20548.

TESTS OF WEAK SEPARABILITY: THE CASE OF DISAGGREGATED MEAT PRODUCTS

1991

Rodolfo M. Nayga, Jr.
and
Oral Capps, Jr.

August 1991

Meat - Demand

* Research Assistant and Professor, respectively, Department of Agricultural Economics, Texas A&M University. Support for this research comes from the Texas Agricultural Experiment Station, Texas A&M University.

AAEA 1991

#20548

TESTS OF WEAK SEPARABILITY: THE CASE OF DISAGGREGATED MEAT PRODUCTS

Abstract

Parametric tests of weak separability are conducted for disaggregated meat products. These tests show that consumers choose among disaggregated meat products of a particular animal origin and not across animal origins. Scanner data and the linear approximation of the Almost Ideal Demand System model are used in the analysis.

TESTS OF WEAK SEPARABILITY: THE CASE OF DISAGGREGATED MEAT PRODUCTS

Introduction

The notion of separability, conceived independently by Leontief and Sono, is a relative concept whose frame of reference is some partition of the commodity set into mutually exclusive and exhaustive subsets. In general, separability of commodities within a utility function implies that the ratio of marginal utilities of a pair of commodities i and j is unaffected by the level of consumption of a third commodity k. Consequently, separability conditions require the marginal rates of substitution for certain pairs of commodities to be functionally independent of the quantities of certain other commodities. Such conditions reduce the number of parameters that enter into the family of demand functions and in short, make estimation of the parameter space more feasible.

The imposition of the assumption of separability attacks the Bieri-de Janvry "degrees-of-freedom problem," thereby making the estimation of complete systems of demand equations, via econometric analysis, tractable. However, this assumption hinges upon the identification of separable groups. In actual practice, it is next to impossible to look upon marginal utilities to determine the nature of separability. If the imposition of separability restrictions are inconsistent with the true preference ordering of the representative consumer, empirical estimates of structural demand parameters are invalid. Thus, it is worthy to consider tests for separability of preferences.

Several studies which involve testing for separability in demand models have surfaced in the literature in recent years. These works may be categorized as those using non-parametric procedures or parametric procedures. Non-parametric tests (Swofford and Whitney; Afriat; Varian) are not conditional on the functional form of the utility function. But, this desirable property is offset by the fact that the non-parametric tests are nonstochastic (Reynolds and Goddard). Parametric tests

(Jorgenson and Lau; Bieri and de Janvry; Pudney; Eales and Unnevehr; Reynolds and Goddard), on the other hand, are conditional on the functional form of the utility function. Unlike the non-parametric procedures, the parametric test statistics follow, at least asymptotically, χ^2 distributions. Therefore, statistical assessments of separability are then made in straightforward fashion.

Many of the studies in the extant literature have focused their analyses on broad and highly aggregated commodities. For example, Reynolds and Goddard conduct tests of weakly separable partitions of meats; fats and oils; fruits and vegetables; beverages; cheese; eggs; cereal; and sugar and syrups for Canada. Also, Swofford and Whitney conduct tests of weak separability for consumption, leisure, and money. Separability restrictions have usually been rejected in empirical work due perhaps to the use of broad commodities. In fact, Pudney states that (p. 561), "the empirical fruit of the theory has been disappointing, but possibly only because it has generally been applied at the wrong level of aggregation."

Moreover, because of the degree of aggregation, considerable amount of information is lost concerning the demands for disaggregated commodities. Some information on the appropriate grouping patterns of the commodities, for instance, could be extracted from using a lower level of aggregation (Pudney). Using tests of separability, Eales and Unnevehr and Pudney suggest the importance of developing models for disaggregated commodities to obtain a fuller understanding of demand. In the study by Eales and Unnevehr, they disaggregate chicken into whole birds and parts/processed products and beef into hamburger and table cuts using annual data over the period 1965-85 for the United States. In the work by Pudney, 20 meat and fish categories are considered relating to quarterly observations for the period 1956 to 1971 for the United Kingdom.

There are several concepts of separability. These concepts include the distinction as to whether there is weak or strong separability; separability of the cost function; separability of the indirect utility function; separability of an implicit representation of the direct utility function; and separability of an implicit representation of the indirect utility function (Hayes, Wahl, and Williams). Pudney has examined some of these concepts by imposing and testing separability in a constant elasticity model and further, he reveals that differences in the empirical results using these different forms of separability are negligible. As well, Pudney rejects weak separability in all cases.

