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THE GREEK ECONOMIC STRUCTURE IN THE 2000's: A ROAD TO CRISIS?

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Abstract
The Greek economy has undergone a deep economic crisis, following the international financial disarray of 2008. It has been widely agreed that a number of signals conveyed the need to reconsider the long-run development strategy, but the Greek economy had been growing quicker than most of Europe at least since the 1960's. Short-term difficulties need not have triggered a major crisis. The question is whether the economic structure by the early 2010's explains such development. This paper searches for connections between that structure and the macroeconomic problems that the economy has encountered, regarding external deficits, employment, productivity and growth. Results suggest that structural change is a condition if Greece is to regain self-sustained growth in the long run.

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Key words: Greek economy, economic structure, sectoral performance

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Introduction

Greece has been singled out as an ill conducted economy since the international financial crisis in 2008, due to large public debt, major fiscal deficit and harrowing banking emergency, among other calamities. International experiences under similar circumstances such as Argentina and Peru in the 1980's, Indonesia, Malaysia and South Korea in the 1990's and more recently Italy, Spain and Portugal have shown that financial concerns gain primacy over economic questions (e.g., Devlin and Ffrench Davis, 2005; Griffith-Jones, and Sunkel, 1988; Jomo, 2003; Ugarteche, 2013), so that the solutions to urgent problems often disregard their impacts on long term developmental matters, to the point that they even damage the productive capacity of the economies concerned, hindering their ability to overcome the slump. After countries have adopted austerity policies recommended by the International Financial Institutions (IFI), deficits did not shrink, but their GDP and employment did, and welfare deteriorated, when sudden reforms amid general economic contraction drove many firms to closure. That is indeed the path that Greece has followed under political pressure and financial urgency, at least since 2011 when the crisis broke, and has continued for the next few years: economic policies have contracted disposable incomes as well as demand, and thus output and employment, while leading to an increased debt/GDP ratio. The alleged aim of such conditioned policies has been to allow restructuring foreign debts and allow the country to meet its financial obligations.

The question however is whether structural weaknesses have encumbered the Greek economy when facing short-term difficulties, originating in and transmitted from the external and financial sectors. Indeed, it is likely that unsustainable financial imbalances collapsed in the first place and then contractive policies transmitted the problem to the whole economic system. In any case, the structural issues could not have triggered the crisis, as they were present before its onset, but certainly it will be necessary to solve them before the economy returns to a growth path.

The analytical perspective adopted in this paper derives from structural analysis and the Input-Output (IO) model, which have been used previously in earlier papers examining the Greek economy in various respects and circumstances (e.g. Mattas and Shrestha, 1991; Korres, 1996; Mattas, Ciobanu and Psaltopoulos, 2010; Tzimos, Papadimitriou and Adamou, 2007). Nevertheless, it is interesting to re-examine the economy from a structural point of view, away from perspectives in vogue that stress the financial and short term issues.

Research on IO techniques in recent years has yielded large numbers of useful methods to study empirical topics, some of which continue to be debated in the literature; nevertheless this paper uses rather basic analytical tools that allow us to reach useful results to understand basic features of economic structures. Moreover, since the purpose here is solely empirical, it is arguable that methodological considerations necessary to explain not so well known techniques may divert the attention from issues that need to be discussed straightforwardly. That does not mean we intend to downplay the importance of developing novel research methods in order to analyse specific economic problems in need of subtler techniques.

The purpose of this paper is to examine a few aspects of the structure of the Greek economy on the brink of the economic crisis of the 2010's, investigating possible weaknesses that explain the road to the crisis. To this end, after this introduction the rest of the document is organised as follows: the first section discusses some facts and data aggregated at industry level characterising the economy and its long-term evolution. The second section explains the indicators to be used in the analysis of the mechanisms of transmission of the slump within the productive apparatus. Results are presented in the third section and finally a few conclusions are offered in the fourth. Unless otherwise stated, most of the data used in this paper was taken from the *Structural Analysis Database* (STAN), published by the OECD[1]. The latter includes IO tables and data on international trade, employment and the overall performance of the economies, both at aggregated levels and at compatible sectoral disaggregation.

1. Greece: economic facts and figures

Greece has experienced a rapid development process in the last few decades, so that the country evolved from mainly rural in the 1950's to urban and wealthy a few decades later (Drakoupoulos and Theodossiou, 1991), with *per capita* Gross Domestic Product (GDP) reaching 20,582 Euros (current prices) in 2010, equivalent to 75% of the European Union average, which makes of it a higher income country. In 2011 the United Nations Development Programme included it amongst the highly developed, ranking it 29 in the World Human Development Index[2].

1. http://www.oecd.org/document/62/0,3746,en_2649_34445_40696318_1_1_1_1,00.html (November 10, 2011).
2. http://hdrstats.undp.org/en/countries/profiles/GRC.html (November 10, 2011).

Greece has ranked amongst the fastest growing OECD and European Union economies since the early 1960's (Drakoupoulos and Theodossiou, 1991), up to 2007 – even though the 1980's were years of slower growth (Christodoulakis and Kalyvitis, 1998) Apparently, however, it is a matter of controversy whether the country has converged with the richest economies; for example, Vamvakidis (2003) presents evidence for such an argument, as the former would have grown fast and steadily – as a result of reform and sound economic policies. On the contrary, Mylonidis and Vassilatos (2011) argue that the real GDP *per capita*, relative to that of the United States has been almost stable in the period 1960-2004, while more successful countries managed to diminish the gap with the country of reference. Those authors explain it as a result of the relative closure of the economy to the world markets, for which producers need not be as competitive.

Persistent deficits both in the trade and current account balances have tainted growth for long periods (Athanassiou, 2009), as imports have grown faster than exports and GDP. Certainly, the economy seems to have been unable to take advantage of its membership of the European single market to build productive capacities in accordance to its level of income, as medium and lower technology activities continue to lead the system. It is well known that trade between most European Union (EU) member states is of intra-industry nature, because their exports are highly differentiated and wealthier consumers value diversity; in contrast, exchange between Greece and its major partners can be described as inter-industrial, due to the lack of supply of manufactures of more advanced technology, similar to the kind of goods Greece imports (Papazoglu, 2009), so the average share of intra-industrial trade was under 35% between 1991 and 2007.

Besides, the European cohesion policies have not been instrumental in transforming the economic structure to warrant sustainable growth. On the contrary, easy access to manufactured imports has impeded Greece from developing a competitive manufacturing industry, able to supply domestic needs or to penetrate foreign markets. On the other hand, the economy lacks a specialization profile, away from lower productivity services, insufficient to keep dynamism and maintain fiscal and current account balances (Brenke, 2012). The growth model before 2010 relied basically upon indebted final demand to keep the economic pace. New higher productivity industries in demand of labour and export oriented are needed to sustain growth in the future.

