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# An economic outlook of the Treenuts sector in Greece

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**SUMMARY –** Nuts constitute an important component in the European food market as they are consumed both fresh as well as being used as inputs for the food processing industry. The cultivation of nuts is widespread in almost all Mediterranean countries accounting for a significant proportion of their total agricultural production and trade, while for some they even are their main exporting agricultural commodities. In this paper an overview of the nut sector in Greece is presented, together with some econometric tests on corresponding time series data set. In Greece nuts are well incorporated in the consumers' diet and per capita consumption is large. Yet, increased competition from other producing countries and small farm size impede further growth of the sector in terms of producing and exporting volumes. Unit root tests on domestic production and consumption show that the data series are integrated of order one and cointegration analysis reveals that there is a certain linkage between domestic production and per capita consumption of nuts.

**Key words**: Nuts, production, consumption, trade, cointegration.

***RESUME –*** *"Perspectives économiques du secteur des fruits secs de culture arboricole en Grèce". Les fruits secs constituent un élément important dans le marché alimentaire européen car ils sont consommés en frais et ils sont aussi utilisés comme intrants dans l'industrie de transformation des aliments. La culture des fruits secs est très répandue dans presque tous les pays méditerranéens, et elle représente une part significative de la production et du commerce agricoles totaux, bien que pour certains pays ces fruits soient la principale denrée agricole à exporter. Cet article présente une étude du secteur des fruits secs en Grèce ainsi que quelques analyses économétriques des données de séries temporelles correspondantes. En Grèce, les fruits secs font partie de l'alimentation des consommateurs et la consommation par habitant est importante. Cependant, la concurrence croissante provenant d'autres pays producteurs et la dimension réduite des exploitations entravent l'expansion du secteur en termes des volumes de production et d'exportation. Les tests de racine unitaire sur la production et la consommation du pays montrent que les séries de données sont intégrées de premier ordre, et l'analyse de cointégration montre qu'il y a un certain lien entre la production intérieure et la consommation par habitant de fruits secs.*

***Mots-clés :*** *Fruits secs, production, consommation, commerce, cointégration.*

## Introduction

Treenut crops have been traditionally cultivated in Greece for many decades mainly due to the favourable weather and soil conditions that prevail in the whole Mediterranean area, which is in fact, a major nut producing area. In contrast, treenuts farming is not as widespread in Northern European countries, which rely to a great extent on imports from the Mediterranean countries, or third countries, such as Near East countries and the USA.

Market potential for nut crops appear to be prosperous, not only because there is a quite substantial domestic demand in most Mediterranean countries, but also because of certain product characteristics that enable exports: nut crops are less perishable than other fruit crops and can thus be stored, preserved, transported and marketed practically throughout the year with no seasonal availability drawbacks that cause supply irregularities and price fluctuations. Nuts are also considered healthy products, being rich in fibre, vitamins, minerals and other nutrients as well as containing mostly monounsaturated fats which have been shown to lower cholesterol levels. Being part of the nowadays increasingly popular 'Mediterranean diet', it is possible to exploit the growing concern on health and dietary aspects of the consumers in order to trigger consumer demand (Albisu, 1995). Furthermore, and in addition to the final consumer demand, nuts are widely used as inputs by the confectionery

industry, a fact that increases final demand sources. In fact, the food processing industry is such a major outlet for nut products that for some crops special varieties have been developed and cultivated to meet distinct product and quality characteristics desirable by the industry.

Nevertheless, despite the economic importance of nuts, at least for the Mediterranean countries, little research has been done in the past at a world level on assessing major economic aspects of the nut sector. Relevant literature is usually limited to reports by organisations' or some countries' national agricultural department offices, such as FAO or USDA respectively. It is surprising to notice that the application of econometric modelling, for instance, on this sector is relatively rare considering the extensive analysis of other agricultural sectors (i.e. animal products, wheat, other fruits and vegetables).

Such is also the case for Greece in particular, despite the sector's magnitude in terms of volume of production (third largest producer of nuts in the European Union) and consumption (highest per capita consumption of nuts); indicative figures stress its importance for the domestic economy. This study will examine the structure of the Greek nut sector and will attempt to identify any changes in the trends regarding the cultivation of nuts in Greece, covering issues from production to consumption. Analysis will be further focused on certain tradable nut crops that are of major economic significance to Greek agricultural economy, namely almonds, walnuts, pistachios, hazelnuts and chestnuts.

The outline of the paper is as follows. In the next session, some illustrative figures of the production of nuts in Greece will be presented, regarding areas of cultivation, volumes of production as well as technical aspects. Trade and consumption of nuts in Greece will be discussed in the third section, followed by a brief presentation of legislative aspects. Finally, results of econometric tests applied on relevant time series data sets will also be provided. Summary and concluding remarks are given in the last section.

## Production

### Cultivated Area

Accounting for a draft delimitation of the production areas of nuts in Greece, it is noticeable that nuts are grown almost everywhere in Greece, primarily on the mainland. Principal producing regions are the districts of Thessaly (28% of total area), Peloponnese (16%) and central Macedonia (15%). Still, there is a wide variation according to the particular nut crop. Almonds are grown to a great extent in the north, namely Thessaly (40%) and central Macedonia (17%). Walnuts are mostly cultivated in the southern areas of Peloponnese (38%) and west-central Greece (26%). Hazelnuts are favoured in central Macedonia (40%) and eastern Macedonia and Thrace (30%), while chestnuts are grown mainly in Thessaly (29%) and Peloponnese (22%). Cultivation of pistachios on the other hand, is not so dispersed: they are grown in specific areas, Greater Athens area (45%) and nearby districts (30%) (National Statistical Service of Greece).

