General Session G07
Earth sciences and Society (teaching and education, health, sustainable development, etc.)

Scientific Annals, School of Geology, Aristotle University of Thessaloniki Proceedings of the XIX CBGA Congress, Thessaloniki, Greece	Special volume 99	435-442	Thessaloniki 2010

DETERMINANTS OF THE DEMAND FOR GRANITES IN THE DOMESTIC MARKET OF GREECE

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Abstract: The extraction, exploitation and trade of marble is one of the most important comparative advantages of Greek economy. However, despite of the presence of many granitic bodies of various sizes in Greece, no granites are extracted systematically. As a result the domestic demand of granites is almost totally covered by imports of either raw or processed granite. This has a serious impact to the trade gap of granites, which increases over the last fifteen years. Data on the Greek granite market are presented and evaluated, in order to elucidate the current trends. According to these, the demand for granites and the penetration of granites in the marble-granite market appear to increase over the period 1992-2008. The main factors that affect the demand for granites are the number of hotels built and the net per capita disposable income of the consumers and to a less extent the number of new and renovated dwellings.

Keywords: granite, trade, granite market, ornamental stones, building materials, hotels, dwellings

1. Introduction

Greece exhibits a long tradition in the extraction and exploitation of building stones, particularly marbles. Today Greece is one of the most important marble producers and exporters of marble of the world. Forty different types of Greek marble are available in the market and cover a wide range of colours and physical properties. The one with the highest commercial value is the snow-white dolomitic marble (Chatzipanagis and Vougioukas, 2005).

In recent years, the use of granite as a decor material in buildings (indoors and outdoors) and monuments has globally been increased, due to its durability and appearance. In this paper, "granite" is a commercial term used in the dimension stone market, and encompasses a variety of igneous and metamorphic rock-types, used as building materials. However, in igneous petrology, granite is a prevailing rock-type describing acid plutonic rocks having a particular mineralogy and geochemistry.

Granites are quite common rocks in Greece. Granitic bodies of various sizes can be found in Rhodope, Serbomacedonian and Atticocycladic Massifs, Circum-Rhodope, Stip-Axios and Pelagonian zones.

Despite the fact that there is a global trend in using granite at increasing amounts instead of other building materials (Ciccu et al., 2005), and the extensive know-how in extracting and processing dimension stones, there is no systematic extraction of Greek granites. However, many granitic bodies may be considered of high quality and could be extracted. Examples include the granites of Pisoderi and Agios Germanos in Florina (Kelesidis and Tsompos, 1990) and Vrontou in Serres (Chrysostomidis et al., 1992).

In this paper an attempt is made to present the general trends in the demand for granite in Greece. Additionally, some factors that may affect the demand will be examined. These are the domestic hotel potential, the net per capita disposable income of the consumers and the number of new and renovated dwellings. In addition some trends in the global stone market will be presented.

1.1 The world stone market

The world stone industry has expanded since the early 1990s with production growing by an average rate of 7% per year. From 2001 to 2005 the annual production growth was accelerated to a rate of 9% (www.immcarrara.com/stat/). Such a long

lasting tendency is linked to the global development of the building industry parallel to the increase of the world population (Ciccu et al., 2005).

Consequently, if this trend continues, it can be estimated that the future volume of production and consumption will reach 450 million tons within the next twenty years. This figure is realistically attainable, since it is supported by an international market rapidly growing and by a strong development in technology.

The world supply of granites is increasing. The overall increase in production and in export activity registered from 2001 to 2005, results from the excellent performance of fast growing countries like China, India, Turkey and Brazil, together with the progress of some recent entries like Iran and Egypt. On the other hand, the traditional leading countries represented by Italy, Spain, Portugal and some newcomers in the 90's such as South Africa and South Korea seem to suffer the pressure of the enormous increase of export of Chinese products. Industry concentration is still very strong; the main four stone producing countries - China, India, Italy and Spain - represent more than 53% of the total production and account for 60% of the global exports (Ciccu et al., 2005).

