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An analysis of Greek wood and wood product imports: Evidence from the linear quadratic aids ☆

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ABSTRACT

The consumption of wood and wood products in Greece is based greatly on imports necessitating every year a great proportion of public expenditures. The study of wood and wood product imports consequently, is important to the national economy and can be a useful guide for the forest farms, wood industries and wood firms. In this paper the Greek aggregate import demand for Unprocessed wood (such as logs) Processed wood (such as sawn wood), Veneer Crafts (such as veneer sheets) and Wood Manufactures during the period 1969–2001 is empirically analysed using the linear approximation of quadratic AIDS (QUAIDS) model. Imports of Unprocessed wood, Veneer Crafts and Wood Manufactures are found to be price-elastic, in contrast to Processed wood imports. Processed wood, Veneer Crafts and Wood Manufacture imports are found to be expenditure-elastic while Unprocessed wood is found to be an inferior good. Substitution possibilities are found to be significant between Veneer Crafts and all the remaining wood imports and between Processed wood and Unprocessed wood.

1. Introduction

According to the most recent census, forests in Greece cover 25.4% of the country's total area (i.e. 3358 thousand ha). Of these, approximately two thirds (65.4%) belong to the state and the remaining 34.6% belong to private entities, local authorities, monasteries, and other welfare institutions (Ministry of Agriculture, 1992).

During the post-war period, significant efforts were made towards the rehabilitation, management and exploitation of degraded forests in Greece, which led to a noteworthy increase in wood production (Arabatzis, 2000; Tampakis et al., 2003; Papastavrou, 2008; Koutroumanidis et al., 2009). Despite the increase in the domestic production after the 1950s, Greece still maintains as a major importer of most wood products (Albanis et al., 1985; Fousekis et al., 2001).

Only the needs in fuel wood, veneers, plywood and particle boards are covered by the domestic production. Greece shows a strong deficit in round wood, sawn wood, cellulose and cellulose products and a small deficit in fiberboards. Also, Greece imports for newsprint, paper for the other categories, paperboard and wood pulp (Albanis et al., 1985).

At the same time, the need for wood and wood products, with the exception of fuel wood, is expected to increase in the coming years (Philipou and Lefakis, 1997; Lefakis et al., 1998). It has been noted that from 1980 to 2000, the balance of payments has been severely affected, with exports representing 22.15% of the value of imports in 1980 compared to only 9.3% of the import value in the year 2000 (Ministry of Rural Development and Foods, 2004).

Thus, it is obvious that the dependence of Greece in wood and wood products is very high. From the economic point of view therefore, studying the country's demand for wood imports and monitoring the evolution over time, is an issue that merits a careful examination. This kind of analyses could be useful for the wood industry and/or the Ministry's policy makers in order to improve the domestic forest management by implementing practices and policies (especially within the framework of the new Rural Development Programme) leading to a better utilization of domestic wood production.

During the last decade various models about production, consumption and forest products trade have been used. In particular, the Global Forest Product Model (GFPM) is a model which was developed in the context of FAO for the production, the consumption and the forest product trade (imports–exports) for 180 countries and 14 commodity products during the period 1994–2010 (Tomberlin et al., 1998). Also, Whiteman et al. (1999) investigate through econometric models the progresses in forest product market and make forecasts for 2010 in combination with the effects on the improvement of the forest management. Tromborg et al. (2000) study the global wood market and the implications of the changes in economic growth, wood supply and technological trends in the global level. They apply a partial equilibrium model separating the world in eight geographical areas and for sixteen forest products.

Furthermore, Zhu et al. (2001) study the effects of accelerated tariff liberalization in the forest product sector and try to forecast the

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impacts on global wood trade coming from the elimination of import tariffs. They forecast equilibrium in the market about the quantities which are produced, consumed and imported for each one of the 180 countries and for 14 commodity groups with the use of GFPM for the period 1998–2010. Kangas and Niskanen (2003) apply the gravity equation trying to explain that trade flow of a country to a certain destination with a log-linear equation using as predictions the economic forces in both the origin and destination of the flow, and forces either aiming or resisting the flow's movement. Also, Hetemaki et al. (2004) investigate for the Finnish forest sector with short-term forecasting models (univariate and multivariate time series models) the wood exports and they saw long demand.

Moreover, Gan (2004) analyzes the effects of China's entry into the World Trade Organization (WTO) on global forest product trade using a computable general equilibrium model. Two scenarios are analyzed: (1) unilateral trade liberalization by China resulting from its WTO accession and (2) combination pf China's trade liberalization with the Uruguay Round (UR). The results indicated that China's accession to the WTO would significantly increase its imports of forest products and reduce its domestic market prices of lumber and wood products as well as pulp, paper, and allied products. Finally, Wibe (2005) constructed and used a simple linear supply and demand model. According to this model everything is formulated and understood in the fundamental concepts of economic theory, and is easy to use in simulating various scenarios and in particular about what will happen in production–consumption and forest product trade in case demand and supply changes. Koulelis (2005) investigates with the use of econometric models (simple regression analysis and multiple regression analysis) the wood market and its products (production, imports, and exports) for 25 countries of the European Union.

Currently, despite the heavy reliance of Greece on wood and wood product imports as it was mentioned above, empirical economic research on the country's demand for foreign wood and wood products is scare.