Sectoral growth and tendencies

The annual average rate of Greek GDP (at factor cost)[3] reached around 3% between 1995 and 2009 (at constant 2000 prices). Looking at Table 1, it is evident that the 42 branches of the economy grow unevenly (measured by sectoral Value Added, VA). Services grew at about 4% per year between 1995 and 2009, industry did so at 2%, but agriculture, hunting, forestry and fishing decreased at -0.3% per annum. The fastest growing industries were computer and related activities (37%), water transport (35%), medical, precision and optical instruments (19%), research and development (16%), while office, accounting and computing machinery and electrical machinery and apparatus decreased by 6%. Most of the faster growing industries are technologically intense manufactures and services; nevertheless those activities are among the smaller in the economy. In contrast, the larger sectors, which include lower and medium technology industries, stagnated and even decreased. In a word, the composition of the economy seems to change slowly in a desirable direction, but higher technology industries are rather small if they are to lead the dynamics of the system.

Like most developed economies, Greece is also based on services which produce 75% of the GDP, while industrial production represents 13%, construction 7% and rural activities 6% on average between 1995 and 2009. The largest branch is that of wholesale and retail trade; repairs (17%), followed by real estate activities (11%) and hotels and restaurants, (8%) and public administration (8%). The added weight in GDP of the public sector reaches 21% (including public administration, education and health and social work and other community, social and personal activities). None of the latter could be called a high technology intensive industry.

3. The database does not include GDP per branch. It is well known that adding sectoral VA results in total GDP at factor cost (Lequier and Blades, 2009).

Table 1. GDP at factor costs*: Annual Average Growth Rate and Composition and GDP per Employee 1995-2009 (Constant 2000 Euros)

Branches		GDP		GDP per Employee
		Rate of Growth	Composition	Rate of Growth
	Total	2.9	100.0	2.2
1	Agriculture, hunting, forestry and fishing	-0.8	5.2	2.5
2	Mining and quarrying of energy producing materials	2.9	0.2	3.1
3	Mining and quarrying except energy producing materials	0.0	0.2	1.4
4	Food products, beverages and tobacco	1.5	5.9	-1.4
5	Textiles, textile products, leather and footwear	-1.9	1.8	2.8
6	Wood and products of wood and cork	-3.7	0.4	0.5
7	Pulp, paper, paper products, printing and publishing	1.0	1.2	1.7
8	Coke, refined petroleum products and nuclear fuel	2.7	2.6	11.7
9	Chemicals (including pharmaceuticals)	1.9	1.3	6.6
10	Rubber and plastics products	0.6	0.6	0.6
11	Other non-metallic mineral products	0.0	1.2	1.6
12	Basic metals: iron and steel and non-ferrous metals	3.0	1.4	5.8
13	Fabricated metal products, except machinery and equipment	7.3	1.0	5.8
14	Machinery and equipment	2.6	0.6	7.5
15	Office, accounting and computing machinery	-5.1	0.0	-12.7
16	Electrical machinery and apparatus	0.3	0.4	-7.3
17	Radio, television and communication equipment	3.4	0.2	3.8
18	Medical, precision and optical instruments	12.9	0.1	-0.4
19	Motor vehicles, trailers and semi-trailers	2.3	0.1	6.7
20	Other transport equipment	5.4	0.4	5.4
21	Other manufacturing and recycling	3.5	0.6	2.0
22	Electricity, gas, steam and hot water supply	4.9	1.8	2.5
23	Collection, purification and distribution of water	4.6	0.3	7.3
24	Construction	1.1	9.0	0.8
25	Wholesale and retail trade; repairs	4.8	13.7	3.0
26	Hotels and restaurants	2.2	7.2	1.9

27	Land transport; transport via pipelines	0.6	1.7	2.3
28	Water transport	21.7	2.9	34.2
29	Air transport	1.4	0.6	13.6
30	Supporting and auxiliary transport activities	6.8	0.8	12.2
31	Post and telecommunications	8.5	2.3	8.2
32	Financial intermediation	5.8	3.7	4.4
33	Real estate activities	0.9	7.0	-5.2
34	Renting of machinery and equipment	1.7	0.2	4.4
35	Computer and related activities	12.6	0.4	18.2
36	Research and development	13.0	0.1	9.2
37	Other business activities	1.9	3.4	-4.5
38	Public administration and defence, social security	3.9	7.2	-0.5
39	Education	3.8	3.5	1.5
40	Health and social work	4.5	3.4	-0.2
41	Other community social and personal service activities	4.3	3.7	2.0
42	Private households with employed persons	9.3	0.4	3.0

Summary

	GDP		**GDP per Employee**
Sectors	**Rate of Growth**	**Weight**	**Rate of Growth**
Industry	1.7	12.7	1.9
Services	3.9	74.6	2.7
Low technology manufactures	-0.1	5.0	2.3
High and medium-high technology manufactures	4.4	2.1	6.3

* GDP at factor costs results from adding value added per branch

Source: Author's computations from OECD STAN database

According to Table 2, Greece exports mainly manufactures (84%), where textiles (16%), food, beverages and tobacco (15%), coke, refined petroleum products and nuclear fuel (11%) and basic metals (10%) make the largest contribution; also agricultural products represent over 12% of total exports. Exports from some higher technology sectors were growing fast, however, given their weight, they were unable to change significantly the total composition. Between 1995 and 2009 export

expansion is unstable as higher and lower rates alternate yearly; the average rate of growth is 2% per annum, lower than both GDP and internal demand rates.

Imports on the other hand (see Table 2) are mainly manufactures as well (84%), but their profile is different from that of exports. As mentioned before, high and medium high technology manufacturing sectors are the biggest sources of imports, but some lower technology products also contribute in not so low proportions. At the industry level, chemicals (15%), mining and quarrying of energy-producing materials (13%), food products, beverages and tobacco (9%) and motor vehicles (9%) are the largest supplying sectors. Imports grew at a 5% annual average, faster than exports and GDP. Domestic production has not expanded as fast as internal demand, having been replaced by imports, which are more suitable both to consumers' tastes and producer's needs for intermediate and investment goods.

Table 2. Exports and Imports: Average Annual Growth Rate and Average Composition 1995-2009 at constant 2000 prices (Excludes Services)

		Exports		**Imports**	
		Growth	**Weight**	**Growth**	**Weight**
	Total	2.2	100.0	5.1	100.0
1	Agriculture, hunting, forestry and fishing	1.2	12.1	4.7	3.6
2	Mining and quarrying of energy producing materials	3.9	0.5	19.8	10.2
3	Mining and quarrying except energy producing materials	1.2	1.2	2.9	0.2
4	Food products, beverages and tobacco	-3.0	14.9	3.6	9.5
5	Textiles, textile products, leather and footwear	0.4	16.6	3.9	7.6
6	Wood and products of wood and cork	1.9	0.4	1.8	1.0
7	Pulp, paper, paper products, printing and publishing	1.4	1.6	0.3	3.2
8	Coke, refined petroleum products and nuclear fuel	11.7	10.9	9.0	3.0
9	Chemicals (including pharmaceuticals)	5.0	9.7	6.5	13.6
10	Rubber and plastics products	-0.8	2.7	2.1	2.3
11	Other non-metallic mineral products	3.5	3.0	1.1	1.5
12	Basic metals: iron and steel and non-ferrous metals	4.9	10.4	3.0	5.3
13	Fabricated metal products, except machinery and equipment	7.0	2.3	2.6	2.2
14	Machinery and equipment	16.1	4.0	4.7	8.3

