed	10.00	
# of Products with Data	4.00		# of Products with Data	10.00	
# of Products Introduced	1.00		# of Products Introduced	8.00	
Avg Length of BEEF Product AP	36.50	weeks	Avg Length of BUFFALO Product AP	42.60	weeks
Avg Length of BEEF Product Intro*	29.00	weeks	Avg Length of BUFFALO Product Intro*	38.63	weeks
# Still on Market of Introduced	1.00		#still on market of introduced	7.00	
Failed Products	0.00		Failed Products	1.00	
Average Length of Failed BEEF Products	0.00		Average Length of failed BUFFALO products	29.00	
			VEAL		
			# of Products Listed	7.00	
			# of Products with Data	6.00	
			# of Products Introduced	3.00	
			Avg Length of VEAL Product AP	47.33	weeks
			Avg Length of VEAL Product Intro*	30.33	weeks
			#still on market of introduced	3.00	
			Failed Products	0.00	
			Average Length of failed VEAL products	0.00	

Canadian Meat Meals Consumed in FAFH

One other area of potentially adding value to meat is through sales at restaurants, the food away from home (FAFH) sector. In Canada this sector has grown to represent approximately 24% of the average Canadian's food expenditure (as compared to 50% in the U.S.). From NPD CREST data restaurant purchases for a representative sample of Canadian households over the period 2000 to 2004 can be categorized. A brief examination was made of that data to see if there were any discernable trends in meat meals consumed over that short period. It should be noted that the period includes the period just after BSE was found in the first domestic cow in Canada in May of 2003. Clearly from the data provided in Figure 7 –

beef, poultry and other mixed meats (sandwiches etc.) dominate the meat content of most restaurant meals. Pork although representing only about 1/5 of the number of meals, as compared to the other three is the one category of growth evident over this short period (in this case bacon was not included in the pork category, bacon is seldom the major part of a meal purchased away from home and normally represents an addition to other content and is therefore included in other mixed meats).

Figure 7: Meat Meal Consumption FAFH 2001 to 2004



	2001	2002	2003	2004
poultry	1058	1025	993	976
beef	1121	1114	934	911
other mixed meats	1007	995	1058	916
pork	277	283	312	324

Source: NPD CREST data

Summary

New product developments in the food industries have been seen by other researchers to have high rates of failure and in many cases little evidence of radical innovation. There is clear evidence in Canada of fresh meat category growth in the Control Label category suggesting that tie-ins with retailers might be a way to secure value adding for meat products – especially since these products are generally sold at a premium over other fresh products. In the frozen meat category boxed meat product introductions are dominated by chicken while new products introduced in the steakette/burger category are dominated by beef. With an increase in the number of new product introductions comes a greater risk of failure in these categories. Although very briefly assessed there seems to be little movement in meat meal sales in FAFH over the early part of this decade.

In the literature on new product introductions in the food industry, success criteria identified centre around understanding the market around the product – consumer interest, competitors and other market characteristics. The rest of the analysis presented in this report is an attempt to provide market context in analysis that has not previously been conducted in Canada. The analysis presented will provide some context for future successful value- added meat product development in Canada.

Canadian Meat Consumption By Type

Nielsen Market Track™ data on fresh and processed meat products for Canada from December 2000 to November 2006 were examined to look in detail at the demand for meat by type. Data for meat quantity sold, on a per capita basis, is presented in Figures 8 and 9.

Figure 8: Per Capita Meat Sales, Monthly

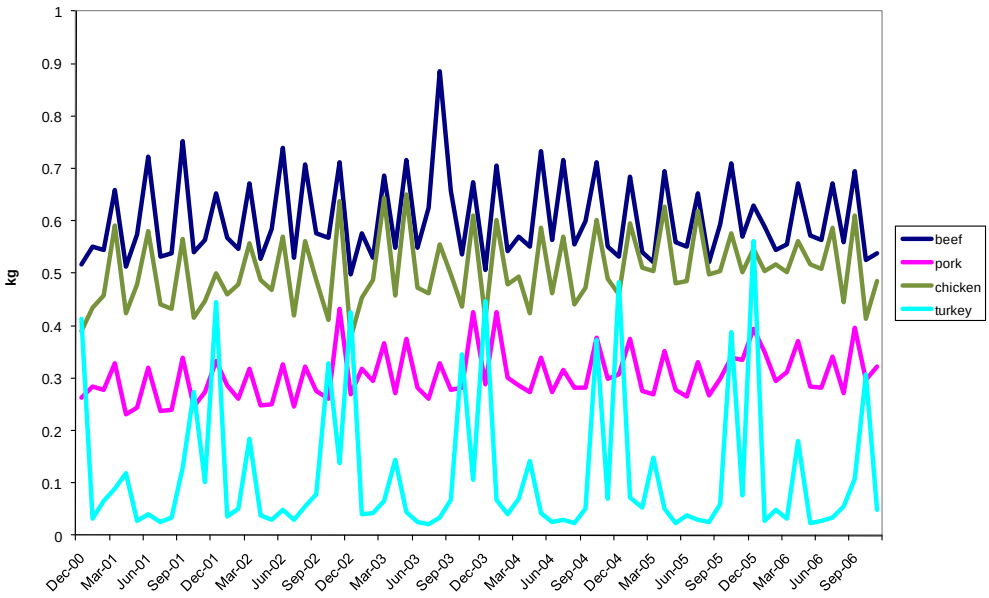
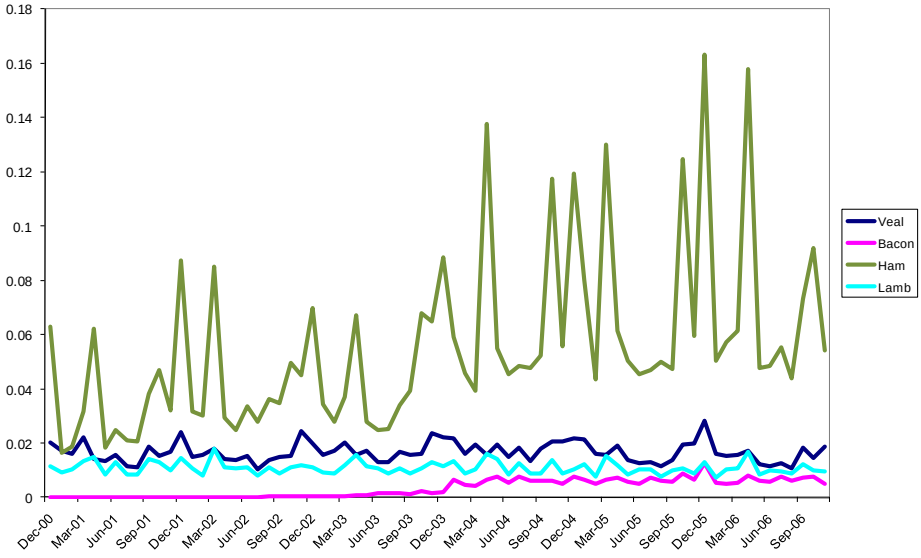


Figure 9: Per Capita Meat Sales, Monthly



A couple of things are particularly noticeable from the graphs above – calculated from grocery scanner sales of individual meats. First, if one considers fresh pork as a separate product from bacon and ham, it appears to be much smaller than chicken and beef sales (as in per capita sales of meat in Figure 2). Disappearance is

a very broad aggregate of all pork product sales. The spike in grocery sales of beef in the summer of 2003, in response to concerns about the BSE crisis is also obvious from the data, as is the dominant seasonality in turkey sales. With the exception of ham and bacon, the other meats do not appear to be exhibiting growth in sales over the period graphed.

The deflated prices for each of the eight meats are shown in Figures 10 and 11.

Figure 10: Real Prices, Major Meats,monthly

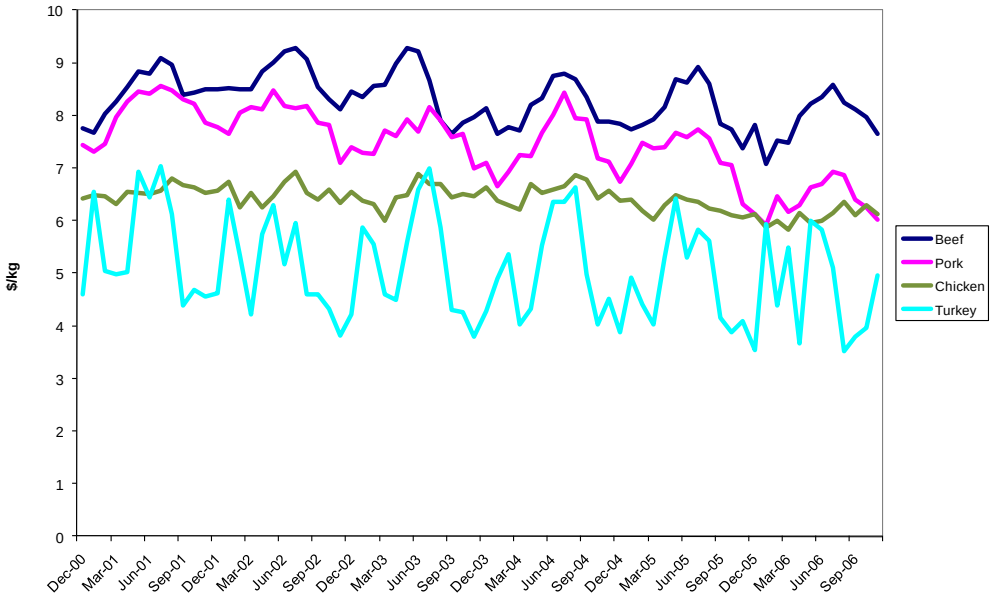
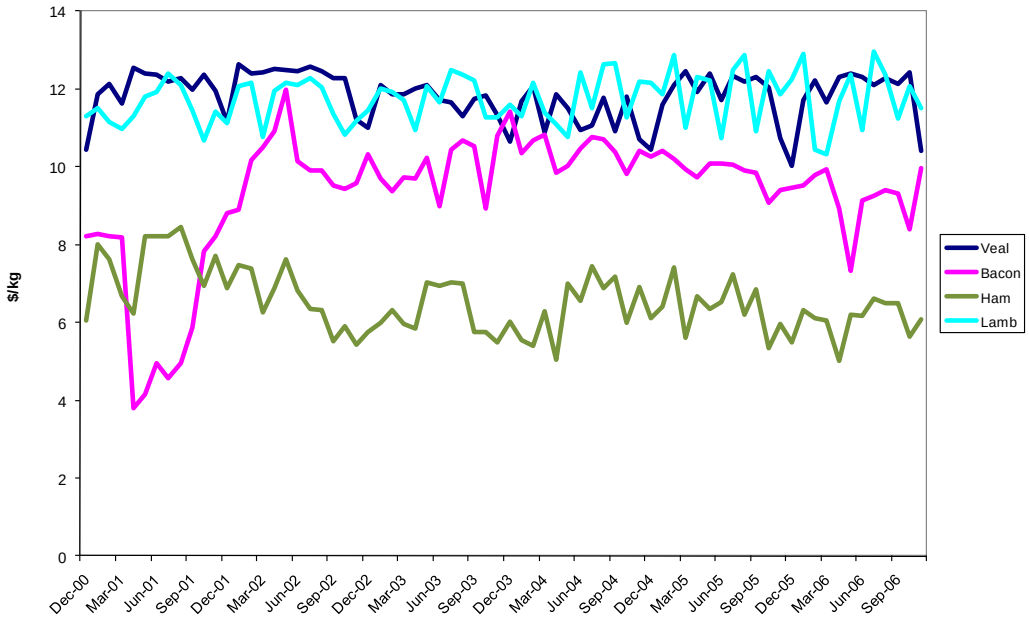


Figure 11: Real Prices, Minor Meats, Monthly



With the exception of ham in some periods, the prices of the minor meats are uniformly higher than the prices of the major meats. There is significant seasonality in turkey prices and the prices of fresh beef and pork (until late 2006) are quite a bit higher than the prices of fresh chicken and turkey, perhaps not surprising for beef but somewhat surprising for pork. Even from this limited data it is clear that purchasers of these meats from grocery stores may be behaving perfectly rationally, responding to relative prices and price changes over time. However understanding more about the magnitude of the relative price responsiveness for each of these meats as well as responses to advertising (for some of the products consistently over time) as well as food safety and health media indices (in the context of the major meats of beef, pork and chicken) could also prove illuminating for farmers and processors of these products.

Empirical Analysis

The data on sales of meat by type for Canada over the period December 2000 to November 2006 were analyzed using a two stage demand system with a logarithmic specification of total meat expenditure by household in the first stage and a trans-log demand system in the second stage. There are a number of heroic assumptions underlying the specification of a two stage demand model, such as the products identified in the model are weakly separable from all other products, in this case other products containing meat such as frozen dinners, other foods and all other goods**.** In essence, based on this assumption it is possible to separate the consumer choice model for the selected meats from all other products consumers purchase.

At the first stage of the demand system, the only information needed is total expenditure and appropriately defined prices for each product class along with other explanatory variables.
The first stage of the demand model is given by the following general form:

$$E_t = \sum_i P_{it} X_{it} = f\left(P_t, Y_t, G_t, B_t, R_t, F_t, M_t, FS, HTH, E_{t-1}\right), \text{ i=1...n} \quad (1)$$

where P_{it} = price of the i-th meat; X_{it} = quantity consumed of the i-th meat at time t; P_t = expenditure share-weighted real average price of all meat products; Y_t = real per capita disposable income; A_t = real aggregate expenditure on advertising of all meats; M_t = a vector of seasonal (monthly) dummies; FS = media index for all meat related food safety newspaper coverage, HTH = media index for all health and meat related newspaper coverage, E_{t-1}= lagged dependent (per capita expenditure) variable; and i = 1 through 8, representing the eight meats defined above.

The first stage of the demand model is normally specified as a double-log equation where the dependent variable is log of total expenditure (E) on meats. That is,

$$\ln\left(E_t\right) = b_o + b_1 \ln(P_t) + b_2 \ln(Y_t) + b_3 \ln(A_t) + b_3 \ln E_{t-1} + b_4 LnT + \sum_{k=1}^{3} b_k M_k + \varepsilon_t \quad (2)$$

where **b**'s are parameters to be estimated; and ε_{1t} is an identically and independently distributed random error term.

The second-stage of the analysis involves the specification of a demand system that is consistent with consumer theory. The correspondence between weak separability and two-stage budgeting along with the existence of the sub-utility functions enables one to establish group indirect utility functions and cost functions (Deaton and Muellbauer 1980b). The conditions that make consumer demand functions theoretically consistent are implied by consumer behaviour. Invoking the concept of duality, the consumer's preference can be represented by the direct utility function, or by the indirect utility function, by the expenditure function, or by the distance function (Deaton and Muellbauer 1980b). All four functions provide identical information about the consumer's preferences.

One of the challenges that consumer demand analysts often face relates to the choice of functional form to use when analyzing consumption patterns. The choice of functional form is a very important consideration although it is a technical issue. The major concern in selecting a proper functional form is that it be flexible in representing a broad range of income and price responses. Commonly used demand systems that are flexible and consistent with the economic theory include the Rotterdam model, the Translog model (Christensen, Jorgenson, and Lau 1975), the AIDS model (Deaton and Muellbauer 1980b), Generalized AIDS model (Piggott and Marsh 2003), An Implicitly Directly Additive Demand System (Rimmer and Powell 1996), Quadratic AIDS (Banks, Blundell and Lewbel), and Lewbel (1989). In our analysis, the challenge of functional form choice appears in the second stage of the demand model. Our fundamental empirical question is then what should the functional form be, to use for the second stage of the demand system; and how to incorporate informational variables into the demand system. One of the challenges is that different functional forms and different ways of incorporating advertising expenditures (or other information) into the second stage of the demand model may come up with different results as to the effectiveness of some strategic variables. The translog indirect utility model is chosen to approximate the true functional form for the second stage of the demand system.

The second stage of the two stage budgeting model can be expressed as :

$w_i = P_iQ_i/E = g(P_i, E, \text{Seasonal dummies (monthly)}, \text{Time}, ADV_i, FS_i, HTH_i, Q_{i,t-1})$,

where $i = 1 \ldots n$ individual meats (in this study n=8).

Estimation Results

Data is available on the meat market from December 2000 until December 2006. The data is provided through a market research firm that collects data from grocery chains willing to sell their data. Not all outlets in Canada are necessarily represented within the data set.

