THE DEPENDENCY OF THE GREEK SOFTWARE INDUSTRY ON THE PUBLIC INVESTMENT PROGRAM OF GREECE

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Abstract

The dependency of the Greek Software Industry (GSI) sector on the Public Investment Program (PIP) of Greece and on certain macroeconomic and sector-specific indices is investigated together with the prospect of expansion of GSI to foreign markets. The main characteristics, a brief historical background and an analysis of the GSI Sector are presented. On the other hand, PIP along with its development over the last fifteen years, has been in incremental relation with the Community Operational Frameworks of the EU. An econometric model is presented that attempts to estimate the dependency of the software sector turnover upon PIP and the following indices: gross domestic product, disposable income, average labor cost, interest rate and change in broadband relations. The process is described in detail and the results show the statistical significance of the independent PIP variable together with seasonality, as the main factors of dependence of the software sector turnover. The model may be further useful to decision making and economic policy regarding the development of the Greek software sector. Finally, after a short description of the current macroeconomic environment, the prospects of expansion of the Greek Software Industry to foreign markets are considered and the most important growth factors, according to a recent survey among sector executives, are presented.

1. Introduction

The Greek Software Industry, an industry younger than two decades, is trying to find its place in a market that is almost totally globalized, while facing the fierce consequences of the current economic crisis.

The aim of this work is to examine the current status of the Greek Software Industry and analyze its strengths and weaknesses. In order to find the level of awareness of the industry towards the changes that the new technological and macroeconomic environment will bring, we address the question of the dependency of the software industry on the government expenditure, especially the Public Investment Program.

Therefore, we apply statistical analysis, having the turnover of the Greek Software Industry as the dependent variable, and examine its dependency on various macroeconomic and sector-specific variables. The main problem that we confronted with in data collection relating to the Software Industry is its indivisibility with its associated industries, namely the Information Technology industry and the Communication industry. Another obstacle was the absence of reliable data concerning the years before 2000, because, during that period, the sector was actually immature.

The outcome of the statistical analysis is quite revealing. The execution of a stepwise regression procedure resulted to the elimination of all the -under examination- independent variables, but the one representing the Public Investment

Program amount. This result allows for interesting conclusions and discussion about the future prospects of the Greek Software Industry.

Section 2 provides a detailed analysis of the Greek Software Industry. It explains the main characteristics of the industry and presents briefly the history of the Greek Software Industry. Moreover, Porter's five forces model enhances the analysis of the current market conditions of the sector. Section 3 gives an overview of the Greek Public Investment Program, its purpose and its relation to the EU funding. The European Regional Policy is outlined and the European Regional Policy towards Greece is stated. Also some data concerning the implementation of the Greek PIP over the last 15 years are presented. Section 4 by means of regression analysis investigates whether PIP is a significant factor of the software industry turnover, along with some other variables, mainly macroeconomic. The variables are theoretically justified and the steps of this analysis are explained. Section 5 examines the prospects of the software sector. A brief analysis of the current macroeconomic environment is made, followed by an analysis of the expansion prospects of the software industry to foreign countries. Moreover, the software industry's opinion about its future growth is analyzed, according to the results of an important research survey that was made among industry's executives. Section 6 presents concluding remarks and discusses on the possibility of future direction of this study, which was initiated by the MBA thesis of one of the authors [36].

2. The Greek Software Industry

An analysis of the Greek Software Industry is provided. Section 2.1 explains the main characteristics of the industry. The following two sections provide a brief history of the Greek Software Industry. At the last section, Porter's five forces model enhances the analysis of the current market conditions of the Information Technology sector.

2.1 Current Status

In general, the main problem that one faces in examining the software industry is its inseparability from the other two relative industries, in which it is embedded. One is the IT (Information Technology) industry, which includes hardware and software products, and the other one is ICT (Information and Communications Technology), which also encapsulates the communications sector and occupies an increasing part of the software production. The problem is biased on the fact that the majority of software production companies are also involved with the production and trade of hardware and communication products, like personal computers and mobile phones. However, there are various studies that attempt to isolate the software market from its relative ones. According to one of these [8], the global software market was estimated at 238.5 billion € in 2008. First country market in size is the USA with 105.6 billion €, which covers the 44.3% of the global market. Europe follows with 85.9 billion € (36% of the global market) and Japan, with 10.3%, and the rest of the world with 9.4% follow in distance. Moreover, market researches show that the global software market is the 23% of

the global IT market (1030 billion €) and just 10.9% of the global ICT market (2197.7 billion €). In Europe, the size of the three major markets, those of Germany, France and Great Britain, is about 60% of the total.

The size of the Greek software industry was estimated at about 1.111 billion € in 2008. Although there are no estimations for the years 2009-2011 from a reliable study, it is expected that the recession, which started in Greece in 2009 and has not finished yet, has not left the software industry unaffected. So, it would not be unrealistic if we estimate the current industry's turnover at approximately 1 bln €.

The major product category in Greece is Application Software [33] with about 88% of total turnover. System software is far behind with about 12% of total turnover. However, system software gains an increasing percentage of the total market (10.6% in 2006), which is a sign of the maturity of the domestic market. The major client-user categories are Private sector (21%), Public sector (20%), Bank and Insurance companies (18%) and Consumer software (12%).

In Greece, the majority of companies that sell software products are part of the IT sector, which includes, apart from software products, hardware products too (personal computers, servers and peripherals), either by producing or, mainly, by importing and selling-in.

Greek IT and software sector is fragmented. According to the Hellenic Statistical Authority, ELSTAT [2], in 2003 there were 4399 companies related to the sector. The total number of companies had an annual increase rate of 35%, since year 2000. However, it is estimated that the real market players are much less that the above number and reach about 400 companies, which still is a very large number, regarding the size of the domestic market. The top-ten of the Greek Software companies represent about 1/3 of the total market (34% in 2007). The top-five companies and their market share in 2007 are: 1. INFO-QUEST (approx. 6%), 2. INTRACOM IT SERVICES (approx. 5%), 3. ORACLE HELLAS (approx. 4%), 4. INTRALOT (approx. 3.5%) 5. SINGULAR LOGIC (approx. 3-3.5%).

2.2 History until year 2000

The first complete computer installation in Greece was done by IBM in August 1939 for the Greek Treasury [34]. The first application was for the Public Sector Pensions.

After World War II, the first organization that used IT machines was the Social Security Organization (IKA) in 1950, followed by the Bank of Greece, the National Bank of Greece and the Treasury. During the 60s, the Private Sector enters the IT field with the IBM 360/20 systems. During the 70s, when the transistor is presented and gave tremendous boost in the IT industry, Emporiki Bank was the first to use a system with the new technology, an IBM 370/145. After the year 1980, the changes are rapid. A landmark is the 22th May 1983, when the Olympic Airways reservation system initiated and fully functioned by Greek operators. Until mid-80s, the Greek Software industry was practically absent. There were no Greek companies, but only the large multinational companies, their

representatives and the -so called- service bureaux, an ancestor of today's outsourcing, which supported the banks and the social security organizations at the management of their applications, mainly payroll [9]. These programs had little in common with modern software. They were applications written in COBOL, RPG and PL1, still present until the year 2000. Moreover, the companies that supported those programs were taking advantage of their "black box" applications, achieving a great percentage of net profit, usually over 50%.

The decade between 1985 and 1995 is characterized by substantial changes to the sector globally. All countries realized that a durable strategic policy on the IT and High-Tech sectors was necessary and inevitable, in order to acquire a comparative advantage.

Having that in mind, most European, but also Asian and American, countries chose the establishment of Tech Towns, where universities, research institutes, public organizations and companies have common activities under favorable legal and investment conditions. The Tech Towns have been proved to be a catalytic factor towards the development of high technologies in a country. In Greece, the government chose the research institute model as the main factor of achieving high-tech comparative advantage. However, the research institutes were not continuously funded by national funds and, as a result, they turned to the development of EU research programs, undervaluing the cooperation with the companies.

The research institutes were used as a mechanism of fast absorbing the EU funds of the Integrated Mediterranean programs that were active at that period. However, their role remained the same even in the Community Operational Frameworks that came later (1st COF: 1989-1993, 2nd COF: 1994-1999, 3rd COF: 2000-2006). It is worth mentioning that the IT Integrated Mediterranean Program was funded with 20 billion drachmas (approx. 6.5 million €), which was then an enormous amount.

During that period, the global impact of the Personal Computer did not leave Greece uninfluenced. This was the key factor that resulted to the establishment of many Greek IT companies that were divided into two main company categories, depending on their activities: Companies that traded-in personal computers and peripherals; Software houses, whose sole activity was the production of enterprise and custom software.