15	Office, accounting and computing machinery	1.7	0.6	7.8	2.1
16	Electrical machinery and apparatus	15.9	2.1	2.7	2.0
17	Radio, television and communication equipment	7.8	2.0	10.2	3.9
18	Medical, precision and optical instruments	9.4	0.8	6.3	2.5
19	Motor vehicles, trailers and semi-trailers	22.4	1.4	4.9	8.8
20	Other transport equipment	4.5	2.0	19.2	6.8
21	Other manufacturing and recycling	34.4	1.0	5.3	2.2
22	Electricity, gas, steam and hot water supply	1.2	0.1	67.4	0.2

Summary

Exports: Average Annual Growth Rate and Average Composition 1995-2009 at constant 2000 prices

Sectors	Exports		Imports	
	Growth	Weight	Growth	Weight
Industry	2.1	100.0	4.6	100.0
Services	--	--	--	--
Low technology manufactures	-0.9	34.4	3.3	23.5
High and medium-high technology manufactures	8.3	22.1	6.1	47.3

Source: Author's computations from OECD STAN database

Employment grew at a slower pace than GDP and it followed a different pattern too between 1995 and 2009 (see Table 3); as a result, output per employee has expanded overall. The annual employment average growth rate reached 1% between 1995 and 2009, but its sectoral behaviour is unstable and contradictory, e.g., employment in mining and quarrying decreased from low amounts, the industrial variable showed a marginal decline while employment in services expanded at 2% per year. The industries that show higher average growth include motor vehicles, trailers and semi-trailers, research and development, renting of machinery and equipment and electrical machinery and apparatus.

Services generate 62% of total employment (20% of the total population engaged in production work in wholesale, retail trade and repairs, 9% in public administration, 6% in education and a similar proportion in hotels and restaurants), agriculture employs 15% of the total, industry 13% and construction 7%. Not surprisingly the manufacturing industry, construction and hotels and restaurants are amongst the activities whose shares in total employment are lower if compared to GDP, which means that productivity in those sectors is above average, whereas

agriculture and wholesale, retail trade and repairs are in the group of sectors showing a higher share in employment than in GDP, indicating that they are also lower productivity activities. In many countries family business, micro-firms and numerous forms of self-employment thrive in lower technology services sectors and rural activities; it is not uncommon that smaller firms in such sectors are staffed regardless of efficiency concerns. Apparently that is the case for Greece, where small-scale enterprises are more generalised than in other EU member countries (Brenke, 2012). Besides, Damaniakos (1997) argues that rural activities still await modernization; farms tend to be run by self-employed owners employing outdated production methods. The Common Agricultural Policy of the EU may also play a role, fostering traditional farming (not only in Greece), and helping to explain how European agriculture outperforms productions from other regions in the World, while preserving lifestyles highly valued from cultural perspectives, among other issues.

Table 3. Employment: Average Annual Growth Rate and Average Composition 1995-2009, Number Engaged in Production

		Growth	**Weight**
	Total	1.0	100.0
1	Agriculture, hunting, forestry and fishing	1.3	14.8
2	Mining and quarrying of energy producing materials	-2.6	0.1
3	Mining and quarrying except energy producing materials	-0.1	0.2
4	Food products, beverages and tobacco	-1.8	2.6
5	Textiles, textile products, leather and footwear	1.1	2.1
6	Wood and products of wood and cork	-3.5	0.5
7	Pulp, paper, paper products, printing and publishing	-1.0	0.9
8	Coke, refined petroleum products and nuclear fuel	1.2	0.1
9	Chemicals (including pharmaceuticals)	1.7	0.6
10	Rubber and plastics products	1.9	0.4
11	Other non-metallic mineral products	0.8	0.7
12	Basic metals: iron and steel and non-ferrous metals	-0.2	0.3
13	Fabricated metal products, except machinery and equipment	2.3	0.8
14	Machinery and equipment	2.5	0.6
15	Office, accounting and computing machinery	0.6	0.0
16	Electrical machinery and apparatus	13.7	0.2
17	Radio, television and communication equipment	2.1	0.1
18	Medical, precision and optical instruments	3.9	0.1

19	Motor vehicles, trailers and semi-trailers	18.6	0.1
20	Other transport equipment	0.3	0.4
21	Other manufacturing and recycling	-1.5	0.9
22	Electricity, gas, steam and hot water supply	0.0	0.5
23	Collection, purification and distribution of water	-2.1	0.2
24	Construction	2.3	7.3
25	Wholesale and retail trade; repairs	2.2	19.6
26	Hotels and restaurants	1.9	6.3
27	Land transport; transport via pipelines	1.9	3.4
28	Water transport	-1.9	0.5
29	Air transport	1.5	0.2
30	Supporting and auxiliary transport activities	-8.6	0.9
31	Post and telecommunications	0.2	0.9
32	Financial intermediation	1.0	2.4
33	Real estate activities	1.3	0.1
34	Renting of machinery and equipment	14.3	0.1
35	Computer and related activities	6.5	0.3
36	Research and development	14.5	0.1
37	Other business activities	11.9	4.9
38	Public administration and defence, social security	5.6	8.7
39	Education	1.3	6.2
40	Health and social work	2.4	4.4
41	Other community social and personal service activities	2.7	0.0
42	Private households with employed persons	1.7	1.9

Summary

Employment: Average Annual Growth Rate and Average Composition 1995-2009, Number Engaged in Production

Sectors	**Growth**	**Weight**
Industry	-0.2	13.4
Services	2.0	61.5
Low technology manufactures	-0.7	7.9
High and medium-high technology manufactures	0.9	2.0

Source: Author's computations from OECD STAN database

Output per employee in the whole economy has grown at around 2% per annum and shows a correlation coefficient of 0.8 with the GDP rate[4]; i.e., both variables follow near to parallel paths. It is widely accepted that factor productivity is an element that explains the expansion of the economy; therefore, it is reasonable to say that the evolution of GDP per employee has contributed significantly to economic growth, alongside labour expansion, as Gogos *et al*. (2012) suggest.

Capital stock has grown at an average annual rate of 3% between 2000 and 2009, slightly higher than GDP and faster than employment (1%); as a result, output per unit of capital has grown at a slightly negative average annual rate in that period (-0.2%)[5]. Moreover, the correlation coefficient between the rate of growth of GDP and that of gross capital formation is higher than the coefficient between GDP and employment growth (see Table 4). These results would imply that capital formation and GDP evolve on closer patterns, while capital formation growth and employment expansion maintain more distant trajectories, showing a correlation coefficient of just 0.457.