As far as the world demand for granites is concerned, beside the traditional stone consumption countries like USA, Italy, France, Germany and Spain, dimension stone industry is encountering favourable conditions in regions where the building industry is dramatically expanding, such as China, India and some Middle East countries. According to data for 2004, it can be noted that:

- The highest per capita demand is found in European countries like Italy, Spain and Greece where more than 1 m^2 of stone products is consumed every year by each habitant. In the Western world, average annual consumption is around 0.5 m^2 with the US and the UK, respectively at 0.24 m^2/inh and 0.18 m^2/inh., offering the largest market growth potential.
- World average annual consumption is around 0.12 m^2/inh, while the key emerging countries China and India are still not reaching half of this figure.
- The new entrant producers Brazil and Turkey have a very high aptitude for export (Ciccu et al., 2005).

2. Data and methods

The branch of marbles is one of the most important in the mining sector and the national economy of Greece. Greek marble is considered as one of the comparative advantages of Greek economy (Herz, 1989). Despite the intensive competition from other countries (China, Italy, India, etc.), the difficulties due to the institutional frame (e.g. difficulties in providing extraction licences) and the high production costs, Greece is among the ten largest producers of marble of the world (Tsirambides, 2005). The demand for marble in Greece is variable, although an increasing trend can be distinguished from 2001 to 2006.

Granite is a substitute product to marble, offering great variability in colour and very good mechanical properties. However there is no systematic extraction of granites in Greece. As a result, the domestic demand is mainly covered by imports of granite either raw or processed. The imported raw granite is processed by several enterprises that are activated in the marble extraction and processing sector.

In order to investigate a possible trend in substitution of granites instead of marbles, data retrieved from the National Statistical Service of Greece (N.S.S.G., 2009) will be used. Moreover data concerning the trade of granites in Greece (exports, imports and countries of origin) will be presented. Finally, two variables that may represent the demand (the total imports of granite and the apparent consumption of granite) will be separately correlated with some factors that are likely to affect them (the domestic hotel potential, the net per capita disposable income and the number of new and renovated dwellings). The correlation between the variables that represent the demand for granite and each one of the variables that may affect it will be assessed by using the r-squared values that were provided by the SPSS software.

3. Results and discussion

The demand of granite in the domestic marble-granite market of Greece increases over the last years. This is evident from the data compiled from the National Statistical Service of Greece (N.S.S.G., 2009) that provide an increasing penetration of granites substituting marbles, in terms of apparent consumption in tonnes. It must be noted that the apparent consumption is different from the real consumption and it is defined as the production, plus the imports, minus the exports (Tab. 1).

Table 1. Penetration of processed granite in the total marble-granite market of Greece.

Year	Apparent consumption of marble end-products (tonnes)	Apparent consumption of granite end-products (tonnes)	Total (tonnes)	Penetration (%) of processsed granite in the marble-granite market
1993	1,674,140	2,971	1,677,472	0.18
1994	1,756,030	1,475	1,757,505	0.08
1995	1,377,480	882	1,378,362	0.06
1996	1,354,850	3,971	1,358,821	0.29
1997	1,434,135	4,571	1,438,706	0.32
1998	1,419,770	13,31	1,433,080	0.93
1999	1,400,155	12,555	1,412,710	0.89
2000	1,491,200	17,001	1,508,201	1.13
2001	1,333,595	11,293	1,344,888	0.84
2002	1,542,865	19,01	1,561,875	1.22
2003	1,722,520	28,648	1,751,168	1.64
2004	1,727,443	41,144	1,768,587	2.33
2005	1,728,131	33,62	1,761,751	1.91
2006	1,702,330	41,447	1,743,777	2.38
2007	1,542,228	34,57	1,576,798	2.19

source: N.S.S.G., 2009

It is noteworthy to mention that there is a strong increase in the apparent consumption of granites from 2003 to 2004. This is likely to be attributed to the large construction activities of this period, concerning the Olympic Games.

Data about the imports of raw and processed granite and the exports of processed granite of Greece are presented in table 2. An increase in the quantity of imported processed granite, with a parallel decrease in the quantity of imported raw granite is evident. That implies a decrease in the added value produced via the processing of granite domestically. This is likely to be caused by the increasing costs of processing granite domestically.

Details about the origin, quantity and value of both raw and processed granite imported in Greece are presented in table 3.

Brazil, S. Africa, Turkey and India are the most important exporters of raw granite to Greece, in terms of quantity and value. However, this is not the case in the processed granite imports. China is by far the largest exporter of processed granite from 2004 to 2006, while Italy and India follow in the second and third place respectively. It is worth noticing that the value of Chinese processed granite is increasing greatly.