The two stage demand system is estimated using functional forms specified above based on per capita data. All prices are deflated by the CPI (consumer price index), advertising expenditure data (by

firm, provided though Nielsen media) are also expressed on a per capita basis and deflated by the consumer price index. To maintain separable homogeneity of the two stage demand system, expenditure elasticities at the second stage are constrained to 1.0. Results in terms of elasticities (measures of sales responsiveness to prices, expenditure (income), advertising, food safety and health indices are provided below.[2]

The elasticities reported are interesting in a number of ways. First of all it is worth reiterating that no previous studies of meat sales through grocery stores disaggregated into these particular products has ever been done in Canada. Second, there are numerous product specifications embedded in each category – while this analysis is for fresh meats by species – even within the fresh category there are branded products and generic products and numerous different cut and semi-processed attributes added to the meats. Hence the price, advertising, food safety response in the whole category may be composed of as many substitutions within the category as it is outside the category. From a marketing perspective it is interesting to identify whether these economic variables are having an impact within their own product category and on other meats outside their category. All of the estimated own price elasticities are elastic – a one percent price change for an individual meat will result in a greater than one percent decrease in sales of the product at grocery. This can be directly compared to almost all other time series estimates of own price elasticities of demand for the major meats in this study using disappearance data (which includes products sold through grocery and through food service and losses in the system) which suggested that the demand for the major meats were inelastic. One thing that is frustrating for agricultural producers is their perception that when farm prices are very low retail prices do not seem to move downward very much, resulting in lower volume of sales than they perceive might be the case if retail prices actually fell. These results suggest that price elasticities are much more elastic at retail than was previously thought to be the case and that retailers resisting lowering prices may be sensible in the long run given the big negative responses they might face when they raise prices in the future. From this study, it is suggested that meat is becoming an inferior good as far as consumers are concerned – as incomes rise less money is spent on meat, in this case through grocery stores. There are strong cross price effects (suggesting complementarity or substitutability) between beef and pork, chicken, turkey, veal, ham and lamb; between pork and beef and turkey; between chicken and beef and turkey; between turkey and all other meats except lamb; between veal and beef, turkey, bacon and lamb; between ham and beef, turkey and lamb; between lamb and beef, veal and ham. Many of these price effects have not previously been estimated but it does suggest that volumes sold of certain meats such as beef and turkey are highly and statistically significantly affected by prices of many other meats, making it more difficult to assess future demand trends for these meats as the entire meat counter is in flux. Some of these interrelationships show up again in the advertising own and cross price elasticities – highlighted elasticities show strong intuitive effects. Not all products have significant advertising efforts across time. In the poultry market there is clearly a bundle of company advertising activities that cannot be divided into chicken and turkey since the companies process both products and advertise simultaneously. Beef brand and

[2] For this and other model estimations summarized in this report, comprehensive results are available from the lead author.

generic advertising appears to have a negative effect on turkey sales, pork advertising has a negative effect on chicken sales (and on pork sales a counter intuitive result), turkey advertising affects chicken sales negatively and turkey sales positively, poultry advertising has a negative effect on veal sales, bacon advertising has a negative effect on sales of veal, ham and lamb (and surprisingly a positive effect on beef sales). Again it is difficult to say exactly why some counterintuitive results may occur with this particular data set but it is worth noting that the advertising budgets of generic advertisers are not necessarily targeting increased sales through grocery stores – they might equally be interpreted as being aimed at increasing sales through restaurants and until both data sets can be created and analyzed together the total effects of the advertising budgets cannot be ascertained. Some of the advertising budgets included in this analysis of branded products within a category may have had the unintended effect of decreasing sales of the overall category – for example advertising a specific semi-processed 'almost instant', for example, meat product from the fresh part of the meat counter might actually reduce the quantity of that meat category sold – people spending more money on semi-processed product could purchase less meat by being able to select smaller packages and also may reduce their category purchases overall due to the higher prices.

Table 2: Price Elasticities Across Two Stages of the Demand System, Income Elasticities (t-statistics in parentheses)

	Beef	Pork	Chicken	Turkey	Veal	Bacon	Ham	Lamb	Expenditure
Beef	-1.46 (-10.64)	-.21 (-3.00)	-.33 (-3.89)	.12 (4.22)	-.03 (-3.26)	-.00 (-.69)	.12 (4.33)	.02 (2.29)	-1.19 (-1.30)
Pork	-.46 (-3.00)	-1.15 (-11.18)	-.15 (-1.53)	.08 (2.00)	-.02 (-1.55)	.01 (.50)	-.05 (-1.11)	-.01 (-.95)	-1.19 (-1.30)
Chicken	-.51 (-3.89)	-.11 (-1.53)	-1.24 (-15.59)	.14 (3.19)	.01 (1.05)	-.01 (-1.52)	-.04 (-1.56)	.01 (-1.14)	-1.19 (-1.30)
Turkey	1.26 (4.22)	.37 (1.99)	.92 (3.17)	-3.86 (-7.82)	-.07 (-3.44)	.04 (2.03)	-.41 (-3.18)	-.03 (-1.04)	-1.19 (-1.30)
Veal	-.80 (-3.25)	-.26 (-1.55)	.20 (1.06)	-.18 (-3.43)	-1.23 (-11.43)	.20 (5.41)	.10 (1.14)	.19 (2.41)	-1.19 (-1.30)
Bacon	-.79 (-.69)	.45 (.51)	-1.37 (-1.52)	.62 (2.03)	1.17 (5.41)	-1.17 (-4.30)	-.61 (-1.06)	-.07 (-.28)	-1.19 (-1.30)
Ham	1.78 (4.33)	-.36 (-1.11)	-.41 (-1.56)	-.58 (-3.17)	.06 (1.15)	-.06 (-1.06)	-2.06 (-6.80)	-.15 (-2.28)	-1.19 (-1.30)
Lamb	.76 (2.29)	-.26 (-.95)	-.34 (-1.14)	-.09 (-1.04)	.29 (2.41)	-.02 (-.28)	-.38 (-2.20)	-1.71 (-10.62)	-1.19 (-1.30)

Table 3: Advertising Elasticities (second stage) (t-statistics in parentheses)

	Beef	Pork	Chicken	Turkey	Poultry	Bacon
Beef	.002 (1.51)	.00 (.09)	-.00 (-.56)	-.004 (-3.51)	.002 (1.30)	.006 (6.60)
Pork	.003 (1.49)	-.005 (-1.94)	-.009 (-.68)	-.002 (-1.17)	-.00 (-.34)	-.00 (-.81)
Chicken	.003 (1.29)	**-.007** **(-2.28)**	-.003 (-.23)	**-.004** **(-1.94)**	.003 (1.40)	.00 (.24)
Turkey	**-.04** **(-1.62)**	.05 (1.40)	-.02 (-.09)	**.067** **(2.74)**	-.04 (-1.37)	-.02 (-1.25)
Veal	.11	-.00	.04	.009	**(-.006**	**-.01**

	(.04)	(-.44)	(2.15)	(3.48)	**(-2.24)**	**(-6.97)**
Bacon	.004 (.27)	.01 (.68)	.003 (.03)	.009 (.72)	.02 (1.07)	-.041 (-4.01)
Ham	-.01 (-1.57)	.02 (1.82)	.15 (2.41)	.02 (1.78)	.003 (.24)	**-.03** **(-6.34)**
Lamb	-.00 (-.67)	.008 (1.33)	.05 (1.85)	-.002 (-.61)	.001 (.26)	**-.01** **(-4.18)**

Table 4: Food Safety and Health Index Statistically Significant Elasticities (second stage) (t-statistics in parentheses)

	Food Safety			Health Index		
	Beef	Pork	Chicken	Beef	Pork	Chicken
Beef				**.15** **(5.17)**	**.29** **(3.32)**	
Pork						
Chicken					**.25** **(1.78)**	
Turkey				**-1.19** **(-2.60)**	**-3.48** **(-2.05)**	
Veal	**-.02** **(-2.39)**	**.02** **(1.61)**	**.02** **(1.85)**	**-.17** **(-3.31)**		**-.30** **(-2.62)**
Bacon				**-.57** **(-2.07)**	**-1.79** **(-1.70)**	
Ham				**-.73** **(-4.22)**	**-1.28** **(-2.18)**	
Lamb						

The complementarity across meat species shows up again in the food safety and health media indices. First of all, the only statistically significant food safety elasticities (crude indicators of food safety media coverage for beef, pork and chicken only) seem to be on veal sales. Second, media coverage of beef and health affects beef sales positively and negatively affects sales of turkey, veal, bacon and ham. In a similar fashion media coverage of pork and health affects pork and chicken sales positively but negatively affects turkey, bacon and ham sales.

Summary

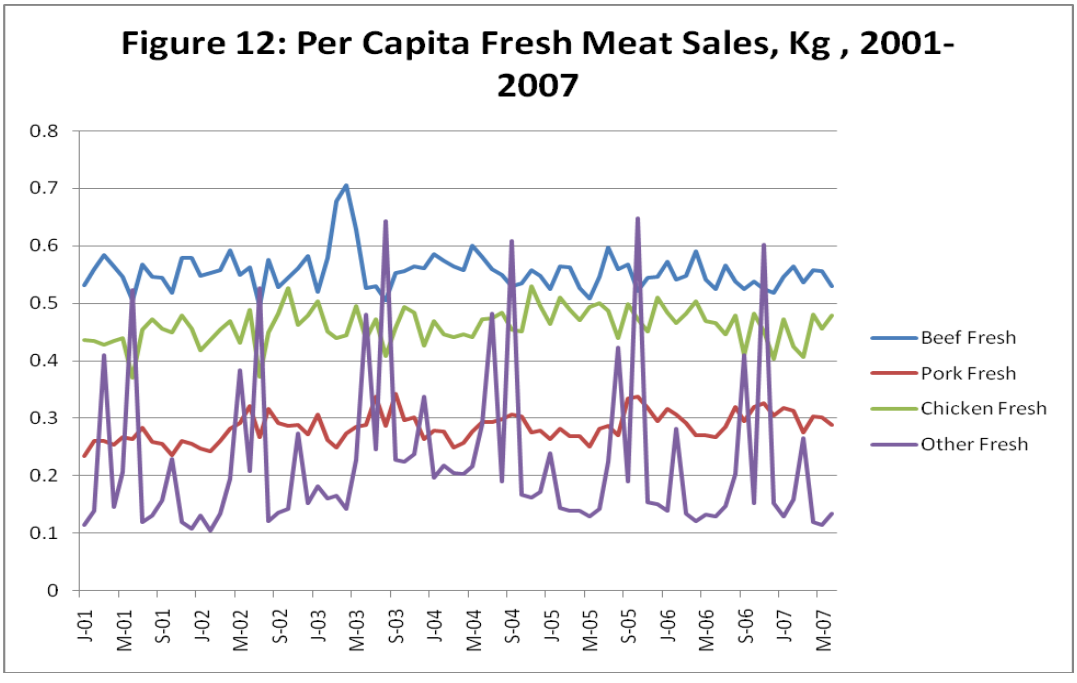
The results of this analysis are far from comprehensive, however they do illustrate a number of factors important to sales of value added meat products. These factors include the fact that there are strong substitution and complementary effects across meats identified in the grocery meat market – the introduction of a new value-added meat product has the potential to cannibalize sales in a category as many times as it does increase sales within a category. Advertising, a key element of the introduction of value added meat products does appear to increase sales of the overall meat category for certain products and not for others. In this case the advertising variable includes both generic and branded advertising and the success of a branded advertising campaign may be influenced by a successful ongoing generic strategy. Even at this aggregate category there are clear effects of food safety incidents and media coverage of health issues on sales within the market, something it is important to consider for the success of a specific meat product launch.

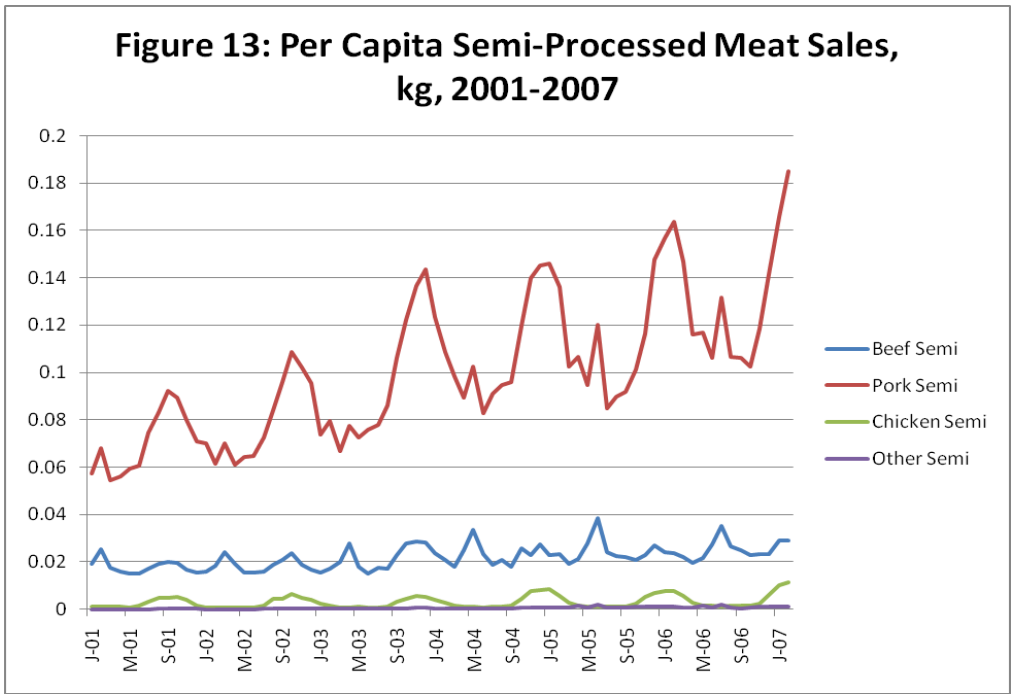
Canadian Meat Consumption By Type of Processing

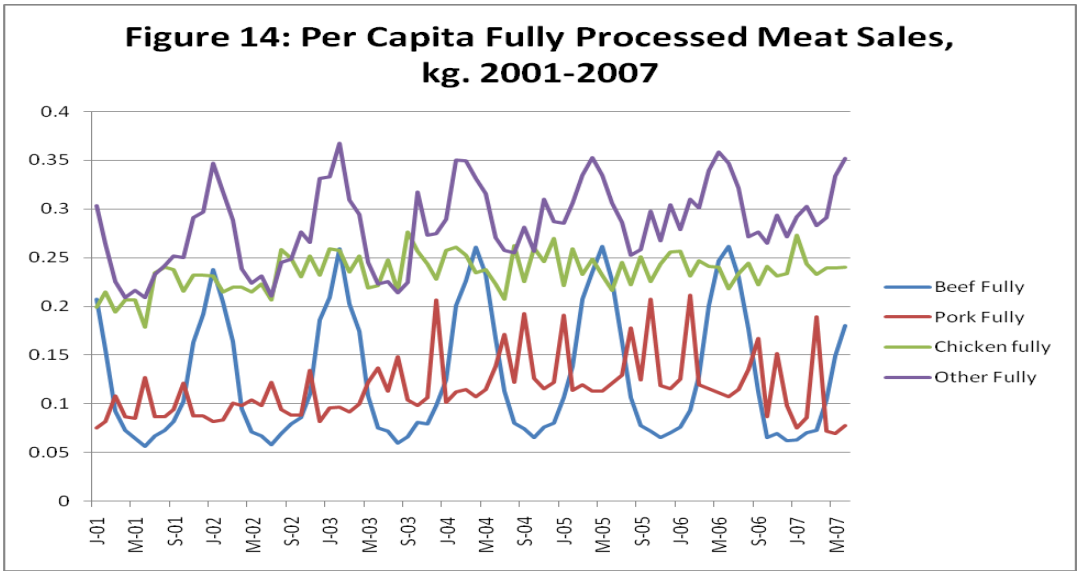
In this section a comprehensive set of estimates of national level meat sales – by type of processing - will be reported. The data used in this section represents all types of meat, sold through grocery stores, in fresh, frozen, processed, branded, deli meat, and all other forms. The authors have used a system of classification to put the meats of four types (beef, pork, chicken and other which includes turkey and seafood to name only two) into three categories – fresh, semi-processed, fully processed – admittedly using an allocation method developed for this study. Examples of semi-processed meats include bacon, sausages, brochettes, skewers, stir-fry, seasoned products. Examples of fully processed meats include schnitzel, burgers, nuggets, meatloaf, deli ham, breaded.

Methodologically this analysis will use the same modeling structure as in the previous section of the report. A two stage demand model is specified for the 12 meat categories with total expenditure on these meat groups modeled in the first stage of the demand system (using a logarithmic functional form) and a translog demand system used at the second stage of the demand system, modeling eleven of the twelve meat categories as functions of prices and advertising expenditure. The twelfth category is derived through restrictions of economic theory imposed on the demand system.

This analysis of Canadian meat demand is based on the assumption that meat is separable from all other goods in consumption. The data used in the analysis is presented in the following six graphs, Figures 12 through 17. The first three graphs provide an illustration of the per capita quantities sold, monthly, from January 2001 to July 2007.



