December 2009

منظمة الأغذية والزراعة للأمم المتحدة	联合国粮食及农业组织	Food and Agriculture Organization of the United Nations	Organisation des Nations Unies pour l'alimentation et l'agriculture	Продовольственная и сельскохозяйственная организация Объединенных Наций	Organización de las Naciones Unidas para la Agricultura y la Alimentación

COMMITTEE ON COMMODITY PROBLEMS

JOINT MEETING OF THE FOURTH SESSION OF THE SUB-GROUP ON BANANAS AND THE FIFTH SESSION OF THE SUB-GROUP ON TROPICAL FRUITS

Rome, 9 – 11 December 2009

PRODUCT SEGMENTATION AND MARKET PERSPECTIVES IN THE EC AND US AVOCADO MARKETS – TECHNICAL APPENDIX

1. Applications of the hedonic model to agri-food products has been frequent in recent years as shown, among the others, by Angulo et al. (2000), Mc Connell and Strand (2000), Schamel and Anderson (2003), and by the literature cited in these papers.

2. The hedonic model is based on the assumption that consumers preferences are defined in terms of the characteristics of goods, rather than in terms of the goods themselves. Good are assumed to be made up of a number of m attributes z_i, and consumer's utility is defined in terms of the level of each attribute contained in goods, as

$$U = f(z_1, z_2, \dots, z_m) \qquad \text{(a1)}$$

The amount z_j of each attribute that the consumers enjoys depends, in turn, upon the amount of the goods consumed q_j and upon the unit content of each attribute in each good x_{ij} according to

$$z_j = f_j\,(q_1, q_2, \dots, q_n, x_{1j}, x_{2j}, \dots, x_{nj}) \qquad \text{(a2)}$$

Substituting z_j into the utility function yields

$$U = U\,(q_1, q_2, \dots, q_n, x_{11}, x_{12}, \dots, x_{nm}) \qquad \text{(a3)}$$

This is maximized subject to a standard budget constraint $\sum_{i=1}^{n} p_i q_i = I$ in which p_i is the price of good i, and I is income.

The solution of this maximization problem yields a definition of the market price of the good in terms of its attributes, of the following type

$$p_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \dots\dots + \beta_n x_{in} \qquad \text{(a4)}$$

in which β_j is the marginal implicit price of the j-th attribute, which is assumed to be constant.

3. In this application, equation (a4) has been estimated by OLS, for the list of variables reported in table A2 to A5, using the market price per ton and the market price per individual fruit as dependent variables.

4. Data employed are weekly wholesale prices from May 2004 to April 2005 from the Market News Service of the International Trade Center UNCTAD - WTO for the EC market, and from the United States Department of Agriculture (USDA) New York weekly quotations for the US market.

5. Results in details are reported in Tables A2 to A5. Estimation show the presence of heteroskedasticity in the residuals; therefore the t-ratios reported in the Tables have been computed from heteroskedastic-consistent standard errors. For both the EC and the US, R-squared value indicates an overall high goodness of fit, which is lower for the estimations run with the "price per fruit" as a dependent variable.

6. Variables are listed in Table A1. Qualitative variables are identified by the "D" on the right. The variable "size of the fruit" is defined in terms of number of fruits per unit of weight; hence the larger the value of the variable, the smaller the fruits.

7. Since many of the dependent variables are qualitative, in order to be able to estimate the model and avoid singularity it was necessary to drop one of them in each group, and to assess the results with reference to the omitted variable. For instance, in the case of the varieties in the US market, the only variable included in the dummy for "other green" varieties. This allows to assess the extent to which the price of these varieties is different from that of the Haas variety. The inclusion of two variables for the Haas and for the green varieties would have generated singularity. Particularly, for the origin of imports into the EC market, results were considered in terms of difference with products coming from Kenya. The most important consumer in Europe is

France; therefore price differentiation across destinations have been observed with reference to the France market. In the US, origins have been assessed with reference to the “other origins”.

REFERENCES

Angulo A. M., Gil J. M., Gracia A. and Sanchez M. “Hedonic prices for Spanish Red Quality Wine” *British Food Journal* vol 102, n.7, pp 481-493, 2000

Mc Connell K. E. and Strand I. E. “Hedonic Prices for Fish: Tuna Prices in Hawaii” *American Journal of Agricultural Economics*, 82, p 133-44, 2000

Schamel, G. and Anderson, K., "Wine Quality and Varietal, Regional and Winery Reputations: Hedonic Prices for Australia and New Zealand". *The Economic Record*, Vol. 79, pp. 357-369, September 2003

International Trade Centre UNCTAD – WTO *Market News Service Fresh Tropical and Off-Season Fruit and Vegetables, European Market*, various 2004 and 2005 issues

United States Department of Agriculture (USDA) *Wholesale Market Fruit Report*, New York, various 2004 and 2005 issues

Table A1. Variables employed in the analysis

PTON	price per ton	(log)
PPF	price per fruit	(log)
PVAR	size of the price range of weekly quotations	(log)
SIZE	size of the fruit	(log)
SHREL	relative market share	(log)
1LAY	one-layer box	D
FRSHAPP	fresh appearance	D
KEN	origin from Kenya	D
SAFR	origin from South Africa	D
MEX	origin from Mexico	D
OTHLA	origin from other Latin American countries	D
ISR	origin from Israel	D
SPN	origin from Spain	D
FLOR	origin from Florida	D
CA	origin from California	D
DR	origin from Dominican Republic	D
OTHV	"green" (non-Haas) varieties	D
HAAS	Haas variety	D
FUER	Fuerte variety	D
PINK	Pinkerton variety	D
AIR	trasported by air	D
GERM	sold in Germany	D
FR	sold in France	D
NTH	sold in the Netherlands	D
UK	sold in the UK	D
SPAN	sold in Spain	D
MAY	May	D
JUN	June	D
JUL	July	D
AUG	August	D
SEPT	September	D
OCT	October	D
NOV	November	D
DEC	December	D
JAN	January	D
FEB	February	D
MAR	March	D
APR	April	D