Organised orchards cultivating nuts in Greece represent only 13% of the total number of tree-cultivating farms, while the percentage of the total area is even lesser, namely 5.5% (Table 1). Intuitively it can be argued that other crops are more favoured as cultivation alternatives among producers in Greece, namely fruits (stone and citrus fruits, apples, peaches) in the low-lands and olives in the high-lands. Although nuts are a traditional agricultural product in Greece and the cultivation of major nut crops (almonds, walnuts, chestnuts, hazelnuts and pistachios) has a long prehistory in the country, producers perceive other cultivation as more profitable due to more stringent national and EU protective policies that reduce competition from third countries and generate higher producer prices and income. Hence, producers begun to pull out nut trees and switch to other cultivation.

It should be further stressed that the size of farms producing nuts is smaller not only compared to that of treenuts farms in other countries, but also compared to the size of other tree crops farms in Greece. Almost two thirds of the nut orchards are less than 20 stremmas (1 stremma = 1000 $m^2$ or 1/4 acre) and more than 40% do not exceed 10 stremmas (2.5 acres). In both cases the percentage is larger than that for fruit and olive trees. This has several negative implications on the competitiveness of Greek nut products and consequently on nut producers' income since it increases production costs and disallows for the implementation of advanced production techniques. Economies of scale cannot be achieved and even the existence of producers organisations that could alleviate this constraint is

not as common in the nut sector as in other sectors; there are only three second-degree and one first-degree co-operatives that are involved in the manufacturing (processing) phase of nuts and another two second-degree co-operatives that are involved in the commercial (distribution) phase (ICAP, 1997).

Table 1. Number of organised orchards and total areas of major tree cultivation in Greece, 1991 (Source: National Statistical Service of Greece, authors' computations)

| | Treenuts | | Olives | | Fruits | | Other | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of farms | Area | No. of farms | Area | No. of farms | Area | No. of farms | Area | No. of farms[††] | Area |
| < 5 stremma[†] | 15561 | 30322 | 83063 | 204484 | 27056 | 54824 | 734 | 1148 | 114785 | 290778 |
| 5-9.9 | 13784 | 55083 | 88364 | 493271 | 33030 | 142547 | 1151 | 3042 | 112504 | 693943 |
| 10-19.9 | 17120 | 107084 | 113318 | 1233964 | 45885 | 337535 | 1904 | 8757 | 137046 | 1687340 |
| 20-29.9 | 9829 | 86442 | 62679 | 1152224 | 26197 | 272387 | 1299 | 9628 | 72527 | 1520681 |
| 30-39.9 | 5571 | 61207 | 36460 | 942708 | 14984 | 185759 | 710 | 6845 | 40773 | 1196519 |
| 40-49.9 | 3057 | 38144 | 20351 | 676352 | 8336 | 114148 | 350 | 4845 | 22181 | 833489 |
| 50 stremma + | 5028 | 93426 | 33963 | 2084613 | 14101 | 229988 | 571 | 14175 | 35589 | 2422202 |
| Total | 69950 | 471708 | 438198 | 6787616 | 169589 | 1337188 | 6719 | 48440 | 535405 | 8644952 |

[†]1 stremma = 1000 $m^2$

[††]The figure representing the total number of farms does not coincide with the sum of all individual numbers of farms, since some farms may grow more than one crop.

An insight of the structure of organised nut orchards in Greece may be provided by tracing and comparing the average sizes of the five different nut crops farms, in terms of acreage (Table 2) and of the total number of trees (Table 3) out of which some interesting issues can be raised. Farm size is small, typical size of a farm for almonds, chestnuts and pistachios being in the range of 10 to 20 stremmas. Hazelnuts and walnuts farms are usually smaller (less than 10 and 5 stremmas, respectively). Large farms with more than 50 stremmas represent for all crops a small fraction of the total and only in the case of pistachios they account for more than 10%. On the other hand, virtually all pistachios and hazelnuts trees are cultivated within organised orchards. At a slightly smaller proportion but still being the overwhelming majority, this is also the case for chestnuts and almonds, while a large number of walnuts (more than 20%) is grown wild. This can be correlated with the fact that the size of walnuts farms was shown to be the smallest among all nuts farms as seen in Table 2.

## Production volumes

Greece is the third larger producer of nuts in the European Union, after Spain and Italy, accounting for almost 10% of the total EU production. At a world level, Greece can be characterised as a medium sized producer of nuts, when compared to the output of USA (around 18%), China (8%), Middle East countries (Turkey 14%, Iran 7%) and other European countries (Spain 6.6%, Italy 6%). Nevertheless, Greece produces more than 2% of the world nuts production, which is almost five million metric tonnes, and ranks ninth among the biggest nut producing countries in the world, following the above mentioned countries as well as India and Brazil (calculated from FAO Statistical databases, 1990-1994 averages). In Fig. 1 the volume of production for the period 1961 to 1994 is depicted. Production had grown at a considerable rate during the period 1961 to 1981, as in 1981 the highest volume ever produced were attained, reaching 126,595 metric tonnes. However, since then, allowing year-to-year variations, there is a downward trend, particularly during the 1990s. In 1994 the volume of production did not exceed 100,000 metric tonnes. It seems that although Greek farmers used to favour the cultivation of nut crops in the past, there has been a strong tendency in the last two decades to abandon this production. The most important reason is the small turnover made, due to increased production costs and lower producer prices. Increased production costs are mainly due to the small

size of farms that disallows for mechanisation and other economies of scale, while low producer prices are attributed to the intensified competition with nuts from other countries that are cheaper.