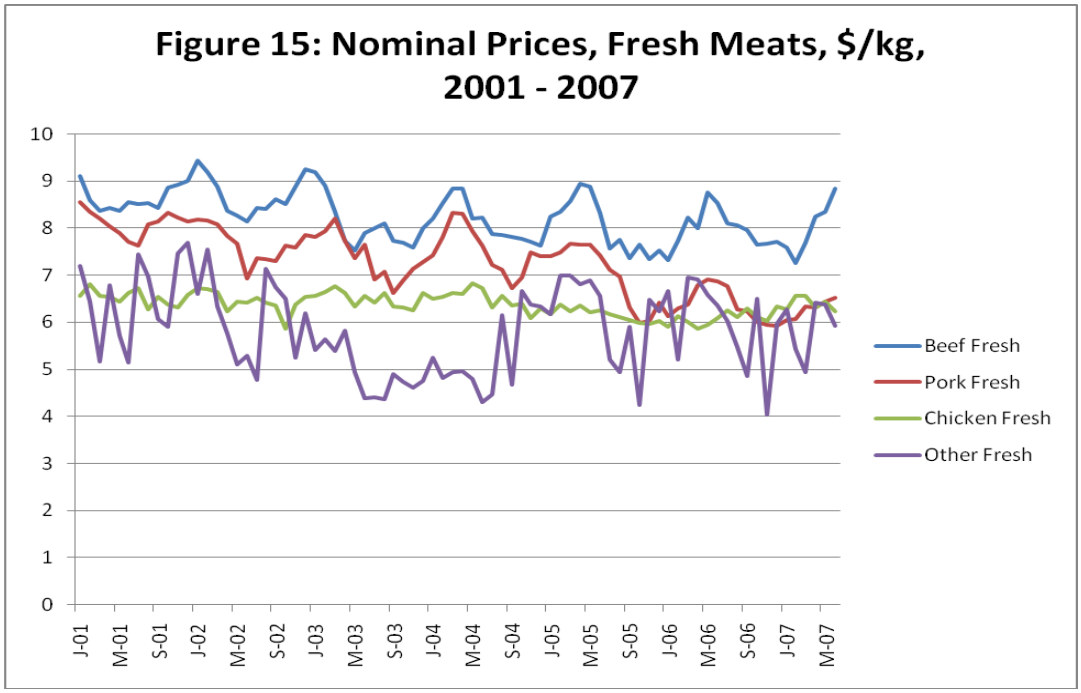


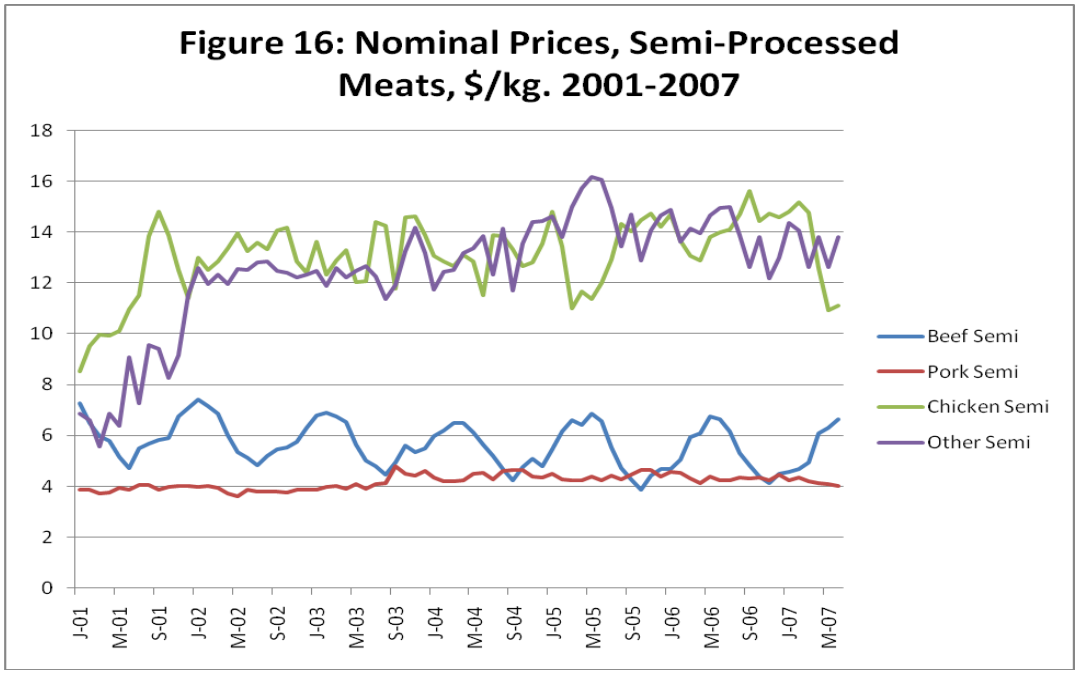


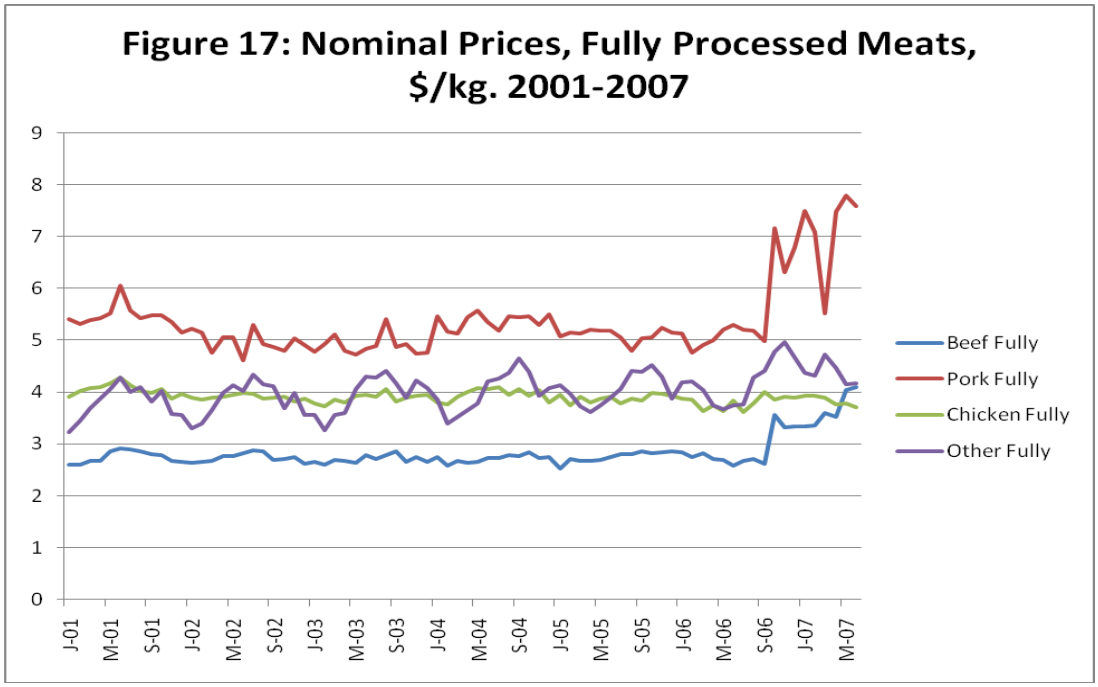
From the quantity graphs above a number of things are obvious - sales of fresh meat (all four types) are the largest in quantity terms of the three processing categories. In the fresh – other category the pronounced seasonality in turkey sales is evident in the monthly graph. The increase in fresh beef sales that accompanied the finding of BSE in May 2003 is equally obvious. Pork dominates the semi-processed meat category

which seems reasonable given that meat from hogs is sold in more forms than meat from any other animal in Canada. In the fully processed category – other meats make up the largest quantity (largely processed seafood products), beef shows a pronounced seasonality due to burgers falling into this category and the bulk of the fully processed pork category is ham which shows much more variability than the fully processed chicken category (nuggets, breaded chicken, for example).

Graphs of the nominal prices for each of the twelve meat types are shown in Figures 15 through 17.







In these graphs it is clear that although higher levels of processing may add value to the animal from whom the products are made, the prices for fully processed meat products on a per kilogram basis may not be the highest. In these examples for most of the types the fresh meat prices are the highest. Fresh beef prices are the highest but, in terms of semi and fully processed beef products, beef prices are generally at or near the

bottom of the category. Fresh pork prices are the second highest but semi-processed pork prices are the lowest in that category and fully processed pork products have the highest prices in that category. Prices for chicken and other meats are third and fourth highest in the fresh category, highest in the semi-processed category and second and third in the fully processed category. The differences in relative prices reflect the vastly different structure of the meat products by animal species (including fish). Beef is sold in possibly the fewest number of forms in the grocery store and much of the fully processed beef category is frozen burgers – admittedly value adding to the lower quality beef cuts, but not a high priced item or a luxury item as are some of the higher priced ham products sold.

Empirical Analysis

Results in terms of price elasticities are presented in Tables 5 and 6 below. The demand system is estimated with the restrictions of symmetry, homegeneity of degree zero in prices and income and homotheticity of the underlying utility function imposed (the latter is a requirement of consistent weak separability (Green, 1971)). This latter restriction results in second stage expenditure elastitices being equivalent to one for all goods.

Table 5: Price Elasticities – First Nine Meat Categories- Across Two Stages of the Meat Demand System (t-statistics in parentheses)

	FRESH			SEMI-PROCESSED			FULLY-PROCESSED		
FRESH	Beef	Pork	Chicken	Beef	Pork	Chicken	Beef	Pork	Chicken
Beef	-1.54 (-15.85)	-.11 (-2.55)	-.45 (-7.63)	.027 (3.34)	.010 (.62)	.022 (5.62)	.112 (6.16)	-.12 (-21.06)	-.12 (-5.69)
Pork	-.25 (-2.54)	-1.58 (-17.55)	-.03 (-.36)	-.02 (-1.23)	.04 (1.04)	-.00 (-.99)	-.04 (-.99)	.093 (2.36)	-.05 (-1.01)
Chicken	-.70 (-7.62)	-.02 (-.36)	-1.51 (-14.01)	.01 (.76)	-.06 (-1.82)	.008 (.99)	-.02 (-.60)	-.01 (-.33)	.11 (2.36)
Other	.59 (3.60)	-.24 (-3.94)	.30 (2.73)	-.77 (-.74)	-.09 (-4.03)	.72 (1.48)	.02 (.57)	-.15 (-2.40)	.10 (2.66)
SEMI-PROCESSED									
Beef	1.05 (3.35)	-.38 (-1.23)	.32 (.76)	-1.28 (-7.26)	.53 (2.16)	.37 (4.82)	.26 (1.11)	.22 (1.26)	-1.44 (-4.54)
Pork	.11 (.62)	.18 (1.04)	-.44 (-1.81)	.15 (2.16)	-.45 (-2.95)	-.02 (-.87)	-.25 (-2.12)	.08 (.79)	-.33 (-2.10)
Chicken	2.66 (5.65)	-.48 (-.99)	.65 (.98)	1.17 (4.81)	-.31 (-.87)	-1.47 (-8.99)	-.46 (-1.25)	.04 (.15)	-2.29 (-4.38)
Other	2.14 (1.85)	.20 (.15)	-4.26 (-2.52)	.19 (.27)	.82 (.85)	.52 (1.19)	1.33 (1.42)	-3.36 (-4.74)	1.80 (1.09)
FULLY PROCESSED									
Beef	1.44 (6.17)	-.20 (-.99)	-.18 (-.60)	.09 (1.11)	-.29 (-2.13)	-.05 (-1.25)	-1.01 (-5.20)	-24 (1.66)	-.61 (-3.31)
Pork	-.87 (-4.14)	.31 (2.36)	-.06 (-.33)	.04 (1.26)	.05 (.79)	.00 (.15)	.14 (1.66)	-1.97 (-15.82)	.17 (1.96)
Chicken	-.61 (-14.70)	-.11 (-1.01)	.34 (2.35)	-.19 (-4.54)	-.15 (-2.10)	-.09 (-4.38)	-.23 (-3.31)	.11 (1.96)	-1.34 (-8.74)
Other	-.20 (-1.89)	-.14 (-1.91)	.06 (.64)	-.17 (-7.63)	-.31 (-8.04)	-.06 (-5.91)	-.47 (-11.25)	.25 (5.22)	.05 (.88)

Table 5 continued: Price and Income Elasticities —Across Two Stages of the Meat Demand System (t-statistics in parentheses)

	FRESH	SEMI PROCESSED	FULLY PROCESSED	
FRESH	Other	Other	Other	Income
Beef	.16 (3.56)	.002 (1.85)	-.05 (-1.90)	-1.31 (-5.51)
Pork	-.14 (-3.91)	.00 (.15)	-.076 (-1.91)	-1.31 (-5.51)
Chicken	.12 (2.64)	-.009 (-.98)	.02 (.64)	-1.31 (-5.51)
Other	-2.58 (-10.44)	-.00 (-.72)	-.01 (-.31)	-1.31 (-5.51)
SEMI PROCESSED				
Beef	-.07 (-.74)	.009 (.27)	-1.62 (-7.63)	-1.31 (-5.51)
Pork	-.26 (-4.01)	.01 (.85)	-.84 (-8.04)	-1.31 (-5.51)
Chicken	.23 (1.47)	.08 (1.19)	-1.88 (-183.34)	-1.31 (-5.51)
Other	-.29 (-.72)	-1.59 (-3.48)	.43 (.45)	-1.31 (-5.51)
FULLY PROCESSED				
Beef	.05 (.55)	.02 (1.42)	-1.55 (-11.25)	-1.31 (-5.51)
Pork	-.29 (-2.41)	-.03 (-4.73)	.46 (5.22)	-1.31 (-5.51)
Chicken	.61 (-14.70)	.01 (1.09)	.07 (.88)	-1.31 (-5.51)
Other	-.01 (-.31)	.00 (.45)	-1.04 (-101.29)	-1.31 (-5.51)

With this categorization of meat product sold through grocery stores, we again see relatively elastic own price responses for all of the twelve products except for semi-processed pork. Elastic own price responses show that for a 1 % change in price, quantities sold will decline by more than one percent. Again the magnitude of these elasticities is larger than previous analysis of time series meat disappearance data would suggest aggregate own price elasticities for beef, pork etc are. There are two reasons for this – first that the aggregate category of beef, for example, has been split into three component parts, allowing for the possibility of substitution between beef products with different levels of processing and secondly, that these data only represent sales through grocery stores but consumers can also buy food through other outlets and through restaurants. Across the four products there are some interesting cross price effects – in the case of beef – the three beef products (fresh, semi and fully processed) are strong substitutes for one another. This type of substitution also shows up between fresh and fully processed pork and fresh and fully processed chicken but not between the semi-processed forms and other forms for these meats. In general, fresh beef shows stronger substitution and complementarity effects with other products than do either pork or chicken. This suggests that beef sales, under any type of processing are likely to be more affected by other product sales – sometimes to the good (in the case of gross complementary effects) and sometimes to the bad (strong substitution effects). For example, a price increase in fully processed pork, chicken or other meats will result in a decline in fresh beef sales. Price increases in fully processed chicken or other meats will also reduce sales of semi and fully processed beef. It is interesting that although fully processed pork sales are also complementary to fully processed chicken and other meats, semi-processed pork shows strong substitution for fully processed chicken and other meats. In the substitution effects an increase in price of fully processed chicken or other meats will result in an increase in semi-processed pork sales. It is worth pointing out that the estimated income elasticity of demand (the same for all products due to the maintained hypothesis of homotheticity) across the two stages of the model again shows that meat purchased from grocery stores is an inferior good as far as consumers are concerned. Advertising elasticities of demand for the twelve meat products are presented in the following table.

