Import demand, domestic supply and new trade theory

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ABSTRACT

In this paper we build a model of trade in differentiated products according to the New Trade Theory. Product differentiation is expressed as the households' preference for the "variety and quality" of goods. Moreover, the model is augmented with the demand and supply conditions in the domestic market. Thus, we construct a system of equations that describes the augmented demand for imports with "variety and quality" (the notional demand) and domestic demand conditions (the effective demand), in addition to the traditional equation. The model differentiates between the notional and the effective demand for imports and endogenously chooses the appropriate one. The empirical importance of this model is then assessed by examining the behaviour of imports of manufactured goods in the Greek economy during the last five decades. We find significant evidence, in line with the predictions of our theoretical model, for the importance of the above two factors for import demand. Also, the estimated equations explain significantly the stylized facts as well as long- and short-term movements in trade.

JEL classification: F14, F41, E21, C22

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1. Introduction

Investigating international trade flows has been one of the most active research areas in international economics. The reason for this interest stems from its implications to a wide range of policy issues, e.g. the effectiveness of demand policies, and the impact of the external balance on a country's growth. The behaviour of imports provides important clues about the competitiveness of domestic production and its ability to satisfy domestic demand.

A key assumption of the traditional model for the demand for imports is that each country produces a single good which is an imperfect substitute for goods produced in other countries. The general specification of this model is that imports depend on economic activity and relative prices. Goldstein and Khan (1985) provide an interesting review of the relevant empirical studies and Hooper et al. (2000) and Marquez (2002) present updated findings. However, import studies based on the traditional model have generally been unsuccessful in terms of their tracking performance, and are subject to several limitations, particularly in recent periods. First, traditional models overstate the response of imports to income changes. Many studies estimating these models obtain income elasticities considerably above one, implying that import shares increase with domestic demand. One explanation of this elasticity is that it is the result of omitted-variables bias. The New Trade Theory, based on the works of Helpman and Krugman (1985), Krugman (1989), and Grossman and Helpman (1991) proposed a model in which countries grow by producing and exporting new varieties of goods. In fact, this theory argues that changes in the number of varieties in these countries can be explained by changes in consumer's tastes in the importing country. Thus, product variety should be introduced in the traditional import demand model.

Second, in the literature most models have paid insufficient attention to the effect that demand and supply conditions in the domestic market can have on imports. The knowledge of the exact relationship between imports and domestic demand could have important policy implications. Increasing import penetration in some countries implies that domestic supply is inadequate to satisfy domestic demand and therefore there is likely to be a spillover effect of excess demand for the domestic good into imports. A study by Anderton, et al. (1992) augments the traditional model by including a time trend to proxy the latter effect.

This paper builds a system of equations that describes the augmented demand for imports with "variety and quality" and domestic demand conditions, in addition to the traditional equation. The model differentiates between these two equations and endogenously chooses the appropriate one. We apply the theoretical model to Greek imports of manufactured goods using quarterly data over the period 1962-2009.

Large imbalances in the external balance of Greece are not rare. In fact, at times high external balance deficits have been a factor restricting the country's economic growth and the pursuit of a stabilisation and growth policy. Almost permanently, Greek balance of payments deficit stems mainly from the high deficit of the trade balance. These chronic trade deficits reflect not only cyclical factors but also structural weaknesses of the production base, which are due to a series of factors that affect the imports and exports of goods. On the imports side, the major factors are the following:

- Domestic investment in machinery and equipment relies almost exclusively on imports of such products, which account for a considerable share of total imports. Additionally, domestic production of ready-made goods depends largely on imports of intermediate goods and raw materials.
- The high import content of exported goods, which entails the interdependence of imports and exports and the persistence of the trade deficit. This is because the value added of exports does not suffice to cover a substantial part of the trade deficit.
- The dependence of the technological upgrading of domestic production on the transfer of technology through imports.
- The high competitiveness of imported goods in the Greek market.
- The inelasticity of supply with respect to changes in demand, due to the negative effect of cost factors and structural rigidities.

Thus, strengthening demand for more varieties and high quality products, economic growth, and technologically modernising domestic production, lead to increased imports and widen the trade deficit.

The analysis shows that two thirds of Greek imports originate from the EU-15, while imports of high-tech goods, despite having increased, fall short of those of the other countries of Southern Europe. Also, import penetration into the domestic market for manufactured goods has been rising fast in the last decade, crowding out domestic industrial products. Finally, the competitiveness of domestic production displays a permanent deterioration from 1988 onwards and worsens after the country's entry into the euro area.

The study introduces some major innovations, most prominent of which are the following: **First**, the empirical analysis relies on quarterly statistical data for the period 1962-2009, i.e. covers a long period (48 years) of economic developments. **Second**, it expands the traditional model of imports, so as to include product diversification in line with the New Trade Theory. **Third**, it further enhances the theoretical analysis of the imports function, so as to incorporate the demand and supply conditions of the domestic goods in the domestic market. To the best of our knowledge this is the first paper in the literature augmenting the traditional import demand model with the above two variables. **Fourth**, it expresses the relationship that links actual imports with the notional demand for imports at the equilibrium level, and also with the effective demand for imports, and specifies the density function for actual imports.

The most important findings of the econometric analysis are the following: **First**, the imports function in its traditional form (i.e. imports as a function of income and relative prices) cannot adequately explain the evolution of imports in both the long and short run. We provide strong evidence for the importance of the two additional determinants of the import demand. The New Trade Theory seems to be verified since our estimation results show that Greek imports are affected not only by relative prices and income but also, particularly, by qualitative characteristics, such as the consumers preferences for "variety and quality" of the imported goods. Also, the inability of supply to meet demand for the domestic good exerts a significant effect on imports. **Second**, in the long run, Greek imports are affected by domestic competitiveness (relative prices), disposable income and particularly the "variety and quality" of the imported goods, as well as domestic demand and supply conditions (capacity utilisation rate). The elasticities of these factors are equal to, or slightly higher than one, save for the relative price elasticity. In the short run, imports are affected by "variety and quality", the capacity utilisation rate and, to a lesser extent, the domestic competitiveness, while they seem to be unaffected by income. **Third**, although in the long run domestic and imported goods are substitutes, in the short run their relationship appears to be complementary.

The study continues as follows: Section 2 presents in some detail the structure of Greek imports and the trade policy. Section 3 discusses the data used. The theoretical model is analysed in Section 4, while Section 5 specifies the econometric estimation of the models. The results of the estimations are presented in Section 6. Finally, Section 7 discusses the conclusions of the study. Appendix A describes the construction of the data.

2. International trade and Greek imports

2.1 The exposure of the Greek economy to international trade and the structure of imports

In the last three decades, a series of factors such as the gradual deregulation of international trade, particularly the establishment of the Single Market within the EU, reduced transport costs, and increased consumer demand for more varieties of products, has contributed to a considerable "opening" of many European countries to international trade. Although the openness of the Greek economy to foreign trade increased appreciably in the period 1997-2009, it still remains the most closed economy among the EU-15 countries.

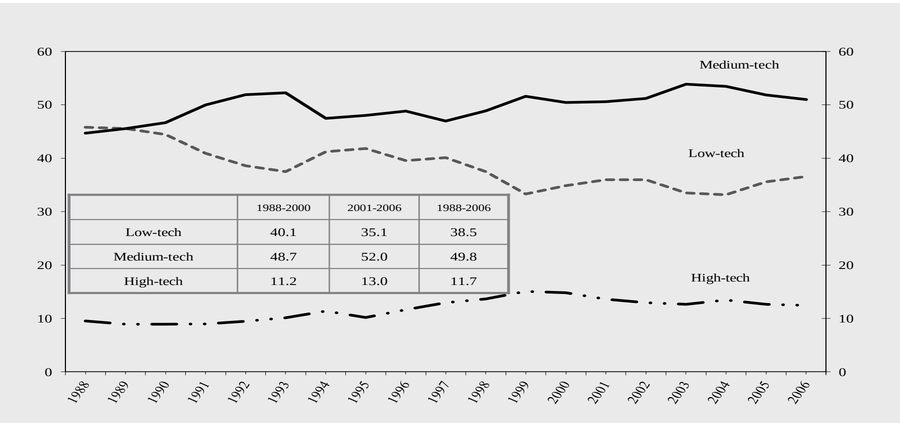
The evolution of imports[1] broken down by geographical area shows that between 2001 and 2009 the share of imports originating from the EU-15 countries fell slightly to 66% from 70% in the previous period 1977-2000, while that for each of the countries/areas of origin – i.e. the US,

[1] The source of data is the Greek Statistical Service.

China, SE Europe, and Middle East and the Mediterranean – ranges between 4% and 6%. However, between the periods 1997-2000 and 2001-2009 the share of China has doubled, while that of the Middle Eastern and Mediterranean countries has also increased considerably. In the period under study, approximately one third of all imports relates to products of the "Machinery and transport equipment" category,[2] and one third to "Other manufacturing products". The share of "Food" and of "Chemicals" stands at roughly 15% for each category, while that of "Raw materials" amounts to 3%. In the period 2001-2009 the share of "Machinery" shows a slight decline compared with the period 1997-2000, while that of "Chemicals" a small increase. It should be recalled that throughout the period 1997-2009 Greek exports of this category recorded a considerable growth.