Weak separability is a key concept in empirical work because it is a necessary and sufficient condition for two-stage budgeting (Deaton and Muellbauer). This paper deviates from previous analyses by focusing on tests of weak separability on various groups of disaggregated meat products using scanner data. Scanner data constitute a source of product specific information. Traditionally, demand systems analyses have generally been dependent upon aggregate annual, quarterly, or monthly time series data of purchases and prices. These data, however, are typically too general for product-specific decision making. On the other hand, quantity, price, and hence expenditure information for a multitude of products are available from scanner data on a daily basis. The use of scanner data, therefore, permits the focus on shorter time intervals and also allows the analysis of more disaggregated food commodities.

AIDS Model

The analysis centers on the use of the Almost Ideal Demand System (AIDS) specification. The AIDS model has been used extensively in recent years (e.g. Blanciforti and Green; Anderson and Blundell; Chalfant; Capps, Tedford, and Havlicek; Eales and Unnevehr). The AIDS model allows for consistent aggregation of microlevel demands to a market demand function. The budget shares are expressed as:

$$w_i = \alpha_i + \Sigma\, \gamma_{ij} \ln p_j + \beta_i \ln(y/p) \quad (1)$$

where w_i is the expenditure share of the ith commodity, p_j are prices, and y is total expenditure on all commodities in the system, and where

$$\ln(p) = \alpha_o + \Sigma\, \alpha_k \ln p_k + (1/2)\, \Sigma\Sigma\, \gamma_{kj} \ln p_k \ln p_j \qquad (2)$$

is a price index. The classical restrictions are expressed as follows:

$$\text{For adding-up: } \Sigma\alpha_i = 1\ ,\ \Sigma\gamma_{ij} = 0\ ,\ \Sigma\beta_i = 0 \qquad (3)$$

$$\text{For homogeneity: } \Sigma\gamma_{ij} = 0$$

$$\text{For symmetry: } \gamma_{ij} = \gamma_{ji}$$

The classical restrictions - adding-up, homogeneity, and symmetry - may be imposed or tested. Due to the nonlinearity of this model, estimation can be difficult. Simplification of the model involves the use of Stone's index, $\Sigma w_k \ln p_k$, in lieu of the expression of ln(p) in equation 4. With the use of the Stone's index, w_{kt-1} is used instead of w_{kt} to avoid simultaneity problems. This specification allows the linear approximation of the AIDS model(LA/AIDS). Due to the importance of dynamics in meat demand, the first difference version of the LA/AIDS model, following Eales and Unnevehr(1988), is used. Consequently,

$$\Delta w_i = \alpha_i + \Sigma\, \gamma_{ij}\, \Delta \ln p_j + \beta_i\, \Delta \ln(y/p) \qquad (4)$$

where α_i represents a trend variable.

When estimating this demand system, one equation must be omitted. This omission avoids the singularity in the variance-covariance matrix of the disturbance terms. The AIDS model is estimated using Zellner's seemingly unrelated regression procedure with homogeneity and symmetry restrictions imposed.

Data

The source of data for the analyses in this study is from a retail food firm in Houston.

Scanner data from all the stores in the firm are aggregated to form weekly time series observations over the period September 1986 to November 1988.

This study is based on point-of-sale purchases. The number of individual fresh meat products is 366. However, to conform to space restrictions, these are aggregated to form 21 meat products (Figure 1). The numbers in parentheses correspond to the number of products in the respective category. A listing of the individual cuts corresponding to these products is available from the authors upon request. Pounds corresponding to the individual cut as well as the price corresponding the individual cut are reported by week for the time period in question.

Figure 1. Fresh Meat Products

Beef	Pork	Chicken	Turkey	Lamb(14)	Veal(18)
Brisket(3)	Chops(13)	Breast(20)	Breast(15)		
Chuck(9)	Ham(60)	Parts(29)	Parts(8)		
Ground(9)	Spare Ribs(7)	All Other Chicken(24)	All Other Turkey(26)		
Loin(23)	Roast(5)				
Rib(11)	Loin(11)				
Round(14)	All Other Pork(16)				
All Other Beef(31)					

The quantities of the various fresh meat products correspond to the sum of the respective quantities of the relevant products. The prices of the products in question are weighted averages of all individual prices within the particular commodity group. The weights correspond to the relative shares of the quantities of the products to the total quantity within the relevant commodity group.