The period from 1995 till the end of the century is characterized by the rapid growth of the industry. Large IT projects were started, aimed to the digitalization of the complex procedures of the public sector. A typical example was the TAXIS system, whose purpose was to simplify the taxing procedures. The advance payment given for that project is still the biggest one given for an IT project, more than 4 billion drachmas, approximately 12 million €. The Greek stock market boom had an impact on the industry, as there were many mergers, usually without a specific plan, but only to the direction of pleasing the shareholders. The following tremendous fall on the Greek Stock Market, together with the impact of the Dot-com bubble that came from the other side of the

Atlantic, forced the industry to realize that it had to be appropriately prepared for the first decade of the new century.

2.3 Status since year 2000

Although the circumstances did not seem very favorable at the beginning of the new century due to the Greek Stock Market fall and the American Dot Com Bubble, the sector continued growing during the years 2000 and 2001.

One of the main reasons was the great demand from many companies about system upgrades, in order that the transition to the new millennium to be smooth (Y2K bug). Moreover, the entrance of many companies from various sectors to the Greek Stock Market had, as a result, a great raise of their available funds. A part of these funds was invested by them to the modernization of their IT systems [6]. Another helping hand was the inevitable software upgrade of many client-companies, because of the adoption of the euro as the national currency, on January 2002. The sector growth came to a peak at year 2004, when the Olympic Games were hosted in Greece and a large number of IT related projects were implemented.

Another characteristic of the first years of the 00s was the establishment of new companies, in an even greater rate than that of the period before 2000. Table 1 [17] shows the total number of companies that were established during various periods between the year 1970 and the year 2008, concerning the ICT sector and the IT and Communications Sector separately. We can see immediately that the great majority of the Greek ICT companies were established during the last 15 years.

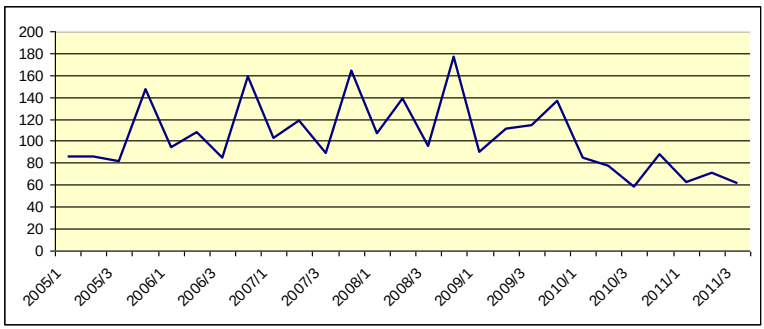
The period between the years 2005 and 2012 is split into two sub-periods. The first sub-period, 2005-2008, is characterized by the continuous and stable growth, especially during the last two years 2007-2008, when the 3rd COF came to its end and many co-funded IT projects were completed. The second sub-period 2009-2012, is characterized by the spread of the economic crisis to Greece and the continuous delays of the implementation of the National Strategic Reference Framework (NSRF). As a result, the sector turnover goes diminishing up to the present time, as there are great uncertainties about the conditions of the domestic and European economy. This is also depicted by the Turnover index of the Hellenic Statistical Authority (ELSTAT) about the "Computer programming, consultancy and related activities" (Code: J62 of NACE Rev.2), which is calculated every 3 months from the 2005 until today [4]. The data of this index is shown in Appendix A: Table 1: column labeled SST.

Chart **1** shows a graphical representation of the SST index.

Table 1. Foundation Year of ICT Companies (Source : Hellastat)

	IT Sector		Communication Sector		ICT Sector	
Foundation Year	**Num. of Comp.**	**%**	**Num. of Comp.**	**%**	**Num. of Comp.**	**%**
Before 1970	7	0.5	3	1.3	10	0.7
1970 - 1979	18	1.4	4	1.8	22	1.4
1980 - 1989	137	10.5	11	4.8	148	9.6
1990 - 1995	271	20.7	30	13.2	301	19.6
1996 - 2000	400	30.6	86	37.7	486	31.6
2000 - 2008	476	36.4	94	41.2	570	37.1
Total	**1309**	**100.0**	**228**	**100.0**	**1537**	**100.0**

Chart 1. Turnover index of the "Computer programming, consultancy and related activities" (Code: J62 of NACE Rev.2) (Source: ELSTAT [4])



Another revealing picture of the sector's bad business climate is given by Chart 2 of the ICT Services Business Expectations index [11], which is quarterly calculated from year 2000 up to year 2011, by the Institute for Economic and Industrial Research (IOBE) and it is dependent on the 1) estimation of the company condition during the last 3 months, 2) estimation of the past demand during the last 3 months and 3) estimation of the future demand during the next 3 months. The index is at its lowest point since year 2000, revealing the difficult position of sector's companies as well as their pessimistic attitude relating to an uncertain future.

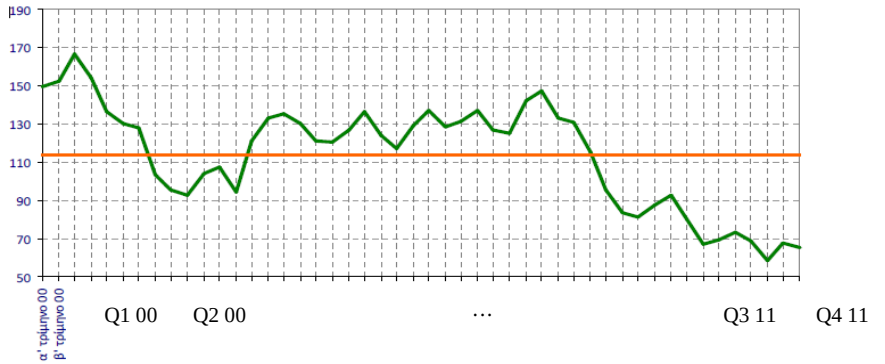


Chart 2. ICT Services Business Expectations Index (Source: IOBE [11])

2.4 IT concentration

According to a study made by the Observatory for Information Society [16], in 2008 there were about 1400 companies whose main or secondary activity was related to the ICT sector. The majority of these (~85%) were related to the IT sector and the rest (~15%) to the Communications one. This results to a number of about 1200 IT companies, which makes it easy to conclude that the sector is fully fragmented, as the Greek market size is rather small for such a number.

Another indication of this, it is offered by the analysis of the personnel number of the ICT sector. The great majority of about 86% has a total personnel number that is below 50 employees, while only 1.9% of the ICT companies have more than 250 employees. Table 2 shows a distribution of ICT companies according to their total personnel number.

Table 2. ICT Companies Personnel (Source: Hellastat)

	%	Average Personnel
≤ 10 employees	41.2	6 employees
11-49 employees	45.0	23 employees
50-249 employees	11.9	93 employees
≥ 250 employees	1.9	568 employees*
Total	**100.0**	**34 employees**

* OTE (Greek Telecommunications Organization) is not included

If we focus on the IT sector and the Communications sector separately, we can see that the above results are even worse for the IT sector, since an average IT company has almost half the personnel of an average Communications company (see Table 3).

Table 3. ICT Companies Personnel per Sector (Source: Hellastat)

	Average Personnel
IT Sector	31 employees
Communications Sector	64 employees

* OTE is not included

The geographic distribution of the ICT companies, as it is expected, is mainly around the capital area, about 80%. The rest 20% of the companies are

distributed to the major Greek cities, where half of them, about 9.3%, are located in the Greek sub-capital, Thessaloniki (see Table 4).

Table 4. Geographical distribution of ICT sector (Source: Hellastat)

Headquarters	Number of Companies	%
Athens	1106	79.4
Thessaloniki	130	9.3
Rest of Greece	157	11.3
Total	**1393**	**100.0**