Table 4. Correlation coefficients between GDP rate of growth and other variables

Employment	0.604
Exports	0.452
Imports	0.775
Gross Capital Formation	0.740
Final Consumption	0.660
Internal Demand	0.819

Apparently capital has outgrown employment, compromising the productivity of the former, as compared to that of labour. The findings by Gogos *et al*. (2012) would support such a hypothesis: indeed they suggest that capital −as a factor− contributed negatively to growth in the 2000's (-0.8%), Total Factor Productivity (TFP) on the other hand rose at 3.2% per annum between 2000 and 2007. As a result Gogos *et al*. (2012) suggest that TFP accounts for most of the economic growth in that period. Unfortunately there seems to be no accessible data to analyse these tendencies for individual sectors which would allow a more detailed analysis.

4. Needless to say, correlation coefficients do not imply causality between variables, but indicate that their evolution maintains relationships of some sort, explained by the economic theory.
5. The data on capital stock has been provided at request by Mr. Stylanos Gogos of the Athens University of Business and Economics. The methodology employed to calculate capital stock is explained at length in Gogos *et al*. (2012).

In simpler models growth can be related to the behaviour of a few variables that characterise the strategy followed by an economy. For example, some IFIs have claimed for a long period now that exports should lead growth in smaller open economies and, by the same token they would warrant the efficient allocation of resources; however sometimes growth is linked to the behaviour of imports rather than exports, e.g. if imports capacity is a requisite for growth, when production and consumption depend on imports (as happens in Greece). On the other hand, domestic final demand can lead growth, when internal markets expand fast enough and new or rising activities are able to satisfy an expanding demand. Capital formation can also be part of a leading final demand but, as has been discussed extensively in the literature (e.g., Popov, 2010), its expansion is not free from problems in regards to the factor productivity and general profitability in the economy, as discussed above, particularly if its increase is not accompanied by more employment and fast innovation that make room for higher capital productivity.

The economy is clearly not oriented towards foreign demand, thus the correlation coefficient between exports and GDP for the period 1995-2009 is under 0.5 (see Table 4), suggesting that exports and GDP follow rather independent trajectories. Such a coefficient is lower than that between internal demand and GDP (0.8), it is also lower than the coefficient between final consumption expenditure and GDP (0.7) and, finally, it is lower than the coefficient between imports and GDP (0.8). Therefore, it is reasonable to say that the economy is driven by internal demand -where final consumption is a major component- and also that the system is highly dependent upon imports.

However, a larger structural problem is that capital stock has outgrown the economy, which means also that imports of capital goods could have been reduced and thus the foreign deficit would have probably been lower; nevertheless, it is not easy to advance an explanation for the sudden reversal of growth tendencies in Greece after 2008 from the structural viewpoint, when the economy was expanding steadily. Athanassiou (2009) suggests that public deficit and foreign debt (public and private) financed an expanding domestic demand, which in turn sustained output growth at least during the 1990's and onwards. Besides, an ever-increasing competitiveness problem was not expected; eventually, when foreign credit shrank, the economy came to a halt. In the remainder of the paper an insight into the transmission mechanism of growth will be explored.

2. Structural multipliers

It has been stated that the largest or the faster growing industries in the economy are not the same; concurrently the economy disregards the opportunities that the single European market offers. Another issue is the sustainability of growth; in that respect, one important element is whether the fastest expanding industries are able to transmit growth impulses to the rest of the system and if so, on the methodological front, how to measure that transmission capability. The question can be addressed by analysing the economic structure − in the sense of studying the role that individual sectors play in the economic dynamics as transmitters or receivers of growth impulses. Sectors' demand and supply input one another and as a result influence one another; e.g., output in one industry would expand if sectors consuming its products enlarge their demand. The Input-Output (IO) model provides a framework to analyse how sectors influence one another by means of their connectivity patterns. The multiplier analysis in particular is a relatively simple technique that measures the ability that each sector has to propagate growth impulses.

The IO model regards the economy as a system of industries interrelated through the demand and supply of produced goods that −in turn− the consuming sector uses as inputs, together with non-produced inputs (labour and capital, for example) to produce some homogeneous good in the amounts necessary to satisfy final demand. The proportions of inputs that each industry uses are determined by the technology that they employ (Leontief, 1944). Those proportions determine the intensity of the connections between the industries and, at the same time, define the shape of the structure of the economic system (for example, industries i and j can be connected in one economy if sector j demands goods from i and disconnected in another if a similar demand is absent). As the economy evolves, each industry narrows its line of production and demands inputs from an increasing number of producers; conversely, each branch will also supply goods to more sectors. Then the economic structure gains complexity as the division of labour advances (Carter, 1970, Leontief, 1963, Smith, 1776).

Numbering the industries and sorting out the set of bills of goods demanded as inputs results in a square matrix (**X**) that shows in its columns the purchases of goods of each industry (to be used as inputs) and in its rows the sales of goods by each sector to the rest (Leontief, 1944; Miller and Blair, 2009). Similarly, the use of factors in each production can be conveniently arranged too, resulting in a rectangular array that shows, in its columns, the demands for each factor by each sector

and, in its rows, the supply of each factor to each producing sector. The payments to these factors are equal to the value added they generate. Likewise, a rectangular final demand matrix results by arranging the sales of final goods from each sector to each type of final demand (e.g. final private consumption, private investment, government demand and so on); this matrix can also be added up in a column vector of final demand **f**. The IO model can be written as:

$$\mathbf{(1)} \qquad \mathbf{x = \iota' X + f}$$

where **x** is a column vector of the revenues of all the sectors in the economy, **X** is the exchange matrix between these sectors, **ι'** is a unit row vector; it allows us to add up the rows of **X**- and **f** is a vector of final demand. Its well-known solution is:

$$\mathbf{(2)} \qquad \mathbf{x = (I - A)^{-1} f}$$

Matrix $(\mathbf{I} - \mathbf{A})^{-1} = \mathbf{L}$ is called the inverse Leontief matrix or the multiplier matrix; its components α_{ij} show the amount of good *j* needed to produce one unit of good *i*, consumed by both sector *i* and by every industry that produces inputs necessary in the production of good *j*[6]. In equation (2) it is assumed that output changes in response to final demand variations, which is the only exogenous variable. From (2) another equation can be derived, in order to cater for changes in **f**:

$$\mathbf{(3)} \qquad \mathbf{\Delta x = (I - A)^{-1} \Delta f}$$

The latter implies that variations in **f** cause linearly proportional adjustments in **x** and:

$$\mathbf{(4)} \qquad \mathbf{m'\Delta f = \iota' (I - A)^{-1} \Delta f}$$

Thus **m'** is a row vector of multipliers; the size of its components is related to the amount and intensity of the connections that each sector maintains with the rest of the industries - through the technical coefficients a_{ij}.