Mean expenditure shares, mean quantities, and mean prices of the disaggregated meat products are exhibited in Table 1. Ground beef and other chicken are the most important items in terms of purchases per 1000 customers. On the average, purchases per 1000 customers is 169 pounds for ground beef and roughly 102 pounds for other chicken. The least important commodity

Table 1. Average Expenditure Shares(W), Average Purchases Per 1000 Customers(Q) and Average Prices(P) of the Meat Products.

Meat Product	W	Q(pounds)	P(cents/pound)
Beef			
Brisket	0.0229	25.842	175.19
Chuck	0.0348	25.708	263.63
Ground	0.1953	169.000	190.42
Loin	0.0988	38.582	440.04
Rib	0.0497	19.566	420.38
Round	0.0623	36.013	309.44
All Other Beef	0.0585	35.602	281.59
Pork			
Chops	0.0541	28.181	321.18
Ham	0.1056	52.997	351.12
Spare Ribs	0.0195	15.576	207.44
Roast	0.0048	4.258	196.13
Loin	0.0181	10.524	286.02
Others	0.0072	6.272	197.24
Chicken			
Breast	0.0994	71.844	231.66
Parts	0.0321	57.281	101.49
Others	0.0579	101.750	110.86
Turkey			
Breast	0.0379	15.875	404.47
Parts	0.0022	4.016	98.24
Others	0.0081	6.532	212.21
Lamb	0.0208	9.322	383.71
Veal	0.0092	2.240	692.50

group is veal with purchases of only about two pounds per 1000 customers on the average. Roast, other pork, turkey parts, other turkey, and lamb also have purchases per 1000 customers of less than ten pounds on the average. For the budget share estimates, ground beef, ham, loin beef, and chicken breasts comprise about 50 percent of the total dollar sales on meat products. The remaining 17 commodity groups comprise 50 percent of the dollar sales. None of these 17 commodity groups comprises more than 7 percent of the dollar sales.

In terms of prices, veal is the most expensive item while turkey parts and chicken parts are the least expensive commodities. Loin beef, rib, turkey breast, and veal are all priced more than 400 cents per pound. Total expenditures per 1000 customers is roughly $1648 on the average.

Tests of Separability

Very few studies involve testing separability within groups of meat products (e.g. Pudney, Eales and Unnevehr). This paper is an attempt at testing for weak separability on "disaggregated" meat products using scanner data from supermarkets. The necessary and sufficient condition for weak separability is that the off-diagonal term in the Slutsky substitution matrix be proportional to the income derivatives of the two separable goods. Following Eales and Unnevehr, if good i in group r is separable to good j in group s then (Goldman and Uzawa),

$$S_{ij} = \Theta_{rs}\,(\partial q_i/\partial y)\,(\partial q_j/\partial y) \qquad \text{for all } i \in r \text{ and } j \in s, \tag{5}$$

where S_{ij} is the appropriate element in the Slutsky substitution matrix, q's are quantities, and Θ_{rs} is an intergroup coefficient which is a measure of the degree of substitutability between groups of goods. For commodities i and j in group r and k in group s, the restrictions in generic form is:

$$S_{ik}/(\partial q_i/\partial y) = S_{jk}/(\partial q_j/\partial y) \qquad \text{for all } i,j \in r \text{ and } k \in s. \tag{6}$$

Utilizing the generic form above, the restrictions for the parameters of the AIDS model, implies

$$\gamma_{ik}(\beta_j + w_j) - \gamma_{jk}(\beta_i + w_i) + (w_i\beta_j - w_j\beta_i)(w_k - \beta_k \ln(y/P)) = 0 \quad \text{for all } i,j \in r \text{ and } k \in s. \tag{7}$$

These restrictions are tested locally at the mean shares.

