The Greek Olive Oil Market Structure

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Abstract

Food product differentiation leads to significant price variations among the same products, meaning that specific products can be sold in higher prices. An Hedonic Price analysis is adopted to investigate the influence of food differentiation on consumer prices and to identify product attributes' values for the olive oil market. This will contribute to device the most appropriate olive oil differentiation strategies in order to be purchased by consumers in a higher price. The retail price structure was estimated in relation to several product natural attributes, to production and processing conditions, to quality control and to labeling and distribution. Findings demonstrate that olive oil price differentiation is mainly influenced by factors relevant to quality of life, purchase uncertainty, acquisition cost and consumers' psychological needs. Additionally, vertical integration in production and processing and the retailer size significantly influence the olive oil price formulation.

Keywords: *differentiation structure, hedonic prices, olive oil market*

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Introduction

Olive oil, one of the major food produce in most of EU and non EU Mediterranean countries constitutes a major commodity in EU market (EU Olive Oil Figures, 2004). In Greece, olive oil production accounts for approximately ten per cent of the total agricultural production, and represents 9.4 per cent of the Greek agricultural GDP. In addition, olive oil constitutes an important component of Greek consumers' diet, since the annual per capita consumption is the highest in the world. Olive oil provides the major fat and oil intake not only for the Greek consumer but also for the EU Mediterranean consumer (EC Olive Oil Figures, 2001).

Food product differentiation strategy attracts all firms aiming at enhancing the added value of their produce and is pursued when ever consumers appear to be willing to pay an extra amount of money for higher quality products (Ferrel et al., 1998, Besanko et al., 1996). The study of product differentiation for the olive oil can contribute in identi-

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fying factors and product attributes influencing the price formulation (Barkema, 1993).

The aim of the present study is to identify olive oil price structure and to estimate product specific attributes by employing an Hedonic Price model. First, a methodological background is given, followed by the model application and finally some concluding remarks are drawn.

Model specification

Olive oil is a processed food product essential for the agriculture of Mediterranean countries as well as for consumers' diet (Migdalas *et al.,* 2004). Though that various studies focused on measuring demand and market conditions of olive oil are exist (Mili and Zuniga, 2001, Siskos *et al.,* 2001, Martinez *et al.,* 2002, Migdalas *et al.,* 2004), in the present study an hedonic pricing approach is adopted to identify the parameters that determine olive oil differentiation in the Greek market.

One of the mostly applied approaches to study product differentiation is the hedonic pricing approach, introduced by Rosen (1974). This approach facilitates the analysis of the price structure of a commodity in relation to its specific attributes through the estimation of product attributes' shadow prices. Thus, valuable information is extracted for an effective product differentiation strategy. Hedonic pricing approach has been widely used and seems to be a suitable and reliable tool to analyse product attributes, seller and buyer attributes as well as market conditions (Rosen, 1974, Ratchford, 1990, Uri and Hyberg, 1995).

According to Rosen (1974) the hedonic supply function can be expressed:

$$\mathbf{P_i}\,(\boldsymbol{Z}) = \mathbf{G^i}(\boldsymbol{Z_1, Z_2,\ldots, Z_m, \beta}) \qquad (1)$$

where P_i is the price of product i in the market and $\boldsymbol{Z_1, Z_2,\ldots, Z_n}$ the product attributes. $\boldsymbol{\beta}$ is an exogenous supply shift variable. In case where no differences in cost among firms exist, $\boldsymbol{\beta}$ can be dropped from the equation (1), while otherwise a probability supply differentiation factors must be considered (Rosen, 1974, Besanko et al, 1996).

In long run equilibrium, hedonic function represents the minimum price at which attributes can be purchased and supplied. That means the marginal price of an attribute will be identical for all firms, considering constant all other factors. The hedonic function also represents the minimum supply marginal cost of the attribute at the same level. This equilibrium facilitates to understand how sellers determine the value of the product they offer and how consumers value the product they buy.

According to Stanley and Tschirchard (1991), consumers gain utility from the services (S) of the product attributes. Such services for olive oil are quality type package size and product image. Let $\mathbf{Z_i}(Z_1,\ldots,Z_n)$ be the vector of product attributes and $\mathbf{S_j}(Z_1,\ldots,Z_n, Y)$ the vector of product services (j=1,…m). A product attribute can have either positive or negative effect on the product service. Attributes whose services are positively or negatively evaluated in the market, are the factors that influence the price structure and the differentiation of the product.