Also, the structure of imports broken down by final domestic destination, shows that 60% of imports are destined for firms and the remaining 40% for households. Imports for firms relate mainly to procurements, i.e. raw materials and intermediate goods (30% of total imports for firms), and machinery (18%). Imports of consumer goods (22%), food (10%) and passenger cars (8%) make up almost the total of imports for households. Although the distribution of imports between firms and households remains unchanged, the structure of imports of these two categories nevertheless changes. Specifically, the shares of procurements and machinery for firms decreased, and the shares of consumer goods and cars for households increased.

Chart 1: Structure of Greek imports of manufactured products based on their technological content (percentages)



2 Henceforth this category will be referred to simply as "Machinery". More specifically, the category of "Food" includes the single-digit categories 1,0 and 4, of the Standard International Trade Classification (SITC) and the category of "Other manufacturing products" the single-digit categories 6 and 8.

Finally, Chart 1 presents the structure of imported goods, grouped under the categories of "low-tech", "medium-tech" and "high-tech" products based on their technological content. This structure exhibited remarkable changes during the period under study. The share of low-tech products fell to 38% in 2006, from 46% in 1996, whereas a rise was observed in the shares of mainly medium-tech products (to 51% from 44%) and, to a lesser extent, high-tech products (to 12% from 10%). However, despite the observed gradual substitution of low-tech products by mostly medium- and, to a lesser extent, high-tech products, the structure of Greek imports remains weaker than that of the countries of Southern Europe, since the share of imports of high-tech products for Greece averages 13% in the period 2001-2006, compared with 17% for Portugal and roughly 16% for Italy and Spain, respectively. This fact, in combination with the limited levels of domestically produced high technology, weighs heavily on domestic production, productivity and exports, particularly when considering the dynamics of strong demand for high-tech products manifest at global level.

2.2 Trade policy, imports and the domestic market

The trade policy pursued by Greece until its entry in the EU aimed, among other things, at moderating imports, and was based on the following three types of measures:

- tariffs and tariff-equivalent taxes;
- importers' mandatory advance deposits with the Bank of Greece; and
- administrative measures.

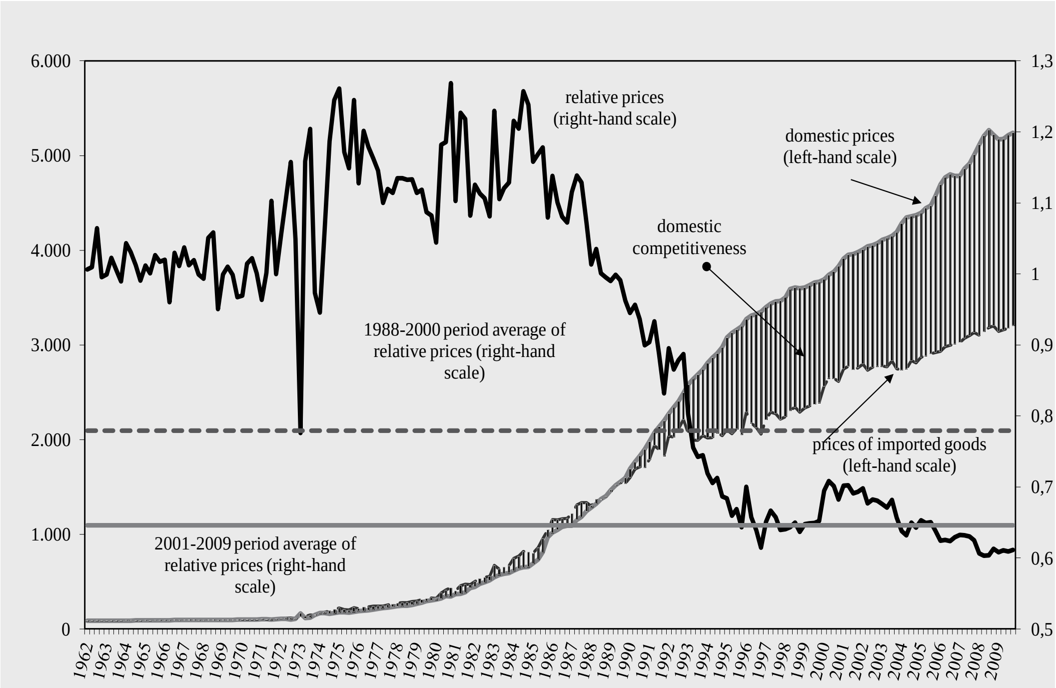
The accession of Greece to the EU in 1981 led to the lifting of these restrictions to its trade policy, resulting in a considerable growth of economic activity in industries where the country had or acquired a comparative advantages, as well as in increased imports. Specifically, in the first decade after Greece's accession, the trade deficit with the EU almost tripled (1980: 2.6 billion US dollars, 1991: 7.4 billion US dollars), while also the share of the trade deficit with the EU in the almost doubled. It should be noted that in 1980 the average nominal tariff and non-tariff protection[3] amounted to around 28%, while effective protection was considerably higher (roughly 60%, Chart B1 in Appendix B).

The real costs of the importers' mandatory advance deposits with the Bank of Greece were used as an important discouragement mechanism imposed by the government on imports. This measure was abolished in 1981 when Greece joined the EU, although a period of exemption followed (1985-1992) due to the implementation of the 1985 stabilisation programme.

In Chart 2 it can be seen that from 1985 onwards domestic product prices rose faster than the prices of imported goods. This rate accelerated from 2001 onwards, causing domestic prices to exceed cumulatively those of imported goods by approximately 40% in 2009. This loss in domestic

[3] For all imports, nominal protection borders on 33%.

Chart 2: Domestic prices, prices of imported goods (excluding fuel) and relative prices (1970=100)



competitiveness during the period 2001-2009 compared with the previous decade amounts to roughly 11 percentage points.

Import penetration[4] (at current prices) in Greece in the period 1996-2009 is slightly lower than the respective EU-15 average. However, import penetration (at constant prices) into Greek manufacturing in the period 2000-2009 recorded a rise, and by 2009 exceeded 80% of the domestic apparent consumption[5] of manufactured goods. The rise in import penetration was more pronounced in the industries of chemicals, base metals, transport equipments, textiles, clothing-footwear and leather (Bank of Greece, 2006).

3. The data

The data used includes the value of real Greek imports of manufactures (after excluding ships and petroleum products) aggregated according to the International Standard Industrial Classification (ISIC), Greek and exporters prices, disposable income measured as permanent[6], the

[4] For the definition see note of Table 2.

[5] Apparent consumption is defined as the sum of the gross value of domestic output plus imports minus exports.

[6] Most studies have employed some measures of current real income. We think that permanent disposable income is more appropriate compared with current income.

expenditure for machinery and equipment as a percentage of the GDP of ten exporting countries and the capacity utilization rate. The advantage of using the ISIC classification as opposed to SITC is twofold: First, the ISIC classification includes imports of all the manufacturing sectors, while SITC (5–8), which is often used in international trade research, fails to include imports of industries such as processed food and beverages, tobacco, leather and furs, which during the period under examination are an important part of Greek production, imports and exports. Second, ISIC accords with the classification method of the rest of the variables used in the estimation, thus avoiding biased coefficients in the estimation due to errors in variables. The variables' descriptive statistical series are included in Table 1.

Table 1: Descriptive statistical series of the variables (1962-2009)

Statistical series	Domestic prices (1970=100)	Imported goods' prices (1970=100)	Relative prices (1970=1)	Imports (millions of euro)	Capacity utilisation rate	Income (millions of euro)	Expenditure in machinery and equipment (% of GDP)
Minimum	86.9	87.5	0.61	9,774	0.66	65,640	7.27
Maximum	5,610.2	3,166.1	1.20	300,554	0.95	753,215	10.73
Average	1,698.1	1,208.7	0.89	114,788	0.80	311,787	8.61
Median	1,108.3	1,073.4	0.90	60,678	0.78	252,280	8.63
Standard deviation	1,635.8	1,029.7	0.16	103,816	0.56	169,778	0.76
Variability coefficient	0.96	0.85	0.18	0.90	0.70	0.55	0.09
Skewness	0.60	0.33	-0.09	0.82	0.85	0.82	0.29
Kurtosis	1.79	1.53	1.75	2.21	2.97	2.23	2.74

The data and sources are described in more detail in Appendix A. It should be mentioned that import prices were approximated by the wholesale price index of exports and not with the unit value of imports because the latter exhibited large measurement errors during the second half of the 1990s.

4. The theoretical model

4.1 Imports in equilibrium

It is assumed that domestic households own firms. Consequently, the representative household has two sources of income: wage income and income from profits. The assumption that profits are distributed in the next period entails that they are exogenous. Additionally, the present study adopts the following two assumptions: that the supply of imports is infinitely elastic, and that consumer demand in the domestic market is satisfied either by domestic or imported goods, or both. The first assumption appears reasonable for a small economy such as Greece. The share of Greek imports in world imports is less than 1%; therefore demand for the imported goods can always be satisfied by supply without affecting prices. The second assumption, which relies on the first, entails that domestic households can increase imports whenever they are constrained in the domestic goods market.

Domestic households have a utility function that depends on the domestic and the imported product. The two goods are imperfect substitutes in the domestic market:

$$U = U\,(D, M), \qquad (1)$$

Households maximise equation (1) subject to the following budget constraint:

$$P_q\, D + P_m\, M = y, \qquad (2)$$

where D = the quantity of the domestic good; M = the quantity of the imported good; P_q = the price of the domestic good; P_m = the price of the imported good; and y = total expenditure (at nominal prices), with $y = P_q\, Y$.