In table 4 the quantities and values of raw, processed and total exports of granite are presented. The exports of both raw and processed granite are confined. Additionally, it seems that there is no regularity in the variation of granite exports.

Table 2. Quantities and values of imported raw, processed and total granites to Greece.

	Raw		Processed		Total	
Year	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
1993	2,06	185,729	1,421	555,008	3,481	740,737
1994	7,734	695,149	2,277	819,806	10,011	1,514,955
1995	11,68	2,126,917	4,838	2,809,561	16,518	4,936,478
1996	16,454	3,624,179	4,839	3,190,154	21,293	6,814,333
1997	20,018	3,358,019	6,691	3,707,974	26,709	7,065,993
1998	21,563	4,089,793	7,017	4,023,927	28,58	8,113,720
1999	22,384	4,614,418	7,867	4,412,654	30,251	9,027,072
2000	19,567	4,590,833	5,634	2,933,627	25,201	7,524,460
2001	26,332	5,952,197	7,965	4,826,261	34,297	10,778,458
2002	26,874	5,826,501	10,241	5,254,094	37,115	11,080,595
2003	22,345	4,897,122	15,884	6,847,492	38,229	11,744,614
2004	25,907	4,367,447	17,56	6,966,399	43,467	11,333,846
2005	19,975	4,533,426	21,799	8,817,856	41,774	13,351,282
2006	19,993	3,995,114	26,681	9,627,829	46,674	13,622,943
2007	24,593	2,799,236	30,77	10,587,748	55,363	13,386,984

source: N.S.S.G., 2009

The trade of Greek raw granites is limited. This is confirmed by table 5, where the destination, quantity and value of Greek raw granites are presented. However, the trade of processed granites is more evolved as expected, because processed granites are products of high-added value, but it is mainly restricted to the Balkan countries.

The trade balance for granites (both raw and processed) is strongly negative. The trade gap is growing with an increasing rate (Fig. 1), mainly due to the increase of demand in the domestic market and the lack of systematic granite extraction.

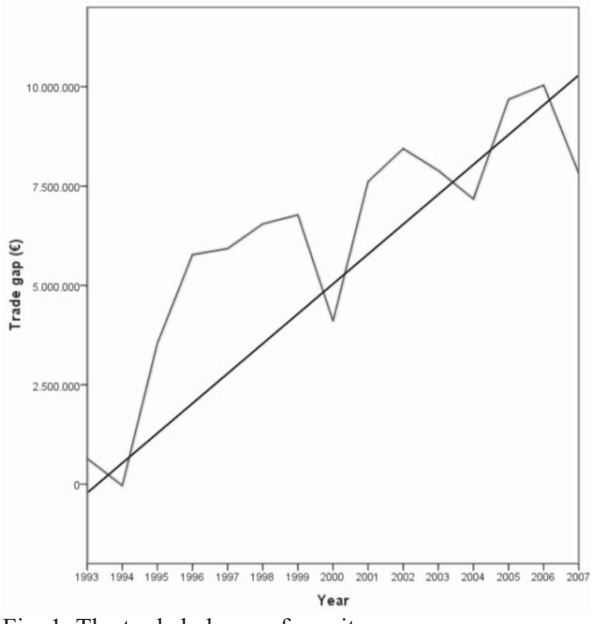

Fig. 1. The trade balance of granites.

Table 3. Quantities and values of raw and processed granite exporters to Greece.

Raw granite imports

Country	2004		2005		2006	
	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
Finland	144	21,579	2,119	197,901	277	248,162
Italy	989	332,872	1	45,737	26	18,972
Spain	1,932	118,213	0	0	2	146,247
U.K.	4	9,007	0	0	0	0
Germany	1	6,718	0	0	0	0
Cyprus	0	0	65	20,576	0	0
Brazil	3,545	529,152	2,894	621,972	4,978	934,031
India	1,138	233,033	5,016	1,175,030	4,855	796,761
S. Africa	2,539	516,713	5,167	1,176,230	4,599	984,211
Turkey	5,884	303,331	449	34,832	2,893	221,786
Norway	1,219	516,562	1,049	395,732	1,412	512,051
Bulgaria	1,035	69,179	326	24,439	487	29,814
China	2,417	684,203	332	95,735	347	96,181
Zimbabwe	3,401	873,069	2,371	729,775	0	0
Egypt	1,181	85,161	95	6,762	0	0
F.Y.R.O.M.	316	32,13	44	2,924	0	0
Ukraine	78	24,758	0	0	0	0
Syria	55	2,517	0	0	0	0
others	29	9,25	47	5,781	117	6,898