Table 6: Advertising Elasticities Second Stage of Demand System (t-statistics in parentheses)

	FRESH			SEMI PROCESSED			FULLY PROCESSED		
FRESH	Beef	Pork	Chicken	Beef	Pork	Chicken	Beef	Pork	Chicken
Beef	**.004 (1.78)**	**.007 (2.08)**	**.04 (2.20)**		**.006 (3.16)**	.006 (1.21)	-.001 (-.30)	-.002 (-.35)	**.008 (3.65)**
Pork	.00 (.33)	**-.007 (-2.20)**	-.01 (-.87)		**.003 (1.98)**	-.00 (-.44)	-.005 (-1.43)	**.007 (1.64)**	-.001 (-.70)
Chicken	.002 (.72)	-.00 (-.09)	.019 (1.01)		.002 (.86)	-.00 (-.00)	-.005 (-.93)	-.004 (-.67)	.003 (1.43)
Other	-.02 (-.94)	-.01 (-.69)	**-.18 (-1.79)**		**-.02 (-1.83)**	-.02 (-.67)	.04 (1.36)	-.00 (-.32)	**-.03 (-2.35)**
SEMI PROCESSED									
Beef	.00 (.87)	-.00 (-.55)	-.04 (-1.02)		-.00 (-.40)	.01 (1.34)	.01 (1.44)	**.04 (3.48)**	**-.02 (-3.54)**
Pork	.00 (.27)	-.00 (-.47)	-.03 (-1.11)		-.00 (-.26)	.006 (.79)	.003 (.49)	.01 (1.52)	**-.007 (-2.36)**
Chicken	-.01 (-1.31)	.02 (1.45)	.006 (.09)		.00 (.88)	.00 (.0015)	-.01 (-.88)	**.04 (2.08)**	-.00 (-.72)
Other	.00 (.19)	.00 (.19)	.11 (.75)		.00 (.42)	**.08 (2.08)**	.08 (2.35)	.06 (1.43)	-.00 (-.41)
FULLY PROCESSED									
Beef	.00 (.25)	.01 (1.57)	.04 (.96)		.00 (.97)	.00 (.25)	**-.02 (-2.07)**	**.03 (3.21)**	-.00 (-.09)
Pork	-.00 (-.69)	**.02 (2.04)**	.00 (.09)		**-.03 (-4.54)**	-.02 (-1.13)	**.02 (1.76)**	**-.03 (-2.36)**	-.00 (-.53)
Chicken	-.00 (-.60)	**-.01 (-2.38)**	.03 (1.37)		.00 (.15)	-.00 (-.33)	-.009 (-1.90)	-.00 (-.11)	-.00 (-.07)
Other	**-.006 (-1.90)**	-.006 (-1.50)	-.00 (-.11)		-.00 (-.19)	.005 (1.03)	**-.01 (-2.43)**	**.011 (2.16)**	.002 (1.23)

Table 6 cont. Advertising Elasticities Second Stage of Demand System (t-statistics in parentheses)

	FRESH	SEMI PROCESSED	FULLY PROCESSED
FRESH	Other	Other	Other
Beef	.00 (.05)	**.006** **(2.65)**	**-.004** **(-1.78)**
Pork	.00 (.23)	**-.004** **(-1.75)**	.002 (.92)
Chicken	.00 (.01)	-.00 (-.46)	**-.005** **(-1.89)**
Other	-.00 (-.39)	-.00 (-.43)	.01 (.85)
SEMI PROCESSED			
Beef	.00 (.11)	-.00 (-.01)	.005 (1.04)
Pork	-.00 (-.10)	-.00 (-.03)	.002 (.79)
Chicken	.005 (.45)	**.02** **(2.28)**	-.01 (-1.39)
Other	-.00 (-.08)	**.05** **(2.08)**	-.01 (-.73)
FULLY PROCESSED			
Beef	.006 (.87)	.001 (.21)	.005 (1.05)
Pork	.005 (.09)	-.01 (-1.44)	.005 (.82)
Chicken	-.003 (-.90)	-.004 (-1.20)	.002 (.60)
Other	.004 (1.30)	-.002 (-.54)	**.005** **(2.21)**

From the advertising elasticities presented above fresh beef sales are positively affected by almost all meat advertising expenditures (fresh beef, pork, chicken, semi-processed pork, fully processed chicken and semi processed other) and negatively by fully processed other meat advertising expenditure. Strangely fresh pork sales are negatively affected by fresh pork advertising and positively affected by semi-processed pork and fully processed pork advertising. Sales of other fresh meat are negatively affected by fresh and fully processed chicken advertising and by semi processed pork advertising. Some of the counter intuitive signs may have been generated by how the advertising variables were created. For some products generic advertising (conducted by commodity organizations) is a major expenditure and for lack of any other defining characteristic the generic expenditures have been allocated to the fresh advertising category by meat type. There is no reason to assume that all advertising content for these generic advertisers exclusively focused on fresh product sales – processed products may also have featured in the ads. What is clear from the above table is that advertising does play a role in shifting people away from and towards particular meat products and is clearly a feature integral to the success of new value-added product launches in the meat market. One example of this is the fact that other meat semi processed and fully processed advertising expenditures affect positively the sales of semi processed other meat and fully processed other meat respectively. This is a category with a significant number of new product introductions on a regular basis.

Summary

With this different categorization of meat sales through grocery stores some other important characteristics of meat sales have been identified. First of all, for some meats (beef, for example) there are strong substitution affects between products with different levels of processing. Hence the introduction of a new value added beef product may not increase sales of beef over all, it may merely shift beef consumption from one type of product to another – this may be good on a value basis if the new product is higher valued and requires specific characteristics from the farm level but the sales of fully processed beef burgers which may substitute for some or all fresh beef cuts may not enhance the value of live animals. For fresh chicken the substitution possibilities are less pronounced than for beef but fully processed chicken products do substitute for fresh chicken products. The other meats categories show strong relationships with chicken and beef categories – strong substitutability with chicken makes sense since turkey is part of the other meats category but the strong relationships with the various beef products may come from either turkey or seafood. Most previous time series disappearance models for meats in Canada have not included seafood as a product, detailed examination of Neilsen Homescan™ data has shown that substitution between beef and seafood is important and that seafood consumption is growing in the middle-aged to older, well educated, higher income households in Canada. It is possible that analysis of this data set is highlighting the same phenomenon, something that may have been missed in earlier studies of meat consumption in Canada.

Canadian Consumption of Fresh Chicken - Analysis of Branded and Generic Products[3]

Since the late 1980s a major Canadian meat processor[4] has pursued a strategy of branding their fresh chicken sales within the grocery sector. Their brand identifier has been associated with chicken produced from farms under contract with the company, to feed only the meat processor's approved feeds. A major innovation in the marketing of their brand of chicken occurred in 2001 (July) when the name of the product was changed, with a guarantee of 100% grain (vegetable) feed used in production. This major Canadian meat processor has achieved premium prices in the marketplace (over the period 2000-2007, and held a quantity market share that has fallen from a high of 8% in early 2001 to an average that hovers around 5 % of the market (quantities represented are for stores that report sales not for the entire grocery market). It is noteworthy that the meat processor has pursued an aggressive advertising strategy, spending significantly more money than the sum of all other generic and branded advertising in the chicken marketplace over the past seven years. Analysis with this data set will include econometric analysis, incorporating food safety and structural change analysis around changes in the meat processor's marketing strategy over the seven years to 2007.

Consistent with consumer theory, this empirical analysis of Canadian chicken consumption is conducted as a two-stage budgeting problem. Weak separability implies that a group of goods (types of chicken products) can be separated from the rest of the consumption commodities, so that preferences within groups can be described independently of the quantities in other groups (Deaton and Muellbauer 1980). For consistent two-stage budgeting, i) weak separability of goods at the second stage and ii) a linear homogeneous utility functions at the second stage of the demand system are the necessary conditions (Green 1971). This leads to the modeling of the consumption of a particular group of good in a two-stage demand model (Armington 1969). The consumer can allocate his/her total current expenditures to chicken at the first stage and to individual chicken products at the second stage. The same model structure that has been used in the previous two analyses reported in this study will be used

For the case of advertising expenditures, it can be hypothesized that generic advertising (e.g., "consume more chicken") would increase the total expenditure on the advertised product and might leave the expenditure shares relatively unaffected except through the increased level of total expenditure. This effect could be captured in the first stage of the two-stage demand system. Alternatively, if advertising is targeted towards a particular meat type (e.g., "consume more Brand A chicken"), it is possible that consumers will not change the overall consumption of chicken but change the relative shares of each chicken type (e.g., Brand A versus other products). In a two-stage demand system, the effects of advertising

[3] These results were originally reported in a study on certification prepared for Agriculture and Agri-Food Canada (Goddard et al, 2009)

[4] Due to the nature of the agreement signed when data were purchased from the Neilsen Company, data identified by individual company are not allowed to be published with company names included.

on the relative shares of chicken type consumption could be captured in the second stage. A further possibility is that both stages of the demand system could be affected by any particular type of advertising expenditure where the effects of advertising could be captured by the combined effects of the two stages.

Estimation Results

Data is available on the chicken market from December 2000 until December 2006. As the data is provided through a market research firm that collects data from grocery chains willing to sell their data. not all outlets in Canada are necessarily represented within the data set. However the data does provide the opportunity to segment the market into Brand A (a processor certified production attribute system) chicken and the rest. Further disaggregations into other brands of chicken and fresh chicken sold in an unbranded form is not possible at this time since the data for the other brands is incomplete.

The two stage demand system is estimated using a translog functional form and based on per capita data, all prices are deflated by the Consumer Price Index, advertising expenditure data (by firm, provided though Nielsen media) are also expressed on a per capita basis and deflated by the consumer price index. Given the focus on 100% vegetable (grain) fed that figured so largely in the advertising campaigns for Brand A Revised, at the time of the finding of the first Canadian BSE cow (May 2003 and forward) a variable for a possible BSE impact on sales of the brand and other chicken is included in the model. This variable is based on a BSE media index. A chicken food safety media index (derived from newspaper coverage in the Globe and Mail as a representative major national Canadian newspaper) is also included in the model to examine whether concerns about food safety in chicken may persuade consumers to purchase the branded product or less chicken or have no effect.

A dummy variable representing the introduction of a revised Brand A by the major Canadian meat processor (in July 2001) is tested in both stages of the demand system. This dummy variable is very near the beginning of the sample period and the results associated with this variable are a little unstable. One reason for including this variable in the demand system is due to the recent literature on stigma effects. For example, the existence of a standard which identifies a certain product as having higher quality (defined in various dimensions) could create the impression that the rest of that product being sold represents inferior quality, reducing the demand for the original product. This negative outcome is of concern among food processors and retailers and has been found to be significant in certain research studies in the U.S. It was recently reported that two states in the U.S. have banned the labeling of certain food products as hormone free because of the negative repercussions on other product sales. Further analysis of this phenomenon is necessary with the existing data before a robust evaluation of whether this result has been found or not can be made. The empirical results do establish that consumers find Brand A chicken a very different product from other types of chicken they purchase. Results in terms of elasticities (produced from a model without

the Brand A revised dummy variable and reported for a model specification without homotheticity imposed) are provided below.

Table 7: Second Stage Price and Expenditure Elasticities (t-statistics in parentheses)

Chicken Quantity	*Generic and Branded Chicken price*	*Brand A Chicken price*	*Expenditure*
Generic and Branded Chicken	**-.88 (49.1)**	.006 (.322)	**.88 (76.01)**
Brand A Chicken	**-1.25 (6.70)**	**-1.06 (5.73)**	**2.31 (19.02)**

Table 8: Price Elasticities Across Two Stages of the Empirical Model

Chicken Quantity	*Generic and Branded Chicken price*	*Brand A Chicken price*	*Income*
Generic and Branded Chicken	**-.86 (41.9)**	.008 (.45)	**.80 (2.73)**
Brand A Chicken	**-1.18 (6.02)**	**-1.05 (5.72)**	**2.09 (2.66)**

Table 9: Advertising Elasticities Across Two Stages of the Empirical Model

Chicken Quantity	*Generic and Branded Chicken advertising*	*Brand A Chicken advertising*
Generic and Branded Chicken	**.003 (2.91)**	**-.04 (3.08)**
Brand A Chicken	**-.009 (5.22)**	**.094 (5.44)**

Table 10: BSE Media Index Elasticities Across Two Stages of the Empirical Model

Chicken Quantity	*BSE Media Index*
Generic and Branded Chicken	.0008 (1.06)
Brand A Chicken	**.008 (1.94)**

Table 11: Chicken Food Safety Media Index Elasticities Across Two Stages of the Empirical Model

Chicken Quantity	*Chicken Food Safety*
Generic and Branded Chicken	**-.012 (2.97)**
Brand A Chicken	.015 (1.52)

The empirical results, in terms of elasticities exhibit some remarkable differences across the two products. First of all, demand for Brand A chicken is significantly more price and expenditure elastic than the demand for the rest of the chicken sold. Secondly there is a significantly larger response to advertising expenditure in Brand A chicken than is exhibited for the rest of the chicken sold. This should be understood in context, other studies have shown significant chicken advertising responses in analysis when chicken is part of a complete demand system with other meats. The demand system reported here is at a much more disaggregated level where different types of chicken products are being assessed and it is in that context that chicken other than Brand A chicken does not seem to be as responsive to the aggregated generic and branded chicken advertising expenditure levels. It is possible that the ability to further disaggregate that chicken quantity into individual brands as distinct from the non-branded chicken sold would provide better estimates of individual brand response to advertising. It is interesting that both of the BSE and chicken food safety variables suggest that consumers do respond to these incidents by changing their chicken consumption variables and that they also respond differently to Brand A chicken than the rest of the chicken in the marketplace. Given the emphasis of Brand A Revised chicken on source of animal feed and the emphasis on animal feed as a source of BSE in cattle (reported in the media) it is not perhaps too surprising that consumers appear to want more Brand A Revised chicken as BSE media coverage grows. Total expenditure on chicken also responds statistically significantly positively to BSE media coverage. The measured responses to chicken food safety media coverage also suggest that consumers view Brand A and the rest of the fresh chicken as different products – responding negatively in the larger chicken category and showing no statistically significant response in the Brand A chicken category. Total expenditure on all chicken responds statistically significantly negatively to chicken food safety media coverage.

Summary

Brand A chicken is clearly a value-added product in the fresh chicken category. Although it represents a small share of the overall fresh chicken market , in quantity terms, it is the most prominent brand in that market. Prices for this product are uniformly higher than prices for all other fresh chicken

products (in aggregate) and advertising expenditures are significantly higher than for other brands or generic advertising in the market. The brand is differentiated through the use of particular company feed rations which over much of the last decade focused on the fact that the feed was 100% grain based. Recently this has not been a major feature of any advertising campaign.

Empirical results clearly show that Brand A chicken is considered by consumers to be a distinct product, as compared to other fresh chicken products in the marketplace. Sales of Brand A are more price and income elastic and have larger responses to advertising expenditure than do sales of the other fresh chicken products. In response to BSE, consumers spend more money on chicken but within the chicken category that money is spent on Brand A chicken not on the other chicken products. Any concerns consumers have about food safety and chicken are felt in the other chicken product category and not in the Brand A chicken category. The development of this specific value added (through branding and identification of credence production attributes) chicken product is successful in terms of consumer purchasing and in terms of product differentiation. It is unknown whether producing this product to the company specifications actually nets higher returns for farmers or not.

Canadian Purchases of Beef and Pork Products from Two Major Canadian Meat Processors[5]

This research is aimed at examining price-advertising-quality strategic interactions between two major meat processors in Canada. Strategic behaviour of firms within a concentrated market such as the meat processing sector in Canada can be a major influence on the success of new product introductions in the market. For example, firms have at their disposal product innovations (or changes in product quality), changes in price and changes in advertising expenditure levels as some of the major variables they can influence in attempting to increase sales from their firm. Using data on sales of two major Canadian meat processors, who both sell beef and pork products in fresh and processed forms, this study examines whether or not strategic behavior exists in the actions of these firms and what effect that strategic behaviour has on firm sales (in aggregate) of beef and pork products. As consumer and public concerns about health are currently significantly affecting food markets the role of programs such as the Health Check™ program of the Heart and Stroke Foundation in the activities of these two firms is also highlighted.

Empirical results show that consumers seem to prefer healthy meat products. Participation in the Health Check™ program may help firms increase sales and also affects their strategic decisions about prices, advertising and quality – with different results for different firms. In this analysis, firms are allowed to dynamically adjust their price, advertising and quality strategies over time. Firms thus have the ability to respond to all actions (price, advertising, quality changes) of their rival in a multiple reaction framework.

Data Description

The sample period in this study is from December 2000 to July 2007 with 80 observations for each meat product of each firm. Because both Firm 1 and Firm 2 have processed and marketed meat product lines under various brand names in the marketplace, aggregation of different branded beef and pork products or cuts for each company is needed for analysis simplicity. Before aggregation and disregarding products with zero observations in the dataset, there are 1,024 beef and pork products produced by Firm 1 and 308 by Firm 2 included in analysis (see Table 13). After aggregation and deleting products with zero observations, 475 beef and pork products of Firm 1 and 173 of Firm 2 are finally included in the analysis (see Table 14). For Firm 2, most of the beef and pork products are fresh meat products with a few ham products. Most of Firm 1's products, however, are processed meat products including ham, bacon, sausage/wieners, bologna, salami, pepperoni and luncheon meats. Beef products are the major meat products that Firm 2 processes and markets in the Canadian market, while pork products (including ham, bacon and sausage/wiener) are Firm 1's major meat products available in the Canadian marketplace. As compared to Firm 1, Firm 2 has a smaller number of major brands for beef and pork products available in the Canadian marketplace than Firm 1.

[5] This section of this report is a summary of information reported in the unpublished PhD thesis of Wenzhao Huang, (Huang 2010)

From Figures 18-19, we find that the number of beef and pork products available in the marketplace varies for each firm. One reason for such a variation is that each firm might introduce new products into the market or remove some products from grocery shelves. Another reason is that the number of brands belonging to each company is different over time. For example, Firm 1 acquired another major meat processor in Canada as well as that firm's brands in 2004. Therefore, the number of Firm 1's beef and pork products increased dramatically since April of 2004 (see Figure 18). However, the number of Firm 2's products did not increase significantly in September of 2005 (see Figure 19) when Firm 2 acquired another meat processor in Ontario and added that acquired firm's brands. The reason is that perhaps the acquisition by Firm 2 did not add as many brands and products to those of the original company.