To be more specific, in Greece a few studies were conducted referring to the structure and the time evolution of different/various categories of wood and wood product imports using simple functional forms such as Cobb–Douglas functions and simple estimation methods such as OLS. All these studies were informative regarding the situation in the wood market and its possible development to the forest farms, wood industries and wood firms (Albanis et al., 1985; Christodoulou and Blioumis, 1997; Lefakis, 1997; Lefakis et al., 1998). The only study that used advanced econometric tools was that of Fousekis et al. (2001) that employed a structural demand system, such as the CBS function.

Many existing studies in applied demand analysis used the Translog or AIDS functional forms. These specifications have budget share equations that are linear functions of the logarithm of income. However, resent analysis by Banks et al. (1997) has shown that linear Engel curves lack sufficient flexibility when confronted with empirical data on household expenditure. Banks et al. developed the quadratic AIDS (QUAIDS) model to allow for Engel curves that are non-linear in the log of expenditure. This is done by considering the preference structure needed to attain a share based demand system that is linear in the log of real expenditure and a general function of real expenditure. However, nonlinearity in parameters becomes problematic, for example, when one tries to take differences to remove stationarity in time series. Nonstationarity price and expenditure are often observed in time series, to which flexible demand systems have been applied in many studies.

Hence, within this context, the objective of this paper is an empirical investigation of the demand for wood imports and the quantification of the responses of different categories of imported wood and wood products to changes in price and expenditure. The price and expenditure and substitution elasticities which are the main outcomes of such an analysis, enable researchers, wood industry and policy makers to measure the costs and benefits associated with changes in market or forest policy. The model that was employed for this purpose is the linear version of quadratic AIDS model by Matsuda (2006). The specific model combines the empirical flexibility of quadratic logarithmic Engel curves with theoretically consistency and estimation efficiency. The rest of the paper is organized as follows: in the second section the empirical model is decrypted in details as well as the estimation procedure. The data are presented in the third section. We continue by showing the empirical results in the fourth section and end the paper with our conclusions.

2. Empirical model and estimation procedure

Accoring to Matsuda (2006), the indirect utility function of the QUAIDS can be specified as:

$$[\log V(p,m)]^{-1} = \left[\frac{\log M - \log f(p)}{g(p)}\right]^{-1} + h(p) \tag{1}$$

where log is the natural logarithm and $\mathbf{p} = (p_1, p_2, \ldots p_n)$ denotes the minimal price vector of n goods, M denotes the total expenditure on the goods for each individual, and $f(\mathbf{p})$, $g(\mathbf{p})$ and $h(\mathbf{p})$ are distinct price aggregator function defined as:

$$\log f(\mathbf{p}) = a_0 + \sum_i a_i \log p_i + 0.5 \sum_i \sum_j \gamma_{ij} \log p_i \log p_j \tag{2a}$$

$$\log g(\mathbf{p}) = \prod_i \beta_i p_i \tag{2b}$$

$$h(\mathbf{p}) = \sum_i \lambda_i \log p_i \tag{2c}$$

$f(\mathbf{p})$ is homogenous of degree one and $g(\mathbf{p})$ and $h(\mathbf{p})$ are homogenous of degree zero in $\mathbf{p}$, so $V(\mathbf{p},M)$ is homogenous of degree zero in $\mathbf{p}$ and M, as required. Thus, $\sum_i a_i = 1, \sum_i \gamma_{ij} = \sum_j \gamma_{ij} = 0, \sum_i \beta_i = 0$ and $\sum_i \lambda_i = 0$ which jointly ensure that the resulting demand system fulfils adding-up and homogeneity. Slutsky symmetry is guaranteed by the additional restriction $\gamma_{ij} = \gamma_{ji}$, $i,j = 1,\ldots..n$.

By applying the logarithm from Roy's identity $s_i = -(\partial \log V / \log p_i)/(\partial \log V / \partial \log M)$ to (1), the QUAIDS is derived as:

$$s_i = a_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{M}{f(\mathbf{p})}\right) + \frac{\lambda_\iota}{g(\mathbf{p})}\left[\log\left(\frac{M}{f(\mathbf{p})}\right)\right]^2, i = 1, \ldots..n, \tag{3}$$

where s_i denotes the expenditure share of good i for each individual. To derive the formulas of the total expenditure and Marshallian demand elasticities, differentiate Eq. (3) with respect to log M and log p_j respectively:

$$e_i = 1 + \left[\beta_i + \frac{2\lambda_i}{g(\mathbf{p})} \log\left(\frac{M}{f(\mathbf{p})}\right]\right/ s_i \tag{4a}$$

$$e_{ij}^M = -\delta_{ij} + \{\gamma_{ij} - [\beta_\iota\left(a_j + \sum_k \gamma_{jk} \log p_k\right) + \frac{2\lambda_i}{g(\mathbf{p})}\left(a_j + \sum_k \gamma_{jk} \log p_k\right) \times \log\left(\frac{M}{f(\mathbf{p})}\right)] - \frac{\lambda_i \beta_j}{g(\mathbf{p})}\left[\log \frac{M}{f(\mathbf{p})}\right]\} / s_i \tag{4b}$$

where δ_{ij} denotes the Kronecker delta, which is equals to unity if $i = j$ and zero otherwise. The Hicksian demand elasticities are obtained through the Slutsky equation namely $e_{ij}^H = e_{ij}^M - e_i s_j$.[2] The Hicksian elasticity represents the uncompensated elasticity which captures both the substitution and expenditure (in percentage terms) effect.

The QUAIDS not only retains the desirable properties of the popular AIDS of Deaton and Muellbauer (1980) nested within it but also has the additional advantage of being versatile in modelling consumer

[2] Where e_{ij}^H denotes the Hicksian elasticity while e_{ij}^M the Marshallian ones.