Table 2. Number of organised orchards and total areas of treenuts in Greece, 1991 (Source: National Statistical Service of Greece, authors' computations)

| | Almonds | | Walnuts | | Chestnuts | | Hazelnuts | | Pistachios | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of farms (%) | Area | No. of farms (%) | Area | No. of farms (%) | Area | No. of farms (%) | Area | No. of farms (%) | Area |
| <5 stremma† | 14.54 | 8327 | 31.64 | 14113 | 16.37 | 3310 | 27.90 | 2797 | 15.78 | 1625 |
| 5-9.9 | 17.97 | 19679 | 21.80 | 18854 | 16.72 | 6577 | 29.43 | 6252 | 18.30 | 3601 |
| 10-19.9 | 27.26 | 48485 | 21.16 | 26726 | 24.39 | 15384 | 26.58 | 8838 | 24.68 | 7278 |
| 20-29.9 | 16.78 | 44178 | 10.42 | 14481 | 17.51 | 17101 | 9.43 | 4191 | 15.23 | 6156 |
| 30-39.9 | 9.61 | 32302 | 5.89 | 9586 | 9.88 | 12693 | 3.46 | 1545 | 9.79 | 4901 |
| 40-49.9 | 5.18 | 19916 | 3.34 | 6080 | 5.50 | 8069 | 1.76 | 899 | 5.40 | 3074 |
| 50 stremma + | 8.66 | 46690 | 5.76 | 13555 | 9.62 | 21563 | 1.43 | 858 | 10.82 | 10435 |
| Total | 32292 | 219577 | 25647 | 103395 | 10921 | 84697 | 4251 | 25380 | 4924 | 37070 |

†1 stremma = 1000 $m^2$

Table 3. Number of treenuts and percentage of them in organised orchards, 1991 (Source: National Statistical Service of Greece, authors' computations)

| | Almonds | | Walnuts | | Chestnuts | | Hazelnuts | | Pistachios | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of rees | % in organised orchards | No. of trees | % | No. of trees | % | No. of trees | % | No. of trees | % |
| 1-49 trees | 606702 | 48.30 | 676196 | 55.15 | 148847 | 74.30 | 24458 | 65.20 | 51815 | 65.12 |
| 50-99 | 458210 | 85.96 | 352578 | 86.45 | 172101 | 92.90 | 47000 | 97.28 | 69826 | 96.06 |
| 100-199 | 698736 | 94.65 | 339495 | 93.96 | 262630 | 97.02 | 145645 | 99.53 | 155142 | 98.57 |
| 200-499 | 1551287 | 98.64 | 228840 | 96.42 | 331934 | 98.75 | 426522 | 99.94 | 292485 | 99.76 |
| 500-999 | 1528504 | 99.15 | 55464 | 90.39 | 255479 | 99.27 | 237811 | 99.98 | 173171 | 99.63 |
| 1000 + | 1261967 | 99.88 | 37046 | 97.84 | 185825 | 99.57 | 93058 | 99.99 | 96537 | 99.97 |
| Total | 6105406 | 92.61 | 1689619 | 77.16 | 1356816 | 95.20 | 974494 | 98.89 | 838976 | 97.09 |

The most important nut crops in Greece are almonds, walnuts, pistachios, hazelnuts and chestnuts. Almonds account for more than half of the total production (about 55,000 MT), followed by walnuts (22,000 MT) and chestnuts (11,000 MT). Hazelnuts (5,000 MT) and pistachios (5,000 MT) represent about 5% each (Fig. 2). For all nuts but pistachios, production has been declining over the last years. The most sharp fall is exhibited by hazelnuts: output is dropping each year since 1988, while compared to the volume produced in 1981-83 it is merely half as much (Table 4). Chestnuts, walnuts and almonds exhibit a similar but less dramatic pattern, as the output reduction ranges from 10% to 20%. On the other hand, there is a distinct increase of pistachio production that has resulted in the doubling of the volume produced in 1994 compared to the period 1981-83. In 1994 pistachio production was the second highest ever achieved, being also for the first time greater than hazelnuts production.