From Figure 20, we find that the quality index for Firm 2's aggregate branded beef and pork products is higher than that of Firm 1. The quality index is defined on nutritional guidelines and has been developed by the authors specifically for this study. Details on the development of this index are available on request. One reason behind this difference could be that Firm 1 processes and markets many more further processed beef and pork products than Firm 2 does. These further processed meat products usually contain significantly more salt than fresh meats, resulting in lower nutritional value (RRR) scores. The same reason can also be applied to explain why Firm 1's quality index has decreased since April 2004 when it acquired another meat processor whose major products were luncheon meats, bologna and sausages containing more salt (see Figures 21, 22). From Figure 21, we can find that pork products of Firm 1 seem to be healthier than their beef counterparts, which might be explained by the fact that the proportion of further processed products containing too much salt is relatively higher for Firm 1's beef products than for its pork products. Similarly, beef products of Firm 2 which are almost all fresh meat products seem to be healthier than their pork counterparts even including some ham products which usually contain higher salt content than fresh meat does (see Figure 22). The sample period for pork products from Firm 2 is shorter as they were not available in the dataset before March of 2002.

From Figures 23 and 24, we can see that Firm 1's aggregated revenue and quantity sales for its aggregate branded beef and pork products are much higher than those of Firm 2. Its revenue and quantity sales have been increasing since April 2004 when Firm 1 acquired the other major meat processor in Canada. Firm 2's merger with another meat processor in Ontario in September 2005, however, did not have such a significantly positive effect on its revenue and quantity sales. From Figure 25, we can find that the price charged by Firm 2 is higher than that of Firm 1, which may explain why Firm 2 has a lower quantity sales level than Firm 1 does. As for advertising expenditures (see Figure 26), Firm 1 has had higher advertising investments for its branded beef and pork products than Firm 2, which in turn may explain why Firm 1's quantity sales are higher than that of Firm 2. The descriptive statistics for all variables involved in analysis are presented in Table 15.

Among those products of each firm, there are some healthy products with relatively lower fat or sodium content (per gram serving size). Moreover, both Firm 1 and Firm 2 have participated in the "Health Check™" program. The dataset contains some products bearing "Health Check™" logos for each firm: 10 products for Firm 1, and 2 products for Firm 2. Such products bearing "Health Check™" logos are considered healthy products. In total, Firm 1 has 68 healthy products while Firm 2 has 9 healthy products.

Summary of Estimation Results

Two firm-specific demand functions with a linear specification are estimated simultaneously. The estimation results are presented in Table 16. For both firms, the own-price coefficient estimates are all statistically significant and negative, which means a lower (higher) price for one product results in a higher (lower) quantity demanded for such a product and beef and pork products (in aggregate) of each firm are normal goods. As for the cross-price effects, the cross-price coefficient estimate is statistically significant while the sign is unexpectedly negative: a lower (higher) price of Firm 2's products seems to increase (decrease) Firm 1's sales. Such a negative cross-price effect implies that beef and pork products between Firm 1 and Firm 2 are gross complements for each other. For own–advertising and own-quality effects on demand, the signs for coefficient estimates are all as expected and positive, which means a higher advertising or quality level for product from a firm results in a higher quantity demanded. Both own-advertising and own-quality effects for Firm 1 are all statistically significant, while the counterparts for Firm 2 are not. One explanation for such insignificant coefficients for Firm 2 might be that consumer response to Firm 2's advertising or quality change is not as fast as consumer response to Firm 2's price changes. Consumers may need some time to realize Firm 2's advertising/quality change and then change their purchase decisions. In other words, consumer may respond to previous rather than current advertising/quality changes from Firm 2. The positive and significant effect of Firm 1's quality strategy on consumer demand for its and products implies that consumers seems to prefer healthier meat products from Firm 1.

As for the cross-advertising effect, the sign is as expected and negative which means a higher (lower) advertising level of one firm's products decreases (increases) the rival's sales. But the coefficient estimate is not statistically significant and the reason behind it might be that consumers do not respond to cross-advertising as quickly as to own-advertising. As for the cross-quality effect, the coefficient is statistically significant while the sign is not as expected and negative: an increase in the quality level of one firm's products seems to have a positive spill-over effect on the rival's sales. Such a positive and significant spill-over effect of Firm 2's quality improvement on consumer demand for Firm 1's products also implies some complementarity in quality. For Firm 1, consumer (current) response to own price changes seems to be more sensitive than the (current) response to its advertising changes. However, consumer (current) response to the quality changes in Firm 1's products seems to be more sensitive than the (current) response to price changes of Firm 1. For Firm 2, consumer (current) price response is

more sensitive to (current) advertising and quality responses as only the (current) price coefficient estimate is statistically significant.

As for the effects of participation in the "Health Check™" program on demand, Firm 2's joining in "Health Check™" program seems to have a statistically significant and positive halo effect on Firm 1's sales. For both firms, own-effects of participation into "Health Check™" program on demand are not statistically significant. For Firm 2, Firm 1's joining in "Health Check™" program seems to have a negative but not statistically significant effect on Firm 2's sales. One explanation for such insignificant effects of "Health Check™" program might be that consumers do not respond to the news that one firm's products bear the "Health Check™" logo very quickly, but they may have a response (e.g., a positive own-effect or a negative cross-effect) to it later on. As for the acquisition effects on demand, Firm 1's acquisition with another major meat processor in Canada has a statistically significant and positive effect on its sales as its beef and pork product line is extended after such a merger. In contrast, Firm 2's merger with another meat processor in Ontario seems to have a significant and negative effect on Firm 1's sales as Firm 2's beef and pork product line is also extended after such an acquisition and it may acquire some market share from Firm 1. As mentioned before, Firm 2's acquisition did not add as many brands from the merged company into its product line as Firm 1 did. Firm 2's merger effect might be too limited to have a significant and positive effect on its sales. However, Firm 1's merger effect might be very large so that it results in a significant and positive cross (and also spill-over) effect on Firm 2's sales.

The publication of the new (2007) version of Canada Food Guide, which resulted in different relative serving recommendations for meat, does not have a significant or instant impact on demand as neither of the demand functions for the two firms have statistically significant coefficients. The change occurs very near the end of the sample period and responses time may be too short to capture such a response. Each firm has a statistically significant and positive coefficient for its one-period (month) lagged quantity demanded, which implies that each firm's decision on price, advertising and quality levels in the last month have effects on demand for the firm's products in the current month. Consumers seem to buy more (less) Firm 1's (Firm 2's) beef and pork products in response to higher income levels. The reason behind it might be that most of Firm 1's products are further processed meat products which are very convenient to consumers who have good income but do not have as much time or don't want to cook. For Firm 1, the coefficient estimate for the time trend measuring structural change in consumer utility is statistically significant and negative, which implies that consumers' utility is decreasing. In contrast, the significant and positive coefficient estimate for the time trend in Firm 2's demand implies that consumers' utility is increasing over time.

For Firm 1, consumers seem to buy less product in the other eleven months than they did in December. However, consumers seem to buy more of Firm 2's products in the spring and summer seasons than they did in other seasons. One explanation for such differences might be that most of Firm 2's beef and pork products are fresh meat products which are appropriate for barbecuing in the spring and summer seasons.

Simulation Results

To illustrate how quality changes affect firm quantity sales and revenues, a simulation of demand and revenue equations is presented. In the base model, each firm's quality index is at actual levels. A number of different scenarios, with single firm or both firm quality increases or decreases, are compared to the base model. The simulation results are presented in Table 17. For the cases with quality increases (decrease), quantity sales and revenues of both firms are increased (decreased) if one or both firms' quality indices are increased (decreased). For cases with quality increases and those with quality decreases, the change in quantity sales and revenues is higher in the case with quality changes for both firms than in the case with quality change for only one firm. As compared to Firm 1, Firm 2 seems to have larger responses to a quality changes in terms of quantity sales and revenues. Moreover, the change in quantity sales and revenues in the case that only Firm 2's quality index is changed is smaller than the cases in which Firm 1's quality change is involved. From the simulation results above, we can find that meat product quality improvement has a positive effect on demand and revenue. Furthermore, a spill-over effect of quality improvement exists in both firms' products. But the spill-over effect of Firm 2's quality improvement are relatively smaller than that of Firm 1.

Figure 18 Monthly Number of Products Available at the Marketplace for Firm 1's Branded Beef and Pork Products and Healthy Products

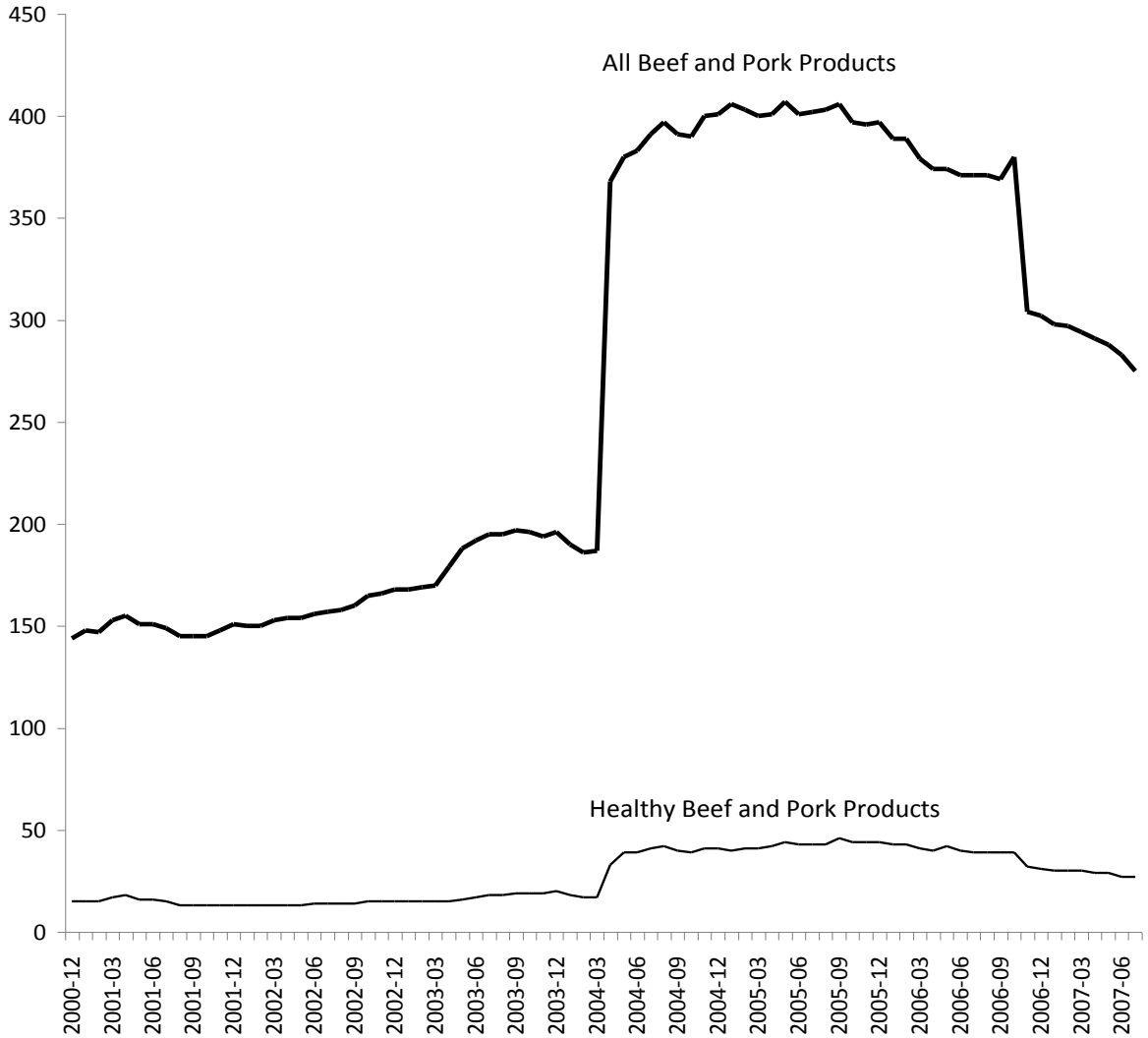


Figure 19 Monthly Number of Products Available at the Marketplace for Firm 2's Branded Beef and Pork Products and Healthy Products

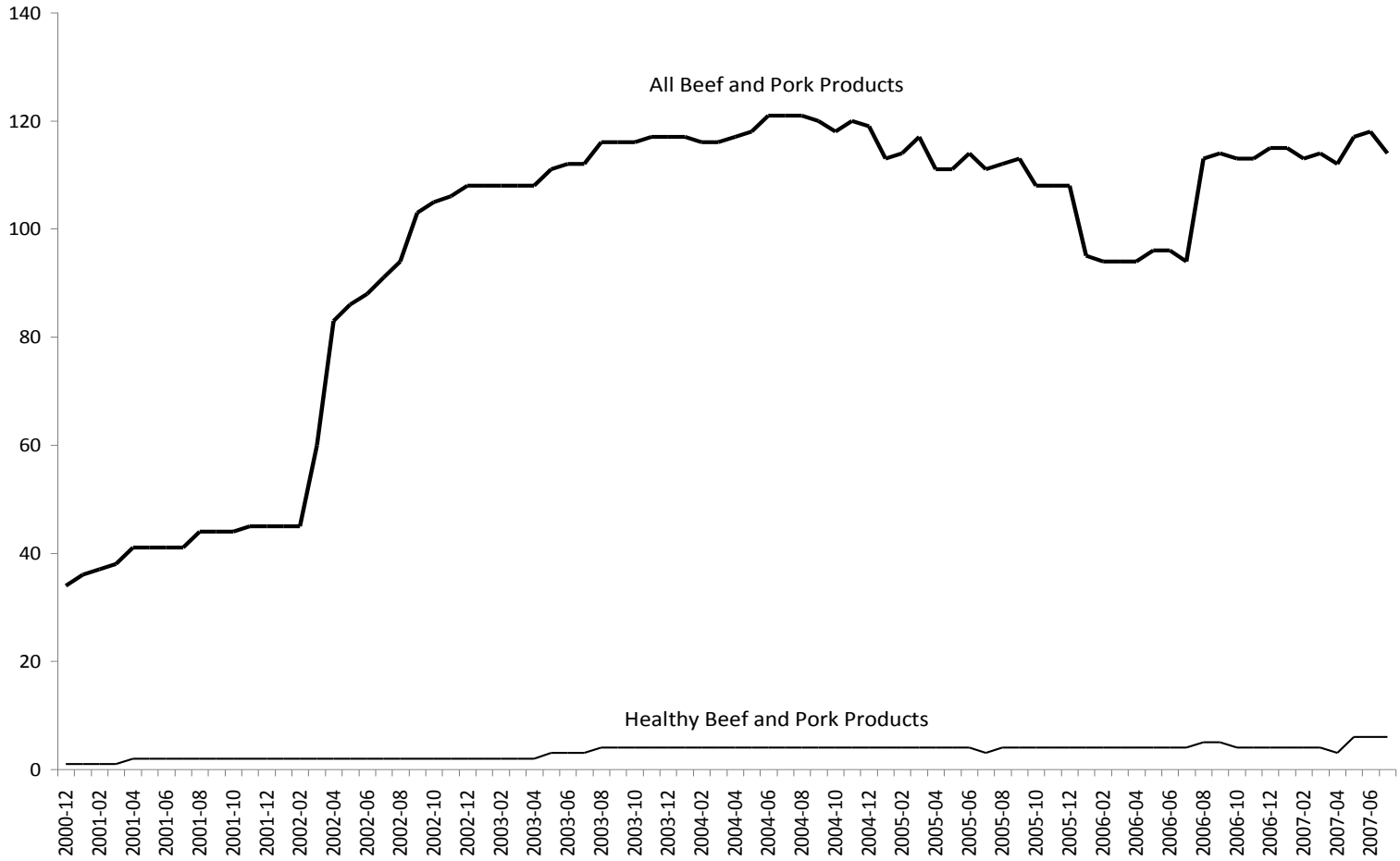


Figure 20 Monthly Quality Indices (Quantity-Count-Weighted) for Firm 1's and Firm 2's Branded Beef and Pork Products