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6. The inverse Leontief matrix L is approximately equal to the sum of an exponential series of matrix A (Miller and Blair, 2009):

$$L \cong A^0 + A^1 + A^2 + ... + A^1 + \ldots$$

where $\mathbf{A}^0 = \mathbf{I}$ (the identity matrix) and indicates that each sector produces one unit of output; then, in order to produce that output each of those sectors requires some inputs directly, in proportions shown by $\mathbf{A}^1 = \mathbf{A}$. In turn the production of one unit of input *j* -demanded directly by sector *i*- requires some amounts of inputs *k*, *l*, *m*, … those are said to be demanded indirectly by sector *i*, according to $\mathbf{A}^2$, then the production of *k*, *l*, *m*, demand in turn further inputs, required indirectly by sector *i*, and so on,. Production in sector *i* impacts the activity in sectors *j*, *k*, …, *l,* which explains that matrix **L** is a multiplier matrix. It is a nonnegative matrix whose existence is warranted because matrix A is also strictly nonnegative.

In fact when output adjusts in response to changes in the final demand of some sector the new output includes the amount in which final demand varied in the first place, which should be deducted in order to avoid double counting. The resulting net multipliers provide a more accurate measure or the contribution of the initial variation of demand to the resulting output change. Following similar logic de Mesnard (2002) shows that net multipliers are:

$$\mu_j = \iota' (I - A)^{-1} - \iota' \qquad (5)$$

Likewise, it is possible to estimate the number of employees needed to produce a unit of each good *i* in the economy, taking into account the direct and indirect demand for labour. That is, the employment multipliers (ε). Labour coefficients (n_i) are defined as the requirements of labour per unit of output in sector each *i* (Miller and Blair, 2009) and employment coefficients are:

$$\varepsilon' = n' (I - A)^{-1} \qquad (6)$$

n' is the row vector of employment coefficients. Similar equations can be defined to estimate the needed amounts of any non-produced input to obtain any commodity[7]. Then, if **Ñ** is the diagonal matrix of employment coefficients

$$e = \tilde{N} (I - A)^{-1} f \qquad (7)$$

yields the vector of employment in the economy (e). If the observed vector **f** is substituted by some other hypothetical **ϕ**, the equation yields the hypothetical employment level, associated with **ϕ**. Otherwise, **f** can also be substituted by one of the components of final demand, resulting in the employment associated with that variable in particular.

3. Results

Output and employment equations have been calculated for Greece using the most recent IO Table included in the OECD STAN database (2005), which consists of three matrices, one of domestic exchange of inputs, one of intermediate imports and one of the total transactions (domestic plus imported inputs). The set is calculated in current Euros and it is disaggregated into forty-eight sectors, plus value added and final demand. There are however six sectors showing nil rows and columns, so it is

7. The imports multipliers would be μ = mL, where m are the imports coefficients and L stands for the inverse Leontief matrix; any other interesting multiplier would thus be calculated similarly, with the appropriate coefficients (Aroche, 2000).

possible to build at least one block of zeroes permuting rows and columns in the matrices, having undesired consequences on the properties of the model, as well as on its results[8]. As a solution, the null vectors have been added up with other accounts, thus the matrices employed include forty-two sectors, compatible to those used in section 1.

In regards to the Greek economy, the first feature to note (Table 5) is that 58% out of the total output corresponds to VA and imported inputs represent about 10%. The services sectors, as well as agriculture, present a similar profile; in contrast, as it happens in many economies the manufacturing industrial branches are more input intensive, thus being a more solid basis for the interdependence between sectors. The more import intensive industries are: coke, refined oil products and nuclear fuel, amounting up to 63% of total output (Greece produces no crude oil), iron and steel (29%), motor vehicles, trailers and semitrailers (27%) and chemicals (26%). Lastly, as happens in many economies, the industries that demand domestic inputs more intensively are manufactures as well, notably food products, beverages and tobacco and wood and products of wood and cork (58%), iron and steel (53%), other non-metallic mineral products (47%). Some of those are also large, but not fast growing industries and are therefore unable to transmit growth impulses to input suppliers.

Table 5. Gross Output by Component 2005

		Intermediate Consumption*	Intermediate Imports	Value Added
	Total	41,94	10,20	58,06
1	Agriculture, hunting, forestry and fishing	37,05	6,08	62,95
2	Mining and quarrying of energy producing materials	39,74	7,55	60,26
3	Mining and quarrying except energy producing materials	45,65	8,12	54,35
4	Food products, beverages and tobacco	65,43	8,38	34,57
5	Textiles, textile products, leather and footwear	54,22	15,27	45,78
6	Wood and products of wood and cork	77,87	16,47	22,13
7	Pulp, paper, paper products, printing and publishing	59,05	16,96	40,95
8	Coke, refined petroleum products and nuclear fuel	86,46	62,65	13,54

8. The mathematical properties of linear models are discussed in many books, for example, Takayama A. (1997) *Mathematical Economics*. Cambridge: Cambridge University Press.

9	Chemicals (including pharmaceuticals)	68,90	25,88	31,10
10	Rubber and plastics products	59,92	20,90	40,08
11	Other non-metallic mineral products	60,69	9,54	39,31
12	Basic metals: iron and steel plus non-ferrous metals	84,62	29,08	15,38
13	Fabricated metal products, except machinery and equipment	67,05	21,57	32,95
14	Machinery and equipment	56,93	22,54	43,07
15	Office, accounting and computing machinery	53,61	12,42	46,39
16	Electrical machinery and apparatus	65,33	22,67	34,67
17	Radio, television and communication equipment	47,03	13,52	52,97
18	Medical, precision and optical instruments	57,76	22,66	42,24
19	Motor vehicles, trailers and semi-trailers	64,21	27,37	35,79
20	Other transport equipment	59,13	22,26	40,87
21	Manufacturing, recycling	51,63	13,67	48,37
22	Electricity, gas, steam and hot water supply	38,54	4,62	61,46
23	Collection, purification and distribution of water	26,15	6,97	73,85
24	Construction	58,49	10,91	41,51
25	Wholesale and retail trade; repairs	32,44	5,42	67,56
26	Hotels and restaurants	43,46	7,59	56,54
27	Land transport; transport via pipelines	51,58	11,95	48,42
28	Water transport	58,73	26,08	41,27
29	Air transport	42,98	9,87	57,02
30	Supporting and auxiliary transport activities	41,29	9,67	58,71
31	Post and telecommunications	18,42	3,70	81,58
32	Financial intermediation	29,16	1,84	70,84
33	Real estate activities	9,53	0,90	90,47
34	Renting of machinery and equipment	41,91	4,92	58,09
35	Computer and related activities	49,25	5,80	50,75
36	Research and development	43,33	4,82	56,67
37	Other business activities	50,52	4,66	49,48
38	Public administration and defence compulsory social security	32,16	8,74	67,84
39	Education	10,19	0,75	89,81
40	Health and social work	35,54	12,87	64,46
41	Other community social and personal service activities	35,60	3,97	64,40
42	Private households with employed persons	0,00	10,20	100,00

* Includes intermediate imports

Source: Author's computations from OECD STAN database

Intermediate consumption represents above 39% of the total output and final demand represents over 60%; as can be seen in Table 6, producers of generalised inputs that sell higher proportions to intermediate uses are: agriculture, hunting, forestry and fishing, mining and quarry, wood and products of wood and cork, other non-metallic mineral products, iron and steel, electricity and some business services. Sectors showing higher final demand components as a percentage of the total output are food products, beverages and tobacco, manufacturing and recycling, construction, hotels and restaurants and water transport.