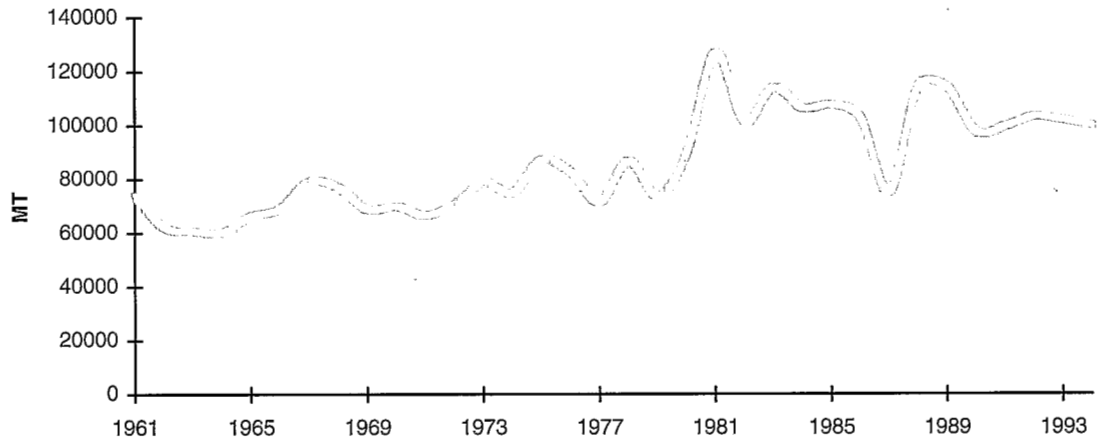


Fig. 1. Production of treenuts in Greece, 1961-1994 (MT) (Source: FAO).

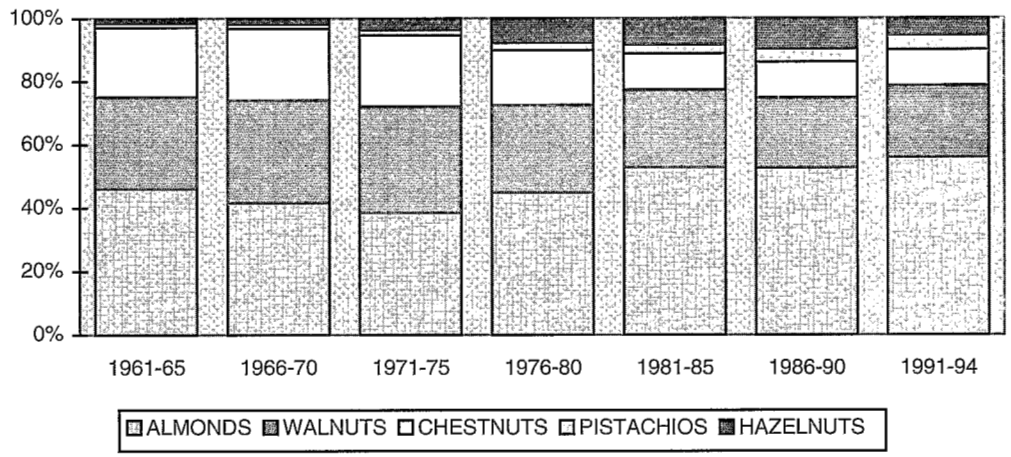


Fig. 2. Share of nut crops in total treenuts production in Greece (Source: FAO).

The most popular varieties of hard shelled almonds in Greece are certain domestic varieties as well as some foreign ones, such as 'Truoito' (Italian), 'Ferragnes' and 'Al' (French) and 'Ferraduel', while medium and soft shelled almond varieties are 'Texas' (USA) and local varieties ('Afrata Chiou' and 'Retsou'). Soft shelled almonds tend to have higher kernel percentage, ranging from 46 to 64 per cent (Vassilakakis, 1996). A major problem regarding the production of almonds in Greece is the early blossoming of most varieties, which due to the low temperatures that occur in early spring, at least in northern Greece, may lead to loss of production.

The cultivation of walnuts in Greece had been rather neglected in the past as most population trees were seedlings and the bulk of the production came from trees not grown within orchards. Hence, problems such as low productivity, sensitivity to diseases and small homogeneity arose. The last years however, a number of varieties and cultivars have been imported from abroad and in addition, attempts are being made to increase the number of grafted trees and to produce breed varieties that have higher productivity and are more disease-resistant. The varieties that are more often cultivated in organised orchards are 'Hartley', 'Payne', 'Franquette' and 'Gustine' (Vassilakakis, 1996). Prospects for walnut cultivation appear to be rather prosperous, provided that production is intensified, due to weather and soil conditions which are in Greece ideal for walnut growing. Moreover, the adoption of the new varieties with horticulturally desirable characteristics may increase productivity, while world

prices are high, demand is large, and gross returns can also be high (Menini, 1995) taking into consideration that the European Union has a deficit in walnut trade.

Table 4. Production index of nut crops in Greece (1981/1983=100) (Source: FAO, authors' computations)