Processed granite imports

Country	2004		2005		2006	
	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
Italy	2,525	1,531,543	2,805	1,915,085	2,855	2,039,626
Spain	210	80,259	637	231,3	666	276,325
U.K.	51	245,967	121	543,133	250	1,051,904
Portugal	269	226,236	222	233,954	51	71,785
Denmark	28	14,001	0	0	0	0
China	12,089	3,846,072	14,367	4,320,132	18,735	4,482,541
India	684	540,974	1,177	881,148	1,445	896,89
Turkey	735	160,396	229	113,72	1,02	272,621
Egypt	564	111,342	1,249	259,193	512	118,084
S. Africa	0	0	253	43,437	469	87,032
Bulgaria	112	12,021	88	9,689	271	33,577
Ukraine	0	0	95	62,586	91	63,288
Brazil	215	143,511	230	82,097	86	88,715
Singapore	34	19,835	110	58,99	66	50,3
F.Y.R.O.M.	2	5,832	20	10,188	14	12,706
U.S.A.	40	20,137	0	0	0	0
Syria	0	0	186	48,761	0	0
others	1	8,273	10	4,443	150	82,435

source: N.S.S.G., 2009

The demand for building materials such as marble and granite can be affected by a variety of factors. The most important of them is the public and private building activity.

Large quantities of marble and granite have been used and will continue to be used for the construction of several large public works. Good examples are the 'Eleftherios Venizelos' airport in Athens, works for the 'Athens 2004' Olympic Games, the

Table 4. Quantities and values of raw, processed and total granite exports from Greece.

Year	Raw		Processed		Total	
	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
1993	85	13,224	413	80,716	498	93,94
1994	12,327	1,159,774	1,845	388,966	14,172	1,548,740
1995	5,968	730,747	1,144	659,709	7,112	1,390,456
1996	428	176,179	1,274	862,811	1,702	1,038,990
1997	244	82,45	1,595	1,055,709	1,839	1,138,159
1998	263	83,533	2,017	1,481,291	2,28	1,564,824
1999	1,315	358,23	2,555	1,893,371	3,87	2,251,601
2000	1,086	376,595	4,386	3,041,166	5,472	3,417,761
2001	1,555	528,375	3,923	2,636,580	5,478	3,164,955
2002	2,108	512,594	2,932	2,125,569	5,04	2,638,163
2003	1,605	337,664	5,263	3,517,041	6,868	3,854,705
2004	2,789	631,412	5,171	3,529,938	7,96	4,161,350
2005	4,327	873,401	3,943	2,796,412	8,27	3,669,813
2006	1,819	390,91	4,806	3,194,484	6,625	3,585,394
2007	11,998	2,387,934	6,09	3,178,645	18,088	5,566,579

source: N.S.S.G., 2009

'Athens Metro' and the 'Thessaloniki Metro' which are still in progress. However, there is no available data for the quantities of marble and granite used in the above works.

Large quantities of granite are also used in hotels in both interior and exterior applications. Consequently, the number of new hotels built can affect the demand for granites. Relative data on the hotel potential of Greece, retrieved from the Hellenic Chamber of Hotels (www.grhotels.gr) are presented in table 6.

The private building activity can affect the demand for granites, as they can be applied at floors or walls as decorative stones in new and renovated dwellings. However the quantities of granite used are likely to be smaller than that used in hotels. Data about the new and renovated dwellings have been compiled from the National Statistical Service of Greece (www.statistics.gr) and are presented in table 7.

Finally, the demand for granites can be affected by other factors such as the per capita disposable income of the consumers and the presence of substitutes in the market and (Table 7). Ceramic or wood tiles can be used instead of marble or granite. According to ICAP (2006) the domestic apparent consumption of ceramic tiles increases with an annual growth rate of 3.6%. The main driving force for consumers to prefer ceramic or wood tiles instead of granite is the price. Granite is a product that appeals to consumers of high economic status.

In order to assess the extent at which the above

Table 5. Quantities and values of raw and processed granite exports form Greece.