By following the classical Porter's five forces model we can distinguish the following reasonable explanations of the IT concentration. 1) *Barriers to entry/exit*: There are not many institutional or economic barriers in the domestic market. The capital amount needed for a new company to enter the market is low, according to the local market players. However, a factor that must be considered by anyone who intends to enter the market is the high mortality of the IT companies compared to the other sectors [8]. Two important ongoing changes are the use of Software as a Service (SAAS) and the spread of the Open Source Software, which is freely distributed through the Internet. Both of these factors are expected to change the rules and the format of the domestic market, as they are going to smash the last obstacles of the already globalized software market. Especially SAAS is considered as a major threat, since it is anticipated to make the installed Greek software useless, if the companies will not follow the trend and take position beside the choices and products that are provided by the large multinational IT companies. Nevertheless, there are historical examples, both on the global and the domestic market, which show that the key-word of success of new players to the sector is just *innovation*. The one who -continuously- provides an innovative product has the chance to succeed. 2) *Availability of substitute products*: There are not any substitutes of the software products, either on the standard products or the large software systems. The software market is fully globalized, giving the customers the possibility to make the best choice, without concern about the origin (domestic or imported) of the product. 3) *Bargaining power of suppliers*: The greater asset of the Software companies is their personnel, especially those with the special technical faculty and knowledge. Having that in mind, there is no significant pressure to the companies concerning the supply-demand of the technical personnel market. The domestic technical personnel has high-level education and skills, although there are often difficulties to find the proper combination of specialization and experience. An example of this is the executives which have the necessary combination of technical knowledge and sales experience. However, the economic crisis, together with the great raise of new graduates from the Greek Universities, has put a stop to the continuous raise on the salaries of the personnel. 4) *Bargaining power of buyers*: The small size of the Greek market and the total fragmentation of the Greek Software market make the latter a buyers' market. The buyers' power is enhanced by the late lasting economic crisis, which forces, both the Public and the Private sector, to seriously cut down expenses. As an investment in software is

usually considered of low priority, the result is the pressure to software demand which has resulted to deterioration of: the turnover of the software companies; the economic terms of all the maintenance contracts; the payment terms of the contracts, which affects the liquidity of the companies; and, overall a continuously diminishing profit margin for all sector's companies. 5) *Competitive intensity*: The competition is very intense, as it is naturally expected in a market which: is shallow and small, in terms of demand; is fragmented to many companies; faces tremendous pressure from the current economic crisis; and, its turnover depends mainly on the size of the Public Investments Program. The competition is focused on the great discounts on the software project competitions that are carried out by the Public Sector and the large companies of the Private Sector.

3. The Greek Public Investment Program

This section aims at providing an overview of the Greek Public Investment Program (PIP) and its relation to the EU funding. In Subsection 3.1, the definition of main terms and the purpose of the PIP is provided. In Subsection 3.2, the European Regional Policy is explained, while in 3.3 a detailed analysis of the European Regional Policy towards Greece is presented. The fourth subsection is devoted to the implementation of the Greek PIP over the last 15 years, while the last subsection explains the inability to raise the exact amounts of funds that were forwarded from PIP to the Software Sector.

3.1 Definition of PIP

The term "public investment" is used to describe all the investment activities of the Public Sector, in order to accomplish the economic growth policy that has been planned. The main aim of the public investments is the redistribution of natural wealth in favor of the social community [7]. Public investments are implemented by the Parliament, the ministries, the local authorities and the Public Organizations. The funding of these investments is covered through PIP.

PIP is the budget that determines the resources that can be provided to fund investment projects. It contains all the necessary expenditures that must be done in order major projects to be accomplished. These projects are mainly targeted on the economic growth and the improvement of country's infrastructure. PIP is created by the Ministry of National Economy or the Ministry of Development, following the proposals of other Ministries and Region authorities. It has an annual duration and is a part of the General Government Budget.

PIP is the most important mean used for the implementation of the economic growth policy of the country. Its projects mainly aim at contributing to the convergence of the country's regions and promote viable growth. The tools that are used to achieve these aims is the stimulation of demand, the enforcement of the employment rate, the support of the country's competitiveness and the promotion of the economic and social justice.

3.2 EU funding and European Regional Policy

Since the establishment of the European Union (formerly named as European Economic Community), the country members realized that, in order the European integration to be accomplished, it must be preceded by a common European Regional policy. The purpose of this policy would be the growth of the less developed regions of the European Community, in order to eliminate major inequalities in prosperity levels both between and within EU countries.

Regional inequalities can exist due to many reasons, including the longstanding handicaps imposed by geographic remoteness and the more recent social and economic change. Another source of inequality is the legacy of formerly centrally-planned economic systems, like those of the former communist countries [25].

Specifically, EU Regional policy aims at helping each region achieve its full potential and improve competitiveness and employment at regional level by investing in areas of high growth potential. Chart 3 displays the distribution of the regional funding to major categories.

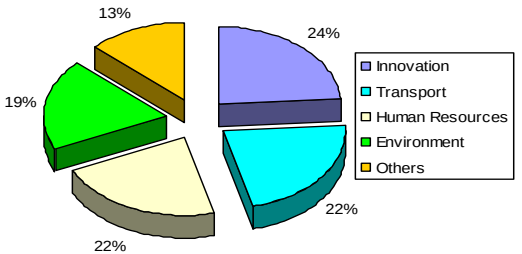


Chart 3. How regional funding is used (Source: European Commission)

3.3 The European Regional Policy towards Greece

Greek regions have benefited from significant inputs of European funds [13, 14], since the first year that Greece joined the European Union, namely 1981. In 1986, the Integrated Mediterranean Programs (Hellas, Co-financed Development Programs (2011), http://www.hellaskps.gr) started, which are considered the first actual step towards substantial European Regional Policy. In 1988, decisions were taken towards the major reformation of the Community Structural Funds (CSF), which are:

- the European Regional Development Fund (ERDF),
- the European Social Fund (ESF),
- the European Agricultural Guidance and Guarantee Fund - Guidance Section (EAGGF Guidance Section) and,
- the Financial Instrument of Fisheries Guidance.

The reformation was targeting on the coordination of the policies of the four CSFs and was scheduling a continuous raise of their funds. This led to the creation of the Community Operational Frameworks (COF), which are the weapons of structuring and acting the European Regional Policy.

The *1st Community Operational Framework* started in 1989 and lasted till 1993. Its main characteristic was the dispersion of the available funds towards small infrastructure projects all over Greece. The main results were the improvement of the prosperity level in agricultural and border regions and the upgrade of the minor transport networks. Moreover, the 1st COF played a significant role to the modernization of the small agricultural companies and to the establishment of small and middle size hotels in many regions.

The 2nd Community Operational Framework started in 1994 and lasted till 1999. Its characteristic was the given emphasis in major infrastructure projects, which help the extroversion of the economy and the country's interconnection with the neighbor countries. The main aims were the improvement of country's competitiveness, the environmental upgrade, and the creation of better living conditions in the urban centers. However, during the 2nd COF, a series of problems and malfunctions appeared, due to the deficiency of the management and implementation operations of these large-scale interventions.

The *3rd Community Operational Framework* lasted from 2000 till 2006. It was developed in order to be the main tool towards the achievement of the Lisbon strategy, an action and development plan devised in 2000, for the economy and the EU between 2000 and 2010. Its aim was to make the EU "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Union Parliament Website, Lisbon European Council 23 and 24 March Presidency Conclusion, http://www.consilium. europe.eu/uedocs/cms_data/docs/pressdata/en/ec/00100-r1en0.htm). The 3rd COF was split in 25 operational programs, 11 of them sectoral, 13 regional and one operational program of Technical assistance. The malfunctions of management and implementation were also present at this COF.

The *4th Community Operational Framework* or, as it is officially named, the *National Strategic Reference Framework* (NSRF), constitutes the reference document for the programming of EU funds for the 2007-2013 period. The revised Lisbon Strategy and the National Reform Program for Development and Employment 2005-2008 were taken into account in developing the main strategic choices - priorities.

In order to avoid the problems of the previous COFs, the NSRF was split into 14 only operational programs, nine of them sectoral and five regional. However, five years after the beginning of the NSRF period and in the middle of a tremendous economic crisis that has led Greece into a 5-year recession, most of the NSRF funds are still frozen, because of the persisted management inefficiency by the Greek Public Sector.

Table 5 shows the EU and National Funds given for each COF, together with funds given by the Private Sector.

Table 5. Funding Table of the Co-funded growth programs in Greece (Source: Min. of Finance)

	Int.Med.progr.* (1986-1989) Thous.ECU In 1986 value**	**1st COF (1989-1993) Thous.ECU In 1989 value**	**2nd COF (1994-1999) Thous.ECU In 1994 value**	**3rd COF (2000-2006) Thous.€ In 2000 value**	**NSRF (2007-2013) Thous.€ (estim.)**
Total Budget	2,101,933	14,342,054	29,721,300	44,363,540	39,400,000
Nation. funds	695,740	5,802,196	7,069,900	11,126,075	11,500,000
EU funds	2,576,000	7,193,241	13,980,000	22,707,000	20,400,000
Private funds	210,193	1,346,617	8,671,400	10,730,465	7,500,000

* The Int. Medit. Programs after the year 1989 where encapsulated into the 1st COF
**1 ECU = 1 € (1/1/1999 exchange rate)

3.4 The Greek PIP over the years

As was mentioned in the introduction of Section 3, PIP is part of the General Government Budget. Since the beginning of the COFs, PIP amounts are analyzed into those amounts of co-funded (with the EU) projects and those amounts of projects funded by national funds. Table 6 shows the distribution of PIP, from 1995 till 2012 (estimate). Except from the amounts of Programs funded with National and EU Funds and their relative percentage of the Total, the percentage change from the previous year is shown together with the PIP Percentage of the GDP. The data of Table 6 is better depicted in stacked column Chart 4, where the EU and the National fund contribution to the total PIP annual amount is shown.