| | Almonds | Walnuts | Chestnuts | Pistachios | Hazelnuts | Nuts (total) |
|---|---|---|---|---|---|---|
| 1975 | 68.55 | 89.88 | 116.09 | 55.92 | 39.14 | 76.51 |
| 1976 | 58.61 | 95.18 | 107.57 | 74.26 | 46.07 | 72.42 |
| 1977 | 51.22 | 74.68 | 93.05 | 64.13 | 57.69 | 62.71 |
| 1978 | 68.34 | 82.11 | 98.85 | 58.15 | 80.26 | 76.13 |
| 1979 | 49.07 | 80.46 | 93.80 | 85.64 | 70.26 | 64.59 |
| 1980 | 67.51 | 84.97 | 101.93 | 98.31 | 87.82 | 78.30 |
| 1981 | 120.50 | 98.75 | 93.92 | 88.10 | 116.97 | 111.11 |
| 1982 | 81.97 | 95.61 | 105.53 | 84.07 | 91.68 | 88.96 |
| 1983 | 97.53 | 105.64 | 100.55 | 127.83 | 91.34 | 99.93 |
| 1984 | 88.40 | 104.59 | 83.40 | 140.77 | 94.87 | 93.31 |
| 1985 | 94.13 | 108.36 | 73.74 | 159.03 | 70.33 | 94.31 |
| 1986 | 85.33 | 93.11 | 81.47 | 143.51 | 110.17 | 90.16 |
| 1987 | 56.29 | 67.36 | 76.72 | 170.02 | 77.14 | 65.78 |
| 1988 | 102.44 | 82.33 | 69.58 | 165.95 | 159.13 | 100.11 |
| 1989 | 103.20 | 91.83 | 98.28 | 217.06 | 73.51 | 99.89 |
| 1990 | 87.92 | 86.43 | 77.57 | 134.48 | 66.83 | 85.49 |
| 1991 | 92.51 | 83.28 | 92.43 | 195.09 | 64.87 | 90.22 |
| 1992 | 101.87 | 94.37 | 81.37 | 187.15 | 54.71 | 95.36 |
| 1993 | 94.22 | 91.92 | 79.12 | 160.32 | 49.90 | 89.41 |
| 1994 | 91.68 | 83.46 | 81.97 | 211.16 | 49.90 | 87.57 |

Hazelnuts are cultivated in northern Greece in semi-mountainous areas and the most important varieties are the local ones with an average productivity of 200-400 kg/stremma. Unlike in the USA, in Greece hazelnut trees are small, of a bushy form. Its importance, as a crop, is declining due to increased competition from produce from other countries (mainly Turkey) and the relatively low world prices especially since 1989 (FAO, 1990).

In Greece, pistachios are mainly grown in the southern parts of the country, the most important variety being a local one, 'Aeginis'. Under ideal circumstances, productivity can be as high as 20 kg/tree, but is usually lower. Domestic consumption and prices are quite high and as such, future prospects for the production of pistachios are optimistic.

Chestnut production is decreasing over the last years, following the overall pattern in most Mediterranean countries, with the exception of Turkey, partly due to its limited uses (primarily intended for human consumption, small proportion by the confectionery industry) and partly due to its susceptibility to diseases and harvesting difficulties (Pereira, 1993). Still, the trend is not as dramatic in Greece, due to particularly higher per capita consumption of this nut in Greece than in other countries; hence the existence of a special tradition, namely the roasting and selling of chestnuts in the streets during winter.

## Trade and consumption

### Greece's balance of trade

Greece was a net importer of nut products until 1980 although the volume traded was not very significant. Total imports rarely exceeded 1000 MT and total exports were even smaller. The country's accession to the European Union however, led to a substantial increase of exports in the first few years, resulting in exporting volumes as high as 20,000 MT in 1989. Since then, exports have dropped to half these quantities, while on the contrary, imports have risen to 15,000 - 20,000 MT (Fig. 3). The most important underlying reason is the fact that the low world prices for most nut crops and the trade liberalisation of the European Union severely affected Greek products competitiveness as they became more expensive than products from other countries. In addition, low volumes of production (both aggregate and by individual orchard), the lack of a well-organised promoting system (non adequately efficient co-operatives, poor trade conducts and export management performance) and perhaps more significantly, the small homogeneity of Greek produce are also accountable for small absorbency of domestic production by big international confectionery industries.

Today Greece mainly imports pistachios from Iran and China, hazelnuts from Turkey, and walnuts from USA and China. It has a deficit in all particular nut crops apart from almonds, where self-sufficiency is achieved and some quantities are also exported.

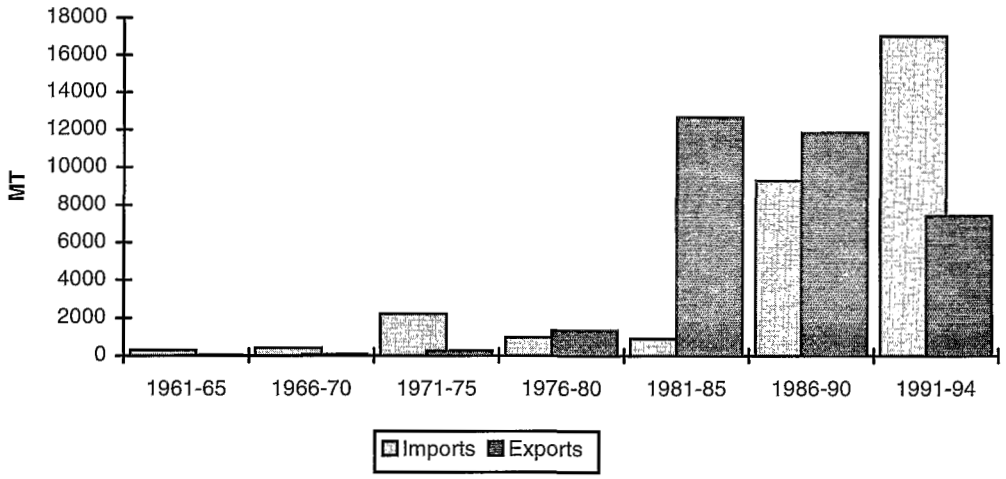


Fig. 3. Imports and exports of nut products in Greece (MT) (Source: FAO).