Several a priori groupings of the disaggregated meat products are specified, based primarily on intuition, to test for weak separability in this paper (Table 2). The first utility tree is partitioned based on animal origin. There are, therefore, six separable groups(beef, pork, chicken, turkey,

Table 2. Possible Utility Trees

Commodity Products	Utility Tree[a]			
	1	2	3	4
Beef				
Brisket	A	A	B	B
Chuck	A	A	B	B
Ground	A	A	B	B
Loin	A	A	A	A
Rib	A	A	A	A
Round	A	A	A	A
All Other Beef	A	A	B	B
Pork				
Chops	B	B	A	C
Ham	B	B	A	C
Spare Ribs	B	B	B	D
Roast	B	B	A	C
Loin	B	B	A	C
Others	B	B	B	D
Chicken				
Breast	C	C	A	E
Parts	C	C	A	E
Others	C	C	B	F
Turkey				
Breast	D	C	A	G
Parts	D	C	A	G
Others	D	C	B	H
Lamb	E	D	C	I
Veal	F	D	D	J
No. of Commodity Groups	6	4	4	10
No. of Joint Tests	153	152	121	147

[a] In each tree, all commodities with the same letter are assumed to belong to the same group. Commodities with different letters are assumed to be weakly separable.

lamb, and veal). The second utility tree is also partitioned based on animal origin but combines the poultry products (chicken and turkey) into one group and lamb and veal into another group.

The third utility tree is partitioned based on the quality of the meat products. The separable groups are high quality meat products, low quality meat products, lamb, and veal. The high quality products are beef loin, beef rib, beef round, pork chops, ham, pork roast, pork loin, chicken breasts and parts, and turkey breasts and parts. On the other hand, the low quality meats are brisket, chuck, ground beef, other beef, spare ribs, other pork, other chicken, and other turkey. This utility tree allows consumers to choose among disaggregated products of the same quality type across animal origin. Utility tree 4 divides the meat products into high quality and low quality products, according to animal origin. Thus, beef, pork, chicken, and turkey products are partitioned into high quality and low quality beef, pork, chicken, and turkey products, respectively. The 10 separable groups for utility tree 4 are: high quality beef; low quality beef; high quality pork; low quality pork; high quality chicken; low quality chicken; high quality turkey; low quality turkey; lamb; and veal.

The number of nonredundant weak separability tests for a utility tree can be determined with the following formula:

$$(1/2)[N^2+N-S^2+S-\Sigma_s n_s(n_s+1)] \tag{8}$$

where N is the number of products in the utility tree; S is the number of separable groups in the utility tree; and n_s is the number of products in group s. For example, in utility tree 1, the number of weak separability tests required is 153. In this case, N is 21; S is 6; n_1 is 7 (beef products); n_2 is 6 (pork products); n_3 is 3 (chicken products); n_4 is 3 (turkey products); n_5 is 1 (lamb); and n_6 is 1 (veal). The (i,j,k) combinations or tests involved for utility tree 1, where products i and j are in group r and product k is in group s, are shown in Table 3.

These tests correspond to the nonredundant restrictions of weak separability. This occurrence can be explained in an example. Consider a smaller demand system of five products (i.e. 1,2,3,4,5), where products 1,2,3, and 4 are in group r and product 5 is in group s. In this case, the six possible (i,j,k) combinations are (1,2,5), (1,3,5), (1,4,5), (2,3,5), (2,4,5), and (3,4,5). However,

Table 3. **Weak Separability Tests (i,j,k Combinations) for Utility Tree 1**

	k																				
i,j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1,2								t	t	t	t	t	t	t	t	t	t	t	t	t	t
2,3								t	t	t	t	t	t	t	t	t	t	t	t	t	t
3,4								t	t	t	t	t	t	t	t	t	t	t	t	t	t
4,5								t	t	t	t	t	t	t	t	t	t	t	t	t	t
5,6								t	t	t	t	t	t	t	t	t	t	t	t	t	t
6,7								t	t	t	t	t	t	t	t	t	t	t	t	t	t
7,8																					
8,9							t							t	t	t	t	t	t	t	t
9,10							t							t	t	t	t	t	t	t	t
10,11							t							t	t	t	t	t	t	t	t
11,12							t							t	t	t	t	t	t	t	t
12,13							t							t	t	t	t	t	t	t	t
13,14																					
14,15							t						t				t	t	t	t	t
15,16							t						t				t	t	t	t	t
16,17																					
17,18							t						t			t				t	t
18,19							t						t			t				t	t
19,20																					
20,21																					

Note: The t's represent the nonredundant tests.

combination (1,3,5) becomes redundant with combinations (1,2,5) and (2,3,5). Likewise, by adding combination (3,4,5) with (1,2,5) and (2,3,5), combinations (1,4,5) and (2,4,5) become redundant. There are, therefore, only three nonredundant tests needed in this case. In the general case where group s has more than one product, additional tests have to be considered. For instance, if product 6 is added to group s, then an additional (i,j,k) combination is needed where i and j refer to products 5 and 6 while k refers to any of the products included in group r.