Raw granite exports

Country	2004		2005		2006	
	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
Cyprus	10	3,05	0	0	92	35,879
Italy	0	0	1,973	378,935	23	24,844
Germany	0	0	94	9,943	0,2	1
Belgium	1	3,012	0	0	0	0
Serbia & Montenegro	1,624	334,202	1,263	250,755	0	0
Serbia	0	0	179	39,012	1,145	212,021
F.Y.R.O.M.	712	171,338	322	72,283	316	51,737
Bulgaria	269	68,501	339	89,311	216	53,429
Ukraine	7	6,548	0	0	0	0
Albania	1	1,012	46	6,218	0	0
others	166	43,749	111	26,944	27	12

Processed granite exports

Country	2004		2005		2006	
	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)	Quantity (tonnes)	Value (€)
Cyprus	1,144	795,436	899	667,778	904	751,96
U.K.	40	52,025	14	21,346	59	55,279
Italy	125	147,115	23	21,828	16	17,221
Germany	147	84,642	64	75,31	13	15,434
Spain	135	41,572	0	0	0	0
Romania	666	423,739	660	432,962	1,277	799,94
Bulgaria	916	564,713	1,049	691,72	1,052	728,682
F.Y.R.O.M.	1,121	538,685	522	313,643	678	316,915
Serbia	0	0	131	79,968	348	236,03
Albania	1	1,384	20	17,574	115	38,195
Australia	163	198,046	29	29,614	89	91,129
Tunesia	11	7,2	0,3	1	42	19,585
Georgia	4	4,01	0	0	23	2,717
U.S.A.	93	100,288	179	186,976	22	21,327
Serbia & Montenegro	338	193,251	138	64,294	0	0
Russia	124	323,171	102	79,8	0	0
others	143	54,661	113	113,598	168	100,07

source: N.S.S.G., 2009

variables are related to each other, the relative correlation matrix was made (Table 8). Two of them monitor the demand for granites in the market (total imports in tonnes and apparent granite consumption in tonnes) and three selected variables (number of hotels, net per capita disposable income and number of new and renovated dwellings), as described above, are likely to affect them. The correlation between all the variables was of cubic form (y=ax^3+b), rather than linear or quadratic, as this one provides the highest r-squared values in all cases.

The granite imports (raw and processed) appear a very good correlation with the number of hotels present in Greece (R^2 = 0.949) and the net per capita disposable income (R^2 = 0.965). On the other hand, the correlation coefficient between granite imports and the number of new and renovated dwellings suggests a weaker correlation between them (R^2 = 0.695).

Table 6. The hotel potential of Greece.

Year	5*	4*	3*	2*	1*	Total
1993	51	629	1,896	2923	1,636	7,135
1994	52	595	1,294	3,592	1,637	7,17
1995	60	621	1,328	3,719	1,659	7,387
1996	62	656	1,362	3,75	1,647	7,477
1997	65	681	1,405	3615	1,628	7,394
1998	72	728	1,449	3,87	1,666	7,785
1999	77	745	1,456	3,907	1,671	7,856
2000	79	766	1,474	3,967	1,65	7,936
2001	90	816	1,543	4,189	1,646	8,284
2002	97	847	1,579	4,329	1658	8,51
2003	104	870	1,613	4,403	1,699	8,689
2004	139	896	1,66	4,473	1,731	8,899
2005	155	944	1,712	4,496	1,729	9,036
2006	176	994	1,804	4,46	1,677	9,111
2007	199	1,048	1,9	4,403	1,657	9,207

The apparent consumption of processed granite also appears very good correlation coefficients (R^2) with the number of hotels present in Greece (0.914) and the net per capita disposable income (0.914). The correlation between the apparent consumption of processed granite and the number of new and renovated dwellings is not so good (R^2 = 0.699) as well as in the case of the granite imports.

In figures 2-7 the above variables are plotted one against each other. In figures 2-4 the correlation between the total imports of granite and the factors that may affect it is presented, whereas in figures 5-7 the apparent consumption of granites is corre-

Table 7. New and renovated dwellings in Greece, with the net per capita disposable income.

Year	New and renovated dwellings	Net per capita disposable income (€)
1993	79,15	6,342
1994	80,607	7,121
1995	70,862	7,317
1996	86,737	7,912
1997	89,603	8,68
1998	97,279	9,345
1999	88,5	9,925
2000	89,341	11,241
2001	108,021	12,056
2002	128,237	12,747
2003	127,051	13,695
2004	122,148	14,622
2005	195,207	15,12
2006	125,387	16,176
2007	103,865	17,078

source: N.S.S.G. (1992-2007)

Table 8. Correlation matrix of the variables studied.