### Domestic market

#### *Consumption*

On the other hand, the domestic market is large enough to counterbalance production. Per capita absorbency[1] of nut products in Greece is the highest in the European Union and one of the highest in the world, amounting to almost 10 kg in 1994 (Fig. 4) with a distinct upwards trend. Other Mediterranean countries such as Spain, Italy, as well as Austria and Germany exhibit also high per capita absorbency. As far as final consumer consumption is concerned, Greece has the highest per capita net consumption of nuts in the world, which is almost 3 kg/year of nuts. If direct and indirect consumption are added, that is, net consumption of nuts and consumption of nut products; 2.5 kg of peanuts, 1.5 kg of almonds and 0.5 kg of walnuts are annually consumed in Greece and there is an annual growth rate of 2% to 4% (Nautemporiki, 1996a,b). According to the Ministry of Development,

[1] These statistics were taken from FAO's statistical database, where their relevant heading is per capita consumption, but most probably indicate absorbency with the sense of including both final consumers demand as well as industry demand. Hence, the term 'absorbency' rather than 'consumption' seems more appropriate.

peanuts represent 33% of the nut market ('Aeginis' 21%, other varieties 12%), almonds account for 22%, walnuts for 14%, hazelnuts for 11% and other nuts for the remaining 20%.

Consumption of nuts in Greece exhibits serious seasonal variations, despite the homogenous supply of the market. Nut consumption seems to be strongly correlated to feasts and is thus at very low levels at summer, it gradually increases later on and has its peak during Christmas. After a small drop in January, it rises during February and March.

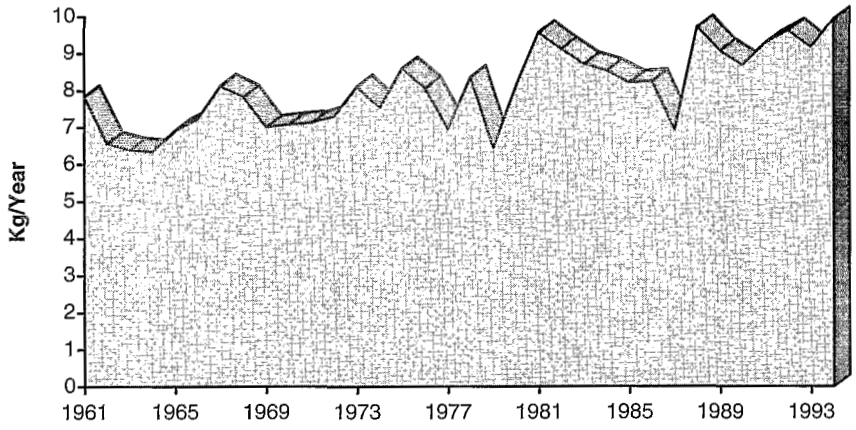


Fig. 4. Per capita absorbency of nut products in Greece (kg/year) (Source: FAO).

### *Prices*

It has been said earlier that the reason for low Greek exports is the low world prices that made domestic products non-competitive. This fact has also had an impact on the domestic market as well. In 1992 trade barriers for imported nuts in Greece were abolished and the protection of domestic production through the imposition of tariffs was relaxed. Consequently, imports from other countries increased substantially. Domestically produced nuts could not compete with imported products because of the latter's lower prices (due to some countries' better efficiency in production techniques, other countries' lower labour input prices) and have therefore lost market shares not only abroad but also in the Greek market. The market deregulation that took place in 1992 resulted in stagnant, or in some cases even decreasing, producer prices for nuts. Retail prices of nuts have also remained stable in the last years as the average prices in the decade 1985-1995 exhibited only small fluctuations. It should be emphasised that imported nuts are generally less expensive than the domestic ones; indeed in some cases their prices can be as much as five times lower than Greek nut prices. For this reason, imported nuts are usually preferred by consumers as they do not place any quality differentiation, at least not any significant enough to pay a premium for. Perhaps the only exemption are peanuts, for consumers strongly prefer the local variety (*Aeginis)* that has considerable price difference from other peanuts.

### *Structure of the supply chain*

Thirty-seven percent of all domestic and imported quantities are directed towards the food industry of pastry-making and confectionery products. Apart from the food firms that use nuts with no processing as inputs for the production of final products (chocolates, etc.), nuts are also used by industries that create semi-final products (almond and hazelnut paste for the chocolate industry, cream paste for pastry products, croissants and snacks). Firms distributing standardised and packaged nuts account for 15% excluding another 10% to 12% that is packaged by small family-like businesses. The bulk is sold unpacked in specialised outlets. Certain quantities are also sold at street-markets, usually by the producers themselves and in large retail chains (super-markets, hypermarkets).

The number of specialised outlets has been increasing over the last years and they are becoming also more organised, expanding the range of the products sold. Today there can be as many as forty different nut products sold, while in the past there were only ten (Nautemporiki, 1996a,b). Apart from the traditional nut crops (almonds, chestnuts, pistachios, walnuts and hazelnuts), increasingly popular are becoming cashews, macadamias, pecans and pine nuts. Nuts are sold in various forms, both shelled and unshelled, whole, halved, chopped or minced, salted or unsalted, blanched, dry-roasted or oil-roasted. In addition, various other products (beverages, alcohol, etc.) have also been added in order to attract consumers. Nevertheless, considering the overall growing importance of large retail chains, it seems that the quantities marketed through these outlets could increase in the future at the expenses of traditional outlets, as a result of the consumers' effort-reducing and convenience-seeking behaviour.