The fact that this set of disaggregated meat products represents a portion of the budget rather than the total budget means that the attempt is to find some internal structure within the set of meat products presented above. Also, due to data unavailability, weak separability from all other non-meat products is implicitly imposed by only focusing on the allocation of food expenditure to these 21 disaggregated meat products.

Empirical Results

The econometric estimates and associated standard errors of the structural parameters in the LA/AIDS model with homogeneity and symmetry restrictions imposed are available from the authors upon request. The estimates of the compensated price elasticities as well as the expenditure elasticities, subject to only the classical restrictions, are exhibited in Table 4. All own-price compensated elasticities are negative and, except for other turkey (-0.164), are in the elastic range. The own-price elasticities vary from -1.215 (fresh ground beef) to -6.255 (fresh brisket). Also, cross-price responses are quite evident, with about 60 percent of the compensated elasticities greater than zero. Consequently, a majority of the commodities are substitutes in the Hicks-Allen sense. All the expenditure elasticities are positive, ranging from 0.793 (fresh brisket) to 1.1975 (fresh lamb).

The results of the separability tests, which are tested at the mean shares, are exhibited in Table 5. The adjusted Wald tests are more appropriate to use than the Wald tests because of the tendency of the latter to over-reject in finite samples (Judge et.al.). According to the adjusted Wald tests, utility trees 2,3, and 4 are rejected at the 0.05 level of significance. However, at the 0.01 level of significance, only utility tree 3 is rejected. Among the four trees, only utility tree 3 allows consumers to choose among products across animal origin. These results suggest that consumers of this particular firm in Houston choose among disaggregated meat products of a particular animal origin. These results are in complete contrast to the Eales and Unnevehr results, which suggest that consumers choose among meat products across animal origin. Also, at least at the 0.01 level of

Table 4. Compensated Price Elasticities and Expenditure Elasticities for the Meat Products