Solving this maximisation programme produces the following demand functions[7] for the domestic and the imported good, respectively:

$$D^d = f\,(\underset{-}{P_q}, \underset{+}{P_m}, \underset{+}{Y}), \qquad (3)$$

$$M_n^d = g\,(\underset{+}{P_q}, \underset{-}{P_m}, \underset{+}{Y}), \qquad (4)$$

The signs that appear under the variables in equations (3) and (4) are acceptable based on both theory and empirical analysis. The theoretical elaboration of equation (4) was undertaken in the study by Leamer and Stern (1970), while Goldstein and Khan (1985), as well as Hooper, Johnson and Marquez (2000) and Marguez (2002) present updated findings.

The equilibrium conditions in the goods market and the economy's external sector are expressed through the following equations:

$$C^d = D\,(P_q, P_m, Y) + M\,(P_q, P_m, Y) - exog, \qquad (5)$$

$$Q^d = C^d + X^d - M^d + exog, \qquad (6)$$

$$Q^d = Q^s, \qquad (7)$$

[7] Also, called Walras (or Marshall) demand functions, or even 'notional' according to Clower (1965).

$$TB = P_q X - P_m M, \quad (8)$$

Consumer demand (5) is the sum of domestic demand for the domestic good plus demand for imports minus the exogenous demand (exog), which is equal to the sum of investment and public expenditure. The identity in (6) specifies total demand for the domestic good in the domestic and the foreign markets. Equation (7) represents the equilibrium condition in the product market. Equation (8) shows the trade balance which is denominated in the domestic currency, while X and M denote the actual (equilibrium) quantities of exports and imports, respectively.

It should be noted that the effect of relative prices P_m / P_q (terms of trade) on domestic demand (for the domestic good) depends on whether the relative price elasticity of imports is greater, equal to, or less than unity (1.0). Relationship (2) entails that:

$$e_m^n = [-\partial M_n^d / \partial(P_m / P_q)].[(P_m / P_q) / M_n^d] = 1 + [\partial D / \partial(P_m / P_q)] . (1 / M_n^d)$$

where e_m^n = the relative price elasticity of demand for imports. From the above relationship, it becomes obvious that:

$$\partial M^d / \partial(P_m / P_q) \geq < 0, \text{ as } e_m^n \geq < 1 \quad (9)$$

Which implies that:

- if $e_m^n < 1 \Rightarrow$ the two goods are complementary, and
- If $e_m^n \geq 1 \Rightarrow$ the two goods are substitutes.

For estimation reasons equation (4) should be expanded to include two trade policy variables:

$$M_n^d = g\,(P_q, P_m, Y, AD, D), \quad (10)$$

where AD = the importers' "opportunity cost",[8] i.e. the real cost of the importers' mandatory advance deposits[9] in the period 1962-1992 and D = a dummy variable that takes the value of 0 for the period 1962-1980 and the value of 1 for the period 1981-2009, that is the after the accession of Greece to the EU period.

[8] For the definition of this variable see Annex A: The statistical data.

[9] See section 2.2 for a discussion about this trade policy variable.

4.2 *Imports and the New Trade Theory*

Import studies based on the traditional model are subject to several limitations. First, traditional models overstate the response of imports to income changes. Many studies estimate income elasticities considerably above one, implying that import shares increase with domestic demand. One explanation of this finding is that it is the result of omitted-variables bias. The New Trade Theory, based on the works of Helpman and Krugman (1985), Krugman (1989), and Grossman and Helpman (1991) argued that product differentiation and scale economies implies that countries grow by producing new goods that can be exported without an adverse effect on terms of trade. This entails that the traditional equations for imports (such as equation (4) or (10)) are imperfectly specified since they fail to include the effect of product (horizontal and vertical) differentiation. Indeed, empirical applications of product differentiation lag far behind theoretical models (Feenstra, 1994).

This product differentiation is expressed as the households' preference for the "variety and quality" of goods. Since, consumers have a taste for variety and quality they will import more goods even in the absence of a decline in relative prices. Therefore, equation (10) can be expanded to:

$$M_n^d = g\,(P_q, P_m, Y, AD, D, VQ), \tag{11}$$

Where VQ = the variable that denotes the "variety and quality" of the imported goods and is proxied by the expenditure on machinery and equipment as a percentage of the GDP of the major countries of origin of Greek imports.[10]

Specifications of import functions based on equation (11) are rare in the international literature. One major problem is that the variety of goods in an economy is not directly measured and therefore should be proxied by some measure. Product variety in the study by Gagnon (2004) is represented by the rate of increase of the exporting country's potential output, while in that by Barrell and Vede (1999) by the importing country's level of foreign direct investment (FDI). Product quality in the study by Thanagopal (2013) is represented by the patents and R&D expenditures. It should be noted that, besides data availability, the potential output variable, as it incorporates a strong trend over time, is trend stationary and thus may generate problems during the estimation of the long-run vector of imports, if the other variables are difference stationary. Moreover, the available statistical data on FDI, patents and R&D expenditures in Greece fall considerably short of the sample of this study.

[10] For the definition of this variable see Annex A: The statistical data.

The PQ variable, used in the present study, in addition to data availability which is a major issue in this paper due to the long sample period covered, shows the exporter level of innovation and technological advancement that can affect trade through the variety and quality of produced and traded goods, i.e. factors that contribute substantially to product differentiation. Thus, this variable proxies comfortably the strong domestic demand for medium and high-tech products. In addition, strength of this variable is its cyclicality which helps to identify the effect in the present time-series analysis.

Second, a small number of studies include in the traditional model of import demand a proxy (capacity utilization or related variables) for the pressure of domestic demand (Anderton, et al., 1992). In the next section we discuss the demand for imports when consumers face a constraint in the domestic market.

4.2 The effective demand for imports

In the event that the domestic market is characterised by excess demand for the domestic good, households recalculate their demand for imports taking into account, besides income, the existing constraint on the domestic product. In other words, the households' maximisation programme can be written as follows:

$\max U = U(D, M)$

s.t.: i) $P_q D + P_m M = y$, and

ii) $D^d \leq \bar{D}$, with $\bar{D} = D$

Where $\bar{D}$ represents the constrained demand for the domestic good, which is assumed to be equal to the actual quantity.

Consequently, the demand for imports, which is now called **effective** (M_e^d), can be expressed as:

$$M_e^d = M_n^d + (P_q / P_m)(D^d - \bar{D}), \quad (12)$$

Where import demand (M_n^d) denotes equation (10), while the term $(P_q / P_m)(D^d - \bar{D})$ on the right-hand side of equation (11) denotes the **spill-over effect** (in nominal terms) from the non-satisfaction of demand for the domestic good. Therefore, based on equation (11), whenever domestic demand for the domestic good exceeds domestic supply, households increase their demand for imports by $(P_q / P_m)(D^d - \bar{D})$, providing that the constraint $(D^d \leq \bar{D})$ really holds.

The effective demand for imports (12) poses considerable econometric problems. First, its linear expression in logarithms is quite complex, and second, the term expressing the spill-over effect is not measurable. To solve the first problem we use Taylor's first order expansions of $\ln M_e^d$ around $\ln M_n^d$, and of $\ln D^d$ around $\ln D$. Replacing these proxies in equation (12), we obtain equation (13):

$$\ln M_e^d = \ln M_n^d + \{ (P_q / P_m)(D^d / M_n^d) \} \ln(D^d / \bar{D}), \tag{13}$$

In any case, obviously equation (13) cannot be estimated econometrically, due to the presence of the ratio (in nominal terms) of domestic demand to demand for imports (spill-over coefficient), as well as of the term $\ln(D^d / \bar{D})$ that represents the disequilibrium in the domestic market for the domestic good. The latter term is unobservable and can only be measured by a proxy.

The present study makes the assumption that the households' utility function is exponential, whereby, in such a function the spill-over coefficient has been proven to be equal to a constant (see Ito, 1980). Consequently, it could be written that:

$$(P_q / P_m)(D^d / M_n^d) = m_{e,6}, \tag{14}$$

The term $\ln(D^d / \bar{D})$ can be expanded as follows:

$$\ln(D^d / \bar{D}) = \ln(Q^d / Q^s) + [\ln(D^d / Q^d) - \ln(\bar{D} / Q^s)], \tag{15}$$

The first term on the right-hand side of equation (15) expresses the pressure of demand in the domestic goods market and can be replaced by a proxy for which statistical data are available. Examples of using the capacity utilisation rate[11] (CU) in such cases abound in the empirical literature. The second right-hand-side term of equation (15) is omitted, given that it can be neither observed nor proxied by the statistical data and, in addition, the error due to the omission of this term is estimated to be small and assumed to be random. Therefore, equation (15) can be written as follows:

[11] For the definition of this variable see Annex B: Chart B4.

$$\ln(D^d / \bar{D}) = \ln CU + v \, , \tag{16}$$

Replacing equations (14) and (16) in equation (13), we obtain:

$$\ln M_e^d = \ln M_n^d + \underset{\pm}{m_{e,6}} \ln CU + u_e \, , \tag{17}$$

where $u_e = m_{e,6} v + u_n$; and u_n= the random error of the M_n^d equation.

The sign of the coefficient of the CU variable in equation (17) depends on the relationship between the two goods. It will be positive in the case that the goods are complementary and negative when they are substitutes. Consequently, if we denote by e_m^e the relative price elasticity of M_e^d, it will hold that:

– if e_m^e (e_m^n) < 1 and $m_{e,6} > 0 \Rightarrow$ the two goods will be complementary, and

– if e_m^e (e_m^n) ≥ 1 and $m_{e,6} < 0 \Rightarrow$ the two goods will be substitutes.