Table 6. Greek PIP over the years (1995-2012) (Source: Min. of Finance)

Year	Public Investment Program (in million €)					PIP Change % from the prev. year	PIP Percentage of the GDP %
	Programs funded with National funds		Programs co-funded with EU		Total		
	Amount	% of Total	Amount	% of Total			
1995	1,469	48,61	1,553	51,39	3,022	-	3.8
1996	1,147	35,69	2,067	64,31	3,214	6.4	3.7
1997	1,602	33,59	3,167	66,41	4,769	48.4	4.9
1998	1,497	27,17	4,012	72,83	5,509	15.5	5.2
1999	1,863	28,21	4,740	71,79	6,603	19.9	5.9
2000	2,109	28,42	5,312	71,58	7,421	12.4	6.1
2001	2,590	33,03	5,252	66,97	7,842	5.7	6.0
2002	3,131	44,64	3,883	55,36	7,014	-10.6	4.5
2003	3,974	47,11	4,461	52,89	8,435	20.3	4.9
2004	4,639	48,72	4,883	51,28	9,522	12.9	5.1
2005	2,569	34,14	4,955	65,86	7,524	-21.0	3.9
2006	2,673	32,66	5,511	67,34	8,184	8.8	3.9
2007	2,763	31,37	6,046	68,63	8,809	7.6	3.9
2008	2,559	26,59	7,065	73,41	9,624	9.3	4.1
2009	2,455	25,60	7,133	74,40	9,588	-0.4	4.1
2010	2,218	26,24	6,236	73,76	8,454	-11.8	3.7
2011	1,390	20,17	5,500	79,83	6,890	-18.5	3.2
2012 (est)	1,300	17,81	6,000	82,19	7,300	6	3.4

There are some noticeable points on the chart. First of all, we can distinguish two peaks of the PIP amount:

- at year 2004, where Greece hosted the Olympic Games, a very large and complex project for the size of the country, which forced the government to spent a significant percentage of the PIP to large infrastructure and athletic construction projects.
- at year 2008, which was the last year of fund payment by the 3rd COF.

The chart also depicts the continuous decline of the PIP funds after the year 2008, when Greece fell into the economic crisis from which still struggles to get off. This is more obvious if we look at the percentage of the PIP that is funded by National Funds. The percentage has fallen from the level of about 50% in 2004, to the current level of 18% (2012 estimation), within 8 years. The PIP funds was an easy way to save costs from the Government Budget, even though many insist that this cut down was (and is) one of the main reasons that makes Greece face the fifth year of economic recession, namely year 2012, and that the benefit from this cut was by far smaller compared to the losses.

The EU understood country's difficult position and, trying to help Greece consume more quickly the offered funds from the NSRF, decided in 2010 to lessen the percentage of the national funds on the co-funded projects, from 25% to 5%

[18]. Another important conclusion can be made by examining the time series of the PIP percentage of the GDP (see Chart 5). Following year 2000, the PIP percentage of the GDP followed an almost continuous decline, reached the level of 3% on year 2011, which is almost half to its peak on year 2000 (6.1%).

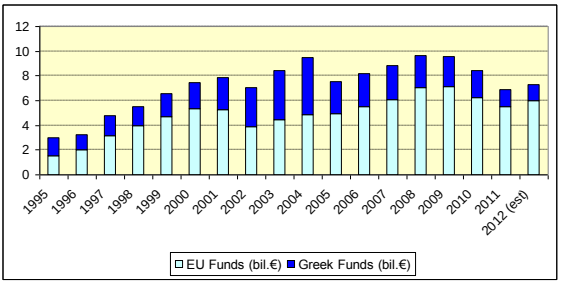


Chart 4. The Greek PIP over the years (1995-2012)
(Source: Ministry of Finance)

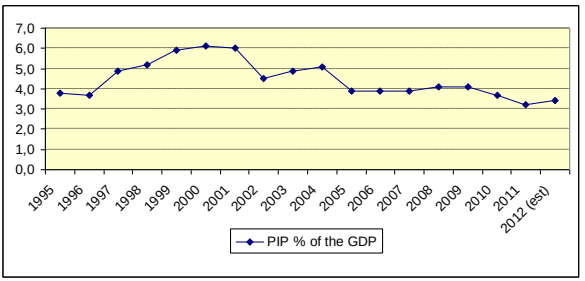


Chart 5. PIP Percentage of the GDP (1995-2012)
(Source: Ministry of Finance)

3.5 The Greek Software Industry and its funding from the Greek PIP

The Greek Software Industry has been being benefited from the Greek PIP, especially after the year 2000, during the 3rd COF and the NSRF implementation. However, it is difficult to calculate the amount of funds that were given to the sector's companies, during the PIP projects implementation, for various reasons.

First of all, the great majority of projects are usually complex. Their implementation needs expertise into different activities. This is the reason that most of the assignments are given to consortia of two or more companies, which cover the appropriate expertise, but, on the other hand, makes it impossible to split the given funds to the relative sectors. Both, 3rd COF and NSRF, have sectoral operational programs that are "targeted" on the Software sector, as for example the "OP Information Society" of the 3rd COF and the "OP Digital Convergence" of the NSRF. However, there is also heavy involvement of the sector companies to most of the rest sectoral and regional programs, which is due to the nature of the sector that can be involved in all aspects of the modernization of the public sector. Another major obstacle is that many companies, especially the major ones, have

various activities and not just ones related to software, like hardware of telecommunications.

Despite the difficulty of calculating the sector funding from the PIP, it is generally admissible that this funding was one of the main reasons of its rapid growth during the last 15 years, as we have already mentioned in Section 2 [9].

4. The dependency of the Greek Software Industry on the PIP

In this section by means of regression analysis we investigate whether PIP is a significant factor of the Software industry turnover, along with some other variables, most of them macroeconomic. The steps to be followed were adopted by the traditional methodology (see, for example, [30, 19]).

4.1 Background on theory

Before we proceed to the statistical analysis, we explain some fundamental macroeconomic equations [32] that are related to various approaches of the Gross Domestic Product definition. These equations will be useful to establishing a suitable econometric model.

4.1.1 Three different approaches to GDP

Gross Domestic Product (GDP) can be determined in three different ways, all of which should, in principle, give the same result [26]. These are the product approach, the income approach and the expenditure approach, as we explain next.

The Product Approach of the GDP considers that GDP equals the market value of all final goods and services calculated during one year. GDP is given by equation

$$\text{GDP} = \text{Total Gross Value Added} + \text{Taxes less Subsidies on products}, \tag{4.1}$$

where Gross Value Added is defined as the subtraction of the intermediate consumption to the total value of output (see equation (4.2)). The latter is defined as the addition of the value of the Total Sales of goods and services to the value of changes in the inventories (see equation (4.3)):

$$\text{Gross Value Added} = \text{Value of Output} - \text{Value of Intermediate Consumption} \tag{4.2}$$

$$\text{Value of Output} = \text{Value of Total Sales of goods and services} + \text{Value of changes in the inventories} \tag{4.3}$$

The Income Approach of the GDP considers that GDP equals the sum total of incomes of individual living in a country during one year. GDP is given by the equation

$$GDP = COE + GOS + GMI + T_{P\&M} - S_{P\&M,} \quad (4.4)$$

where acronyms and explanations are as follows: COE stands for Compensation of Employees, GOS for Gross Operating Surplus, GMI for Gross Mixed Income, $T_{P\&M}$ for Taxes on Production and Imports, $S_{P\&M}$ for Subsidies on Production and Imports.

The Expenditure Approach of the GDP considers that GDP is equal to the sum of all expenditure incurred by individuals during one year [20]. GDP, usually denoted by Y in this approach, is given by the equation

$$Y = C + I + G + (X–M), \quad (4.5)$$

where acronyms and explanations are as follows. C stands for the private Consumption, also known as household final consumption expenditure, I for Investment, G for Government spending, which is the sum of government expenditures on final goods and services, while it includes salaries of public servants, the expenditure of PIP program and any investment expenditure by a government, X for Exports, M for Imports.

For simplicity purposes, we can assume that Government spending, G, equals the government expenditure on PIP and all the other expenditure on non-investment activities, so

$$G = PIP + \text{Expenditure in other (non-investment) activities.} \quad (4.6)$$

4.1.2 Relations between turnover and the variables under examination

In this section we investigate potential relations between a Software Sector company's turnover and various macroeconomic and sector-specific variables. Specifically, the macroeconomic variables that are examined are the Gross Domestic Product (GDP), the Public Investment Program expenditure (PIP), the Disposable Income (YD), the Average Labor Cost (ALC) and the Interest rate (i), whereas the sector-specific variable is the Broadband Connections Change (BRC). The extracted relations of the macroeconomic variables are based on the theory of the GDP definition approaches that were presented on the previous section, while the relation of the sector-specific variable is based on published researches about the Software sector.