	Beef							Pork						Chicken			Turkey			LAMB	VEAL	EXPEND
	BRISK	CHUCK	GBEEF	LOIN	RIB	ROUND	AOB	CHOPS	HAM	SRIBS	ROAST	LOIN	OPORK	CBRST	CPARTS	OCHICK	TBRST	TPARTS	OTURK			
BRISK	-6.255	0.257	0.637	0.216	0.522	0.967	0.325	0.396	0.464	-0.325	0.062	0.177	0.026	0.204	0.172	0.275	0.151	0.067	-0.016	0.131	1.540	0.793
CHUCK	0.169	-3.197	0.218	0.303	0.259	0.534	0.541	0.072	0.300	0.113	0.043	0.058	0.043	0.157	0.064	0.133	0.094	0.007	-0.070	0.009	0.142	1.025
GBEEF	0.074	0.038	-1.215	0.138	-0.034	0.106	0.125	0.056	0.169	0.004	0.009	0.022	0.003	0.058	0.031	0.054	0.044	0.002	0.058	0.009	0.242	1.018
LOIN	0.050	0.107	0.273	-2.003	0.041	0.410	0.196	0.098	0.126	0.125	0.000	0.008	-0.016	0.245	0.103	0.040	0.183	-0.002	0.015	-0.093	0.089	1.091
RIB	0.240	0.181	-0.133	0.081	-1.616	0.217	0.094	0.269	0.114	-0.256	-0.000	0.056	-0.004	0.091	0.078	0.076	-0.291	-0.120	0.054	-0.035	0.901	1.017
ROUND	0.355	0.299	0.334	0.650	0.173	-3.533	0.135	0.163	0.279	0.127	0.035	0.097	0.049	0.095	0.072	0.109	0.050	-0.002	0.044	0.093	0.368	1.031
AOB	0.127	0.322	0.417	0.332	0.080	0.144	-2.445	0.113	0.073	0.125	0.017	0.078	0.011	0.084	0.035	0.080	0.267	0.013	-0.021	0.087	0.054	1.044
CHOPS	0.168	0.046	0.201	0.180	0.247	0.188	0.122	-1.420	0.238	-0.044	-0.120	-0.168	-0.101	0.059	0.037	0.090	0.110	-0.006	0.044	-0.104	0.231	1.050
HAM	0.100	0.099	0.313	0.118	0.054	0.164	0.040	0.122	-1.659	0.033	0.015	0.006	-0.003	0.084	0.031	0.156	0.062	-0.012	-0.057	0.005	0.324	1.158
SRIBS	-0.382	0.202	0.040	0.635	-0.652	0.405	0.375	-0.123	0.178	-3.444	0.146	0.639	0.190	0.923	0.255	0.091	0.615	-0.131	-0.308	0.241	0.101	0.979
ROAST	0.292	0.311	0.397	0.001	-0.005	0.456	0.214	-1.344	0.343	0.588	-1.888	-1.694	0.873	0.175	0.230	0.256	0.447	0.138	-0.518	-0.378	0.760	1.056
LOIN	0.225	0.112	0.246	0.048	0.156	0.333	0.254	-0.503	0.034	0.689	-0.455	-2.023	0.130	0.186	0.156	0.218	0.121	0.124	0.115	0.107	-0.278	1.156
OPORK	0.085	0.210	0.084	-0.228	-0.033	0.426	0.093	-0.759	-0.050	0.511	0.585	0.324	-2.500	-0.046	0.075	0.121	-0.011	0.355	-0.109	-0.047	0.913	1.074
CBRST	0.047	0.055	0.114	0.244	0.045	0.059	0.049	0.032	0.089	0.181	0.008	0.033	-0.003	-1.750	0.085	0.137	0.237	0.008	0.037	-0.045	0.332	1.037
CPARTS	0.123	0.069	0.190	0.319	0.121	0.141	0.065	0.063	0.102	0.155	0.035	0.088	0.017	0.263	-2.180	0.213	0.095	0.025	-0.086	-0.055	0.231	0.970
OCHICK	0.109	0.080	0.183	0.068	0.065	0.117	0.081	0.084	0.286	0.030	0.021	0.068	0.015	0.235	0.118	-1.910	0.003	0.018	0.011	0.010	0.299	0.979
TBRST	0.091	0.087	0.226	0.478	-0.381	0.082	0.412	0.156	0.173	0.316	0.057	0.057	-0.002	0.620	0.081	0.005	-2.100	-0.022	-0.139	0.607	-0.809	1.167
TPARTS	0.685	0.122	0.191	-0.089	-2.661	-0.056	0.340	-0.167	-0.578	-1.145	0.299	1.000	1.150	0.384	0.368	0.481	-0.372	-2.057	0.127	0.966	1.011	1.047
OTURK	-0.047	-0.306	1.405	0.187	0.333	0.341	-0.155	0.295	-0.749	-0.745	-0.312	0.258	-0.098	0.462	-0.343	0.081	-0.656	0.035	-0.164	-0.379	0.559	1.095
LAMB	0.144	0.016	0.093	-0.446	-0.084	0.280	0.246	-0.271	0.027	0.226	-0.008	0.093	-0.016	-0.216	-0.085	0.030	1.108	0.104	-0.147	-1.808	0.715	1.197

Beef	Pork	Chicken	Turkey	Lamb	Veal
BRISK -- Brisket	CHOPS -- Chops	CBRST -- Breast	TBRST -- Breast	LAMB	VEAL
CHUCK -- Chuck	HAM -- Ham	CPARTS -- Parts	TPARTS -- Parts		
GBEEF -- Ground Beef	SRIBS -- Spare Ribs	OCHICK -- All Other Chicken	OTURK -- All Other Turkey		
LOIN -- Loin	ROAST -- Roast				
RIB -- Rib	LOIN -- Loin				
ROUND -- Round	OPORK -- All Other Pork				
AOB -- All Other Beef					

Table 5. Weak Separability Test Results

Utility Tree	Degrees of Freedom	Wald Test	Prob. > Value	Adjusted Wald Test	Prob. > Value
1	153	196.95	0.0095	1.1551	0.1012
2	152	205.99	0.0023	1.2161	0.0423
3	121	230.86	0.71E-08	1.7120	0.000046
4	147	204.43	0.0012	1.2479	0.0270

significance, evidence exists to support the notion of three different separable partitions. This evidence is in contrast to the work by Pudney, who rejects weak separability in all cases. However, the findings regarding weak separability in this paper could be attributed to the fact that weekly scanner data as well as a more "disaggregated" set of meat products are used.