Three major issues arise when comparing equations (11) and (12):

First, an increase in the constraint $\bar{D}$ reduces effective demand M_e^d:

$$\partial M^d / \partial \bar{D} = - P_q / P_m < 0.$$

Second, the effective marginal propensity to import is higher than the respective Walrasian one:

$(\partial M_e^d / \partial Y) > (\partial M_n^d / \partial Y)$, and

Third, the slope of the effective demand for imports curve is less steep than the respective Walrasian one:

$$\begin{aligned}\partial M_e^d / \partial(P_m / P_q) &= \partial M_n^d / \partial(P_m / P_q) + \partial[\, P_q / P_m \, (D^d - \bar{D}) \,] / \partial(P_m / P_q) \\ &= \partial M_n^d / \partial(P_m / P_q) + (P_m / P_q) \, [\partial D^d / \partial(P_m / P_q) - (P_m / P_q) \, (D^d - \bar{D})]\end{aligned}$$

Whatever the sign of the partial derivative of D^d with respect to (P_m / P_q), it will always hold that:

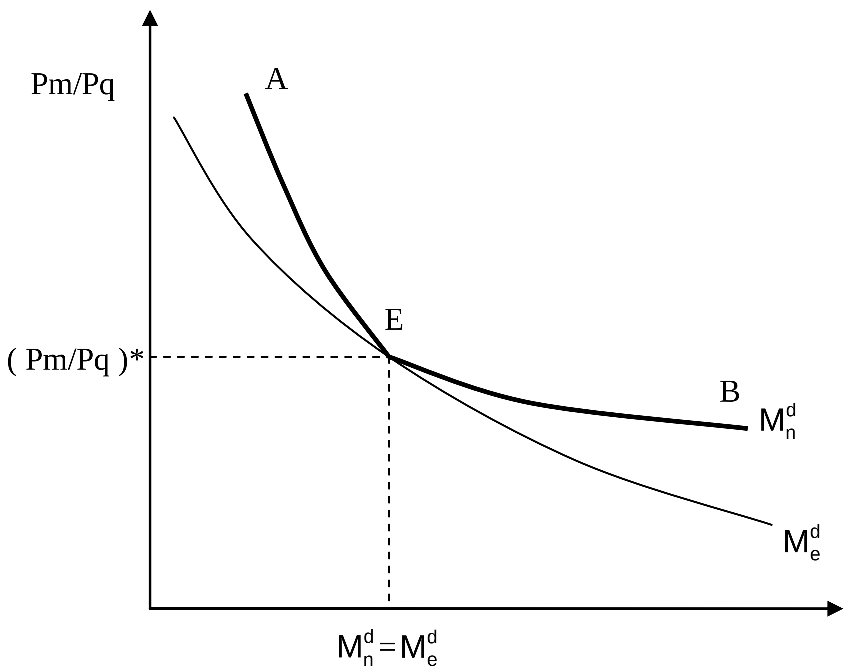
$$[\partial M_e^d / \partial(P_m / P_q)] < [\partial M_n^d / \partial(P_m / P_q)]$$

The above relationship entails that the relative prices elasticity of the effective demand is lower than that of the notional demand for imports: $e_m^e < e_m^n$.

Based on all the above, the graphs of M_n^d and M_e^d are depicted in Chart 3. In this chart, when relative prices are higher than $(P_m / P_q)^*$, the demand for imports lies in section AE of the effective demand schedule M_e^d. In case relative prices are lower than $(P_m / P_q)^*$, demand is given by section EB of the demand M_n^d. Therefore, in light of the above in combination with the assumption that **actual imports** are always equal to demand, we find that **actual imports** M will be:

$$M = \max(M_e^d, M_n^d), \tag{18}$$

Chart 3: Actual imports and demand curves for imports



In Chart 3, the bold line AEB represents relationship (18). Finally, **the system of equations** to be estimated includes the following:

$$\ln M = \max(\ln M_n^d, \ln M_e^d), \tag{19}$$

$$\ln M_n^d = m_{n,0}+m_{n,1}\ln(P_m / P_q)+m_{n,2}\ln Y+m_{n,3}\ln AD+m_{n,4}D+m_{n,5}\ln VQ +u_n , \tag{20}$$

$$\ln M_e^d = m_{e,0}+m_{e,1}\ln(P_m / P_q)+m_{e,2}\ln Y+m_{e,3}\ln AD+m_{e,4}D+m_{e,5}\ln VQ \; m_{e,6}\ln CU+u_e , \tag{21}$$

5. Econometric specification

5.1 Estimation of actual imports

To estimate the system of equations (20) to (21), we first need to calculate the density function of actual imports. The relevant density function for the max condition (19) is expressed by the following proposition:

***Proposition**:*

If the following assumptions hold:

i) $u_n \sim N(0, \sigma_{u_n})$ and $u_e \sim N(0, \sigma_{u_e})$;

ii) $cov(u_{n,t}, u_{n,t-1}) = 0$;

iii) $cov(u_{e,t}, u_{e,t-1}) = 0$; and

iv) $cov(u_{n,t}, u_{e,t}) = 0$,

Then, the density function of equation (19) is given by the following relationship:

$$f(M) = f_n(M)\, F_e(M) + f_e(M)\, F_n(M)\,, \tag{22}$$

where $f_n(M)$ = the density function of M in case $M = M_n^d$

$F_e(M)$ = the probability density function of $M = M_e^d$

$f_e(M)$ = the density function of M in case $M = M_e^d$

$F_n(M)$ = the probability density function of $M = M_n^d$ and

$f_n(M) = 1 / \sigma_{u_n} \sqrt{2^n} \exp(-u_n^2/2\sigma_{u_n}^2)$

$f_e(M) = 1 / \sigma_{u_e} \sqrt{2^n} \exp(-u_e^2/2\sigma_{u_e}^2)$

$$F_e(M) = \int_{-\infty}^{M} f_e(M)\, dM_e^d$$

$$F_n(M) = \int_{-\infty}^{M} f_n(M)\, dM_n^d$$

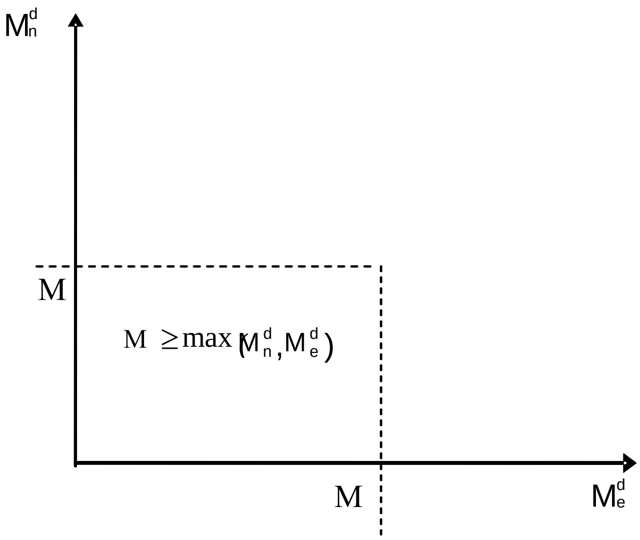
Proof:

In Chart 4, the region of the plane $M_n^d M_e^d$ where $\max(M_n^d, M_e^d) \le M$ is the set of points such that $M_n^d \le M$ and $M_e^d \le M$. Therefore, the probability masses in this region are given by the relationship:

$$F(M) = F(M, M), \tag{23}$$

But since the events (M_n^d = M) and (M_e^d = M) are independent based on assumption (iv), equation

Chart 4: Probability distribution in the imports market



(23) is written as follows:

$$F(M) = F(M, M) = F_n(M)\, F_e(M), \tag{24}$$

Taking the total differential of equation (24), we arrive at relationship (22) – q.e.d.

The idea behind (22) is that for a given set of prices and quantities (Pm/Pq, M) the density of observing the actual demand for imports in case, say $M_n^d < M_e^d$, is the probability of being on M_e^d evaluated at M times the cumulative probability of M_n^d evaluated from minus infinity to M.

For the maximum likelihood estimation, we need to specify the common density function or the probability function for the vector of the independent variables. For independent observations, this function is given by the following equation:

$$L(M) = \prod_{t=1}^{T} f(M) \ , \tag{24}$$

In logarithms, equation (24) is written as:

$$\ln L(M) = \sum_{t=1}^{T} \ln f(M) \ , \tag{25}$$

Finally, the maximisation of likelihood function (25) yields the estimates of the relevant parameters of the two import functions. We can also get, as a by-product, the probabilities associated with each import demand function. In the maximisation of this function we use the

GRADX (Quadratic Hill Climbing) algorithm with analytic derivatives. This method is deemed sufficiently reliable and effective, as it uses first and second derivatives. However, reliable starting values for the parameters of the two import equations are needed in order to facilitate the initiation of the optimization routine and achieve convergence of the likelihood function. Bearing this point in mind, we decided to apply the method of estimating a Vector Autoregressive Error Correction Model (VECM) based on the Johansen and Juselius (1990) and Johansen (1991) approach.

5.2 Estimation of individual equations of the demand for imports by the cointegration method

The analysis of time series variables in a multivariate context is carried out in three steps (Enders, 1995). First, one has to determine the integration order of the time series, which is a prerequisite for cointegration analysis. Second, if the variables are integrated of the same order I(1), the next step is to estimate the long-run equilibrium relationship, using cointegration analysis. Third, provided that the variables are cointegrated, one estimates the model's dynamic behaviour by incorporating in it the "residuals" from the long-run estimation lagged one period, as an error correction term (Vector Error Correction Model, VECM). The correspondence between cointegration and the VECM is specified by Granger's "representation theorem" (Engle and Granger, 1987).