Relation between Turnover and GDP

According to equations (4.1), (4.2) and (4.3) of the product approach definition of the GDP, we can see that the Value of Total Sales of goods and services is proportional to GDP at producer price

Value of total sales of goods and services 4.3) alue of Output 4.2) ross Value Added 4.1) (DP (

Hence, the Value of total sales of goods and services, which is actually all the companies' turnover, is related to the GDP at producer prices. Moreover, this relationship is expected to be positive, which means that a raise of the turnover is expected to cause a raise at the GDP and vice versa. Hence, we can conclude that the Turnover is dependent on the GDP, so

$$\text{Turnover} = f(\text{GDP}), \text{ for some function } f \quad (4.7)$$

Relation between Turnover and Public Investment Program (PIP)

From the equations (4.5) and (4.6) of the expenditure approach definition of the GDP, we can see that PIP expenditure is proportional to the GDP

PIP expenditure	GDP

4.6) 4.5)

Since in equation (4.7) turnover is positively related to GDP, it follows that Turnover is positively related to PIP.

Relation between Turnover and Disposable Income (YD)

As we previously saw, the income approach of GDP considers that GDP (Y) is equal to the National Income. However, the Disposable Income (YD) equals the National Income (Y) plus the Transfer Payments (TR) minus the taxes (TA),

$$YD = Y + TR - TA \quad (4.8)$$

It follows, from equations (4.5), (4.7) and (4.8), that Turnover is positively related to the Disposable Income. Hence, Turnover is dependent on the YD, so

YD $\propto$ (4.8)	DP (4.5)	over 4.7)	Turn

Relation between Turnover *and Average Labor Cost (ALC)*

The Average Labor Cost (ALC) can be calculated from the division of the Total Compensation of all employees to the Total number of employees. Moreover, equation (4.4) of the income approach of the GDP showed that factor COE represents the Total Compensation of all Employees,

$$\text{Average Labor Cost (ALC)} = \frac{\text{Total Compensation of all Employees}}{\text{Total Number of Employees Turnover}} \quad 4.9)$$

Hence, from equations (4.9), (4.4) and (4.7), we can conclude that the Average Labor Cost is related to the Turnover and this relation is expected to be positive, which means that a raise of the Average Labor Cost is expected to cause a raise of the Turnover. Hence, Turnover is a function of ALC

ALC $\propto$ (OE DP (T urnover
4.9) 4.4) 4.7)

Relation between Turnover and Interest Rate

According to the Keynesian theory of investment [31], there is a negative relationship between Investment (I) and interest rates (i), which means that a raise on the interest rates is expected to cause a fall on the Investment level. However, the expenditure approach of the GDP (see equation (4.5)) shows that Investment is part of the GDP. Hence and from the equations (4.5) and (4.7), we can conclude that the Turnover is negatively related to the interest rate. Accordingly, Turnover is dependent of the interest rate I, so if Interest Rate i increases, then Investment I decreases, so

i $\propto$ DP (Turnove r
4.5) 4.7)

Relation between Turnover and Broadband Connections

According to [6, 8], which are studies on the Greek Software Sector, the intrusion level of broadband connections to the Greek households is a significant factor for the growth of the sector, as it helps expanding its customer base. So, we can assume that there is a positive relation between the sector's turnover and the change in the Broadband Connections (BRC). Consequently, the Turnover of a software company is a function of BRC.

4.1.3 The Econometric Model

Having had discussed the relation between the critical factors of the Software Sector Turnover (in abbreviation, SST), we can conclude that SST is a function of Gross Domestic Product (GDP), Public Investment Program (PIP), Disposable Income (YD), Average Labor Cost (ALC), Interest rate (i) and Change on Broadband Connections (BRC). Based on the assumption that SST is locally linearly dependent upon the independent variables GDP, PIP, YD, ALC, i and BRC, the regression to be estimated is

$$\mathrm{SST} = \mathrm{b}_1 + \mathrm{b}_2 \times \mathrm{GDP} + \mathrm{b}_3 \times \mathrm{PIP} + \mathrm{b}_4 \times \mathrm{YD} + \mathrm{b}_5 \times \mathrm{ALC} + \mathrm{b}_6 \times \mathrm{i} + \mathrm{b}_7 \times \mathrm{BRC} + \varepsilon \quad 4.10)$$

where b_1 is the intercept, and b_2, b_3, b_4, b_5, b_6 and b_7 are the slope coefficients of the endogenous variables and, ε is the error that represents the exogenous factors which affect Software Turnover. The validity of linear regression model (4.10) is based on the usual basic assumptions in order to justify its use for prediction purposes: 1) linearity of the relationship between dependent and independent variables, 2) independence of the errors, 3) homoscedasticity of the errors, and 4) normal error distribution. Therefore, our main task in the

following sections is to perform a regression analysis, in order to estimate the values of the regression coefficients and to examine their statistical significance.

4.2 Data

There were various difficulties in collecting the data concerning the sales of the software sector. Some of them were noted in Section 2.1.3, like the inseparability between the two relative IT industries, hardware and software, and the continuous technological and business merger between the IT and the Communications sector. Another difficulty is that the Greek Software Sector industry has actually less than two decades of life, a fact that makes it almost impossible to find data about Software Sector's sales beyond past decade. Below, we explain the process of deriving the data that were used in our analysis and explain underlying relations between the variables.

4.2.1 Software Sector Turnover

Although there are various studies about the sector, most of them focus on the data of the last five years, in order to make predictions about its perspective. Therefore, in order to have as many observations as possible, we selected the quarterly index of the services sector, calculated by the Hellenic Statistical Authority (ELSTAT), and especially the one about NACE Rev.2 code J62: "Computer programming, consultancy and relative activities". The index has been calculated since the 1st Quarter of year 2005 and is based on the assumption that the index of year 2005 was 100 [4].

The decision to select this quarterly index has advantages and disadvantages. An advantage is the ability to have 27 observations of the turnover index (Quarter 1 of 2005 till Quarter 3 of 2011), somehow necessary for a model that contains already six independent variables. However, because of the quarterly data, we were forced to include three dummy variables, Q_1, Q_2 and Q_3, in order to check the seasonal behavior of the index, which resulted in increasing the total number of the independent variables of the model to nine.

Hence, our analysis will make an attempt to isolate the independent variables that are significant to the estimation of the specific index. To the rest of the paper, Software Sector Turnover index will be denoted by SSTi. The data concerning SSTi were obtained from ELSTAT. They are presented in Appendix A, Table 1 and displayed in Chart 1.

4.2.2 Gross Domestic Product (GDP)

The quarterly data about Gross Domestic Product were taken from [5]. The GPD amounts were estimated according to the expenditure approach and were calculated at constant prices of year 2005. The GDP data are presented in Appendix A, Table 1 and in Chart 6. The Y-axis represents the Software Sector Turnover Index (SSTi), while the X-axis represents the GDP amount. The GDP data is measured in million €. The line fit has a positive slope as expected from theory.

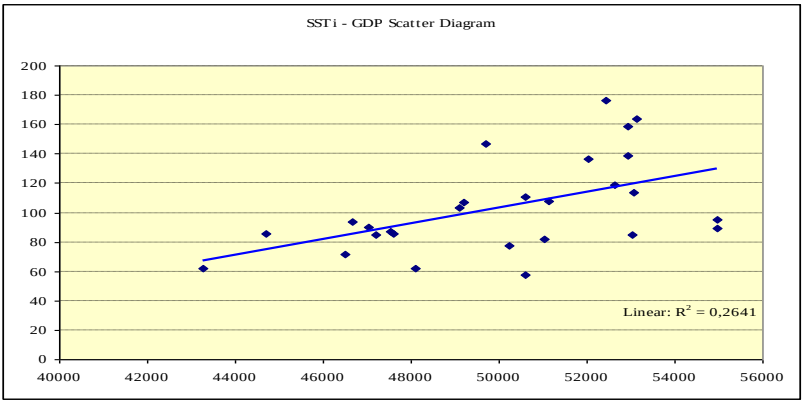


Chart 6. Scatter Diagram of SSTi against GDP (Source: Elstat)

4.2.3 Disposable Income (YD)

We were not able to find any quarterly data about Disposable Income. However, we took advantage of the annual ELSTAT data [3] and transformed the annual data into quarterly ones at constant prices by dividing the annual data by 4 and by dividing the result by the Consumer Price Index (CPI) that ELSTAT also publishes monthly. The results are shown in Appendix A, Table 1. The scatter diagram of SSTi against YD is shown in Chart 7. The Y-axis represents the Software Sector Turnover Index (SSTi), while the X-axis represents the YD amount. The YD data is measured in million €. The dispersion of the values on the diagram, which are confirmed by the low value of R^2 of the trend line, reveal no actual trend.