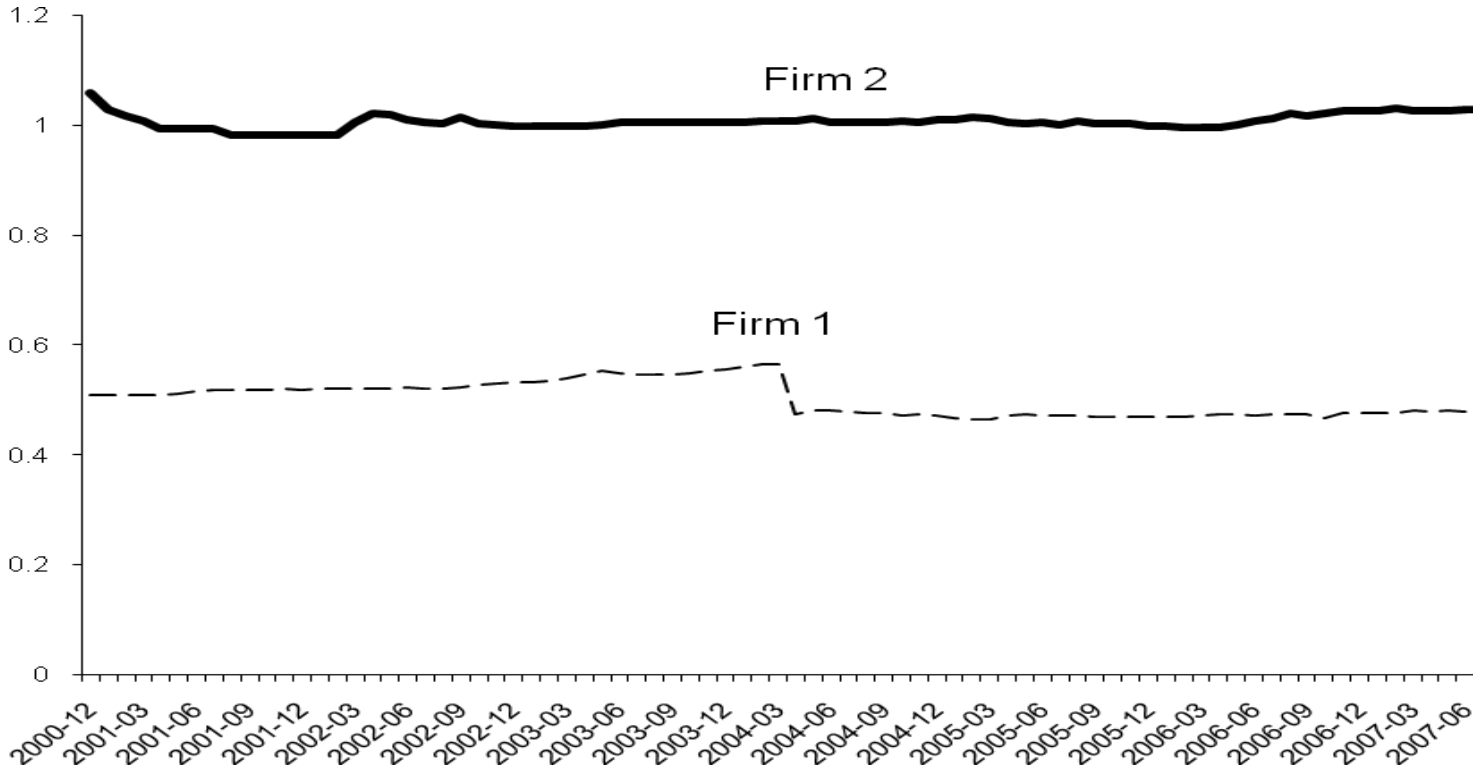


Figure 21 Monthly Quality Indices (Quantity-Count-Weighted) for Firm 1's Branded Beef Products and Branded Pork Products

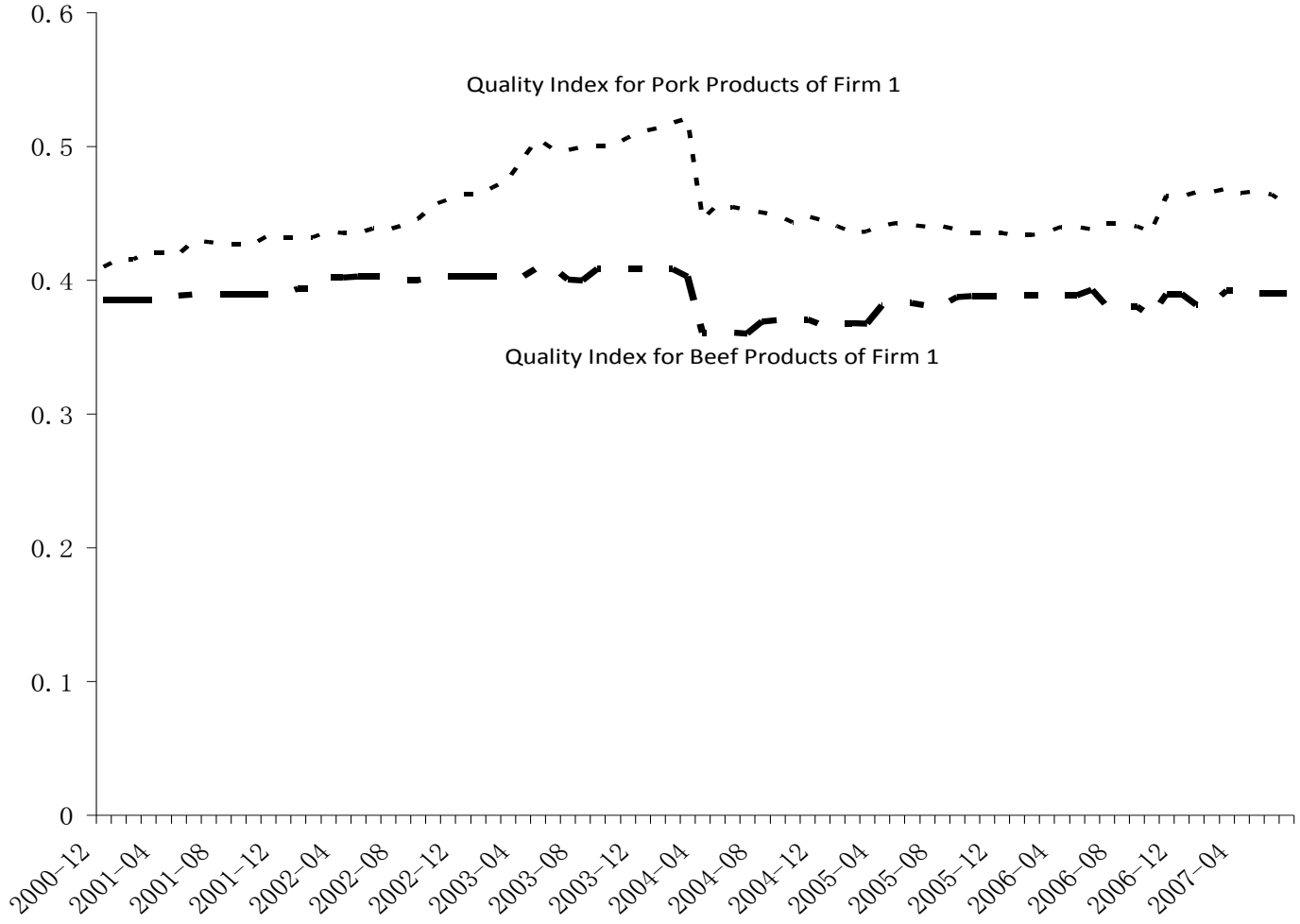


Figure 22 Monthly Quality Indices (Quantity-Count-Weighted) for Firm 2's Branded Beef Products and Branded Pork Products

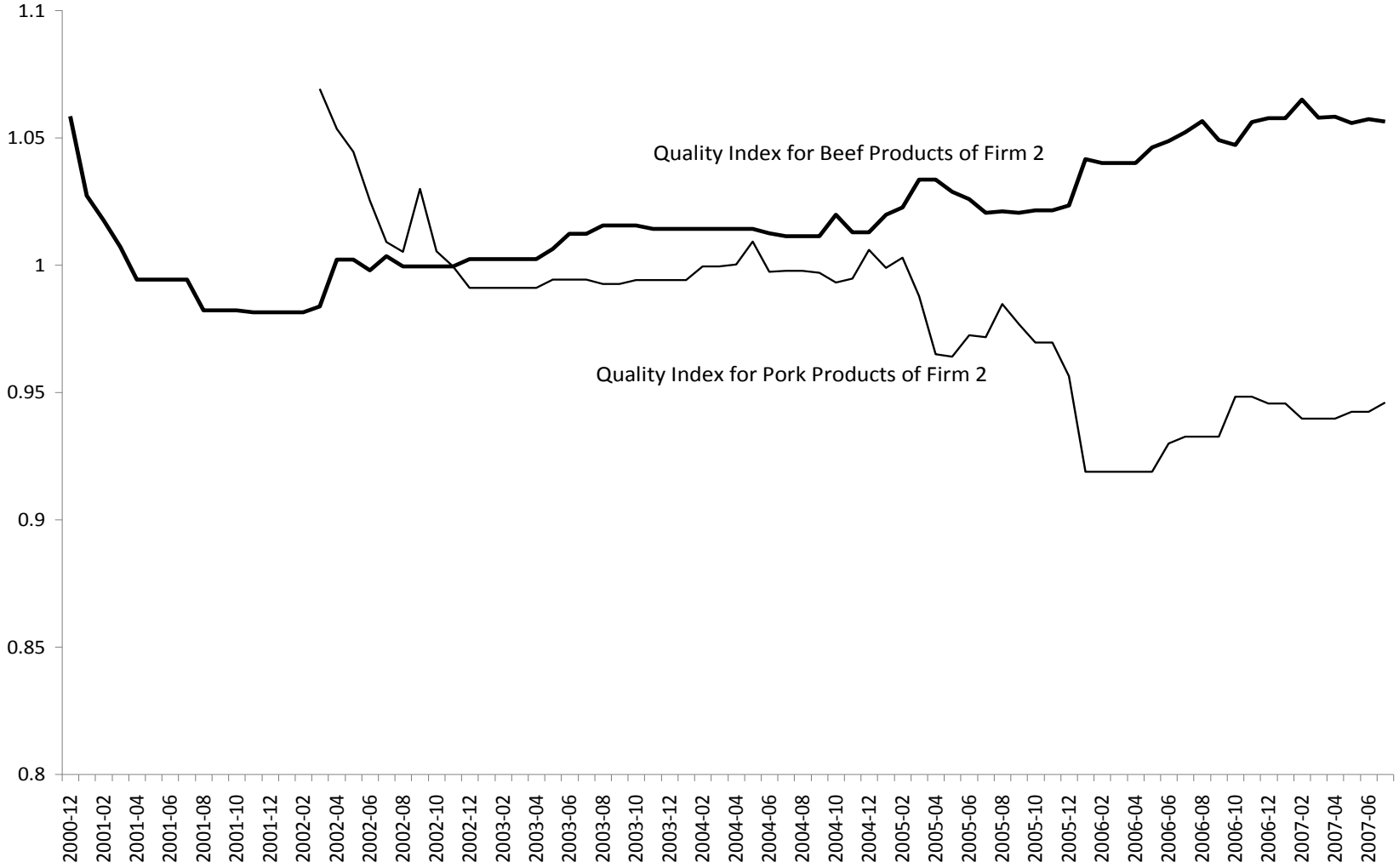


Figure 23 Monthly Real Revenue Sales for Firm 1's and Firm 2's Branded Beef and Pork Products (in Canadian Dollars)

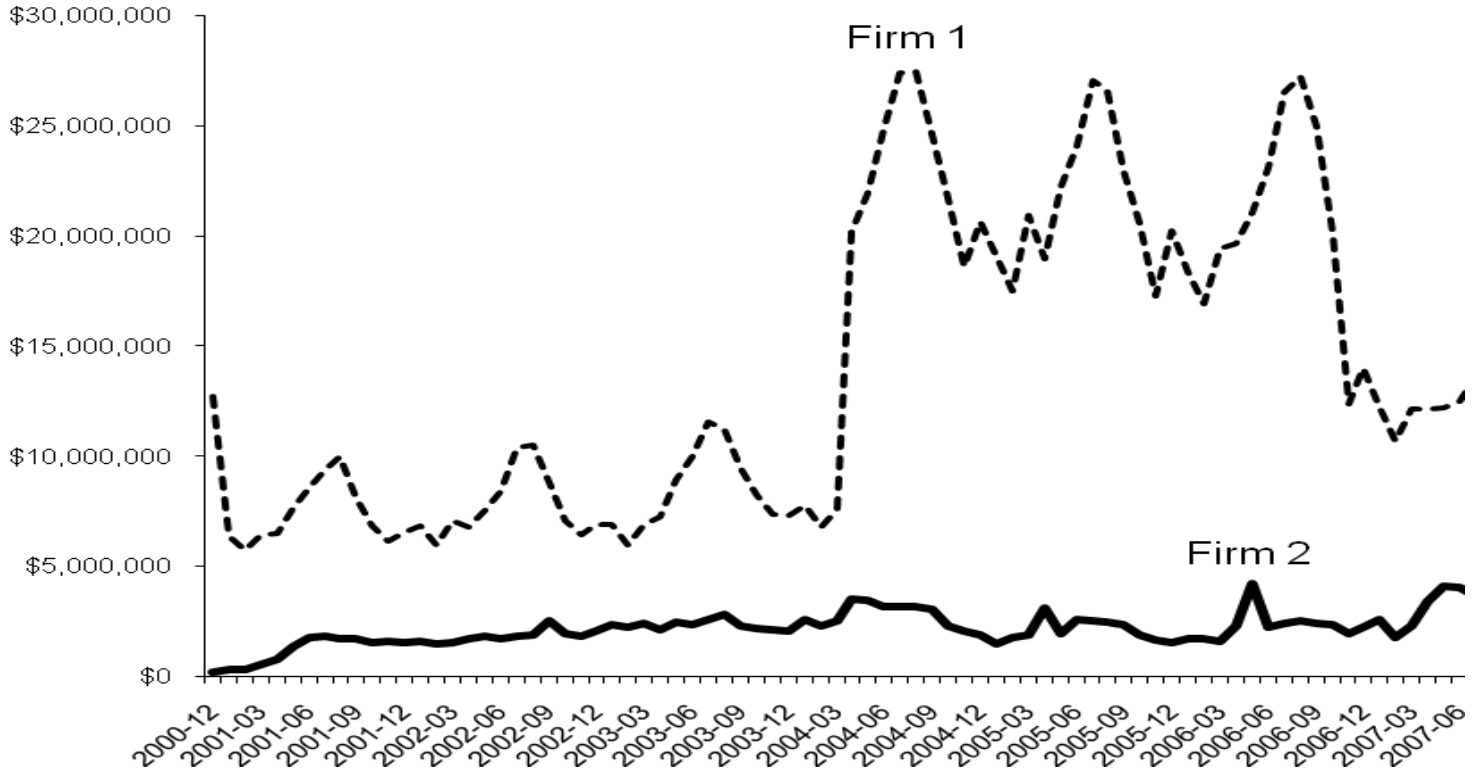


Figure 24 Monthly Quantity Sales for Firm 1's and Firm 2's Branded Beef and Pork Products (in Kilograms)

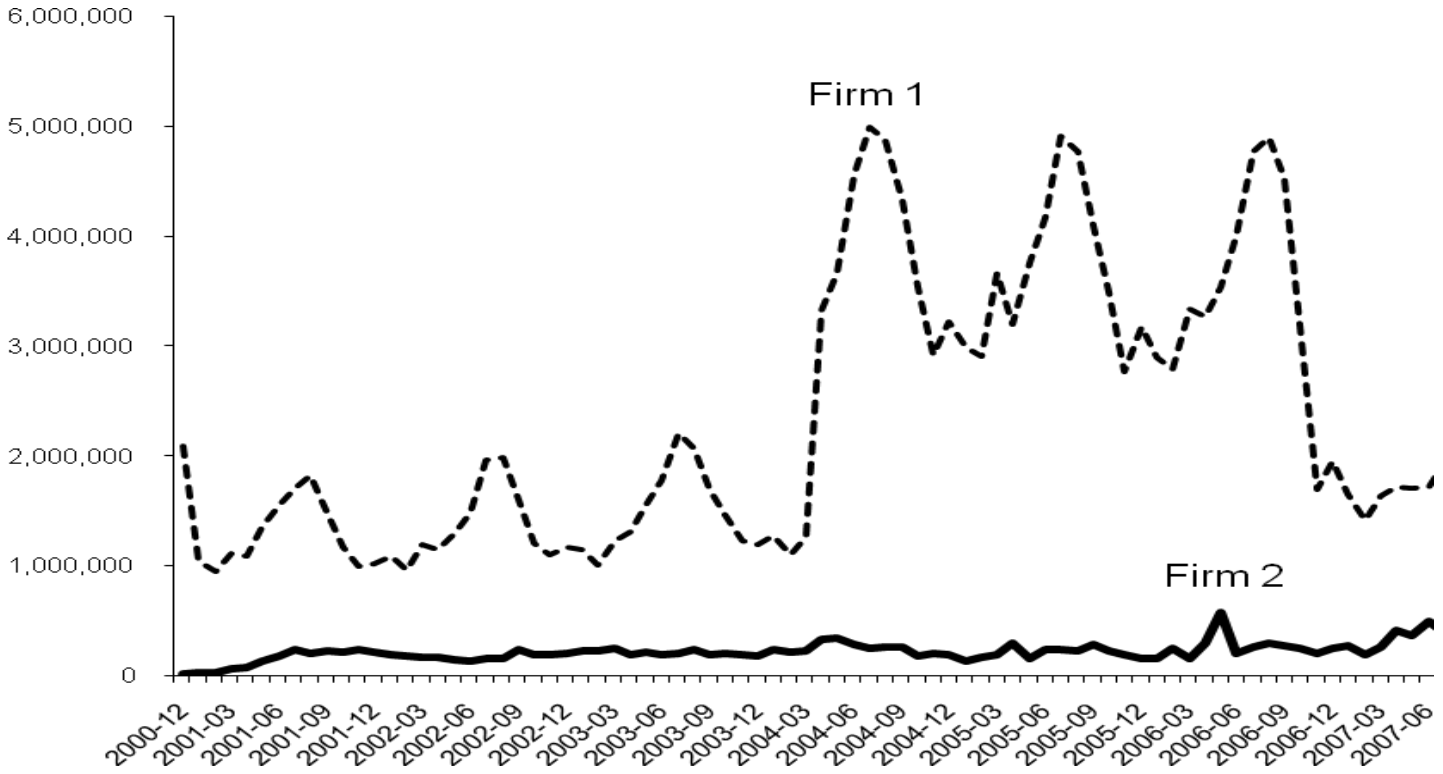


Figure 25 Monthly Real Prices for Firm 1's and Firm 2's Branded Beef and Pork Products (CA$/Kg)

