Demand for Meat in Canada:
Model Specification and Structural Change

Peter Y. Chen and Michele M. Veeman

Staff Paper 89-11

Authors are Doctoral candidate and Professor, respectively, Department of Rural Economy, University of Alberta.

Financial assistance from Farming for the Future Council for this study is acknowledged.

Abstract

Two features of the specification of single-equation models of the demand for meat are explored using Canadian data, specifically the use of meat expenditures versus disposable income in the demand equation and the use of quantity versus price as the dependent variable in the demand models. The appropriateness of the expenditure or income variable is examined using non-nested J tests, and appropriateness of quantity or price as the dependent variable is explored by testing for exogeneity. The impact of different specifications on tests of structural change in the demand for meat is assessed using Chow tests. Conclusions from these tests are sensitive to the alternate specifications, confirming the importance of proper specification of demand functions in appropriate testing for structural change in the demand for meats.

1 Introduction

Observed changes in meat consumption patterns in Canada since the mid-1970s have led to interest in the size and stability of demand parameters for different types of meat. The issues of whether there have been structural changes in demand for red meats due, for example, to consumers' perceptions of healthy diets, or whether changes in prices and incomes largely explain observed changes in meat consumption patterns, are of importance to producers' choice of marketing strategies and to policy makers. The focus of this paper is that in estimating and testing the stability of demand parameters it is important that demand models be properly specified; misspecification can lead to biased parameter estimates and to invalid conclusions of structural change.

The following three specific questions are explored: (1) are prices predetermined in quantity-dependent models of demand for meats? (2) what is the appropriate income variable to include in such models of demand for meats? and (3) has there been a structural change in demand for meat in Canada, as judged by testing whether demand elasticities have changed, based on model specifications from 1 and 2?

2 Overview of Previous Studies of Canadian Demand for Meat

A number of studies have estimated parameters of Canadian consumer demand for meat. Tryfos and Tryphonopoulos (1973) estimated demand equations for beef, veal, mutton and lamb, pork and chicken over the years from 1954 to 1970. Hassan and Katz (1975) estimated Canadian domestic consumption of beef, pork, lamb, veal, chicken and turkey from 1954 to 1972 using Zellner's seemingly unrelated regression and full information maximum likelihood estimators. Hassan and Johnson (1976) estimated demand elasticities for all foods, including individual meats. Hassan and Johnson (1979, 1983) also estimated demand functions for beef, pork, veal, chicken and turkey using non-linear single equation models with quarterly data. Curtin **et al.** (1987) estimated the demand for food, including various meats, from 1973 to 1985.

Using single equation models and quarterly data, Young (1987) investigated the issue of structural change in Canadian meat demand and found no evidence of a structural shift in demand for beef. Kerr **et al.** (1989) examined the same issue but found evidence of structural change in demand for beef. The empirical results assessing whether there have been structural changes in U.S. and Australian meat demand are also mixed. A number of studies have concluded that there is evidence of structural change in beef demand during the 1970s (Nyankori and Miller 1982; Chavas 1983; Braschler 1983), while others have found no such evidence (Moschini and Meilke 1984; Martin and Porter 1985). As Dahlgran (1987) has pointed out, the contradictory results and conclusions from such studies seem, in large measure, to be due to differences in model specification, data, and definitions of structural change.

3 Some Issues of Specification and Structural Change

3.1 The Specification of the Income Variable in Single-Equation Demand Models

In principle, Marshallian demand functions specify quantity demanded as a function of a vector of relative prices and some measure of consumer income or expenditure, that is, $q_i = q_i(P_1, \ldots P_n, E)$. The theory of individual consumer's behavior suggests that: (a) all prices of consumption goods and services as well as consumer's income enter the demand functions; and (b) the individual consumer faces predetermined or exogenous prices. However, in specifying models of empirical demand, for example, for meat, the estimated equations commonly include only the prices of the product and its close substitutes. These models incorporate the notion of weak separability and multi-stage budgeting to exclude all non-meat prices from their models. As Alston and Chalfant (1987) have pointed out, the separability assumption, in turn, suggests that expenditures on meat, rather than the commonly used levels of per capita disposable income, is the appropriate explanatory variable. The issue of whether or not it is appropriate to assume separability is an empirical question.