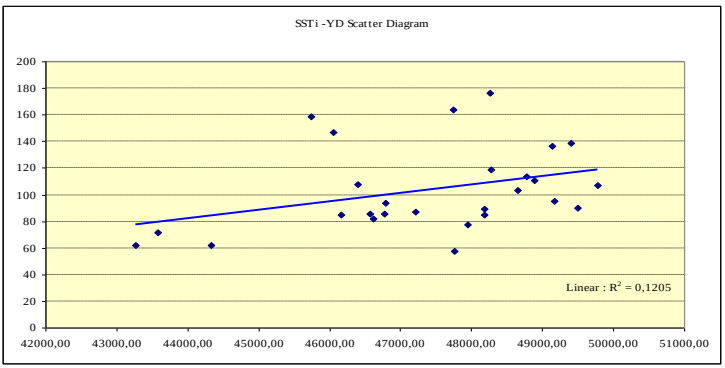


Chart 7. Scatter Diagram of SSTi against YD (Source : Elstat)

4.2.4 Average Labor Cost (ALC)

The quarterly data about Average Labor Cost (ALC) were taken from ELSTAT and is shown in Appendix A, Table 1. The scatter diagram of SSTi against ALC is shown in Chart 8. The Y-axis represents the Software Sector Turnover Index (SSTi), while the X-axis represents the ALC amount. The ALC

data is measured in €. Linear and polynomial trend lines are presented. The graph of the polynomial line indicates increasing returns to ALC.

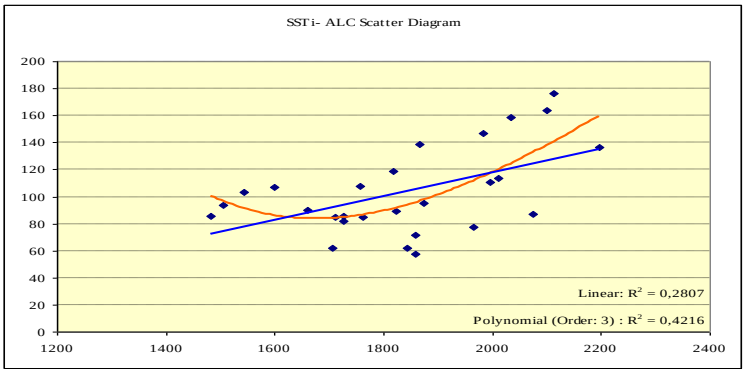


Chart 8. Scatter Diagram of SSTi against ALC (Source : Elstat)

4.2.5 Interest Rate (i)

The interest rate data were taken from the European Central Bank [21]. We transformed this data to quarterly data by calculating the average interest rate of each quarter. The results are shown in Appendix A, Table 1. The scatter diagram of SSTi against Interest rate is shown in Chart 9. The Y-axis represents the Software Sector Turnover Index, while the X-axis represents the Interest rate (i) value. Notice that the slope of the line is the opposite of what it is expected according to theory, for it is positive instead of being negative.

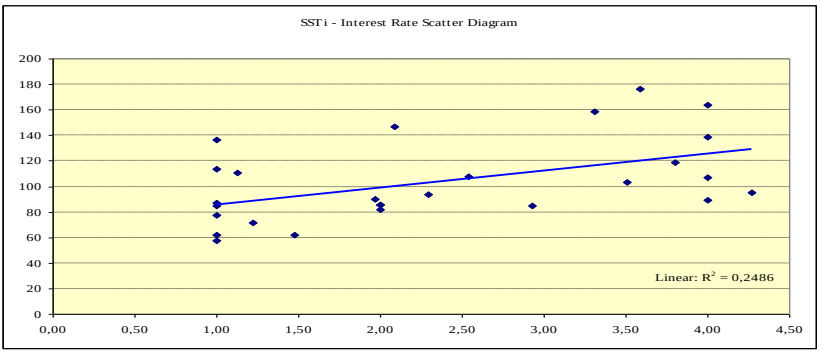


Chart 9. Scatter Diagram of SSTi against Interest Rate (Source: ECB)

4.2.6 Public Investment Program (PIP)

The data concerning PIP expenditure at current prices were extracted from each Budget Execution Bulletin that the Ministry of Finance publishes at the end of each year's quarter [15]. In order to transform this data into PIP data at constant prices, we divided the data by the Consumer Price Index (CPI) that ELSTAT publishes every month. Moreover, we calculated the moving average of the four last quarters and use it as the PIP data in the estimation of our econometric model.

The reason for relying upon this technique is that usually there is a delay of one or two quarters by the time the government calculates a PIP expenditure till the time this expenditure is included to the financial statements of the relative company that PIP expenditure is given. The calculated PIP data are shown in Appendix A, Table 1. The scatter diagram of SSTi against PIP is shown on Chart 10, where the PIP data is measured in thousand €. The Y-axis represents SSTi, while the X-axis represents the PIP amount. The graph of the polynomial line indicates diminishing returns to PIP.

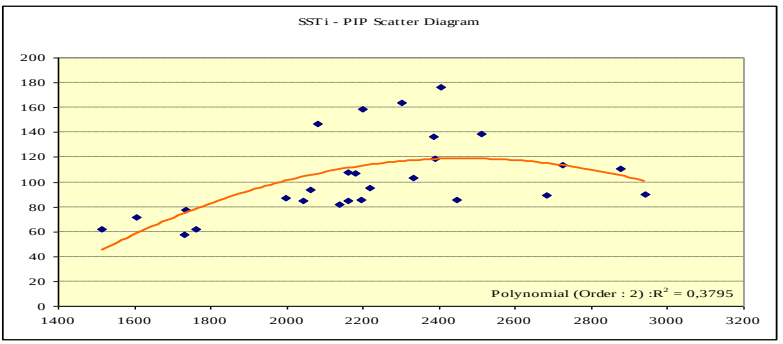


Chart 10. Scatter Diagram of SSTi against PIP (Source: Ministry of Finance)

4.2.7 Broadband Connections (BRC)

The data concerning the quarterly changes of total Broadband Connections were found from the annual reports of the Hellenic Telecommunications and Post Commission (EETT) [1]. The subjects of these studies were about the perspective of the Broadband Technology in Greece and the level of its penetration to the Greek households. The data is shown in Appendix A. The scatter diagram of SSTi against BRC is shown on Chart 11. The Y-axis represents SSTi, while the X-axis represents the BRC quarterly change in thousand connections. The line fit has a positive slope, as expected from theory.

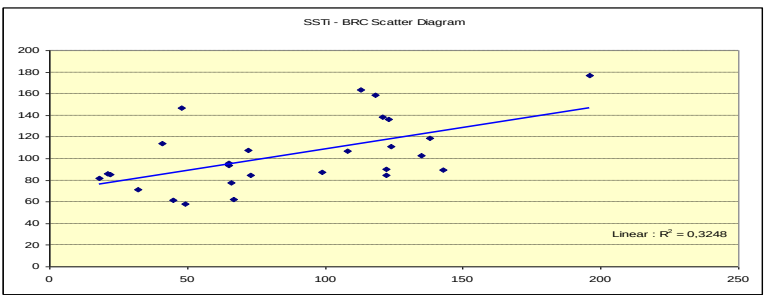


Chart 11. Scatter Diagram of SSTi against BRC (Source : EETT)

4.3 Estimation of the Econometric Model

4.3.1 The procedure

The econometric model (4.10) has six independent variables, or predictors, where five of them are macroeconomic, namely GDP, PIP, YD, ALC, and i, and one is a sector-specific variable (BRC).

In Section 4.2.1, we explained that the adoption of the ELSTAT Software Turnover quarterly index as the dependent variable of our model resulted to the addition of three dummy variables Q_1, Q_2 and Q_3, which are used to represent each year's quarter. As a result, equation (4.10) that represents our econometric model becomes

$$SSTi = b_1 + b_2 \times Q_1 + b_3 \times Q_2 + b_4 \times Q_3 + b_5 \times GDP + b_6 \times PIP + b_7 \times YD + b_8 \times ALC + b_9 \times i + b_{10} \times BRC \quad (4.11)$$

Our task, which is the major contribution of this work, is to examine and select among these nine independent variables, the statistically significant ones that are the best predictors. In order to eliminate the least significant variables, we apply a backward elimination process, which begins with all the predictors in the model and then, step by step, removes the least significant variable from the model until all remaining variables have individual P-values smaller than the chosen level of significance. According to [29], the advantage of this procedure over alternative ones is that it is possible for a set of variables to have considerable predictive capability even though any subset of them does not.