We check for the existence of stochastic trends among the model's variables, using the Dickey-Fuller (ADF), Phillips-Perron (P-P), and Bierens (1993) tests of the hypothesis of a unit root B(LT), against the linear trend stationarity I(0), as well as the Bierens (1997) unit root test against the non-linear stationarity B(NLT). In addition, we apply the Bierens-Guo (1993) test of the hypothesis of stationarity against the alternative of a unit root (B-G). All the aforementioned tests are also used on the variables' first differences. The estimation of the cointegration vector (VECM) relies on the maximum likelihood approach elaborated by Johansen and Juselius (1990) and Johansen (1991) (J-J ML). The number of cointegrating vectors is determined applying two tests: the λ-trace and the λ-max (maximum eigenvalue). As mentioned earlier, we initially estimate the long-run relationship.

6. Results of the estimations

6.1 Estimation of long-run relationships by the cointegration method

The imports functions are estimated for the period 1962:1-2009:4 using seasonally adjusted quarterly data. The results of the unit root tests imply that all the variables in logarithms follow the I(1) process and that their first differences are I(0) stationary (Table 2 below and Table B1 in Appendix B). Specifically, the p-values of the Bierens B(NLT) test for the variables in levels are the simulated values of the F distribution on the basis of 1000 replications. The t-test and the non-parametric T-test results for all the variables indicate that the null hypothesis of the presence of a unit root cannot be rejected. Also, the results for the first differences of these variables under the Bierens (B (LT)) test provide evidence for linear trend stationarity.

Table 2: Unit root tests of the variables in levels

Tests \ Variables	M	Y	(Pm/Pg)	VQ	AD	CU	Hypotheses Ho	H1
ADF								
• stat.	1.975	-0.072	-0.728	-2.146	-2.257	-2.243	UR	ST
• p-value	1.00	0.95	0.84	0.23	0.45	0.19		
P-P								
• stat.	2.316	0.885	-1.311	-1.813	-2.356[1]	0.153[2]	UR	ST
• p-value	0.99	0.99	0.62	0.37	0.40	0.66		
B (LT)								
• stat.	-2.800	-2.07	-1.683	-5.484	-3.52	-4.51	UR	TS
• p-value	0.86	0.90	0.92	0.36	0.74	0.86		
B (NLT)								
• t-stat.	-8.119	-7.300	-6.250	-5.680	-7.341	2.809		
• p-value	0.10	0.09	0.01	0.06	0.09	0.06	UR	TS(NL)
• T-stat.	1.470	9.354	39.88	12.578	341.7	682.8		
• p-value	0.13	0.12	0.04	0.02	0.10	0.09		
B-G								
• stat.	112.6	145.0	7.399	87.87	12.810	7.045	ST	UR
• p-value	0.01	0.0	0.09	0.01	0.05	0.09		
Notes:	ADF=Augmented Dikey-Fuller test. P-P=Philips-Peron test. B(LT) =Bierens (1993) unit root test against linear trend based on higher order sample autocorrelation. B(NLT) =Bierens (1997) unit root test against non-linear stationarity. B-G=Bierens-Guo test. UR=Unit root. ST = stationarity. TS=Trend stationarity. TS(NL) =Non-linear TS.							
1. With no trend. 2. No constant.								

The AIC (Akaike Information Criterion), HQ (Hannan-Quinn) and F statistics were used in order to choose the lag-length of 2 as appropriate in the vectors 1.1-1.4 of Table 3. Table 3 (part A) presents the λ-trace and λ-max statistics, which specify the number of the cointegration vectors. These statistics prove the presence of only one cointegration vector for each of the equations (1.1-1.4) estimated on the basis of critical values equal to 1% and 5%, respectively. In all these estimates the vector is very stable, since it satisfies both stability conditions, i.e. its characteristic root is equal to one (1.0), while its second root is considerably less than one (1.0).

Table 3 (part B) reports the estimation results of the traditional model (equation 1.1), the notional demand model which includes the "variety and quality" of goods variable (equations 1.2 and 1.3) and the effective demand for imports (equation 1.4). Closer examination of Table 3 (part B) reveals the following: *First*, the coefficients on all the variables, with the exception of the ad variable which takes the wrong sign and is highly insignificant, have the expected signs, and in almost all cases are statistically significant. *Second*, price effects are highly significant and of the expected sign. However, imports are inelastic with respect to relative prices (0.49 in equation 1.1, 0.43 in equation 1.2 and 0.33 in equation 1.4).[12] Moreover, taking into account that the relative

[12] This implies an elasticity of substitution close to 1.5.

price elasticity of Greek exports (price competitiveness) is marginally higher than one (1.0) (see Athanasoglou and Bardaka, 2010), it can be seen that the "usual" form of the Marshall-Lerner condition is satisfied. *Third*, the income elasticity ranges from 0.97 in the traditional model to 1.31 in equation 1.4, which also includes, in addition to the "variety and quality" variable (VQ), domestic demand relative to supply (CU). As has been observed in previous studies (Athanasoglou, 1992), the fact that the income elasticity of Greek imports is higher than that of domestically produced-goods,[13] implies that in periods of economic growth (recession), the demand for imports rises (falls) faster than that for domestic goods. The above **estimates** of

Table 3: Cointegration analysis of demand for imports (1962:1-2009:4)

A. Cointegration tests

H_0: Number of vectors (r)	λtrace	λmax	λtrace	λmax	λtrace	λmax	λtrace	λmax
critical value: 1% or 5%	54.5	32.2	76.1	38.8	76.1	38.8	103.2	45.1
r ≤1	3 8.8	21.1	60.2	24.0	68.1	24.9	100.5	39.2

B. Coefficients of the cointegration vector variables

Variables \ Equations	1.1	1.2	1.3	1.4
Constant	5.103	2.650	5.321	0.496
p_m/p_q	-0.492 (-3.04)	-0.446 (-3.29)	-0.440 (-3.60)	-0.327 (-2.71)
y	0.950 (13.01)	1.118 (16.70)	0.189 (0.80)	1.312 (17.99)
ad	0.018 (1.30)	0.007 (0.66)		0.003 (0.28)
vq		0.940 (3.51)	2.081 (4.39)	1.260 (4.72)
cu				-1.327 (-4.29)
D	0.805 (6.88)	0.560 (5.35)	0.470 (3.56)	0.449 (4.46)
a_1	-0.199 (-3.66)	-0.253 (-3.98)	-0.184 (-2.88)	-0.242 (-3.98)
Log L	959	1588	635	1907
Stability condition	1st ch.r.: 1 2nd ch.r.: 0.680	1st ch.r.: 1 2nd ch.r.: 0.674	1st ch.r.: 1 2nd ch.r.: 0.805	1st ch.r.: 1 2nd ch.r.: 0.670
Period	1962-2009	1962-2009	1993-2009	1962-2009

Note: Low case fonts denote logarithms of the initial variables.
Vectors are estimated lagged two periods.
The λtrace and λmax statistics have been adjusted with the degrees of freedom.
The t statistics are presented in parentheses.
For the dummy variable D, see Section 4.2.

(both relative prices and income) elasticities of the Greek economy[14] lie rather at the lower end of the spectrum compared with those for other countries (see Anderson, 1993; Hooper et al., 1998;

[13] The income elasticity of private consumption has been found to be appreciably less than one (1.0) (see Zonzilos, 1990, and Bank of Greece, 1989).

[14] Similar estimations of long-run income elasticity have also been carried out in other studies (see Zonzilos, 1991).

Barrell and te Velde, 1999; and Bahmani-Oskooee and Kara, 2008). *Fourth*, with respect to the "variety and quality" variable imports have an elasticity close to one (0.95) in equation 1.2 and greater than one (1.26) in equation 1.4. As already mentioned, the omission of this variable from the imports equations entails a bias error due to incorrect model specification. Indeed, as can be seen by comparing equation 1.1 with equations 1.2 and 1.4, the constant in the latter equations has fallen significantly (from 5.1 to .5), while the value of Log L has also increased considerably (from 959 to 1907). Moreover, as expected from the theory, the relevant elasticity is particularly high in the period 1993-2009 (equation 1.3: elasticity equal to 2), a time when economic activity in Greece recorded high rates of growth (around 4%), resulting in a stronger consumer preference for buying imported goods of wider variety and high quality. *Fifth*, imports are elastic with respect to domestic demand relative to supply (CU). This elasticity has a negative sign and takes a value (–1.33) slightly higher than income elasticity, a fact which implies that the two goods, the imported and the domestic one, are in the long run substitutes, and therefore, the relative increase of the supply of the domestic product can reduce imports of goods, to an extent that may neutralise the effect of income. *Finally*, the positive sign and the significance of the coefficient of the dummy variable D, as it was expected, indicates that Greece's accession to the EU in 1981 had a long-run increasing effect on imports. Also, the coefficient α_1, which denotes the speed of adjustment to long-run equilibrium, is significant and has the correct sign.

Therefore, the estimates of Table 3 (part B) show that "variety and quality" (VQ), as well as the demand and supply conditions of the domestic good in the domestic market, denoted by the capacity utilisation rate (CU), have a considerable effect on Greek imports of goods. Excluding these two variables from the imports equation causes a significant specification error to the model.