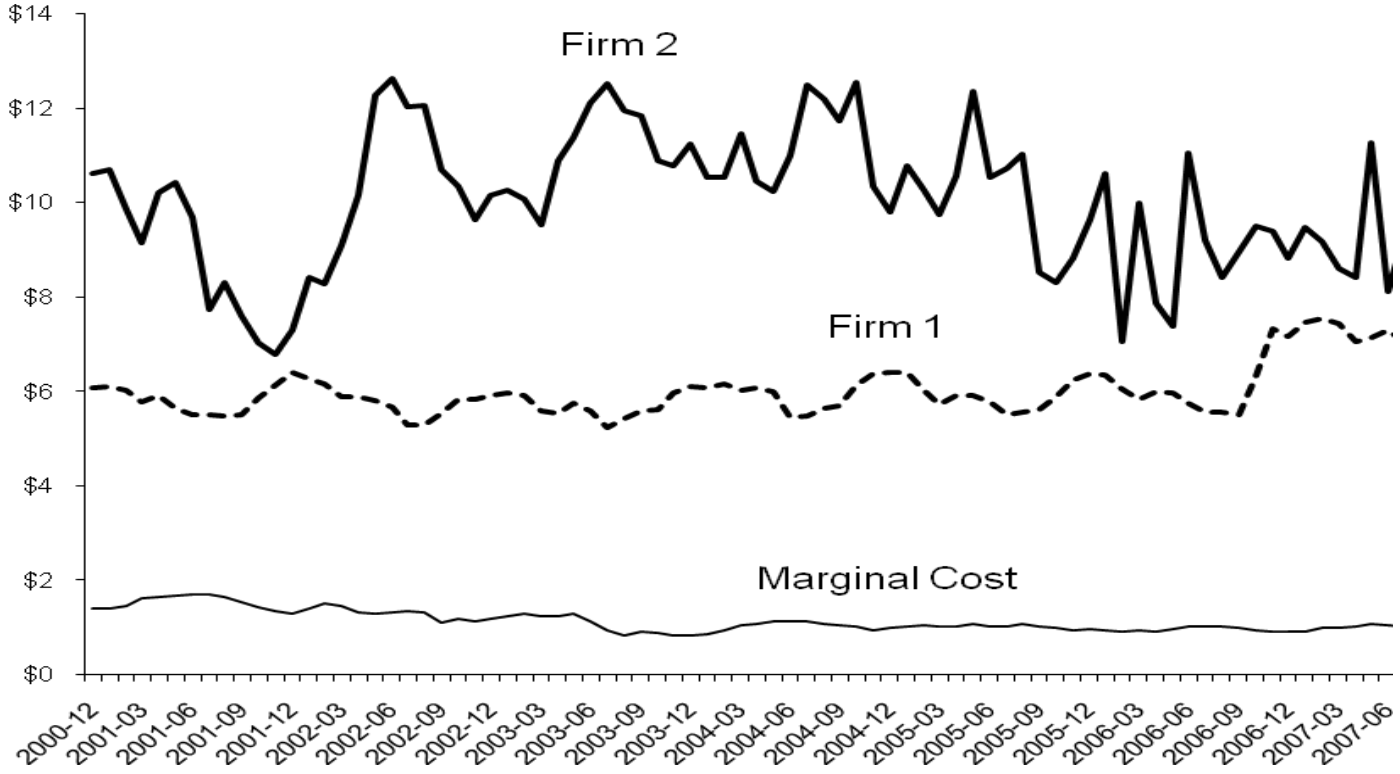


Figure 26 Monthly Real Advertising Expenditures for Firm 1's and Firm 2's Branded Beef and Pork Products

(in Canadian Dollars)

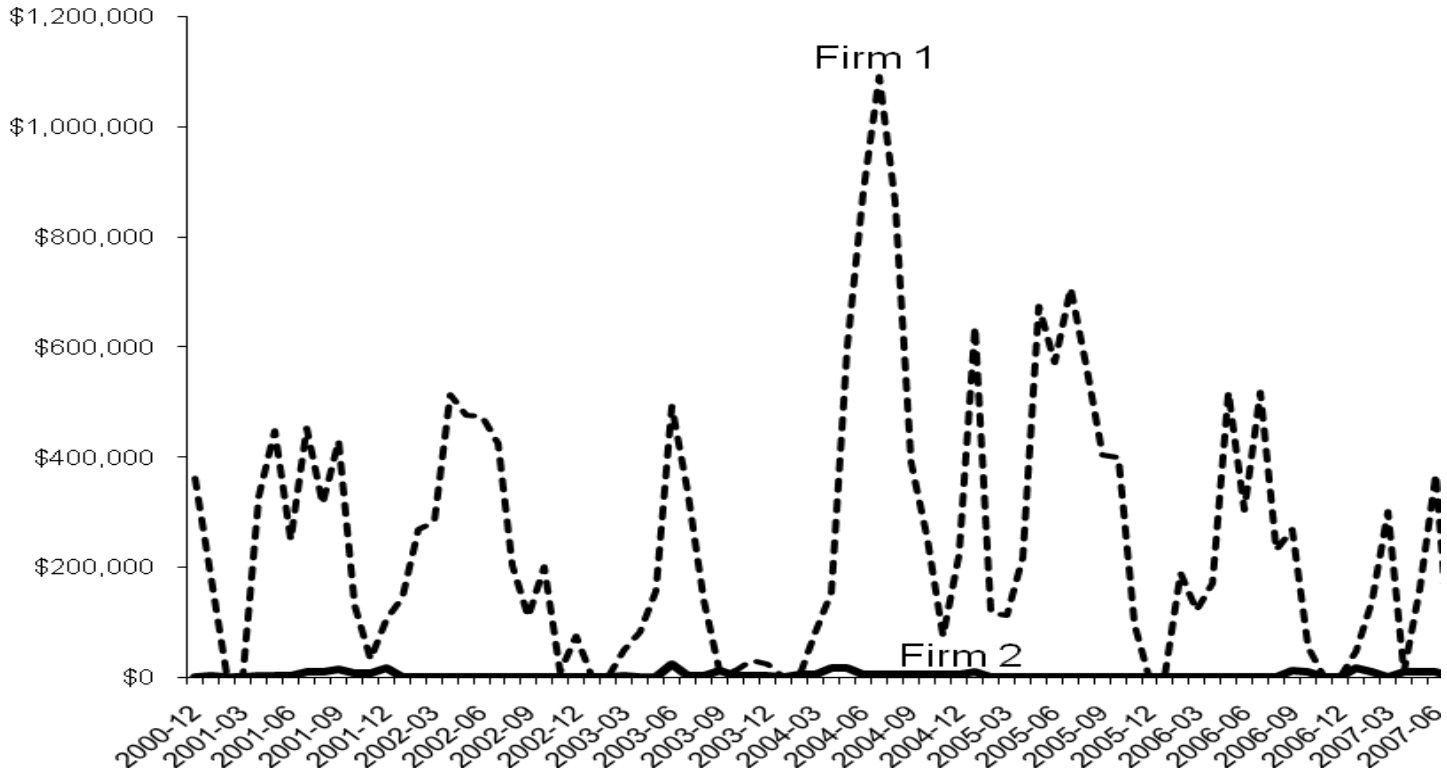


Table 13 Total Number of Branded Beef and Pork Products of Firm 1 and Firm 2 in the Dataset

(before Aggregation)

Company	Meat Categories, Number of Branded Beef and Pork Products
Firm 1 (1,024)	1. Fresh and Frozen Meat (272) 2. Frozen Boxed Meat (9) 3. Frozen Meat Patties and Steakettes (30) 4. Luncheon Meat (309) 5. Sausage/Wiener (405)
Firm 2 (308)	1. Fresh and Frozen Meat (303) 2. Frozen Meat Patties and Steakettes (5)

Note: the number of beef and pork products in parentheses.

Table 14 Total Number of Branded Beef and Pork Products of Firm 1 and Firm 2 in the Dataset

(without Zero Observations & after Aggregation)

Company	Number of Branded Beef and Pork Products
Firm 1	731 (without zero observations) ⇨ 475 (after aggregation)
Firm 2	300 (without zero observations) ⇨ 173 (after aggregation)

Table 15 Descriptive Statistics (Dec. 2000 - Jul. 2007)

Variable	Definition	Mean	Standard Deviation	Maximum	Minimum
q_1	Per capita quantity demanded for branded beef and pork products of Firm 1	0.073	0.038	0.156	0.031
q_2	Per capita quantity demanded for branded beef and pork products of Firm 2	0.007	0.003	0.018	0.001
p_1	Real price for branded beef and pork products of Firm 1	5.999	0.536	7.531	5.233
p_2	Real price for branded beef and pork products of Firm 2	10.027	1.474	12.633	6.789
adv_1	Real advertising expenditure (per capita) for branded beef and pork products of Firm 1	0.008	0.007	0.034	0
adv_2	Real advertising expenditure (per capita) for branded beef and pork products of Firm 2	0.0001	0.0002	0.001	0
qua_1	Quality indices for branded beef and pork products of Firm 1	0.502	0.031	0.564	0.465
qua_2	Quality indices for branded beef and pork products of Firm 2	1.006	0.013	1.058	0.981
c	Real Marginal Cost	1.129	0.230	1.690	0.819
Inc	Real personal disposable income	19,167	669	20,737	18,277
Time	Time trend	40.50	23.238	80	1

Table 15 Descriptive Statistics (Dec. 2000 - Jul. 2007) (Cont'd)

Variable	Definition	Mean	Standard Deviation	Maximum	Minimum
DHCMLF	Dummy variable for Firm 1's Participation in Health Check Program	0.69	0.466	1	0
DHCCGL	Dummy variable for Firm 2's Participation in Health Check Program	0.31	0.466	1	0
DCF	Dummy variable for the publication of the 2007 version of Canada's Food Guide	0.08	0.265	1	0
DMLF	Dummy variable for Firm 1's merger	0.50	0.503	1	0
DCGL	Dummy variable for Firm 2's merger	0.29	0.455	1	0
M_1	Dummy variable for January	0.09	0.284	1	0
M_2	Dummy variable for February	0.09	0.284	1	0
M_3	Dummy variable for March	0.09	0.284	1	0
M_4	Dummy variable for April	0.09	0.284	1	0
M_5	Dummy variable for May	0.09	0.284	1	0
M_6	Dummy variable for June	0.09	0.284	1	0
M_7	Dummy variable for July	0.09	0.284	1	0

Table 15 Descriptive Statistics (Dec. 2000 - Jul. 2007) (Cont'd)

Variable	Definition	Mean	Standard Deviation	Maximum	Minimum
M_8	Dummy variable for August	0.08	0.265	1	0
M_9	Dummy variable for September	0.08	0.265	1	0
M_{10}	Dummy variable for October	0.08	0.265	1	0
M_{11}	Dummy variable for November	0.08	0.265	1	0
CPI	Consumer Price Index (1992=100)	1.240	0.053	1.334	1.147
$MISPI$	Meat Industry Selling Price Index (1992=100)	1.268	0.050	1.383	1.182
$MISPI \times qua_1$	average quality cost per unit existing quantity for Firm 1	0.637	0.053	0.744	0.556
$MISPI \times qua_2$	average quality cost per unit existing quantity for Firm 2	1.275	0.050	1.399	1.177
$MISPI \times q_1$	average quality cost per unit quality index level for Firm 1	0.092	0.048	0.214	0.039
$MISPI \times q_2$	average quality cost per unit quality index level for Firm 2	0.009	0.003	0.021	0.001

Table 16 Estimation Results for the Linear Demand Specification

Parameter	Estimate	t-statistic
Firm 1's Demand Function Coefficient Estimates (R-squared = .985368)		
Intercept	-.704285	-4.79670***
Firm 1's Price	-.037151	-10.6804***
Firm 2's Price	-.172451E-03	-.394729
Firm 1's Advertising	.045737	2.03991**
Firm 2's Advertising	-.789537E-02	-1.48908
Firm 1's Quality Index	.819755	4.60254***
Firm 2's Quality Index	.110209	2.54160**
Firm 1's Health Check Dummy	-.218001E-02	-.569933
Firm 2's Health Check Dummy	.966386E-02	2.38928**
Canada's Food Guide Dummy	-.217925E-02	-.533608
Firm 1's Merger Dummy	.105062	8.93771***
Firm 2's Merger Dummy	-.012764	-2.99623***
Personal Disposable Income	.143731E-04	3.20904***
One-Period Lagged Quantity Demanded (Firm 1)	.201020	3.83090***
Time Trend	-.605228E-03	-4.00572***
January Dummy	-.897473E-02	-2.87045***
February Dummy	-.013962	-4.45374***
March Dummy	-.011098	-3.27282***
April Dummy	-.013902	-4.17843***
May Dummy	-.964665E-02	-2.74444***

Note: * , ** , *** *represent statistically significant at 10%, 5%, and 1% of significance level, respectively.*

Table 16 Estimation Results for the Linear Demand Specification (Cont'd)

June Dummy	-.572583E-02	-1.52219
July Dummy	-.382093E-02	-.875010
August Dummy	-.287894E-02	-.697958
September Dummy	-.979923E-02	-2.58315***
October Dummy	-.012888	-3.93736***
November Dummy	-.012480	-4.40547***
Firm 2's Demand Function Coefficient Estimates (R-squared = .788355)		
Intercept	-.060380	-1.27026
Firm 2's Price	-.120847E-02	-8.37982***
Firm 2's Advertising	.013092	.518488
Firm 2's Quality Index	.016014	.444419
Firm 1's Health Check Dummy	-.112876E-02	-1.13736
Firm 2's Health Check Dummy	-.155594E-02	-1.53129
Canada's Food Guide Dummy	.912420E-03	1.06975
Firm 1's Merger Dummy	.527256E-02	1.91376*
Firm 2's Merger Dummy	-.985531E-03	-.936758
Personal Disposable Income	-.108970E-05	-.979268
One-Period Lagged Quantity Demanded (Firm 2)	.156569	2.04233**
Time Trend	.942010E-04	2.30238**
January Dummy	.127644E-02	1.60183
February Dummy	-.128777E-03	-.165982
March Dummy	.282515E-03	.369374

Note: * , ** , *** *represent statistically significant at 10%, 5%, and 1% of significance level, respectively.*

Table 16 Estimation Results for the Linear Demand Specification (Cont'd)

April Dummy	.244622E-02	3.31270***
May Dummy	.386632E-02	4.70636***
June Dummy	.284012E-02	3.31018***
July Dummy	.316421E-02	3.46837***
August Dummy	.278481E-02	3.23917***
September Dummy	.215175E-02	2.69327***
October Dummy	.988307E-03	1.34826
November Dummy	-.192060E-03	-.284739

Note: * , ** , *** *represent statistically significant at 10%, 5%, and 1% of significance level, respectively.*

Table 17 Simulation Results for the Effects of Quality Changes on Quantity Sales and Revenues

(Sample Period: January 2001 – July 2007)

Model	Quantity Demanded Changes (Firm 1)	Quantity Demanded Changes (Firm 2)	Revenue Changes (Firm 1)	Revenue Changes (Firm 2)
Scenario 1: Firm 1's quality increases 1% while Firm 2's quality does not change				
Linear Demand	+4.946%	+6.628%	+5.000%	+6.750%
Scenario 2: Firm 2's quality increases 1% while Firm 1's quality does not change				
Linear Demand	+0.942%	+1.364%	+0.953%	+1.388%
	Scenario 3: Each firm's quality increases 1%			
Linear Demand	+ 5.888%	+7.992%	+5.953%	+8.137%
Scenario 4: Firm 1's quality decreases 1% while Firm 2's quality does not change				
Linear Demand	-4.971%	-6.661%	-5.025%	-6.783%
Scenario 5: Firm 2's quality decreases 1% while Firm 1's quality does not change				
Linear Demand	-0.946%	-1.371%	-0.958%	-1.394%
Scenario 6: Each firm's quality decreases 1%				
Linear Demand	-5.917%	-8.032%	-5.983%	-8.178%

Summary

The results presented in this section are not comprehensive or exhaustively representative of the analysis that is found in the PhD thesis of Wenzhao Huang. The results as presented here are intended to be an illustration of how important it is to consider strategic interactions between firms as an additional variable in how the development of value- added product may play out in the marketplace. Firms do not exist in vacuums and the strategic behaviour of one firm does play a role in determining actions of other firms and in determining outcomes from innovations such as quality improvements made by one firm. In this example provided, quality levels of two firms in the meat industry in Canada are important drivers of sales of the two firm's products. It is clear that this type of analysis could be extrapolated to more products and more firms.