Table 6. Gross Output by Demand Component 2005

		Domestic Intermediate Consumption	Total Intermediate Consumption*	Final Demand**
	Total	29,14	39,37	60,62
1	Agriculture, hunting, forestry and fishing	47,20	52,83	47,17
2	Mining and quarrying of energy producing materials	96,48	797,57	-697,57
3	Mining and quarrying except energy producing materials	140,13	163,86	-63,86
4	Food products, beverages and tobacco	22,75	27,92	72,08
5	Textiles, textile products, leather and footwear	16,27	40,59	59,41
6	Wood and products of wood and cork	78,01	130,18	-30,18
7	Pulp, paper, paper products, printing and publishing	43,33	82,37	17,63
8	Coke, refined petroleum products and nuclear fuel	52,11	68,72	31,28
9	Chemicals (including pharmaceuticals)	38,09	154,17	-54,17
10	Rubber and plastics products	52,68	86,98	13,02
11	Other non-metallic mineral products	82,37	97,79	2,21
12	Basic metals: iron and steel and non-ferrous metals	62,77	119,86	-19,86
13	Fabricated metal products, except machinery and equipment	63,89	77,16	22,84
14	Machinery and equipment	19,93	110,49	-10,49
15	Office, accounting and computing machinery	26,96	762,39	-662,39
16	Electrical machinery and apparatus	62,76	131,42	-31,42
17	Radio, television and communication equipment	22,13	77,93	22,07
18	Medical, precision and optical instruments	57,05	314,89	-214,89
19	Motor vehicles, trailers and semi-trailers	10,67	156,41	-56,41
20	Other transport equipment	17,98	47,57	52,43
21	Manufacturing; recycling	10,96	19,78	80,22

22	Electricity, gas, steam and hot water supply	72,59	74,10	25,90
23	Collection, purification and distribution of water	66,14	66,14	33,86
24	Construction	11,98	12,15	87,85
25	Wholesale and retail trade; repairs	37,70	37,70	62,30
26	Hotels and restaurants	4,12	4,12	95,88
27	Land transport; transport via pipelines	43,69	44,82	55,18
28	Water transport	3,99	4,74	95,26
29	Air transport	51,54	75,73	24,27
30	Supporting and auxiliary transport activities	45,43	206,98	-106,98
31	Post and telecommunications	56,79	59,78	40,22
32	Financial intermediation	58,48	63,03	36,97
33	Real estate activities	22,17	22,17	77,83
34	Renting of machinery and equipment	70,68	82,01	17,99
35	Computer and related activities	40,48	45,25	54,75
36	Research and development	37,65	46,22	53,78
37	Other business activities	81,25	86,66	13,34
38	Public administration and defence compulsory social security	1,59	1,59	98,41
39	Education	1,18	1,18	98,82
40	Health and social work	2,42	2,46	97,54
41	Other community social and personal service activities	14,53	15,95	84,05
42	Private households with employed persons	0,00	0,00	100,00

* Includes domestic intermediate consumption plus intermediate imports by demanding sector

** Final demand plus total intermediate consumption equals gross output (100,00)

Source: Author's computations from OECD STAN database

As it is seen in Table 7 many sectors show larger final demand components than their total output. Apart from accounting aspects that explain those imbalances, it would be interesting to address the development process of those activities. For instance, office, accounting and computing machinery, as well as radio, television and communication equipment, and medical, precision and optical instruments import huge amounts of goods destined to support investment that has been characterised above as not so efficient for the economy as a whole. Those three are the most import-oriented sectors, as revealed by their imports coefficient. The first sector is shrinking, but the other two show positive rates of growth.

At the same time machinery and equipment, office, accounting and computing machinery, electrical machinery and apparatus, medical, precision and optical instruments, motor vehicles, trailers and semi-trailers and building and repairing of ships and boats, mining and quarry and textiles are the largest sources of Greek im-

ports. Such imports are often used as inputs in many productive processes; in turn, those may hamper domestic production, which might not be produced in adequate amounts, quality levels or technical specifications. The competitiveness of the incumbent sectors may not be as high. Finally, the most export-oriented sectors are mining and quarrying, chemicals, office, accounting and computing machinery, medical, precision and optical instruments, motor vehicles, trailers and semi-trailers and other transport equipment, since they show the largest export coefficients.

Table 7. Final demand components (% of total industry output) 2005

		Private Consumption	Government Consumption	Capital Formation	Exports	Imports
	Total	42,78	11,01	12,73	14,43	20,29
1	Agriculture, hunting, forestry and fishing	49,30	-0,18	9,12	11,08	49,30
2	Mining and quarrying of energy producing materials	0,19	184,11	1,00	882,54	0,19
3	Mining and quarrying except energy producing materials	2,15	-69,00	16,81	13,82	2,15
4	Food products, beverages and tobacco	82,78	2,77	10,06	23,53	82,78
5	Textiles, textile products, leather and footwear	168,42	-52,11	41,56	98,45	168,42
6	Wood and products of wood and cork	13,25	7,29	5,18	55,54	13,25
7	Pulp, paper, paper products, printing and publishing	70,73	-14,30	5,66	44,46	70,73
8	Coke, refined petroleum products and nuclear fuel	26,17	3,71	26,51	25,11	26,17
9	Chemicals (including pharmaceuticals)	94,55	2,24	40,91	191,88	94,55
10	Rubber and plastics products	50,10	2,08	23,95	0,00	50,10
11	Other non-metallic mineral products	12,76	2,16	9,33	0,00	12,76
12	Basic metals: iron and steel and non-ferrous metals	1,35	3,18	34,59	0,00	1,35
13	Fabricated metal products, except machinery and equipment	25,25	9,37	11,58	23,35	25,25
14	Machinery and equipment	42,27	162,20	23,07	238,03	42,27
15	Office, accounting and computing machinery	981,99	7940,43	35,75	9622,13	981,99
16	Electrical machinery and apparatus	8,82	22,68	27,85	90,78	8,82