4.3.2 Results and Interpretation

The backward elimination procedure was completed in six steps. The first five steps resulted in having one or more non-significant variables. In the sixth step, all the remaining variables, namely Q_1, Q_2, Q_3 and PIP, were significant. We avoid the detailed regression calculations that were based on the elimination process and present in Table 7 a short description of the result of each step, focusing on the eliminated variable and the reason of its elimination.

Table 7. Main results of each step of Backward Elimination Procedure

tep No	Eliminated Variable	Reason of Elimination, result
tep 1	ALC	Highest P-value between the quantitative variables
tep 2	i	Highest P-value and inverse relationship with the dependent variable
tep 3	BRC	Highest P-value and inverse relationship with the dependent variable
tep 4	YD	Highest P-value between the quantitative variables and inverse relationship with the dependent variable
tep 5	GDP	High correlation with the rest variables
tep 6	-	All variables are significant, end of the procedure

The regression statistics of the sixth step, as calculated by the Regression Analysis Tool of Microsoft Excel, are shown in Table 8. The complete output is presented in Table 2 of Appendix A.

Table 8. Regression Statistics of the final step of the Backward Elimination Procedure

Multiple R	0.854	Standard Error	18.01
R Square	0.730	Observations	27
Adjusted R Square	0.681		

We see that the Standard Error is 18.01. After estimating the predictors, our econometric model obtains the form

$$\hat{SST}i = 59.85 - 56.16 \times Q_1 - 42.61 \times Q_2 - 59 \times Q_3 + 0.038 \times PIP \qquad 4.12)$$

The regression statistics show that the Adjusted Coefficient of Determination (Adjusted R^2) is equal to 0.681, which means that 68.1% of a change on the Software Sector Turnover index is caused by PIP and the seasonal variables Q_1, Q_2 and Q_3. The residuals are shown on the Appendix A, Table 1 (Residuals) and the scatter diagram is in Chart 12. The residuals are distributed around zero with a slightly convex pattern. Moreover, a closer look at the Normal Probability Plot (see Chart 13) of the residuals shows a nearly linear pattern, but the deviations, especially to the last percentile, makes us doubt about the normality of their distribution. Moreover, Chart 14 of Observations vs. Predictions shows that there is a greater variation of the observations for the prediction range between 100 and 140, which also raises some doubt for the assumption of the errors homoscedasticity.

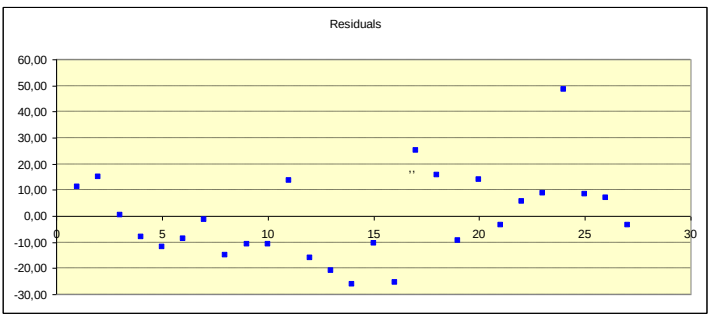


Chart 12. Residual Scatter Diagram

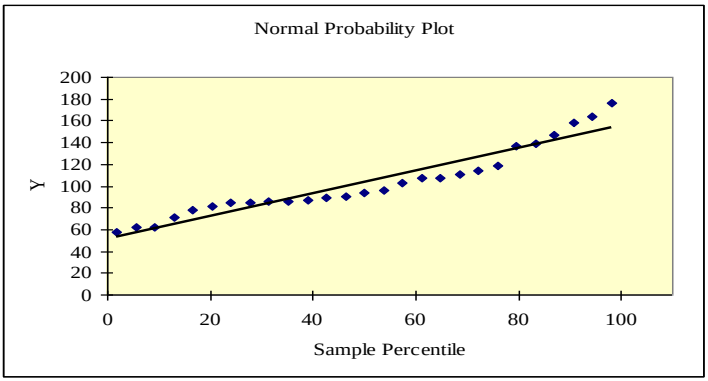


Chart 13. Normal Probability Plot of the Residuals

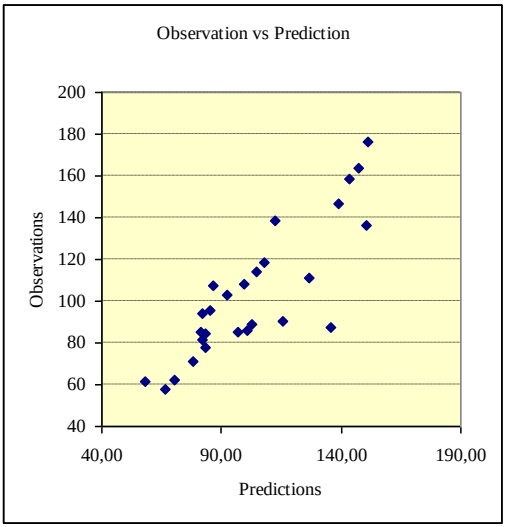


Chart 14. Scatter Diagram of Observations vs Predictions

Equation (4.12) reveals the dependency of the Software Sector Turnover on the Public Investment Program expenditure. According to the relative regression coefficient (0.038), a raise of 1 billion € on the PIP Program moving average expenditure is expected to raise the Software Sector Turnover index by 38 units (0.038×1000 million as PIP variable is in million €). Moreover, (4.12) shows that there is a seasonal variation of the Software Sector Turnover Index, as all the dummy variables that represent each year's quarters (Q_1, Q_2, Q_3) were significant. According to their calculated coefficients, the year's quarter which is expected to have the greatest turnover index is the 4th one. The 1st quarter is expected to have a smaller index than the 4th one at a rate of 56.16 units, the 2nd is expected to have a smaller index at a rate of 42.61 units, while the 3rd one is expected to have a smaller index at a rate of 59 units. The intercept b_0 was also found to be a significant factor of our regression equation, indicating that the Software Sector

Turnover index potential, with zero PIP expenditure, is 59.85 units at the 4th quarter of each year.

4.4 Forecasting

We are going to use the calculated model in order to check its forecasting capability on the Software Sector Index for the 4th quarter of 2011 and the four quarters of year 2012.

Although we have the actual value of the PIP variable for the last quarter of year 2011, the actual values of year 2012 were prior to our study. Thus, we are going to estimate the PIP values of the four quarters of year 2012, in order to forecast the desired Software Sector Index. We assume that the distribution of the annual PIP expenditure at the four quarters follows a pattern similar to that of year 2011. The annual PIP expenditure of 2012 is expected at the level of 7300 million €. Accordingly, Table 9 displays the expected expenditure of PIP during 2012.

Table 9. Expected PIP Expenditure (Amounts in Million €)

	2011	**Percent. of Total**	**2012 est.**
1	77	10,25%	748
2	454	22,00%	1606
3	401	21,20%	1546
4	076	46,58%	3400
otal	608	100,00 %	7300

We apply the approach of the past data of PIP expenditure and we reduce the estimated amounts into constant prices of 2005. Since the inflation rate in Greece is expected to be around zero, we divide each amount by ELSTAT Price Index of December 2011, namely 109.63. Then, we calculate the moving average of the last four quarters. The results are presented in Table 10.

Table 10. Calculated PIP variable

	Current Prices (in Th.€)	**Constant Prices (2005)**	**Moving Average of last four quarters (PIP variable)**
2011/Q4	3076	2805	1511.14
2012/Q1	748	682	1525.39
2012/Q2	1606	1465	1558.01
2012/Q3	1546	1410	1590.50
2012/Q4	3400	3101	1664.50

Hence, we are about to forecast the SST Index for the last quarter of 2011 and all the quarters of year 2012, by applying the above PIP values to our econometric estimation model, i.e. equation (4.12). The predicted index values are

in Table 11 and the graphical representation of the SST index from 2005Q1 till 2012Q4 is portrayed on Chart 15, where the dotted line indicates the predicted values. An immediate explanation is that the index is expected to follow during 2012 the general pattern of year 2011, since there are no radical changes on the PIP expenditure among these years.