6.2 Results from the estimation of actual imports- Estimation of short run equations

We estimate the short-run dynamics of equations (20) and (21) of the notional import demand and the effective import demand, which are expressed by equations (26) and (27) respectively:

$$\Delta \mathrm{M}_t = \alpha_0 + \alpha_1 EC_{t-1} + \sum_{i=1}^{n} \alpha_{2,i} \Delta \mathrm{M}_{t-1} + \sum_{i=1}^{n} \alpha_{3,i} \Delta (P_m / P_q)_t + \sum_{i=1}^{n} \alpha_{4,i} \Delta \mathrm{Y}_t + \sum_{i=1}^{n} \alpha_{5,i} \Delta AD_t + \lambda_1 D \,, \quad (26)$$

$$\begin{aligned} \Delta \mathrm{M}_t = \beta_0 + \beta_1 EC_{t-1} + \sum_{i=1}^{n} \beta_{2,i} \Delta \mathrm{M}_{t-1} + \sum_{i=1}^{n} \beta_{3,i} \Delta (P_m / P_q)_t + \sum_{i=1}^{n} \beta_{4,i} \Delta \mathrm{Y}_t + \sum_{i=1}^{n} \beta_{5,i} \Delta AD_t \\ + \sum_{i=1}^{n} \beta_{6,i} \Delta VQ_t + \sum_{i=1}^{n} \beta_{7,i} \Delta CU_t + \lambda_2 D \end{aligned} \,, \quad (27)$$

Where Δ = the operator of the first differences of the variables' logarithms. EC_{t-1} is the lagged error-correction term that represents the disequilibrium from the long-run relationship, and

α_1 (β_1) is the speed of adjustment coefficient. Consequently, this framework recognizes that the short-run import demand is not immediately adjusted to its long-run equilibrium, due to lags between the initially agreed for the goods and their final prices, expectations, and adjustment costs (e.g. transport costs, market research costs, etc.).

As we said above, in the maximisation of the density function (22) reliable starting values for the parameters of the two import equations are needed for the convergence of the likelihood function. Therefore, each short-run import equation (26) and (27) was estimated with maximum likelihood (ML) using up to 2nd order autoregressive and moving average errors (ARCH/GARCH model). The results of these estimations are reported in Table 4 as equations 1.1, 1.2 and 1.4.

Table 4: Estimates of actual (short-run) import equations (1962:1-2009:4)

	Estimation of single equations			**Estimation of equations system**	
Equations **Explanatory variables**	**1.1**	**1.2**	**1.4**	**1.2a**	**1.4a**
Constant	0.028 (3.58)	0.029 (4.01)	0.028 (3.60)	0.029 (3.51)	0.018 (2.99)
Δm^d_{t-1}	-0.268 (-2.65)	-0.211 (-3.55)	-0.233 (-3.49)	-0.220 (-3.78)	-0.265 (-3.66)
$\Delta(p_m/p_q)_t$	0.141 (-1.13)	-0.329 (-1.92)	-0.256 (-1.58)	-0.384 (-2.70)	-0.142 (-1.20)
Δy_{t-1}	0.326 (1.88)	0.042 (0.28)	0.110 (0.88)	0.168 (0.81)	0.120 (0.60)
Δad_t	-0.019 (-1.40)	-0.021 (-2.10)	-0.014 (-1.23)	-0.009 (-0.85)	- 0.005 (-0.36)
Δvq_{t-1}		1.134 (3.60)	1.365 (3.44)	0.668 (1.72)	0.995 (2.15)
Δcu_t			0.317 (1.99)		0.448 (3.28)
EC_{t-1}	-0.190 (-3.29)	-0.315 (-3.90)	-0.190 (-3.91)	-0.247 (-4.81)	-0.233 (4.15)
D	0.051 (0.89)	0.034 (1.60)	0.022 (1.10)	0.040 (0.460)	0.035 (0.60)
Log L	210	225	225	710	710
Wald	49	850	73		
ρ_1(A)	0.233 (2.84)	0.289 (2.69)	0.290 (3.23)		
ρ_1(G)	0.578 (3.60)	0.655 (6.03)	0.588 (4.76)		

Note: Δ denotes the first differences of the variables in logarithms.
The t statistics are presented in parentheses.
For the dummy variable D, see Section 4.1.3.
The equations were estimated by the ML method with lags of two periods.
The second autocorrelation coefficients of the residuals and the fluctuation, i.e. ρ2(A) and ρ2(G), are statistically insignificant in all cases.

These estimates constituted the starting values for the maximization of the density function (22). However, the computational burden involved was immense.[15] Based on the probabilities associated with each of the two imports functions, it can be seen that approximately 95% of the sample's observations are accounted for by the effective demand for imports. This observation leads to the safe conclusion that Greek imports are accounted for by that function (effective) which, in addition to consumer preference for variety and quality, also incorporates the demand and supply conditions of the domestic market.

The estimated coefficients that represent short-run (impact) elasticities, derived by our system equation method, are presented in Table 4 (columns 1.2a and 1.4a). They are consistent with economic theory and have the expected signs. The coefficient of the error correction term (EC_{t-1}) is negative and statistically significant. This coefficient is lower than that identified for other countries (Barrell and Velde, 1999; Bahmani-Oskooee and Kara, 2008) but close to that for Greece (Zonzilos, 1991; Bahmani-Oskooee and Kara, 2008). It can be observed that the adjustment to disequilibrium is completed in five quarters in equation 1.1 and in four quarters in the augmented equations 1.2a and 1.4a.

Relative prices have only a minor effect on imports and are significant only in (the notional demand) equation 1.2a (1.2). This result is consistent with the findings of our theoretical model that the relative prices elasticity of the effective demand is lower than that of the notional demand for imports ($e_m^e < e_m^n$). Disposable income has a statistically insignificant effect on imports in all cases except in the traditional model (equation 1.1), where its effect is still minor (0.33).

The "variety and quality" variable seems to have the strongest effect on imports. The short-run elasticity takes a value of 0.67 in equation 1.2a and of 0.99 in equation 1.4a (Table 4). The latter is exactly the value of 1 implied by the simple Krugman (1989) model[16]. Note that the introduction of this variable in the traditional model turns the income coefficient to become insignificant, while the prices coefficient increases and becomes significant. These results entail that, when the short-run imports equation is imperfectly specified as in the traditional model (eq. 1.1); the effect of relative prices on imports is underestimated, whereas the effect of income is overestimated.

In (the effective demand) eq. 1.4a the effect of the CU variable in the current period appears to be statistically significant with a coefficient of roughly 0.45 i.e. takes a positive sign. This estimate leads to the conclusion that, contrary to what was estimated for the long-run period, in the short run domestic and imported goods are complementary. Consequently, a 10% higher

[15] We are not sure that the obtained maximum is the global one. However, the use of the GRADX algorithm and the strong convergence criteria used supports our believe that this maximum is at least, close to the global one. In addition, we tried several slightly different sets of initial parameters values but we got exactly the same results.

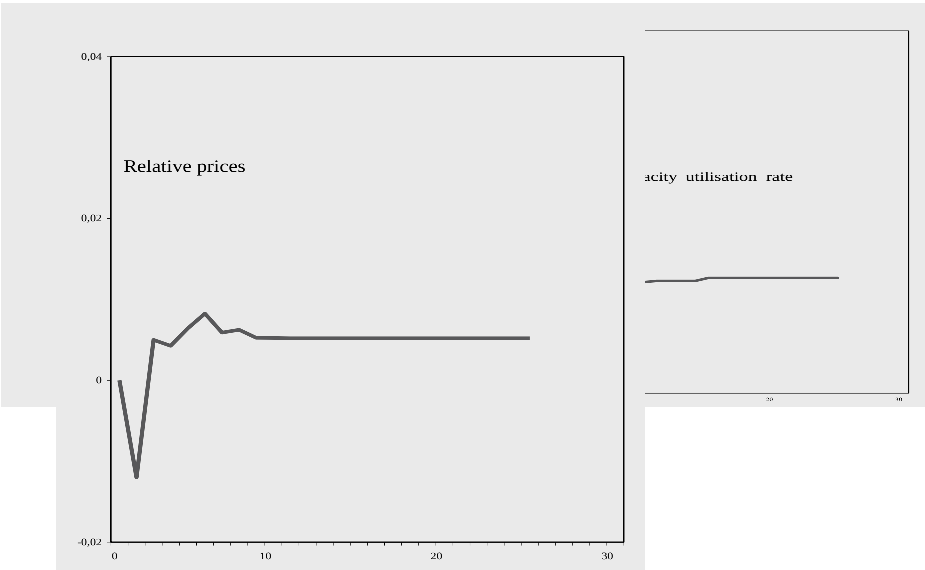
[16] In Gagnon (2004) the estimated coefficients of this variable are somewhat larger than the value of 1.