Two alternative single-equation models of meat demand are used in this study for estimation and hypothesis testing. These are the double-logarithmic demand function specification and the single-equation version of the almost ideal demand specification of Deaton and Muellbauer (1980). The first formulation, although widely used due to its good data fitting features, has the disadvantage of lacking consistency with standard utility maximization theory, a feature that does not apply to the second functional form used in this study. Models 1a and 1b are the double-logarithmic model versions; they differ only in their inclusion of expenditure or income as explanatory variables. They are:

(1a) $ln q_i = \alpha_i + \sum_j \gamma_{ij} ln P_j + e_i ln E + u_i$, and

(1b) $lnq_i = \alpha_i + \sum_j \gamma_{ij} lnP_j + e_i lnY + u_i$

where:

q_i = kilograms per capita of meat i (i.e. beef, pork, poultry meat, fish);

p_j = price index of meat j in nominal terms;[1]

E = per capita nominal expenditure index for meat $\left(E = \sum_i p_i q_i\right)$; and

y = per capita nominal disposable income. The consumption data for pork and beef are revised unpublished retail-weight per capita consumption data from Agriculture Canada. The other data are from Agriculture Canada (1988).

The single equation versions of Deaton and Muellbauer's model are also tested with alternative expenditure and income variables. These are:

(2a) $s_i = \alpha + \sum_j \gamma_{ij} \ln\left(\frac{P_j}{CPI}\right) + e_i ln\left(\frac{E}{P*}\right) + u_i$, and

(2b) $s_i = \alpha_i + \sum_j \gamma_{ij} ln\left(\frac{P_i}{CPI}\right) + e_i ln\left(\frac{Y}{CPI}\right) + u_i$

where:

s_i = the share of meat i (beef, pork, poultry, fish) in total meat expenditure;

CPI = the consumer price index; and

$P* = \sum_i s_i \ln P_i$ (Stone's geometric index). The other variables are as previously defined.

In choosing among the alternative demand models, non-nested hypothesis tests of Davidson and MacKinnon (1981) are used to assess the appropriateness of the income or expenditure measures as alternative explanators of meat consumption patterns. The hypotheses are:

H_0: Expenditure on meat explains the demand for meat;

H_1: Disposable income explains the demand for meat.

The non-nested tests for Models a and b are based on a compound regression model formed as:

(3) $\ln q_i = (1-\alpha) Model1a + \alpha(Model1b) + u$

1 Autocorrelation resulted when the double-log model was fitted to real income or expenditure and price data.

Following the Davidson and McKinnon procedure, Model b is replaced by its forecast values to perform J tests. The test of the null hypothesis H_0, is equivalent to the test that $\alpha = 0$ in Equation 3. The hypothesis H_0 is rejected if the t-statistic for α exceeds its critical value. The test procedure is also reversed, i.e. Model b is tested against a. The results of these tests are reported in Table 1. The computer program SHAZAM (White, 1978) was used.

The results in Table 1 support the use of expenditure on meat, rather than per capita disposable income, as the income variable in all but one instance. The exception applies in the case of the almost ideal specification of the demand for pork. In this equation both the income variables considered here are rejected, suggesting that some other measure may be a more appropriate income measure in this instance. This requires further examination.

Table 1

Results of Non-Nested J Tests of Income Variables and Expenditures

		t-statistics of $\alpha = 0$	
Model Type:		H_0: Expenditure on Meat is Appropriate Explanatory Variable	H_1: Per Capita Disposable Income is Appropriate Explanatory Variable
$\ln q_i$	Beef	0.291[1]	7.667*
	Pork	-0.495	4.267*
	Poultry	-1.299	3.500*
S_i	Beef	-0.719	13.655*
	Pork	7.478*	4.841*
	Poultry	1.389	4.290*

1 Autocorrelation is present in this equation. This is corrected using the Beach-MacKinnon ML procedure prior to application of the J test.

* Denotes α is statistically significant different from zero at the 5 percent level; significant t-statistics indicate the rejection of the hypothesis. The critical value of t* is 2.080.

The results also provide some support for the hypothesis that weak separability of the meat group consumption from other consumption groups applies. Based on the results of these non-nested specification tests, endogeneity tests and stability tests are applied to Models 1a and 2a.

3.2 Exogeneity Tests of Functions Estimating Market Demand for Meat

The other major issue of specification addressed in this paper is the question of whether or not prices are predetermined in market demand functions. As Thurman (1987) has pointed out, the proper specification of quantity or price as the appropriate dependent variable in market demand estimation has received little attention. Yet, if price is endogenous in the quantity-dependent market demand equations, the resulting estimates will be biased and inconsistent due to the presence of simultaneous equation bias. Consequently, tests of structural change based on such a model may not be valid. To assess whether price, quantity, or both are endogenous for aggregate market demand for meat in Canada, the Wu-Hausman test procedure is applied.