	Total imports (tonnes)	Apparent granite consumption (€)	Total number of hotels	Net per capita disposable income (€)	New & renovated dwellings
Total imports (tonnes)	1				
Apparent granite consumption (€)	0.761	1			
Total number of hotels	0.949	0.914	1		
Net per capita disposable income (€)	0.965	0.914	0.992	1	
New & renovated dwellings	0.695	0.699	0.364	0.332	1

lated with the same factors.

The total imports of granites appear to have slightly better correlation coefficients than the apparent consumption of processed granites in all cases, except for the number of new and renovated dwellings. As a result, the total imports of granites are likely to be a better index of the demand of granite in the Greek market.

It is worth to note that the correlation between number of new and renovated dwellings and both the imports and the apparent consumption of granite is rather diffuse. This reveals that granite is not preferred as building material in private houses as much as it is in hotels, which is likely to be caused by the presence of many competitive products. Moreover the quantity of granite used in private dwellings is a lot smaller than that used in hotels. The fact that granites are more expensive than other building materials (marbles, ceramic tiles and wood) should also be considered. Moreover the suspiciousness of private consumers about the natural radiation of granites could also prevent them from applying granite to their dwellings. The enterprises that activate in the granite sector should apply marketing and advertising policies in order to inform the public about their products available in the market, their properties and applications.

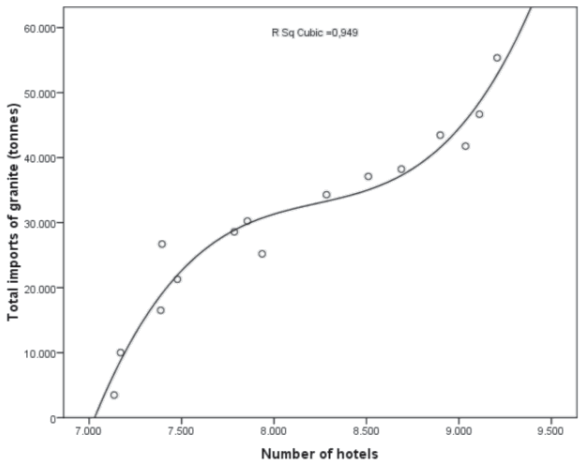

Fig. 2. Total imports of granite versus total number of hotels.

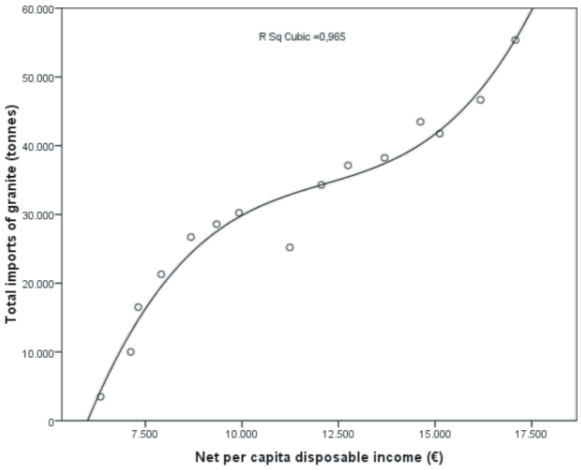

Fig. 3. Total imports of granite versus net per capita disposable income.

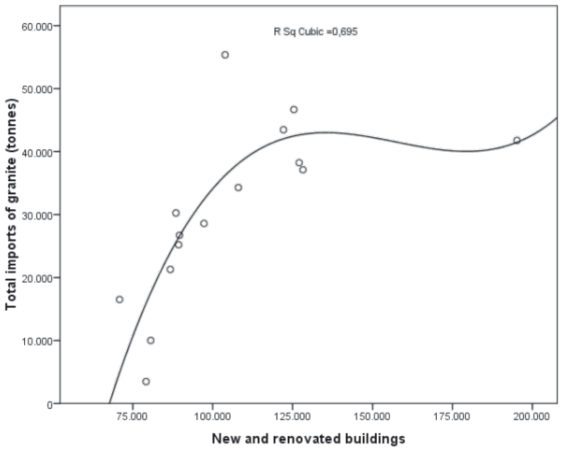

Fig. 4. Total imports of granite versus new & renovated dwellings.