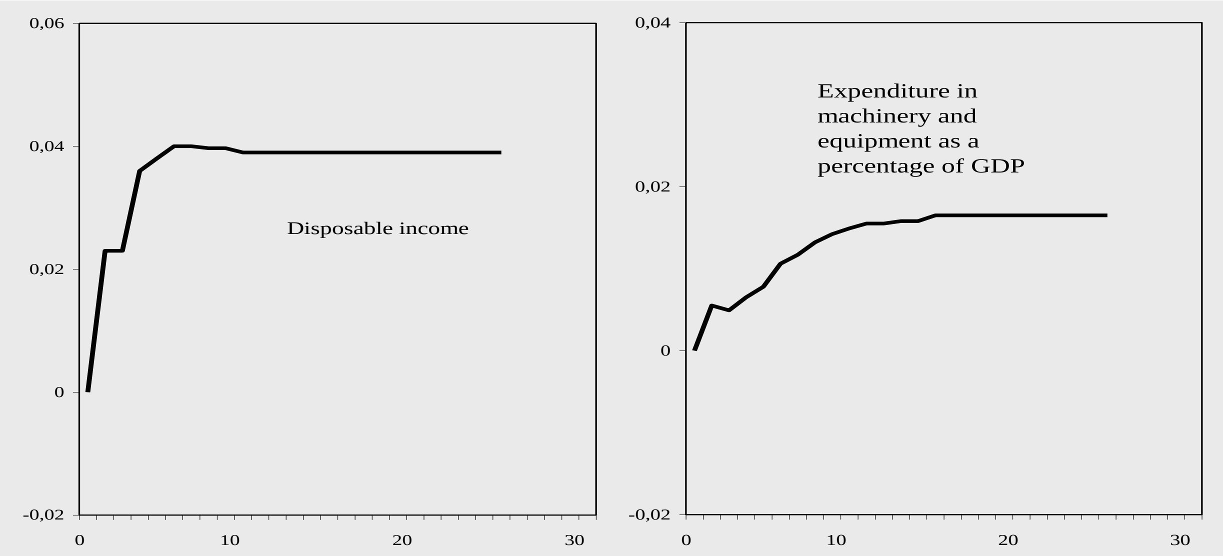
capacity utilisation rate can lead to a contemporaneous increase of imports of around 4.5%. This result is unsurprising, given that a share of about 60% of total imports relates to machinery, equipment and intermediate goods. Finally, the coefficient of the ad variable takes a negative, as expected, sign but is significant in one only case (eq. 1.2). Also, insignificant in all cases is the coefficient of the dummy variable D.

The results of the estimates derived by this method are close to those derived by the single equation method (equations 1.2 and 1.4) with respect to relative prices and income. In contrast, the estimated coefficients of the "variety and quality" and CU variables in both functions (1.2a and 1.4a) appear to be substantially smaller and higher than that derived by the single equation method respectively. Moreover, this method, as we mentioned above, endogenously chooses the appropriate import demand equation, which in the present case is the effective import demand equation (eq. 1.4a). In light of the foregoing analysis we arrive at the conclusion that Greek imports of goods are better explained by the effective demand, where the spill-over effect from the domestic product's market is taken into account in addition to the "variety and quality" variable. Therefore, not including variables proxying these effects in the Greek imports function, as was the case in the relevant literature, causes a considerable specification error.

Chart 5 shows the path of imports (dynamic forecast) after a one unit increase in their major determinants. Specifically, higher relative prices, although they initially decrease imports, later lead to a marginal increase. Indeed, not only relative prices but the other variables as well –

Chart 5: Simulation of imports equation 1.4





i.e. disposable income, "variety and quality" and the capacity utilisation rate generate **permanent effects** on imports.

7. Conclusions

This study examined the behavior of imports of goods in the Greek economy in the last five decades and their determinants, with an emphasis on the "variety and quality" of the imported goods, as well as on the demand and supply conditions of the domestic market.

Greek imports display a high geographical concentration, as roughly two thirds of total imports originate from the EU-15. However, the last decade has seen a considerable increase of imports from China and the countries of the Middle East and the Mediterranean area. The commodity structure of Greek imports reveals a high share of investment goods and intermediate goods for further processing. As regards the final use of imports, a share of approximately 60% is destined for firms and the remaining for households. It is indicative that in the last two decades Greek imports recorded a slight shift from low-tech goods to mainly medium- and, to a lesser extent, high-tech goods. However, Greece lacks in its imports of high-tech goods compared with the other EU Southern European countries. Therefore, the transfer and overall supply of high technology is relatively low in Greece, a fact that has a negative impact on productivity growth, domestic supply and exports. The analysis showed that domestic competitiveness, as measured by the imported (excluding fuel) to domestically produced goods (excluding fuel) prices ratio, displays a permanent deterioration from 1988 onwards, which indeed intensifies in the period after the country's accession to the euro area. Import penetration in manufacturing has followed an upward trend, indicating the inability of domestic supply to satisfy domestic demand.

Empirical investigation of the factors that affect imports involved the estimation of functions for the period 1962-2009. The econometric analysis of the time series reveals that the imports function in its traditional form (i.e. imports as a function of income and relative prices) cannot adequately explain the evolution of imports. For that purpose, it was expanded to include consumer preferences satisfied by "variety and quality" of imported products (New Trade Theory), as well as the pressure exerted by the relationship between domestic demand and supply of the domestic good.

Indeed, the New Trade Theory seems to be verified since our estimation results show that Greek imports are affected not only by relative prices and income but also, particularly, by qualitative characteristics, such as the "variety and quality" of the imported goods. The effect of this factor is considerably high in the last two decades. Finally, the inability of supply to meet demand for the domestic good also exerts a significant effect on imports.

In the long run, the elasticity with respect to the above factors is equal to or slightly higher than one (1.0), saves for the relative price elasticity, which is estimated to be relatively low. In the short run however, only "variety and quality" and the part of demand for the domestic good not satisfied by domestic production, as well as, to a lesser extent, relative prices shape the change in imports. In contrast, the contribution of income is statistically insignificant. Finally, although in the long run the two goods are characterised as substitutes in the short run the relationship between the domestic and the imported goods appears to be complementary.

These findings are highly relevant for policy. In traditional models where trade is a function of relative prices and income, policies need to target domestic income and real exchange rates to correct trade imbalances. However, if imports are driven mainly by consumer's tastes and supply factors, completely different policies are needed. Specifically, on the basis of the above results, prices as policy tools, e.g. through the incomes policy or measures to limit the domestic market's oligopolistic structure, have a limited effect on imports, and consequently on the trade balance as well, both in the short and the long run. In the short run, although domestic price restraint can contribute to a reduction of imports, the effectiveness of their change is limited. In general, imports are affected in the short run by the phase of the economic cycle and the level of economic activity. In the long run, the greater than one income elasticity and the strong negative disequilibrium error correction term in the short run equation indicate that Greece faces an external constrain on growth. Thus, policies that strengthen domestic production and supply are those that can contribute to a substitution of imports and the narrowing of the trade deficit. In fact, the contribution of the relative increase in the supply of the domestic product can have the following results: first, reduce imports of goods, to an extent that may neutralise the effect of increasing income; second, if increased domestic production concerns new varieties of goods then the country will be able not only to substitute imports but also, to export these new goods and maintain balanced trade without suffering any deterioration in its terms of trade. Therefore, enhancing the factors that increase productivity and the potential growth rate of production (mainly in new varieties) contributes effectively to the substitution of imports and the reduction of the current account deficits.

References

Anderson, P.S. (1993), "The 45^o – rule", *Applied Economics*, 25, 1279-84

Anderton, B., Pesaran, B. and Wren-Lewis, S. (1992), 'Imports, output and the demand for manufactures', *Oxford Economic Papers,* 44, 175-86.

Athanasoglou, P. (1992), "Economic policy and the balance of payments", Bank of Greece, *Studies and Speeches Archive*, 72 [in Greek].

Athanasoglou, P. and I. Bardaka (2010) "New trade theory, non-price competitiveness and export performance", *Economic Modelling*, 27, 217-28.

Bank of Greece (1989), *Annual Report*, Athens.

Bank of Greece (2006), *Annual Report*, Athens.

Barrell, R. and D.W. te Velde (1999), "Evolving patterns in manufacturing demand in the European Union: an empirical investigation of 10 European countries", National Institute of Economic and Social Research.

Bennett, H., J. Escolano, S. Fabrizio, E. Gutierrez, I. Ivaschenko, B. Lissovolik, M. Moreno-Badia, W. Schule, S. Tokarick, Y. Xiao and Z. Zarnic (2008), "Competitiveness in the southern euro area: France, Greece, Italy, Portugal and Spain", IMF, Working Paper, 1120.

Bierens, H.J. (1993), "Higher order autocorrelation and the unit root hypothesis", *Journal of Econometrics*, 57, 137-60.

Bierens, H.J. (1997), "Testing the unit root with drift hypothesis against non-linear trend stationarity, with an application to the US price level and interest rate", *Journal of Econometrics*, 81, 29-64.

Bierens, H. J. and S. Guo (1993), "Testing stationarity and trend stationarity against the unit root hypothesis", *Econometric Reviews*, 12, 1-32.

Bahmani-Oskooee, M. and O. Kara (2008), "Relative responsiveness of trade flows to a change in prices and exchange rate in developing countries", *Journal of Economic Development*, 33.

Clarida, R. H. (1994), 'Cointegration, aggregate consumption, and the demand for imports: A structural econometric investigation', *American Economic Review* **84**, 298-308.

Clower, R. (1965), "The keynesian counterrevolution: a theoretical appraisal", in Hahn and Brechling (eds.), *The Theory of Interest Rates*, London, Macmillan.

Enders, W. (2005), *Applied Econometric Time Series*, 2nd ed., John Wiley & Sons.

Engle, R.F. and C.W.J. Granger (1987), "Co-integration and error correction: representation, estimation and testing", *Econometrica*, 55, 2, 251-76.

Gagnon, E.J. (2004), "Productive capacity, product varieties, and the elasticities approach to the trade balance", *International Finance Discussion Papers*, 781, Board of Governors of the Federal Reserve System.