The basic concept of the Wu-Hausman test is that if a single equation quantity-dependent demand model is well specified (i.e. if price is predetermined) the estimated slope coefficient of the price from an OLS estimator should not differ significantly from the corresponding estimates from an instrumental variable estimator of a simultaneous equation model of supply and demand. Such estimates of slope coefficients of the price are expected to be quite different from one another if the single equation model is poorly specified.

Specifically, the Wu-Hausman test statistic is:

(4) $$WH = (\beta_{iv} - \beta_0)'[V(\beta_{iv} - \beta_0)]^{-1}(\beta_{iv} - \beta_0) \sim \chi^2(q),$$

where:

β_{iv} = the estimate from the instrumental variable technique;

β_0 = the estimate from the OLS technique;

q = the number of variables for which exogeneity is questioned; and

V = the variance of the variables.

For poultry meat, prices of chicken have, at least for recent years, been determined by Canadian poultry marketing boards. It can, therefore, be expected that retail poultry meat prices are predetermined and that the quantities demanded are endogenous, suggesting that a quantity-dependent model of the demand for chicken is reasonable. Since the Canadian red meat market is relatively small compared to the much larger U.S. market and since prices of beef and pork are believed to be determined by market forces in the total North American market, it may be reasonable to assume that retail prices are predetermined and that quantities in the Canadian market are endogenous. Nevertheless, it is possible that for some meats, quantities supplied to the Canadian market may have an effect on market prices in Canada. Thus, whether prices, or quantities, may be treated as predetermined or exogenous, or whether these are interdependent in the Canadian market for meat is a question subject to empirical investigation.

To examine the exogeneity of the price and quantity variables in demand models, both quantity- and price-dependent demand equations must be tested. In this section, the commonly used double-logarithmic functional form is applied to test alternative versions of this model.

The quantity-dependent version of demand is:

$$(5)\quad lnQ_i = a_i + \sum_j b_{ij} lnP_j + e_i LnE + u$$

A price-dependent version of demand is:

$$(6)\quad lnP_i = b_i + \sum_j C_{ij} lnP_j + g_i lnQ_i + f_i lnE + u$$

where:

Q_i = kilograms per capita of meat i (specifically, beef, pork, poultry, and fish);

P_i = nominal price index of meat i; and

E = per capita expenditure on the four meat types. Data are as for Models 1 and 2.

The supply equation is taken as a function of output and input prices, based on the concept of profit maximization:

$$(7)\quad lnQ_i = h_i + k_i lnP_i + \sum_j m_{ij} lnZ_i + u$$

where:

$Z_i = (P_{if}, P_{il})$

and:

P_{if} = price index of feed; and

P_{il} = price index of hired farm labor.[2]

The null hypotheses to be tested are the predeterminedness of P_i in equation (5) and the predeterminedness of Q_i in equation (6). The instrumental variable estimator used in the tests is two-stage least squares (2SLS).

In applying Wu-Hausman (WH) specification tests, we found the estimated demand equations (5) and (6) show autocorrelation.[3] The WH test statistic is not valid in the presence of autocorrelated error terms. Among the several possibilities that may cause autocorrelated disturbances are factors such as consumption habits, missing

2 Data on P_{if} and P_{il} are taken from Statistics Canada, *Farm Input Price Index*, Cat. 62-004.

3 Specifically, autocorrelation patterns of an AR (1) process with estimated coefficients of one-period error term ranging from .60 to .80 in both OLS and 2SLS residuals was found.

relevant variables, or structural shifts. The possibility of structural shifts was examined because of the suspicion of possible structural change in the demand for red meats. To investigate this, demand equations (5) and (6) were respecified. Based on the observed change in consumption patterns in mid-1970s, a dummy variable ($d_i = 0$ for the period of 1960-1975, and $d_i = 1$ for 1976-1987) was added to equations (5) and (6). The variable d_i was allowed to interact with P_i and E in equation (5) and to interact with Q_i and E in equation (6), as well as with the intercept terms. The respecified models were estimated using OLS and 2SLS. The results indicated that the problem of autocorrelation in the error terms had disappeared. Based on the estimates of these models, Wu-Hausman statistics were calculated. These are reported in Table 2.