Conclusions

This paper addresses the important issue of using weak separability tests in arriving at appropriate groupings of disaggregated meat products in a demand systems framework. Results generally suggest that consumers allocate expenditures first to animal product aggregates, and then among disaggregate products within an aggregate. These results imply that disaggregate meat products of a certain animal origin(e.g. beef, pork) can be assumed as weakly separable from disaggregate meat products of other animal origins. Thus, consumers in this case, do not allocate expenditure across meat products or between high quality and low quality products from different animal origins.

This paper, however, does not cover all the plausible grouping patterns suitable for a disaggregated model. Another area of concern lies with generalizing the results to regional or national levels. The use of scanner data permits the focus of analysis on shorter time intervals(e.g.

weekly) and also allows the analysis of disaggregated meat commodities. This paper documents the utility of scanner data in testing hypotheses of modern restrictions of demand theory and demonstrates the great promise that it hold as a data source available to market and research analysts.

Most analysts who have employed parametric procedures to test for separability of preferences fail to address or account for the fact that tests results are not invariant to functional form. Further work should center attention on the use of alternative demand specifications when conducting parametric tests of separability. To illustrate this point, Reynolds and Goddard use the AIDS and Rotterdam specifications in considering tests of weak separability among commodities in Canada. Conclusions derived from the Rotterdam model were in general dissimilar to those derived from the AIDS model. Too, another area of research deserving attention is the use of non-parametric tests together with parametric tests in considering tests of separability.

References

Afriat, S., "The Construction of Separable Utility Functions from Expenditure Data," Mimeo, Purdue University, 1967.

Anderson, A. and R. Blundell, "Testing Restrictions in a Flexible Dynamic Demand System: An Application to Consumers' Expenditure in Canada," *Review of Economic Studies*, 50(1983):397-410.

Bieri, J., and A. de Janvry, *Empirical Analysis of Demand Under Consumer Budgeting*, Giannini Foundation Monograph No. 30, University of California, Berkeley, September 1972.

Blanciforti, L., and R. Green, "An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups," *Review of Economics and Statistics*, 65(1983):511-515.

Byron, R.P., "A Simple Method for Estimating Demand Systems under Separable Utility Assumptions," *Review of Economic Studies*, 37(1970):261-274.

Capps Jr., O., J. Tedford, and J. Havlicek, "Household Demand for Convenience and Nonconvenience Foods," *American Journal of Agricultural Economics*, 67(1985):862-869.

Chalfant, J., "A Globally Flexible, Almost Ideal Demand System," *Journal of Business and Economic Statistics*, 5(1987):233-242.

Deaton, A. and J. Muellbauer, *Economics and Consumer Behavior*. Cambridge MA: Cambridge University Press, 1980.

Eales, J.S., and L.J. Unnevehr, "Demand for Beef and Chicken Products: Separability and Structural Change," *American Journal of Agricultural Economics*, 70(1988):521-532.

Goldman, S., and H. Uzawa, "A Note on Separability in Demand Analysis," *Econometrica*, 32(1964):387-398.

Hayes, D., T. Wahl, and G. Williams, "Testing Restrictions on a Model of Japanese Meat Demand," *American Journal of Agricultural Economics*, 72(1990):556-566.

Jorgenson, D.W. and L.J. Lau, "The Structure of Consumer Preferences," *Annals of Economic and Social Measurement*, 4(1975):49-101.

Judge, G., W. Griffiths, R. Hill, H. Lutekpohl, and T. Lee, *The Theory and Practice of Econometrics*. New York: John Wiley and Sons, 1986.

Leontief, W.W., "Introduction to the Theory of the Internal Structure of Functional Relationships," *Econometrica* 15(1947):361-373.

Pudney, S., "An Empirical Method of Approximating the Separable Structure of Consumer Preferences," *Review of Economic Studies*, 48(1981):561-577.

Sono, M., "The Effect of Price Changes on the Demand and Supply of Separable Goods.: *International Economic Review*, 2(1961):239-271.

Swofford, J.L., and G.A. Whitney, "Nonparametric Tests of Utility Maximization and Weak Separability for Consumption, Leisure and Money," *The Review of Economics and Statistics*, 69(1987):458-64.

Varian, H.R., "Non-parametric Tests of Consumer Behaviour," *Review of Economic Studies*, 50(1983):99-110.