17	Radio, television and communication equipment	37,17	268,10	31,72	314,91	37,17
18	Medical, precision and optical instruments	83,86	80,29	34,77	413,83	83,86
19	Motor vehicles, trailers and semi-trailers	648,80	241,60	26,70	973,53	648,80
20	Other transport equipment	66,69	156,10	21,48	191,81	66,69
21	Manufacturing; recycling	100,81	58,92	5,81	85,33	100,81
22	Electricity, gas, steam and hot water supply	28,03	0,01	0,27	2,41	28,03
23	Collection, purification and distribution of water	33,73	0,11	0,02	0,00	33,73
24	Construction	3,01	85,36	0,93	1,45	3,01
25	Wholesale and retail trade; repairs	45,28	8,75	8,28	0,00	45,28
26	Hotels and restaurants	94,52	0,02	1,32	0,00	94,52
27	Land transport; transport via pipelines	52,20	1,24	3,55	1,80	52,20
28	Water transport	3,84	0,29	91,62	0,12	3,84
29	Air transport	42,30	0,11	17,78	35,63	42,30
30	Supporting and auxiliary transport activities	41,03	0,12	20,37	169,47	41,03
31	Post and telecommunications	29,82	8,85	5,58	4,03	29,82
32	Financial intermediation	42,88	0,02	2,64	8,50	42,88
33	Real estate activities	77,26	0,57	0,00	0,00	77,26
34	Renting of machinery and equipment	24,10	0,00	4,07	10,16	24,10
35	Computer and related activities	1,05	56,10	8,14	10,54	1,05
36	Research and development	0,71	0,28	16,40	16,16	0,71
37	Other business activities	8,72	4,26	6,98	6,57	8,72
38	Public administration and defence compulsory social security	4,66	0,17	0,54	0,41	4,66
39	Education	35,90	0,01	0,28	-0,01	35,90
40	Health and social work	53,38	0,01	0,42	0,46	53,38
41	Other community social and personal service activities	84,36	1,44	1,40	4,26	84,36
42	Private households with employed persons	100,00	0,00	0,00	0,00	100,00

Source: Author's computations from OECD STAN database

Greek output and employment multipliers

First of all it is interesting to note the big difference between domestic and total multipliers (Table 8), resulting from the weight of imports in total supply, which has been discussed already. The total multiplier for the economy as a whole is 0.86, the domestic multiplier reaches 0.45: If final demand grew by one unit, domestic supply would grow by just 0.45 and intermediate imports would do so by 0.41. This is one undesired characteristic of the Greek economy, its high dependency on imports and thus, the proclivity to transfer abroad growth impulses derived from demand expansion.

Table 8. Net Output and Employment Multipliers 2005

		Output		Employment	
		Internal	Total	Internal	Total
	Total	0,455	0,859	0,221	0,272
1	Agriculture, hunting, forestry and fishing	0,433	0,654	0,468	0,542
2	Mining and quarrying of energy producing materials	0,488	0,696	0,143	0,157
3	Mining and quarrying except energy producing materials	0,836	0,770	0,266	0,180
4	Food products, beverages and tobacco	0,526	1,169	0,153	0,331
5	Textiles, textile products, leather and footwear	0,845	0,938	0,349	0,344
6	Wood and products of wood and cork	0,539	1,499	0,341	0,545
7	Pulp, paper, paper products, printing and publishing	0,284	1,015	0,162	0,270
8	Coke, refined petroleum products and nuclear fuel	0,566	1,446	0,079	0,150
9	Chemicals (including pharmaceuticals)	0,522	1,289	0,155	0,256
10	Rubber and plastics products	0,746	1,136	0,197	0,242
11	Other non-metallic mineral products	0,815	1,036	0,163	0,201
12	Basic metals: iron and steel and non-ferrous metals	0,633	2,100	0,094	0,186
13	Fabricated metal products, except machinery and equipment	0,456	1,541	0,154	0,238
14	Machinery and equipment	0,539	1,125	0,190	0,247
15	Office, accounting and computing machinery	0,583	0,917	0,961	1,034
16	Electrical machinery and apparatus	0,437	1,454	0,147	0,225
17	Radio, television and communication equipment	0,409	0,802	0,181	0,241
18	Medical, precision and optical instruments	0,462	1,041	0,173	0,247
19	Motor vehicles, trailers and semi-trailers	0,491	1,210	0,108	0,199
20	Other transport equipment	0,515	1,149	0,209	0,259
21	Manufacturing; recycling	0,455	1,000	0,245	0,358
22	Electricity, gas, steam and hot water supply	0,245	0,637	0,059	0,088
23	Collection, purification and distribution of water	0,650	0,455	0,127	0,103
24	Construction	0,344	1,078	0,185	0,266

25	Wholesale and retail trade; repairs	0,483	0,510	0,280	0,278
26	Hotels and restaurants	0,469	0,767	0,188	0,258
27	Land transport; transport via pipelines	0,399	0,825	0,307	0,364
28	Water transport	0,403	0,965	0,055	0,141
29	Air transport	0,401	0,696	0,080	0,115
30	Supporting and auxiliary transport activities	0,176	0,658	0,205	0,261
31	Post and telecommunications	0,345	0,269	0,108	0,094
32	Financial intermediation	0,130	0,419	0,108	0,156
33	Real estate activities	0,461	0,178	0,060	0,024
34	Renting of machinery and equipment	0,543	0,630	0,161	0,173
35	Computer and related activities	0,504	0,735	0,172	0,217
36	Research and development	0,579	0,675	0,221	0,250
37	Other business activities	0,292	0,749	0,296	0,370
38	Public administration and defence compulsory social security	0,125	0,529	0,204	0,247
39	Education	0,269	0,174	0,300	0,296
40	Health and social work	0,403	0,627	0,229	0,257
41	Other community social and personal service activities	0,000	0,546	0,161	0,232
42	Private households with employed persons	0,270	1,000	0,853	0,797

Source: Author's computations from OECD STAN database

Industry by industry multipliers vary significantly, but sectors showing the highest total multipliers are also amongst the most dependent on imports: other non-metallic mineral products, wood and products of wood and cork, coke, refined petroleum products and nuclear fuel, iron and steel or machinery and equipment. According to García and Carvajal (2012), the first three are also "key sectors"[9], which means that they are important in weaving the whole economy together, given their above average ability to influence other sectors, through their demand and supply of goods used as inputs. Sectors with higher domestic multipliers are textiles, textile products, leather and footwear, rubber and plastic products and chemicals (including pharmaceuticals), which are also large export sectors. Many service industries (most notably wholesale, retail trade, repairs, hotels and restaurants and financial intermediation) show rather low output multipliers, while being also large industries in terms of their product and employment. It would imply that these sectors are unable to generate or transmit growth to the economy, despite the fact that they are

9. Key sectors show above-average ability to spread growth impulses in the economic system through their above average demand for inputs (per unit of output) and their above average capacity to offer goods demanded as inputs by other producers (per unit of output).

important for the specialization profile of the economy. Such structural characteristics do not contribute to the sustainable character of growth.

García and Carvajal (2012) complete the list of key sectors with the following low and medium technology sectors[10]: agriculture, hunting, forestry and fishing, mining and quarrying, pulp, paper, paper products, printing and publishing, basic metals; fabricated metal products, except machinery and equipment, electrical machinery and apparatus, renting of machinery and equipment. Only two high technological intensity activities are key sectors: computer and related activities and other business activities. In general high technology sectors do not play a major role in weaving the productive sector together, because of their size and their imports dependency.

The average employment coefficient in Greece is 0.15; i.e. in order to produce one Euro of total output there is that number of people employed directly. Sectors with lower coefficients are coke, refined petroleum products and nuclear fuel, water transport, production, collection and distribution of electricity and air transport. On the other side of the scale, sectors that offer more jobs per unit of output are fabricated metal products, except machinery and equipment, private households with employed persons and extra-territorial organisations and bodies, agriculture, hunting, forestry and fishing.