4. Conclusions

The global stone market is growing by an annual rate of 9% over the period 2001-2005. Greece is not currently extracting granites systematically. Among the reasons are mostly the institutional frame problems, environmental issues and the high competition of newcomers in the market such as China and India.

However, the demand and penetration of granites in the Greek marble-granite market is growing.

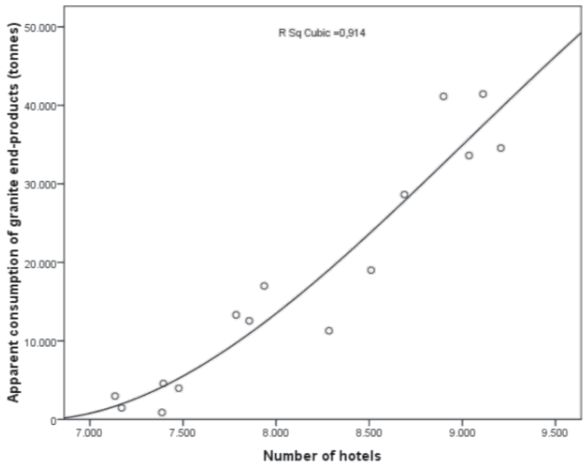

Fig. 5. Apparent granite consumption versus total number of hotels.

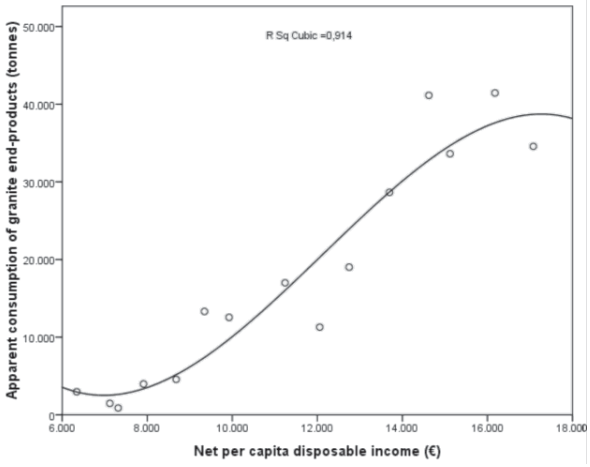

Fig. 6. Apparent granite consumption versus net per capita disposable income.

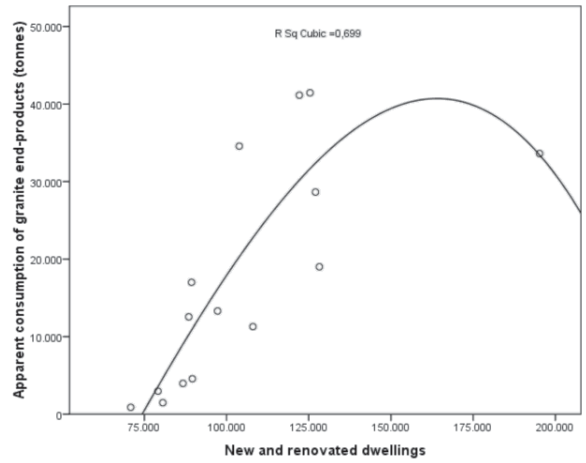

Fig. 7. Apparent granite consumption versus new & renovated dwellings.

The main reason of this growth is the use of granites in public constructions (airports, metro stations) and hotels, rather than in private dwellings. The increase of the net per capita disposable income is also a significant factor that affects the increasing demand for granites.

Both the variables selected to represent the demand for granites in Greece (total imports and apparent consumption) were highly correlated (r-squared > 0.91) with the number of hotels and the net per capita disposable income. However the correlation of both with the number of new and renovated dwellings is not so good (r-squared < 0.7).

The total imports of granites should be considered as a better measure of domestic granite demand than the apparent consumption of processed granites, due to the slightly higher correlation coefficients of the first.

The trade balance of granite in Greece is strongly negative with an increasing growing rate. Consequently, as long as the demand for granites increases, the extraction of Greek granites becomes necessary to investigate. Finally, in terms of natural radioactivity of Greek granites, according to (Karavasili 2004) and (Papadopoulos et al. 2010 – in press), the relative hazard indices appear to be below international limits and in many cases, below the natural radioactivity, measured in the imported granites (Pavlidou et al. 2006)

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