Goldstein, M. and M. Khan (1985), "Income and price elasticities in trade", in Jones and Kenen (eds.), *Handbook of International Economics*, II, North-Holland, Amsterdam.

Grossman, G. and E. Helpman (1991), *Innovation and growth in the global economy*, MIT Press, Cambridge, MA.

Helpman, E. and P.R. Krugman (1985), *Market structure and foreign trade: Increasing returns, imperfect competition and the international economy*, MIT Press, Cambridge, MA.

Hooper, P., K. Johnson and J. Marquez (2000), "Trade elasticities for the G-7 countries", *Princeton Studies in International Economics*, 87, August.

Ito, T. (1980), "Methods of estimation for multimarkets disequilibrium models", *Econometrica*, 48, 97-126.

Johansen, S. (1991), "Estimation and hypothesis testing of co-integration vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-80.

Johansen, S. and K. Juselius (1990), "Maximum likelihood estimation and inference on co-integration – with application on the demand for money", *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Krugman, P. (1989), "Differences in income elasticities and trends in real exchange rates", *European Economic Review*, 33, 1031-54.

Leamer, E.E. and R.M. Stern (1970), *Quantitative international economics*, Allyn and Bacon, Boston.

Thanagopal, T (2013), "Price versus quality war – A case study of France and Germany", Université Paris-Sorbonne 1 and Paris School of Economics.

Zonzilos, N. (1990), "Consumption: empirical investigation of the rational expectations permanent income hypothesis in Greece", *Spoudai*, 40, 60-80, [in Greek].

Zonzilos,N. (1991), "Modelling imports when variables are stochastically trending", *Greek Economic Review*, 2, 269-86.

Annex A

The statistical data

M = the value (at 1970 constant prices, in millions of euro) of imports, excluding imports of fuel and ships. Source: National Statistical Service of Greece (NSSG), Foreign Trade Statistics.

y = the domestic disposable income at 1970 constant prices. Given that no quarterly statistical data were available for the period under study, these were calculated based on the annual data on disposable income, applying the quarterly seasonal pattern of the employees' earnings in Greece during a calendar year.

P_m = the imports unit value index, excluding fuel (1970=100).

$P_{m,d}$ = the adjusted P_m index by the "tariffs and taxes",[17] which is written as follows:

$$P_{m,d} = P_m \left(\frac{1+d_t}{1+A_t d_o}\right) , \tag{28}$$

where d_t = the tariffs (and taxes) rate at time t; d_o = the tariffs rate in the base year; and A_t = the adjustment parameter.

It can be seen from the above that in this study the adjustment of import prices, based on tariffs and taxes, is different from that usually carried out in other studies, based simply on the $(1+d_t)$ / $(1+d_o)$ ratio. To demonstrate that this latter approach is incorrect, we can assume that imported product prices include tariffs and taxes. Therefore, the Paasche price index is written as:

$$P_{m,d} = \frac{\sum (Pij + Dij)Qij}{\sum (Poj + Doj)Qij} , \tag{29}$$

where P_{ij} and D_{ij} = the unit price and the unit tariff (and tax) of product j at time i; Q_{ij} = the quantity of the product, and i, j = the time (in quarters) and the products, respectively. Equation (28) can be written as follows:

$$P_{m,d} = \frac{\sum PijQij + \sum DijQij}{\sum PojQij + \sum DijQij}$$

or, dividing the numerator and the denominator by $\sum PojQij$, as:

$$P_{m,d} = \frac{\frac{\sum PijQij}{\sum PojQij} + \frac{\sum DijQij}{\sum PojQij}}{1+\frac{\sum DojQij}{\sum PojQij}} = \frac{\frac{\sum PijQij}{\sum PojQij}\left(1+\frac{\sum DijQij}{\sum PojQij}\right)}{1+\frac{\sum DojQij}{\sum PojQij}} , \tag{30}$$

[17] The term "tariffs and taxes" comprises: (1) import tariffs; (2) stamp duties; (3) the special tax under article 17 of Law 3092/54; (4) consumption tax; and (5) luxury tax.

In this relationship the ratio in the denominator does not represent the share of tariffs in the base year, unless we adopt the assumption that in the base year all imported goods were subject to the same tariff rate. However, this last hypothesis is rejected by the data. Thus, this ratio is expanded as follows:

$$\frac{\sum DojQij}{\sum PojQij} = \frac{\sum DojQij}{\sum PojQij} \cdot \frac{\sum DijQij}{\sum DojQoj} \cdot \frac{\sum PojQoj}{\sum PojQij}$$

$$= \frac{\sum DojQij}{\sum PojQij} \cdot \frac{\sum\left(\frac{DojQoj\left(\frac{Qij}{Qoj}\right)}{\sum DojQoj}\right)}{\sum\left(\frac{PojQoj\left(\frac{Qij}{Qoj}\right)}{\sum PojQoj}\right)} = \frac{\sum DojQij}{\sum PojQoj} \cdot A_t$$

In the above expression it can be seen that coefficient A_t is derived as a weighted sum of the volume indexes of the individual goods, where the weights in the numerator are the share of tariffs of each product in total, in the base year, and in the denominator the share of imports of each product in total, in the base year. To calculate the weights we used the breakdown of imports and of tariffs and taxes by single-digit code level of the SITC. The time series of the adjustment parameter A_t justifies this effort, as it takes values ranging between 0.95 and 1.25, rather than always being equal to one (1.0).

P_q = the NSSG wholesale index of domestic goods (excluding fuel) for domestic consumption.

AD = the real cost of the importers' mandatory advance deposits, calculated based on the relationship AD = D.r.d/P_q , where D = the importers' mandatory advance deposits with the Bank of Greece; r=the interest rate on 3-month time deposits; and d=the advance deposits' duration.

VQ = the expenditure for machinery and equipment as a percentage of the GDP of ten countries (eight European ones, the US and Australia) from which roughly 70% of total Greek imports originate. This expenditure was weighted based on the shares of Greece's annual imports from these countries to total Greek imports.

CU = the capacity utilisation rate. Estimates based on the production method for the period 1962-1980, and IOBE data for the period 1981-2009.

Annex B

Chart B1: Prices of imported goods (excluding fuel) and import tariffs

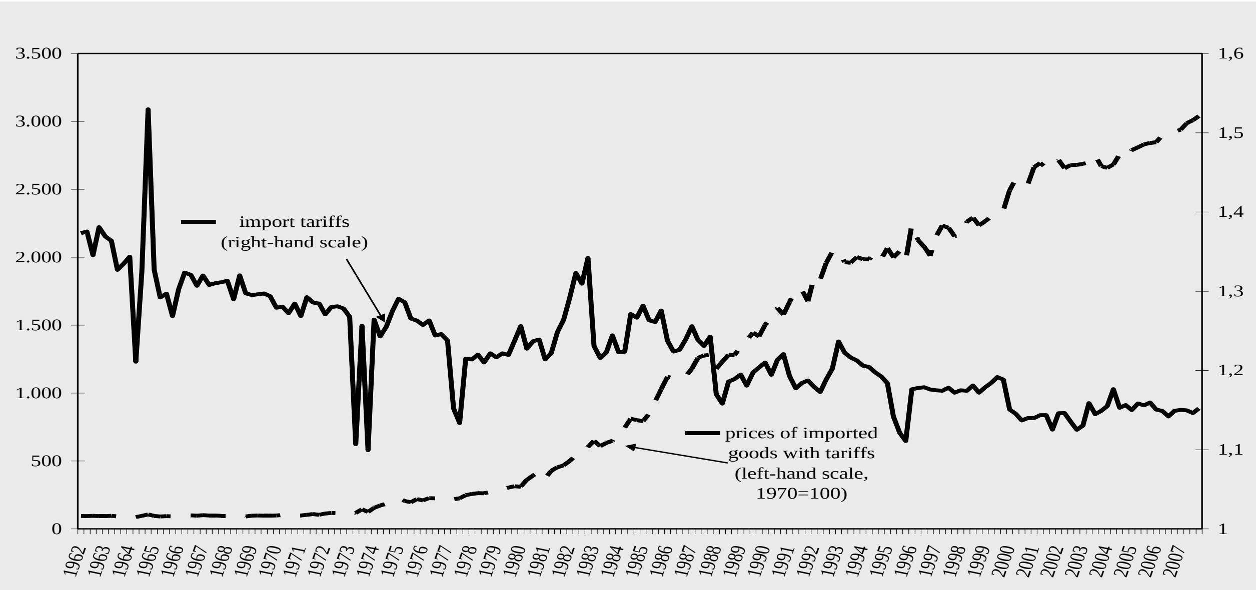


Table B1 : Unit root tests of the variables in first differences

Tests \ Variables	M	Y	(Pm/Pg)	VQ	AD	CU
ADF						
• stat.	-7.156	-12.893	-18.593	-5.672	-8.497	-7.959
• p - value	0.0	0.0	0.0	0.0	0.0	0.0
P-P						
• stat.	-20.553	-12.977	-20.440	-5.780	-8.531	-22.481
• p - value	0.10	0.0	0.0	0.0	0.0	0.0
B (LT)						
• stat.	-458.4	-372.0	-14.290	-14.310	-100.8	-28.030
• p - value	0.07	0.06	0.09	0.0	0.0	0.0
B - G						
• t - stat.	0.445	0.194	0.073	1.304	0.041	1.013
• p - value	0.73	0.88	0.95	0.42	0.97	0.49
NOTES: See notes in Table 2.						