Canadian Household Behaviour in Meat Purchasing

Two brief examples of how Canadian households respond to various actions within the meat industry are also provided here as additional information on how important consumer response is to the development of value added products. Both of these examples are aimed at identifying the heterogeneity in consumer response and the importance of understanding the impact of demographics and attitudes on consumer response to innovation in the meat market. The authors had access to the Neilsen Homescan™ data through a complementary research project funded by the Alberta Prion Research Institute. The focus of the funded research project was on determining the impact of real and perceived (such as BSE) food safety incidents on Canadian meat purchases. One of the unique aspects of access to the Neilsen data over time was the opportunity to select a sample of household for which there was historical panel data on meat purchases over an eight year period. These same households were also surveyed (through a survey designed by the authors) by Neilsen at a particular point in time (January 2008) to establish their underlying beliefs about food, about meat, about trust in various agents ability to deal with food safety issues, about risk perceptions and attitudes.

Consumer Variation in Risk Perceptions/Attitudes and Response to BSE

In the first study the role of food safety concerns, and trust in various agents in the food industry in affecting household level meat purchases were examined[6]. The empirical methods include cluster analysis (CA) and revealed preference meat demand analysis. First, based on the 2008 consumer survey, the sample of Canadian households is classified by a CA into five groups based on attitude scores. The meat purchases (beef, pork, chicken turkey and seafood) for each of the different groups are evaluated separately with a two stage meat demand system (following similar methods described in earlier sections of this report). The price and substitution elasticities of demand for individual meat products are calculated for each group and compared. Further, based on the Social Amplification of Risk Framework (SARF) (Kasperson et al., 1988), an equation explaining consumer risk perceptions related to BSE is constructed and estimated for each group from 2004 to 2007. The application of SARF in this demand analysis is an initial effort to both track consumer risk perceptions over time and to measure the impacts of quantity and quality of media information on consumer risk perceptions.

Data

The sample of households used in this analysis is not completely representative of the Canadian population, as compared to the Census of 2006. This is not surprising given that the sample was selected on

[6] Results from this study were first reported in a research poster (Yang and Goddard 2009)

the basis of participation in the Neilsen Homescan™ panel over a seven year period (younger busier people find the participation onerous and usually drop out while older better educated, higher income households seem to have more longevity in the sample). 50% of the sample households are from Ontario and Quebec, 37% are from Alberta, B.C., Manitoba and Saskatchewan. The households with single or two members account for 71% of total households. Households with no children under 18 are dominant in the sample (77%). 46% of sample households have annual incomes beyond $50,000. Household heads have various education levels from high school to university. Around 60% of the households are from urban areas. Household meat purchase data show that 70% of their meat purchases are beef, 63% are chicken, 50% are pork and 15% are seafood.

From the cluster analysis five groups are formed including two groups with high levels of beef risk perceptions and attitude and low levels of trust (group 1 and group 2), two groups with low levels of beef risk perceptions and risk attitudes and high levels of trust (group 4 and group 5) and one neutral group (group 3). Groups 1 and 2 are concerned about food safety, particularly with reference to beef and those in other groups are either neutral or unconcerned. Once the groups of households are formed demand systems are estimated for each group to establish how different their responses to prices actually are. The own price elasticities estimated for each group are presented in Table 18. A brief examination of the elasticities reported suggests that the consumers in the different groups have very different prices responses. For example, the groups were created based on risk perceptions about beef, - the 'concerned' groups have larger own price responses in beef demand than do the 'unconcerned' groups.

Table 18. Own-price Elasticities across two stages after BSE in 2003 (standard errors in parentheses)

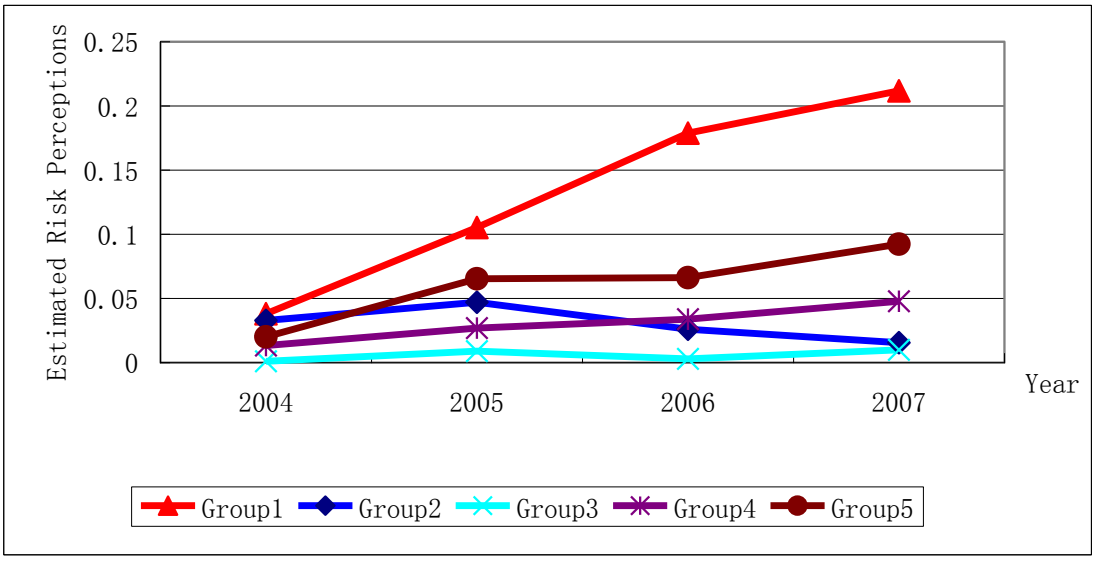
Meat type	*Group1*	*Group2*	*Group3*	*Group4*	*Group5*
Beef	*-1.1(0.16)****	*-0.81(0.28)****	*-1.02(0.11)****	*-0.78(0.1)****	*0.25(0.11)***
Pork	*-1.07(0.07)****	*-0.62(0.13)****	*-1.14(0.05)****	*-1.2(0.05)****	*-0.94(0.12)****
Chicken	*-1.01(0.12)****	*-0.99(0.22)****	*-0.95(0.09)****	*-0.89(0.08)****	*-1.23(0.06)****
Turkey	*-1.94(0.44)****	*-0.82(0.85)*	*-1.31(0.31)****	*-1.05(0.27)****	*-0.98(0.1)****
Seafood	*-0.49(0.14)****	*-0.23(0.22)*	*-0.65(0.09)****	*0.04(0.09)*	*-1.1(0.31)****

*** statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level
Source: Yang and Goddard, 2009

For each group the risk perceptions associated with BSE are calculated over time (for details of this process see Yang and Goddard, 2009). These results are presented in Figure 27. It is clear that, in terms of

the estimated risk perceptions about BSE from 2004 to 2007, group 1 has the highest risk perceptions about BSE. Group 3 as the group with neutral attitude has close-to-zero risk perceptions about BSE. Other groups have relatively modest levels of risk perceptions about BSE. This directly implies very different responses to issues that arise in the marketplace , in this case BSE, but it could equally well be other health or safety issues. The point of this analysis is to illustrate the heterogeneity of the Canadian consuming public.

Figure 27. Estimated Risk Perceptions about BSE



Source: Yang and Goddard, 2009

Consumer Trust and Purchases of Fresh versus Processed Meat

In the second study[7] the same data set was used to examine whether trust in the food industry plays a role in affecting decisions about the form in which meat is purchased. Previous results reported in this study have shown that consumers differentiate between meat products in fresh, semi processed and fully processed forms. Qualitative research indicates that the role of consumers' trust in the food industry is becoming more important in food choices. Trust is found to be integral to food choice (Coveney 2007). On the one hand there is evidence that consumers perceive foods as less safe the higher the degree of processing (Kjaernes et al. 2005). On the other hand, food safety incidents, such as Salmonella or Listeria, have been shown to negatively affect consumers' interest in unprocessed food. Distinguishing between unprocessed and processed meat expenditures, this study is aimed at aligning these ideas by answering the following research questions. Does the stated level of trust in the food industry have a significant impact on actual purchases of processed and unprocessed meat and in what direction is this impact? Are the determinants of processed and unprocessed meat expenditures different for different levels of consumer trust? It is found that there are

[7] The results reported here are from a presentation made by Larissa Drescher and Ellen Goddard at the University of Wisconsin in July 2009.

weakly significant differences in total, processed and unprocessed meat expenditures between consumers with low and high trust levels (clustered based on specific survey questions related to trust). Low (high) trusting consumers are found to purchase less (more) meat overall. However, consumers with low trust are found to buy less processed but more unprocessed meat (than consumers with medium trust) whereas the high trusting consumers buy more of both, processed and unprocessed meat. Thus, trust has a marginally significant but not a very distinct impact on meat purchases. For the second research question we find no statistically significant differences of the determinants of meat purchases between the three trust clusters. There is only a small impact of trust on purchases of processed versus unprocessed meat. This confirms the following statement by Grunert (2006, 158): "…many people have attitudes towards meat production, but for most consumers these will be weak and will, in most situations, not affect their purchase behavior, although they may affect other behaviours". However, it has to be noted that in this paper trust was measured with respect to food safety in general, not regarding the meat sector. This means that the trust measure was more general than the behavioral measures, which might have suppressed the strength of the association. Research has shown that the link between attitudes and behaviour is stronger when both are measured with the same level of specificity (Ajzen and Fishbein 1977). Moreover, trust is measured on the individual level (household head) and behaviour is measured on the household level. If one person distrusts meat, family members might still purchase meat.

Summary and Conclusions

In this study the results of a number of different analyses related to value added-meat products in Canada are presented. The value-added meat category has received little attention in terms of economic analysis within Canada. Overall meat disappearance in Canada is relatively flat over the long term, growth in many meat commodity sectors has been driven more by exports than by a focus on the domestic market. A detailed analysis of meat sales through retail outlets has not previously been possible due to limited availability of data. Data purchased for this project has allowed significant analysis of this major segment of meat sales, rather than the previous analysis of disappearance which dominated previous Canadian meat demand studies.

There are some interesting trends within the domestic grocery meat category. First of all, there is growth in the Control Label section of the fresh meat market, suggesting that retailers are interested in developing their own 'brands' within the category. Within the frozen meat category new product introductions appear uneven with chicken and beef each dominating a particular category.

In examining the sales of meat, through grocery stores, by meat type there are some interesting relationships. An important characteristic identified is the relationship between grocery store meat purchases and consumer disposable income, a negative relationship in the estimates presented in this study. This suggests difficulty in the sector overall in attracting new consumers as incomes grow and that meat, in aggregate, may be perceived by many consumers to be an inferior good. Further research is necessary to establish whether this is across all grocery categories, whether individuals are substituting meat meals away from home for those they cook at home, whether they are substituting meat purchases from other outlets such as farmer's markets for grocery purchases and whether any concerns such as food safety, health or livestock production issues are driving this behaviour. Other interesting relationships include the fact that there are strong substitution and complementary effects across meats identified in the grocery meat market – the introduction of a new value-added meat product has the potential to cannibalize sales in a category as many times as it does increase sales within a category. Advertising, a key element of the introduction of value added meat products does appear to increase sales of the overall meat category for certain products and not for others. In this case the advertising expenditure includes both generic and branded advertising and the success of a branded advertising campaign may be influenced by a successful ongoing generic strategy. Even at this aggregate category there are clear effects of food safety incidents and media coverage of health issues on sales within the grocery meat market by type, something it is important to consider for the success of a specific meat product launch.

With a different categorization of grocery meat sales, by meat type and by level of processing, some other important characteristics of meat sales have been identified. First of all, for some meats (beef, for example) there are strong substitution affects between beef products with different levels of processing. Hence the introduction of a new value added fully processed beef product may not increase sales of beef

over all, it may merely shift beef consumption from one type of product to another – this may be good on a value basis if the new product is higher valued and requires specific characteristics from the farm level but the sales of fully processed beef burgers which may substitute for some or all fresh beef cuts may not enhance the value of live animals. For fresh chicken the substitution possibilities are less pronounced than for beef but fully processed chicken products do substitute for fresh chicken products. The 'other meats' category shows strong relationships with chicken and beef categories – strong substitutability with chicken makes sense since turkey is part of the other meats category but the strong relationships with the various beef products may come from either turkey or seafood. Most previous time series disappearance models for meats in Canada have not included seafood as a product, detailed examination of Neilsen Homescan™ data has shown that substitution between beef and seafood is important and that seafood consumption is growing in the middle-aged to older, well educated, higher income households in Canada. It is possible that analysis of this data set is highlighting the same phenomenon, something that may have been missed in earlier studies of meat consumption in Canada.

Examination of the determinants of purchases for a particular branded fresh chicken product highlight a number of important characteristics. Brand A chicken is clearly a value-added product in the fresh chicken category. Although it represents a small share of the overall fresh chicken market, in quantity terms, it is the most prominent brand in that market. Prices for this product are uniformly higher than prices for all other fresh chicken products (in aggregate) and advertising expenditures are significantly higher than for other brands or generic advertising in the market. The brand is differentiated through the use of particular company feed rations which over much of the last decade focused on the fact that the feed was 100% grain based. Recently this has not been a major feature of any advertising campaign. Empirical results clearly show that Brand A chicken is considered by consumers to be a distinct product, as compared to other fresh chicken products in the marketplace. Sales of Brand A are more price and income elastic and have larger responses to advertising expenditure than do sales of the other fresh chicken products. In response to BSE (May 2003 and forward), consumers spent more money on chicken but within the chicken category that money was spent on Brand A chicken not on the other bigger fresh chicken category. Any concerns consumers had about food safety and chicken were felt in the other chicken product category and not in the Brand A chicken category. The development of this specific value added (through branding and identification of credence production attributes) chicken product is successful in terms of consumer purchasing and in terms of product differentiation. It is unknown whether producing this product to the company specifications actually nets higher returns for farmers.

Examination of beef and pork (in aggregate) product sales from two companies to determine strategic interactions existing, if any, was conducted. The focus of the analysis was whether or not firms react to each other in terms of setting price, advertising budgets and changing the quality mix of the products sold. This is particularly important in light of the emphasis consumers place on health in food purchasing. Other determinants of demand for the products of the two major Canadian meat processing firms included the use of the Health Check™ symbol and a test to see if changes in the recommendations of

Canada's Food Guide made any difference to sales of the two firms. Firm's sales were seen to respond to their own prices, advertising and quality changes as well as to the other firm's price, advertising expenditure and quality changes. Understanding your competition and their competitive reactions to your product changes is therefore, critical to your long term success. Use of instruments like the Health Check™ can enhance sales of a firm's entire line of products, through a halo effect. This too is a successful value-adding strategy.

The importance of recognizing heterogeneity in consumers was highlighted by short reports from two studies using Neilsen Homescan™ data and a survey conducted by the PI for this project in January 2008. In terms of response to BSE, rather than the often asserted information that all Canadians were unaffected, results show that there were at least five different segments of Canadian society who had identifiably different responses in beef purchases to the domestic BSE case in May 2003 and subsequent animal findings. For some the increase in risk perceptions associated with beef changed their beef consumption patterns significantly and permanently, others appeared to ignore the entire issue. In a different study householder trust in the food industry was shown to affect the form in which meat was sold. There are some small effects, even at the aggregate meat category, suggesting that trust drives whether you purchase meat in fresh or processed forms.

Clearly there is more work to be done to further characterize value-added meat sales within Canada. This study has provided a first step. Longitudinal analysis with newer data could provide a significant enhancement of the results reported in this study. The data purchased for this study and extended with research monies provided by the Alberta Prion Research Institute currently ends in 2007. Purchasing the data from 2007 to the present would provide a richer basis for individual product analysis.

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