For olive oil, the services a consumer receives can be grouped in four clusters: services related to quality of life, to product acquisition cost, to purchase uncertainty and to the image of the product in relation to consumer psychological needs (Stanley and Tschirhart 1991, Besanko *et al*, 1996, Ferrel, *et al*. 1998). Services strongly affecting

quality of life are those derived from natural product quality and production conditions. These services are mainly referred to the organic aspects of the product (free from agrochemicals). Services related to product acquisition cost are those who facilitate purchase choices and minimize purchase time. Presently these services are referred to supermarkets, cooperatives and processing firms. Services relevant to purchase uncertainty can be derived from the adoption of a quality control system by the firm as well as by the product information provision. Finally, services related to product image are referred to the appearance of the product (package material, design).

According to Rosen (1974), three preconditions are required for the application of hedonic price method. The first precondition is referred to market orientation, meaning that producers' attempts and consumers' needs are met. In the present study this precondition is provided due to the large number of sellers (producers, wholesalers, cooperatives, retailers) who offer various sets of product attributes (size category, nutrition value, production and processing conditions, packaging). The second precondition implies that products and services cannot be split or merged without an additional cost like the extra virgin olive oil and the package size. The third precondition is that the product can be described using a large number of attribute combinations in order the choice of the attributes to be continuous and regular. This precondition is met by the large number of attribute combinations (including the various olive oil quality types and package sizes which satisfy different consumer needs). Table 1 indicates a series of attributes and the expected signs.

Only natural attributes observable by the consumers are considered such as quality type (Extra virgin, Virgin) and the special character of the product (improved variety or aroma and herb enrichment). According to EU legislation, the quality type of olive oil (extra virgin, virgin and olive oil) should be recorded on package. The extra virgin and the virgin olive oils are considered of higher quality and are expected to have a higher shadow price ($\partial P/\partial Z_1>0$, $\partial P/\partial Z_2>0$) and the same stands for the special character of the product ($\partial P/\partial Z_3>0$). Organic aspects of the product are expected to provide a higher shadow price ($\partial P/\partial Z_4>0$), while the low temperature conditions during processing (no thermal processing) provide higher quality to the product and are expected to have a positive effect on its shadow price ($\partial P/\partial Z_5>0$).

In pricing the various package sizes, the larger quantity corresponds to lower price per product unit. This can be attributed to the fact that the small size of the package requires higher package cost (Granger and Billson, 1972, Nason and Della Bitta, 1983, Wansink, 1996). It is expected the smaller size to share a higher shadow price ($\partial P/\partial Z_6<0$). The interest in the package appearance is expected to positively affect product price ($\partial P/\partial Z_7>0$).

Information on the application of a quality control system is expected to affect the demand function and leads to uncertainty reduction. Thus, the implementation of a quality control system increases the production cost and leads to a higher price level and consequently to a higher shadow price ($\partial P/\partial Z_i>0$, i=8, 9, 10). Advertising reduces inquiry time and purchase uncertainty as well (Kotler *et al.,* 2002). Since advertising cost is an additional cost for the firm it is expected to lead to a higher shadow price ($\partial P/\partial Z_{14}>0$, $\partial P/\partial Z_{15}>0$).

Table 1. Product differentiation attributes and expected signs

Clusters	Variable	Provided services	Expected signs
Natural characteristics	Extra virgin (Z_1)	Nutrition	+
	Virgin (Z_2)	Nutrition	+
	Special character (Z_3)	Image	+
Production/ Processing conditions	Organic (Z_4)	Nutrition / Environment	+
	Without thermal processing (Z_5)	Nutrition / Environment	+
Packaging	Size of packaging (Z_6)	Image	-
	Innovative package (Z_7)	Image	+
Quality system	ISO 9001, HACCP (Z_8)	Uncertainty/Cost	+/-
	Individual system (Z_9)	Uncertainty/Cost	+/-
	Protec. Design. of Origin (Z_{10})	Uncertainty/Cost	+/-
Additional label information elements	Nutritive elements (Z_{11})	Uncertainty/ Image	+
	Taste, aroma (Z_{12})	Uncertainty/ Image	+
	Product selection (Z_{13})	Uncertainty/ Image	+
Product information	Advertising (Z_{14})	Uncertainty/ Image	+
	Customer line (Z_{15})	Uncertainty/ Image	+
Vertical integration – Marketing via:	Super market (Z_{16})	Cost	-
	Cooperative (Z_{17})	Cost	+/-
	Local firm (Z_{18})	Cost	+/-
Type of retail supplier	Hypermarket (D_1)		-
Retailer's location	Athens – Thessaloniki (D_2)		+/-

Producers try to establish an effective communication channel with consumers in order to provide them detailed product information and to receive consumer preferences' information (Kotler, *et al*., 2002). Product information is provided via labeling and leads to the reduce in acquisition cost and purchase uncertainty. In the case of olive oil, such information regards product nutrition elements, taste and aroma and product selection (producer, region, quality choice). The information record on package increases labeling cost and consequently is expected to have higher shadow prices ($\partial P/\partial Z_i>0$, i= 11, 12, 13).