(log) = logarithm of
D = dummy variable

Table A2. Results of the hedonic model for the EU

Dependent variable PTON

	Coefficient	t-ratio
Constant	3.12	37.90
PVAR	0.54	1.28
SIZE	-0.01	-2.64
SHREL	0.01	0.13
SAFR	0.10	2.59
MEX	0.12	3.18
OTHLA	0.09	2.26
ISR	0.07	1.98
SPN	0.12	3.77
OTH	0.04	0.56
AIR	0.11	3.00
HAAS	0.13	4.51
FUER	-0.05	-1.78
PINK	-0.02	-0.55
GERM	0.00	-0.05
NTH	0.00	-0.03
UK	-0.12	-1.77
SPAN	-0.05	-1.09
OTHC	0.04	0.53
JUN	0.04	1.23
JUL	-0.08	-3.08
AUG	0.09	2.22
SEPT	0.17	5.54
OCT	-0.05	-1.71
NOV	-0.05	-2.02
DEC	0.02	0.50
JAN	-0.05	-1.45
FEB	0.04	1.06
MAR	0.07	2.31
APR	-0.02	-0.59

sigma	0.10	RSS	3.65
R^2	0.62	F(29,373) =	21.06
log-likelihood	376.15	DW	1.45
no. of observations	403	no. of parameters	30
mean(PTON)	3.23	var(PTON)	0.02

source: author's calculation on MNS data

Table A3. Further results of the model for the EU

Dependent variable PPF

	Coefficient	t-ratio
Constant	-0.31	-2.96
PVAR	0.45	1.02
SHREL	0.41	2.86
SAFR	0.02	0.32
MEX	0.10	1.95
OTHLA	0.15	3.15
ISR	0.06	1.34
SPN	0.10	2.13
OTH	0.12	1.97
AIR	0.14	3.87
HAAS	0.03	0.84
FUER	-0.11	-2.96
PINK	-0.04	-0.97
GERM	-0.23	-1.96
NTH	-0.36	-2.37
UK	-0.32	-4.06
SPAN	-0.14	-2.36
OTHC	-0.23	-2.20
JUN	0.06	2.11
JUL	-0.05	-1.87
AUG	0.12	2.36
SEPT	0.18	5.82
OCT	-0.05	-1.64
NOV	-0.05	-1.64
DEC	0.02	0.65
JAN	-0.04	-1.17
FEB	0.04	0.96
MAR	0.05	1.30
APR	-0.02	-0.43

sigma	0.1	RSS	0.17
R^2	0.4	F(29,373) =	8.57
log-likelihood	239.9	DW	1.67
no. of observations	403	no. of parameters	29.0
mean(PTON)	-0.4	var(PTON)	0.0

source: author's calculation on MNS data

Table A4. Results of the hedonic model for the US

Dependent variable PTON

	Coefficient	t-ratio
Constant	3.13	31.40
PVAR	0.14	0.47
LSIZE	0.00	-0.74
1LAY	0.03	0.78
BSH	0.42	7.83
FRSHAPP	-0.01	-0.17
MEX	-0.06	-1.28
FLOR	-0.11	-1.89
CA	0.05	1.02
DR	-0.02	-0.55
OTHV	-0.21	-3.85
JUN	0.25	3.00
JUL	0.11	2.95
AUG	-0.05	-0.99
SEPT	0.01	0.25
OCT	0.03	0.62
NOV	0.01	0.40
JAN	0.04	1.03
FEB	0.07	2.10
MAR	0.11	2.82
APR	0.12	2.86
MAY	0.10	1.71

sigma	0.09	RSS	0.88
R^2	0.81	F(21,115) =	23.81
log-likelihood	151.61	DW	1.54
no. of observations	137	no. of parameters	22
mean(PTON)	3.02	var(PTON)	0.03

source: author's calculation on MNS data

Table A5. Further results of the model for the US

Dependent variable PPF

	Coefficient	t-ratio
Constant	-0.34	-7.91
PVAR	-0.08	-0.19
1LAY	0.16	2.49
BSH	0.28	3.15
FRSHAPP	0.01	0.16
MEX	0.03	0.44
FLOR	-0.07	-1.10
CA	0.15	2.45
DR	0.10	2.01
OTHV	0.08	1.72
JUN	0.30	4.03
JUL	0.16	3.19
AUG	-0.03	-0.52
SEPT	0.06	1.24
OCT	0.11	1.79
NOV	0.10	3.60
JAN	0.10	2.38
FEB	0.08	2.00
MAR	0.14	2.90
APR	0.14	4.06
MAY	0.10	1.37

sigma	0.1	RSS	0.91
R^2	0.4	F(21,115) =	4.43
log-likelihood	98.3	DW	1.90
no. of observations	137	no. of parameters	21
mean(PTON)	-0.1	var(PTON)	0.02

source: author's calculation on MNS data