Table 2

Exogeneity Test Results of Each Quantity- Price-dependent Demand for Meat Equations

		Chi-square Statistics (W-H value)	
Dependent Variable:	Meat Type (i)	H_0: Price of Meat (i) is Predetermined (1960-75)	H_0: Price of Meat (i) is Predetermined (1976-87)
$\ln q_i$	Beef	2.389	1.322
	Pork	0.276	0.167
	Poultry	0.039	1.736
		Chi-square Statistics (W-H value)	
Dependent Variable:	Meat Type (i)	H_0: Quantity of Meat (i) is Predetermined (1960-75)	H_0: Quantity of Meat (i) is Predetermined (1976-87)
$\ln P_i$	Beef	1.667	2.378
	Pork	0.249	0.146
	Poultry	0.127	1.912

Note: The critical value of Chi-square at the 5 percent level of significance is 3.841 with one restriction. The null hypothesis is rejected when the W-H test statistic exceeds its critical value.

The tests of exogeneity indicate that none of the null hypotheses that the price of meat i are predetermined in the quantity-dependent model of demand for meat i are rejected for the periods from 1960 to 1975 and from 1976 to 1987. These results support the assumption that consumers face exogenous prices. This, in turn, suggests that quantity can be legitimately specified as the dependent variable in models of the demand for meat. In the case of the models in which price is specified as the dependent variable, the empirical results suggest that quantity variables are exogenous, suggesting that price-dependent demand models can also be justified. The results indicate that the simultaneous supply-demand model specification does not yield significantly different demand parameters from the single equation models.

3.3 A Test of the Stability of Demand for Meat

In the light of the results from the two previous models we apply conventional Chow tests of model stability. Model 1a, (incorporating the time dummy variable) in its quantity and price-dependent form is estimated as is the almost-ideal single-equation demand model 2a, for beef, pork and chicken. The six demand equations are estimated using ordinary least squares, without imposing any cross-equation restrictions implied by demand theory, using annual Canadian data from 1960 to 1987. The estimated demand parameters are given in Tables 3 and 4.

In the case of Model 1a (Table 3), the estimates appear to be satisfactory; all own-price and expenditure elasticities have expected signs, are plausible in magnitude and are significant at the 5 percent level. The estimated beef demand equation suggests that price elasticity fell from -1.09 over the period of 1960-75 to -0.53 over 1976-87, and the expenditure elasticity fell from 1.40 to 0.57 between these two time periods. It appears that over time Canadian consumers' consumption of beef has become less sensitive to price and income changes. This is less obvious for pork and chicken. The feature that some cross-price elasticities are negative suggests complementary goods; for all but one pair these implausible estimates are statistically insignificant.

The expenditure share equations (Table 4), yield coefficients of expenditure that are statistically significant at the 1 percent level and have a negative sign, indicating that a lower proportion of income is spent on beef, pork, and chicken as real income increases. This suggests that beef, pork and chicken are necessities for Canadian consumers. While the estimated expenditure coefficients conform with prior expectations, the positive estimated own-price coefficient is counter intuitive. This is a frequently encountered problem in estimated expenditure share demand equations for food (Deaton and Muellbauer, 1980).

Table 3

Single Equation Estimates of Demand for Meat Based on Model 1a with Time Dummy Variables

Explanatory Variables:[2]	Estimated Coefficients[1]			
	Beef (1960-75)	Beef[3] (1976-87)	Pork (1960-87)	Chicken (1960-87)
$\ln P_b$	-1.09 (-4.260)	-0.53	0.17 (0.998)	-0.30 (-2.099)
$d_1 \ln P_i$	0.56 (2.068)		0.38 (0.593)	0.11 (0.323)
$\ln P_p$	-0.13 (-1.267)	-0.13	-0.89 (-5.988)	0.05 (0.400)
$\ln P_c$	-0.19 (-2.140)	-0.19	-0.01 (-0.109)	-0.85 (-7.448)
$\ln P_f$	-0.04 (-0.297)	-0.04	-0.05 (-0.323)	0.02 (0.083)
$\ln E$	1.40 (5.678)	0.57	0.69 (2.563)	1.13 (3.910)
$d_2 \ln E$	0.83 (-3.440)		-0.26 (-1.199)	0.13 (0.427)
d_0	4.88 (4.704)		0.59 (0.600)	-1.58 (-1.261)
Constant	-2.64 (-2.734)	2.24	0.55 (0.493)	2.22 (-1.816)
R^2-adjusted	0.96		0.91	0.97
D.W.	2.195		1.403	1.452

[1] t-statistics are in parentheses.