Consumers seem to perceive olive oil processed and labeled by local firms (cooperatives or private) of a better quality. Consequently, package labeling can be associated either by a lower or a higher shadow price depending on the origin of labelling (retailers or local firms).

Vertical integration brings about substantial cost cuts due to decline in transaction, transfer and storage cost and due to economies of scale (Besanko *et al,* 1996, Kotler *et al*, 2002). Therefore, a firm with several marketing functions (production, wholesaling retailing), can reduce product price for the same set of attributes ($\partial P/\partial Z_{16}<0$,

$\partial P/\partial Z_{17}<0$). Identical savings can be achieved when the processing is provided at local level and the shadow price is expected lower ($\partial P/\partial Z_{18}<0$).

As a large retail supplier achieves economies of scale, it attempts to increase the number of reached consumers by expanding its activities to a large region. Consumers gainer substantial benefits due to lower prices by huge retail suppliers (hypermarkets) adopting such an expansion strategy. Sequentially, a dummy variable (D_1) is introduced in the model which equals to one if the product is purchased from a hypermarket and equals to nill in any other case. A dummy variable (D_2) is introduced, which represents the location of the retailers and takes the value of one if the retailer is located in Athens and the value of zero otherwise.

Empirical analysis

Data obtained by observing product labels on the shelves of representative retail shops in the metropolitan areas of Athens and Thessaloniki, during the summer of 2004. Finally, 920 sets of observations were gathered and 805 of them considered reliable and utilized in the estimation. The estimation of a linear form of equation (1) was introduced, using the ordinary least square method (OLS) for the 805 sets of observations. The model includes twenty independent variables. The variable that represents the package size (Z_6) takes values from 0.25 to 5. All the remained independent variables are dummies and detailed description of the variables is provided in Table 2.

The results of the econometric estimation (variable coefficients, standard errors, t-statistics and probability values) are provided in Table 3. The hypothesis for homoskedasticity in error terms was rejected and a correction heteroskedasticity test was applied. The significant effect of each independent variable on the dependent one was tested with a t-statistic. At 5% significance level the hypothesis of zero coefficient is rejected for twelve variables out of twenty, whereas at 10% significance level, the relevant hypothesis is rejected for two variables. The remained variables did not found to significantly affect the dependent variable. The results of the F-test (F= 75.157, probability price lower to 1%) indicate that all the independent variables significantly affect the dependent variable. The high value of the adjusted R-square (0.651), indicates that high percent of retail olive oil price variability is explained from the considered independent variables.

Thus, quality type of olive oil affects price determination as the higher the quality (extra virgin, virgin), the higher the price expected. The seller (producer, cooperative, local wholesaler) may achieve a higher price for the product if s/he produces high quality olive oil.

The higher shadow prices are attributed to the organic nature of the product (Z_4) and the production without thermal processing (Z_5). The special nature of the olive oil (Z_3) due to an improved tree variety or aroma and herb enrichment is also attached a very high shadow price.

The estimated price elasticity of package (average package size X coefficient estimator / average olive oil price) equals to 0.07, meaning that if the average package size increases by 50 per cent the decrease in retail olive oil price will be equal to 3.5 per cent. The shadow price is high for the innovative package of olive oil (Z_7) and therefore the seller (producer, cooperative, wholesaler) may achieve a higher price for the product if s/he offers smaller and innovative packages.

Table 2. Description of the variables included in the model

Differentiation clusters	Variable	Variable description
Natural characteristics	(Z_1)	if olive oil extra virgin = 1, otherwise = 0
	(Z_2)	if olive oil virgin = 1, otherwise = 0
	(Z_3)	if olive oil special character = 1, otherwise = 0
Production/ Processing conditions	(Z_4)	if olive oil organic = 1, otherwise = 0
	(Z_5)	if olive oil without thermal processing = 1, otherwise = 0
Packaging	(Z_6)	size of package from 0.25 liters to 5 liters
	(Z_7)	if olive oil package innovative = 1, otherwise = 0
Quality system	(Z_8)	if quality control system ISO 9001 HACCP = 1, otherwise = 0
	(Z_9)	if quality control system individual = 1, otherwise = 0
	(Z_{10})	if PDO = 1, otherwise = 0
Additional label information elements	(Z_{11})	if label information nutritive elements = 1, otherwise = 0
	(Z_{12})	if label information taste, aroma = 1, otherwise = 0
	(Z_{13})	if label information product selection = 1, otherwise = 0
Product information	(Z_{14})	if advertising = 1, otherwise = 0
	(Z_{15})	if label information customer line = 1, otherwise = 0
Vertical integration – Marketing via:	(Z_{16})	if marketing via Supermarket = 1, otherwise = 0
	(Z_{17})	if marketing via Cooperative = 1, otherwise = 0
	(Z_{18})	if marketing via local firm = 1, otherwise = 0
Type of retail supplier	(D_1)	if type of retail supplier Hypermarket = 1, otherwise = 0
Retailer's location	(D_2)	if retailer's location Athens = 1, otherwise = 0