Typical of the supply chain of nuts in Greece is the large number of firms involved, whose size is in most cases small. There are more than 350 small businesses that are active in any of the processing, packaging, and distributing (wholesaling) stage, as opposed to only 10 large businesses that nevertheless, have the biggest share of the market, which in total is around 35-40 billion drachmas (at 27/02/97: 1 US$ = 263,83 drachmas). Consequently, small businesses face several difficulties, while large firms have managed to expand, in some cases, by offering differentiated products with higher added value, in other cases, by diversifying into foreign markets. The latter is expected to increase in the future, since for some companies, export sales already constitute around 30% of their turnover, although they can be even greater, almost 70%.

Major export destinations are Eastern European countries (Russia, Czech, Bulgaria, Romania) and considerable bulk of exports is directed also to Western European countries (Germany, Belgium, UK). In this sense, Greece may not be exporting nuts raw, but it has managed to increase its a efficiency as a intermediary and redistribution centre for the rest of Europe, as imported quantities are destined not just for domestic consumption, but after being stored, processed, standardised and packaged, they are re-exported to third countries. In some cases, future plans for certain Greek firms include investments on plant production abroad; one is already operating in Moldavia, processing walnuts. Big Greek companies in the nut sector include Cardassilaris & Sons S.A. (5,360,541 thousand drachmas turnover in 1995. The company is both processor and wholesaler), Vamvalis S.A. (3,191,333 Processor), Natex S.A. (2,070,896. Both), Argyrakis Bros S.A. (1,260,156. Both), Kalatheris S. & Bros S.A. (1,243,640. Processor), Xirofrout S.A. (878,177. Both), Pami S.A. (758,076. Processor), Siprima Fruits Ltd. (702,145. Wholesaler), Alco S.A. (687,151. Processor), Roupakas Ltd. (649,898. Both) (ICAP, 1997).

Manufacturing companies in the nut sector represent around 1.5% of total sales of food manufacturing industries in Greece, while their profitability share is almost similar, as opposed to milk products (16 and 8 % respectively), oil and fats products (16% and 11%), sugar products (11% and 22%), flour and bread products (10% and 12%) and meats (7% and 5%). Total advertisement expenditures of nut processing industries is in general limited, reaching 6,065,000 drachmas in 1994, approximately 37% increase over 1993, and was allocated almost exclusively in magazines (5,994,000 drachmas). No advertising was made on television and newspapers (although for the latter, in 1993 the share was almost equivalent to that of magazines) and very small on the radio (Hellenews 1994, 1997).

## Legislation

The current market situation of the nut sector is expected to be affected by the last GATT Agreement and the reform of the CAP on sectors that were not changed during the reform of May 1992 such as the fruit and vegetable sector, in which nuts are also included. Under the new GATT regime nuts produced and traded in the European Union, as all the other agricultural products, are faced with reductions of protectionism measures, i.e. trade barriers on imports from third countries, export and price subsidies. Regarding the sector as a whole, all reference prices have to be eliminated and transformed into penetration prices - equal to the average reference prices of the period 1986-1988 - variable compensatory taxes must be converted into constant tariff equivalents and minimum access percentage must be at least 5% by 2000. This however, does not pose a major problem for nuts, since EU imports already exceed this minimum. Although the total level of protection for all products of this category has been agreed to be reduced during 1995-2000 by only 20%, for some

particular products including almonds and walnuts, the reduction will be higher. On the other hand, returns for exports will be granted only for quantities destined to specific markets and in addition, only to those products that were included in this regime in the base period 1986-1990; almonds and walnuts fall into this category (European Parliament, 1994).

Following GATT, the EU has proposed a new regulation on the common markets organisation for fruit and vegetables that is to be implemented, which mainly regulates standards for marketable products regarding standardisation, labelling, as well as setting criteria for the operation and subsidisation of producers groups. In this regulation, specific mention is made about nuts, as the European Commission will finance actions intending to increase their consumption, such as conducting of market research and marketing promotion actions, furtherance of alternative product uses, development of new and improved packaging materials. Almonds, walnuts and hazelnuts are included in the products that are subject to standards when sold 'fresh' to the final consumer. In particular regarding hazelnuts, in 1997 a subsidy of 15 ECU/100kg will be granted to those producer groups that will implement an operational programme commencing the same year (European Commission, 1996).

In essence, the new regime is expected to affect marketing trends and patterns of nuts in Greece only slightly. Production of almonds and hazelnuts had been already declining, while on the other hand the outlook for pistachios and walnuts looks more promising for the future. In general, taking into consideration that exports do not constitute a considerable alternative for Greek production and that domestic market is the most important destination which has already been liberalised, it seems reasonable to argue that the further liberalisation of the European market is not going to have a dramatic effect on Greek production, except perhaps in the case of hazelnuts, where increased exports from Turkey have already made a substantial impact.