[2] The subscripts b, p, c, and f represent beef, pork, chicken, and fish, respectively.

[3] These are derived by adding the coefficients of $\ln P_b$ and $d_1 \ln P_b$ and of $\ln E$ and $d_2 \ln E$ respectively; dummy variables for cross-price effects were tested, found to be not significant, and deleted.

Table 4

Single Equation Estimates of Demand for Meat Based on Model 2a

Explanatory Variables:[2]	Elasticity Estimates[1] Beef	Pork	Chicken
$\ln P_b$	0.26 (3.941)	0.07 (0.499)	-0.02 (0.021)
$\ln P_p$	0.12 (1.347)	0.03 (0.144)	0.16 (1.160)
$\ln P_c$	-0.13 (-1.317)	0.76 (3.820)	0.48 (3.111)
$\ln P_f$	-0.28 (-2.415)	-1.44 (-6.020)	-0.86 (-4.620)
$\ln(E/P^*)$	-0.38 (-13.831)	-0.18 (-3.141)	-0.20 (4.419)
Constant	5.175 (15.404)	2.659 (3.811)	2.957 (5.462)
R^2-adjusted	0.99	0.98	0.98
D.W.	1.225	1.406	1.391
$\hat{\rho}$	0.356[3]	0.270	0.254

[1] Estimates calculated at the sample means; t-statistics are in parentheses.

[2] The subscripts b, p, c, and f represent beef, pork, chicken, and fish, respectively.

[3] As the Durbin-Watson value falls into the inconclusive range, an asymptotic test for detecting autocorrelation is used. The critical ρ value is $\frac{2}{\sqrt{T}} = 0.388$. Thus the hypothesis of non-autocorrelation cannot be rejected.

The results of Chow tests of structural change for these equations are presented in Table 5. The null hypotheses that slope coefficients and intercepts are the same between the period of 1960-75 and 1976 to 1987 are tested for Model 1a. (This break point was chosen based on the plot of meat consumption over time). For Model 2a, a set of sequential Chow test statistics which split the sample into consecutive sub-periods were computed.

For the double-logarithmic specification, the Chow test results indicate structural changes in beef and chicken demand in both the quantity- and price-dependent versions of Model 1a, but not for pork. The results based on the single-equation

Table 5

Results of Chow Tests for Structural Change

Dependent Variable	Meat Type	Break Periods[1]	Chow Test F Statistic[2]
$\ln q_b$	Beef: Model 1a	1975	22.216*
$\ln P_b$[3]	Beef: Model 1a	1975	5.660*
$\ln q_p$	Pork: Model 1a	1975	2.075
$\ln P_p$[3]	Pork: Model 1a	1975	3.123
$\ln q_c$	Chicken: Model 1a	1975	5.321*
$\ln P_c$[3]	Chicken: Model 1a	1975	3.462*
S_b	Beef: Model 2a	1975-78	1.35- 1.10
S_b	Beef: Model 2b	1975-78	11.26-11.34*
S_p	Pork: Model 2a	1975-78	11.55- 4.88*
S_p	Pork: Model 2b	1973-79	4.85- 4.59*
S_c	Chicken: Model 2a	1975-79	5.75- 3.73*
S_c	Chicken: Model 2b	1968-76	5.72- 4.96*

[1] The break point for Model 1a is based on the plot of meat consumption over time. For Model 2, the range of break periods is detected by those Chow test statistics that are significant at the 5% level.

[2] The null hypothesis is that the intercept and slope coefficients are the same for the two sub-periods. Critical values of F for Model 1 versions are 3.13 (5% level of confidence) and 5.01 (1% level). For Model 2, critical values of F are 2.74 (5%) and 4.20 (1%). Values exceeding the 5% level are indicated by *.

[3] Price-dependent versions of Model 1a.

versions of the almost ideal demand specification (Models 2a and 2b) provide different conclusions. Specifically, no indication of structural change was found from the Chow tests for beef, while evidence of structural change around the period of 1975 to 1978 was seen for the pork equation. These are the opposite conclusions of parameter stability for beef and pork from testing Model 1a. Using this parametric approach of examining the issue of structural change, both Models 1a and 2 show evidence of structural change in the demand for chicken in the mid- to late-1970's, while Model 2b shows parametric instability in the demand for beef, pork, and chicken. The results of Model 2 versions for beef also indicate that conclusions of parameter stability may depend on which income variable is used. Model 2b suggests structural change; the test results based on Model 2a (the preferred version based on the J tests reported in Table 1) do not support a structural change conclusion.