The adoption of a quality control system in processing (Z_8) is connected with a low shadow price while the adoption of an individual control system (Z_9) and the protected designation of origin (Z_{10}) do not seem to influence olive oil price formulation. This is in accordance with Capmany *et al*. (2000) suggesting that quality control systems in agriculture were firstly applied for firm's reliability reasons, though afterwards can provide external benefits. Additional label information is found to affect olive oil price formulation. More precisely, taste and aroma (Z_{12}), product selection (Z_{13}), as well as advertising (Z_{14}) lead to higher shadow prices.

Vertical integration leads to lower shadow prices when it is provided by supermarkets (Z_{16}) and local wholesalers (Z_{18}). However, vertical integration provided by cooperatives (Z_{17}) does not seem to influence price formulation. The statistically significant effect of the dummy variable D_1 indicates that the type of the retail supplier influences olive oil shadow prices. Namely, hypermarkets contribute to the formulation of lower prices for the same set of product attributes, but increase product acquisition cost.

Table 3. Results of econometric estimation of the model

Differentiation clusters	Variable	Coefficient	Std. Error	t-Statistic	Probab.
	C	4.221272	0.120040	35.16546	0.0000
Natural characteristics	(Z_1)	0.277747	0.046981	5.911831	0.0000
	(Z_2)	3.481733	0.628585	5.539002	0.0000
	(Z_3)	0.229889	0.120815	1.902817	0.0574
Production/ Processing conditions	(Z_4)	3.115216	0.478963	6.504085	0.0000
	(Z_5)	0.232866	0.104148	2.235921	0.0256
Packaging	(Z_6)	-0.133589	0.010235	-13.05228	0.0000
	(Z_7)	0.572761	0.111970	5.115305	0.0000
Quality system	(Z_8)	-0.364046	0.163216	-2.230449	0.0260
	(Z_9)	0.001996	0.058436	0.034149	0.9728
	(Z_{10})	0.289715	0.226224	1.280656	0.2007
Additional label information elements	(Z_{11})	0.105165	0.134735	0.780531	0.4353
	(Z_{12})	0.318608	0.116488	2.735112	0.0064
	(Z_{13})	0.223681	0.099947	2.237996	0.0255
Product information	(Z_{14})	0.149701	0.087178	1.717183	0.0863
	(Z_{15})	0.110502	0.114246	0.967231	0.3337
Vertical integration – Marketing via:	(Z_{16})	-0.476559	0.139105	-3.425890	0.0006
	(Z_{17})	-0.093503	0.111113	-0.841506	0.4003
	(Z_{18})	-0.193591	0.106115	-1.824356	0.0685
Hyper market	(D_1)	-0.300666	0.059548	-5.049117	0.0000
Athens -Thessaloniki	(D_2)	0.006247	0.046581	0.134105	0.8934
	R-squared 0,659 Adj. R-squared 0,651 F statistic 75,157 N 805				

Finally, retailers' location (D_2) does not affect price formulation and therefore there is no price differentiation between purchase places.

Concluding Remarks

In the present study a hedonic price approach was applied in olive oil market to identify the product specific attributes affecting price determination. By collecting data from domestic olive oil market, the retail price structure was estimated in relation to product natural attributes, production and processing conditions, quality control, labeling and distribution.

Findings suggest that the price structure of olive oil is influenced by several attributes like quality type, organic nature and special character, non thermal processing conditions, package size and package design, recorded information on package and advertising. In addition, the quality control system, the vertical integration and the distribution via hypermarkets are identified as factors conducive to product price. Thus, by the applied hedonic price model factors related to the internal and the external quality of the product and at the same time market and cost parameters are taken into account. Results will provide the underpinnings to processors and retailers to develop the appropriate product differentiation strategy in order to achieve higher product prices and to enhance the share of their product in the olive oil market.

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