## Long-run relationships

In this section an attempt will be made to address the issues of the existence of a possible correlation between production of nuts and per capita total consumption in Greece, applying the cointegration econometric method as developed by Engle and Granger (1987) and Johansen and Juselius (1990). This method is often applied in the literature in order to identify whether there exists a correlation between two or more macroeconomic variables that is statistically significant, as a basis for further interpretations.

Assuming that the two series, nut production and per capita consumption, are found to be cointegrated, it would be implied that there is a linkage between them as they move closely together not deviating in the long-run. Cointegration also suggests the existence of causality between the two series in at least one direction, meaning that one series can be used to forecast the other (In and Menon, 1996; Masih and Masih, 1996). In other words, cointegration analysis in this framework, will show whether between these two variables there is one equilibrium relationship that keeps them bound together in the long-run or not. In the latter case, it would be implied that either one of the two variables could move away from the other.

In Table 5 the results from the Augmented Dickey-Fuller (ADF) test for unit roots is presented. It can be seen that both time series are integrated of order one [I(1)], i.e. they are non-stationary at the level, yet they turn stationary when they are first differenced, a necessary condition for the existence of a cointegrating equation. In the table, the number of lags for each variable are also presented as well as the Durbin-Watson test for autocorrelation. The test shows that there is no evidence of autocorrelation existence and therefore no corrective measures have been taken. By further applying the Johansen cointegration test, it is established (Table 6) that there exists a linear combination of production and per capita consumption of nuts in Greece that does not have a stochastic trend. The Johansen cointegration test is carried out in two stages. At the first stage the null hypothesis of the existence of no cointegrating equation among the variables under consideration is tested and in this case is rejected. This, however, is not sufficient, since it should also be tested whether there are more than one cointegrating equations; if there were, it would actually mean that the two series are not in fact integrated (contrary to prior estimates obtained by the ADF test), since there can only be *n-1* cointegration equations (with *n* being the number of variables). Yet, in this case the null hypothesis of at most one cointegrating equations is accepted. Intuitively it can be argued that consumption and production of nuts in Greece do have a long-run equilibrium relationship.

Table 5. Unit root hypothesis tests (Augmented Dickey-Fuller)†

| | Variable | Test statistic | No. of lags | DW |
|---|---|---|---|---|
| Level | Production | -1.405 | 2 | 1.988 |
| | Per capita consumption | -1.743 | 1 | 2.111 |
| First difference | Production | -6.296 | 1 | 1.982 |
| | Per capita consumption | -5.882 | 1 | 2.048 |

†Critical value (MacKinnon) for rejection of hypothesis of a unit root is 2.62 at a 10% significance level and 2.97 at 5%.

Table 6. Cointegration test (Johansen's)

| Tested equation | Null hypothesis ($H_0$) | Likelihood ratio | Critical values | |
|---|---|---|---|---|
| | | | 5% | 1% |
| PCC, Production | No coint. equation | 17.202† | 15.41 | 20.04 |
| | At most one | 3.547 | 3.76 | 6.65 |

†Denotes the rejection of $H_0$ at a 5% significance level.

Unambiguously, the method carried out in this work is not complemented, principally because it does not reveal direction of causality between per capita consumption and production series. It is however, a first attempt to apply econometric modelling on data regarding the nut sector in Greece. Additional work can be done by implementing the Granger causality test in order to speculate more in-depth on this relationship and reveal further aspects, as for instance, which variable may be used to forecast the other.

## Conclusions

Treenuts cultivation in Greece has remained stable over the last years, despite certain prosperous potentials in the world market for such products. Nuts are usually cultivated in Greece in semi-mountainous areas that are not adequately irrigated, while average farm size is relatively small, a fact which disallows for economies of scale and the implementation of more advanced technologies. Production costs are high and this has an effect on nut prices that are higher than the world average. Consequently, foreign markets and food processing industries do not constitute a major alternative, mainly due to heavy competition from other sources with lower prices and greater exporting volumes. The competitiveness of the Greek nut sector, as well as the aggregate competitiveness of all food products, seems to have declined (Mattas and Galanopoulos, 1996).

Nevertheless, nuts constitute an important element of Greek diet and domestic consumption is accordingly, quite high and adequate to absorb not only home production, but also imported quantities as well. Per capita consumption of nuts in Greece is the highest in the world with a distinct upwards trend and therefore, if mechanisation of production techniques is intensified and nut orchards become more market-oriented, by cultivating varieties that have desirable characteristics and emphasising on quality rather than price differentiation, future perspectives can be prosperous. Considerable gains for the producers could be generated if producer organisations become more organised in order to be eligible for EU subsidisation programmes and increase their involvement in the distribution of nuts.

In the commercial side of the nut sector, there is a big number of firms involved in processing and distribution, but the majority are small businesses. Large Greek nut processing firms have grown over the last years, increased their market share in the domestic market and have expanded their exports abroad capitalising on lower input prices of imported nuts that due to the relaxation of import barriers became easily accessible to them.

In essence, the cultivation of pistachios and walnuts appears to be more preferred since future market prospects for these two nut crops show favourable demand trends, as opposed to hazelnuts, almonds and chestnuts, whose market is saturated and production is declining. The domestic market is crucial for the volume of nut production. Factors such as consumer and industry demand, price levels and import quantities will have an impact on the production side. This is further sustained by the fact that domestic production and per capita total consumption of nut products are found to be cointegrated.

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