It is evident that the conclusion of whether or not there has been structural change in demand for beef and pork depends on the functional form and other features of specification of the model. Since the use of expenditure rather than income was supported by the non-nested tests and the use of single equation models was justified by the price-exogeneity tests, the specification of Model 2a which is consistent with demand theory seems most appropriate for estimating and testing the demand for meats and for examining the issue of structural change. It is clear that tests of stability are sensitive to functional form, and that this constitutes a problem in testing parametric stability.[4] Overall, the results reported in this paper confirm the importance of proper specification of demand functions in appropriate testing for structural change in the demand for meats.

4 References

Agriculture Canada. (1988). *Handbook of Food Expenditures, Prices, and Consumption.*

Alston, J. and J. Chalfant (1987). "Weak Separability and a Test for the Specification of Income in Demand for Meat in Australia." *Australian Journal of Agricultural Economics*. 31(1): 1-15.

Braschler, B. (1983). "The Changing Demand Structure for Pork and Beef in the 1970's: Implications for the 1980's." *Southern Journal of Agricultural Economics.* 9: 271-82.

Chalfant, J. and J. Alston (1988). "Accounting for Changes in Tastes." *Journal of Political Economy*. 96(2): 391-410.

Chavas, J.P. (1983). "Structural Change and Demand for Meat." *American Journal of Agricultural Economics.* 65: 148-53.

Curtin, L. *et al.* (1987). "Demand for Foods in Canada." Working Paper 13/87, Agriculture Canada.

Dahlgran, R. (1987). "Complete Flexible Systems and the Stationarity of U.S. Meat Demand." *Western Journal of Agricultural Economics.* 12: 152-63.

Davidson, R. and J. MacKinnon. (1981). "Several Tests for Model Specification in the Presence of Alternative Hypotheses." *Econometrica.* 49: 781-94.

Deaton, A. and J. Muellbauer. (1980). "An Almost Ideal Demand System." *American Economic Review.* 70: 312-27.

Hassan, Z. and L. Katz. (1975). "The Demand for Meat in Canada." *Canadian Journal of Agricultural Economics.* 23(1): 53-63.

Hassan, Z. and S. Johnson. (1976). "Consumer Demand for Major Foods in Canada." Economics Branch Publication No. 76/2, Agriculture Canada.

4 Non-parametric testing of structural change such as that used by Chalfant and Alston (1988) does not have this shortcoming.

Hassan, Z. and S. Johnson. (1979). "The Demand for Meat in Canada: An Application of the Transformation of Variables." *Canadian Journal of Agricultural Economics.* 27(3): 1-12.

Hassan, Z. and S. Johnson. (1983). "Quarterly Demand for Meat in Canada with Alternative Seasonality Hypotheses." *Canadian Journal of Agricultural Economics.* 31(1): 77-94.

Kerr, W. *et al.* (1989). "An Alternative Hypothesis for Structural Change in Canadian Demand for Meat." Discussion Paper Series No. 89-114, University of Calgary.

Martin, W. and D. Porter. (1985). "Testing for Changes in the Structure of the Demand for Meat in Australia." *Australian Journal of Agricultural Economics.* 29(1): 16-31.

Moschini, G. and K. Meilke. (1984). "Parameter Stability and the U.S. Demand for Beef." *Western Journal of Agricultural Economics.* 9: 271-82.

Nyankori, J.C. and G.H. Miller. (1982). "Some Evidence and Implications of Structural Change in Retail Demand for Meats." *Southern Journal of Agricultural Economics.* 14: 65-70.

Stone, J.R.N. (1953). *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-38.* Cambridge: Cambridge University Press.

Thurman, W. (1987). "The Poultry Market: Demand Stability and Industry Structure." *American Journal of Agricultural Economics.* 69(1): 30-37.

Tryfos, P. and N. Tryphonopoulos. (1973). "Consumer Demand for Meat in Canada." *American Journal of Agricultural Economics.* 55(1): 84-91.

White, K. (1978). "A General Computer Program for Econometric Methods - SHAZAM." *Econometrica* 46 (1): 239-40.

Young, L. (1987). "Canadian Meat Demand." Working Paper 10/87. Ottawa: Agricult ure Canada, Policy Branch.