Employment multipliers (Table 8) are obviously higher than the corresponding labour coefficients, as they refer to the direct plus indirect employment required per unit of output; the complexity of the economic structure explains that difference – in other words, in more complex economies differences between direct labour coefficients and labour multipliers are more significant. In Greece, total employment multipliers are over 1.7 times labour coefficients and domestic employment multipliers are 1.4 times bigger than the labour coefficients. These latter differences are due to the distance between the employment requirements of the domestically produced inputs and the imported ones. That means that domestic sectors and the sources of imports use similar technologies; nevertheless by importing inputs, jobs are not created in the country. Those could be compensated by exports, but it has been already shown that it is not the case.

Another interesting feature is that sectoral hierarchies of the total and domestic employment multipliers are not so different, because they are calculated with the

10. García and Carvajal (2012) use a slightly different industry classification based on EUROSTAT database, but their results are comparable to those presented here.

same labour coefficients, on the one hand and, on the other because domestic and foreign producers use similar technologies. There are a few sectors that present higher domestic multipliers, i.e., domestic production would create more jobs with the present technology if compared to the total supply of similar goods, which includes imports. Those are office, accounting and computing machinery, education and other business activities. Such results are due to statistical imbalances in the IO tables.

The fastest growing and exporting activities show employment multipliers slightly below the national average. Yet, as discussed already, those are rather small to absorb a significant part of the labour supply. Such industries also present lower domestic employment multipliers, but higher total ones since imports replace domestic production; developing those industries under the present technological conditions would export their ability to create jobs. On the other hand, the largest employing industries, mostly services, together with agriculture and construction use also less intense technologies; increasing employment there would not raise productivity.

A further exercise has been performed in order to estimate the employment associated with foreign trade of goods. According to equation (7), about 16% of total employment is generated by exports; using the same equation, over 34% of the total employment of the economy would be associated with the value of imports (see Table 9). This means that lowering the dependence on imports, the economy could increase the number of employees up to 34%, with the present technology used in the productive sector. Autarky is not desirable, nor would it be possible in the European institutional setting. Besides the country does not produce many natural resources, nor could it instantly produce many of the manufactures currently imported, but there is certainly significant room to increase output and employment.

Table 9. Estimated employment associated to exports and imports 2005

		To exports	To imports
	Total	15,88	34,27
1	Agriculture, hunting, forestry and fishing	16,65	25,72
2	Mining and quarrying of energy producing materials	383,59	1445,27
3	Mining and quarrying except energy producing materials	47,66	91,33
4	Food products, beverages and tobacco	13,26	27,70
5	Textiles, textile products, leather and footwear	53,56	124,78
6	Wood and products of wood and cork	24,68	152,05
7	Pulp, paper, paper products, printing and publishing	23,14	84,99

8	Coke, refined petroleum products and nuclear fuel	51,10	54,85
9	Chemicals (including pharmaceuticals)	92,22	386,55
10	Rubber and plastics products	39,57	105,03
11	Other non-metallic mineral products	16,21	40,90
12	Basic metals: iron and steel and non-ferrous metals	101,71	241,20
13	Fabricated metal products, except machinery and equipment	22,37	50,51
14	Machinery and equipment	43,81	319,03
15	Office, accounting and computing machinery	211,10	10039,42
16	Electrical machinery and apparatus	46,36	140,48
17	Radio, television and communication equipment	48,33	388,95
18	Medical, precision and optical instruments	51,17	499,97
19	Motor vehicles, trailers and semi-trailers	44,14	1061,94
20	Other transport equipment	60,98	212,01
21	Manufacturing; recycling	9,48	94,19
22	Electricity, gas, steam and hot water supply	26,50	69,76
23	Collection, purification and distribution of water	18,52	24,60
24	Construction	3,15	6,87
25	Wholesale and retail trade; repairs	16,13	19,98
26	Hotels and restaurants	3,19	1,64
27	Land transport; transport via pipelines	15,48	19,30
28	Water transport	94,84	0,86
29	Air transport	40,34	60,46
30	Supporting and auxiliary transport activities	175,49	197,63
31	Post and telecommunications	18,33	23,96
32	Financial intermediation	16,90	33,66
33	Real estate activities	4,18	7,99
34	Renting of machinery and equipment	42,69	41,22
35	Computer and related activities	19,01	22,46
36	Research and development	22,52	27,32
37	Other business activities	26,94	54,14
38	Public administration and defence compulsory social security	0,90	1,20
39	Education	0,43	0,25
40	Health and social work	0,59	0,74
41	Other community social and personal service activities	4,09	8,44
42	Private households with employed persons	0,00	0,00

Source: Author's computations from OECD STAN database

There is even more to gain if the country manages to modernise its manufacturing and services sectors and make them competitive enough and export oriented. As stated above, trade between developed countries relies more on product differentiation and adopts an intra-industry character. Modernizing the present productive

apparatus would provide the economy with the necessary tools to compete in the foreign markets and increase the employment opportunities for the population.

4. Final Remarks

The Greek economy has grown fast in the last few decades, while transforming from rural into an urban high incomes country. Apparently however it has not been able to close the gap with the wealthiest countries in the world. Despite its performance and even before the onset of the 2010's economic crisis, there were signs of structural difficulties that would eventually weigh on the economy, even if they would not trigger the crisis.

One of these weaknesses is the dependency of the economy on imports. Such goods replace domestic produce, so far absent in the volume or desired characteristics to satisfy domestic demand; for example, domestically higher technology industries are small and concurrently they are amongst the largest sources of imports. Exports on the other hand, lag behind and few industries are oriented towards external demand. The competitiveness of the economy has not been a priority in the long-term economic strategy. In a word, the external deficit has structural origins and will not be easily solved.

Labour productivity and total factor productivity are the main forces leading economic growth. On the other hand, investment seems to enlarge capital stocks and introduce newer technologies into the economy. Apparently however, capital stock has outgrown the economy in the last few years, so capital productivity has also grown sluggishly if compared to other grow determinants.

In terms of the Greek economic structure, value added represents a high proportion of output, which would indicate that overall intermediate inputs are used efficiently, but on closer inspection of the figures, industries, such as agriculture or some low technology services are large contributors to output and employment by European standards. These industries demand smaller proportions of inputs, for which they show large VA employing primary inputs in larger amounts with lower productivity; hence their multipliers are smaller. Economic policy could contribute to raise sectoral productivity and locate factors more efficiently elsewhere, probably allowing at the same time a lowering of the economy's dependency on imports.

It is reasonable to conclude that Greek growth is not a self-sustained process, because there is no correspondence between the faster growing sectors and the largest, nor between the former and those that weave the economic structure together. Therefore, expansion depends upon final demand, and that demand on its financing

supports. It is clear that the economy needs restructuring towards a more industrial character before it can resume fast growth and perhaps manage to converge with the richest economies.

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