Table 11. Predicted SST Index values for 2011 Q4 and year 2012

	1	2	3	PIP	SST-est
2011/Q4	0	0	0	1511,14	117.27
2012/Q1	1	0	0	1525,39	61.64
2012/Q2	0	1	0	1558,01	76.44
2012/Q3	0	0	1	1590,50	61.29
2012/Q4	0	0	0	1664,50	123.10

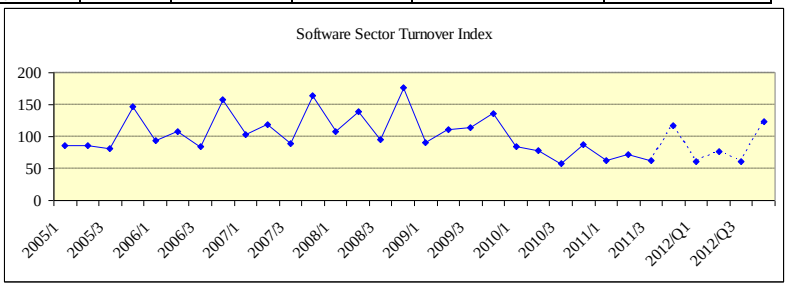


Chart 15. Software Sector Turnover Index (Actual and Predicted values)

4.5 Using the Model for Policy Purposes

The use of our econometric model may be a useful tool for the software sector's managers, in order to estimate the sector's turnover index and, depending on the results, take the appropriate decision.

Primarily, the results revealed a dependency of SSTi on PIP, along with seasonality. Indeed, the substantial fall of PIP expenditure during the last three years 2009-2011 resulted to an analogous fall of SSTi, indicating that a change on PIP expenditure has an immediate impact on the software sector's turnover.

A process that makes use of our econometric model may well be useful to policy reasons. For example, a software sector executive may be helped by applying our model to the turnover of his company, in order to examine its dependency on PIP. If the latter is proved, then actions could be taken on either of the following directions:

1. *Make a thorough analysis of the macroeconomic environment and EU regional policy, in order to make right predictions of the PIP expenditure development in the upcoming years, so that the company be prepared and take pre-active measures,*
2. *Make proper decisions in order to break the exclusive dependency of his company on PIP.*

There is a market expectation of PIP growth on the upcoming years 2013-2014. This is because of the expected rapid absorption of the rest NSRF funds, in order that the latter not to be totally lost, as the NSRF program ends in 2013. However, there is great uncertainty about the future implementation of PIP, after the upcoming end of the NSRF program, which makes it rather difficult to propose possible actions for the sector executives.

5. Future Prospects of the Greek Software Industry

This section aims at examining the prospects of the software sector. It starts with a brief analysis of the current macroeconomic environment, which is then followed by an analysis of the expansion prospects of the industry to foreign countries. Finally the software industry's opinion about its future growth, as expressed by an important survey among industry's executives, is presented.

5.1 The Macroeconomic Environment

The world is still in a harsh crisis that started in the USA at the summer of 2008, mainly triggered by liquidity problems of the US banking system. This bank crisis has turned into a country debt crisis that has caused many economic analysts to doubt about the strength of the global economic system.

Greece was hit by the crisis after a decade (1998-2007) of continuous growth, whose level was greater than the EU average, as we can see in Table 12 [27]. However, the country's national debt and the annual deficits of its government budget were still over the high limits that were stated in the Stability and Growth Pact of the EU [22]. Hence, when the effects of the US banking crisis reached Europe, Greece was the first to be directly affected. Excluded by the money markets and in order to avoid default, the country sought for help to the International Monetary Fund and its EU partners.

Table 12. Real GDP growth rate - volume (Source: Eurostat)

Geo\time	998	999	000	001	002	003	004	005	006	007
EU (27)			.9	.2	.3	.4	.5		.3	.2
Eurozone (17)	.8	.9	.8		.9	.7	.2	.7	.3	
Greece	.4	.4	.5	.2	.4	.9	.4	.3	.5	

The debt crisis has stroke Ireland and Portugal as well, which have also signed Memoranda of Understanding with the EU, the ECB and the IMF [23, 24]. The debt infection still continues as large countries like Italy, Spain and even France see their interest rates of their bonds raising continuously, making global markets shiver on the possible outcome of a dissolution of the Eurozone and the end of the existence of the second most important currency in the world, the euro.

Greece, having no other actual option, but to implement the restrictive economic policy that has agreed with its creditors, is facing the fifth year of

recession in a row and the unemployment rate seems to exceed the level of 20%. However, the debt continues to break new high records and the deficit cannot even approach the acceptable, by the EU, level of 2% of the GDP. In Table 13, the values of the major macroeconomic indexes (GDP, Debt, Deficit, and Unemployment Rate) are displayed, from year 2008 until 2012.

Table 13. Major Macroeconomic Indices (Source: ELSTAT, Min. of Finance)

Year	GDP (% change)	National Debt (%)	Budget Deficit (%)	Unemployment Rate (%)
2008	-0.2	110.7	-9.8	8.3
2009	-3.2	127.1	-15.4	10.3
2010	-3.5	142.8	-10.5	14.4
2011	-7.0	161.8	-9.2	20.0
2012 (est)	-4.4	172.7	-7.8	24.0

In this macroeconomic environment, there is no industry in the country that will be unaffected. The Greek software industry entered the crisis in a state where the NSRF funds were expected to be used by the government, in order to warm its sales. However, as we have already noticed in Section 3, there were delays on that part that forced the sector companies to enforce cutting-down procedures by taking unpleasant measures like layoffs and salary reductions. The situation is getting worse by the fact that the banks have actually terminated the loan procedures to the private sector, diminishing the credit pressure to its companies and deteriorating their liquidity problems.

It follows that each sector company, functioning in a macroeconomic environment full of risks and uncertainties, will not be willing to take any additional risks and is actually in a pending situation, having as a priority the achievement of surviving by the end of this economic storm. Whenever this time comes, the next movements will be made after having evaluated the condition of the market.

5.2 Prospects of Expansion

Still, there are prospects of expansion of the Greek Software companies to foreign markets. We begin by analyzing the international trade data of the last decade. Although there are no data available about international trade of intangible products, like software, the available data about tangible products of the ICT market is indicative, as Table 14 shows. The latter displays the annual imports and exports of the ICT products for the period 2000-2007, the relative trade flow and the trade balance. Moreover, the trade flow and trade balance of all products is displayed for comparison reasons [17].

Table 14. Trade Balance of ICT Products (Source: Eurostat)

	ICT Products				All Products	
ear	Imports*	Exports*	Trade Flow*	Trade Balance*	Trade Flow*	Trade Balance*
000	3 .884.254	8 25.180	4 .709.434	- 3.059.074	4 8.971.900	- 23.526.745
001	3 .484.550	7 71.154	4 .255.704	- 2.713.396	4 8.417.227	- 23.066.900
002	2 .703.336	6 34.297	3 .337.633	- 2.069.039	4 4.399.767	- 22.373.260
003	3 .059.267	6 20.589	3 .679.856	- 2.438.678	5 1.479.788	- 27.820.102
004	3 .511.161	7 42.829	4 .253.990	- 2.768.332	5 4.721.030	- 30.108.324
005	3 .255.143	7 54.251	4 .009.394	- 2.500.892	5 7.643.597	- 29.867.037
006	3 .803.404	1 .030.837	4 .834.241	- 2.772.567	6 7.193.397	- 34.142.799
007	4 .289.293	9 77.496	5 .266.789	- 3.311.797	7 2.824.086	- 38.404.761
hange 00-07)	**10.43%**	**18.46%**	**11.83%**	**8.26%**	**48.71%**	**63.24%**

*All amounts in thousands €

The trade balance of the period 2000-2007 is characterized by a continuous deficit, which rose at about 8.26% between years 2000 and 2007. This is smaller than the raise of the deficit of all products, which was 63.24%. Chart 16 shows a graphical representation of the Imports, Exports and Trade Balance of the ICT Products (data were taken from Table 14) for the period 2000-2007.

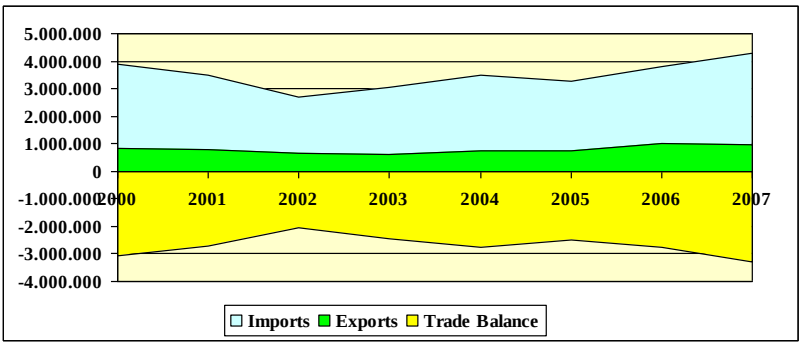


Chart 16. Imports, Exports and Trade Balance of the Greek ICT Products (Amounts in Thous. €) (Source : Eurostat)

Two indices that are commonly used, in order to estimate a sector's potential and the ability of its products to be absorbed by the international markets, are:

1. The Import Cover index, which is the percentage of the import expenditure that is covered by the export collections (Exports/Imports), and
2. The Balassa index, which is the percentage of the Trade Flow that is covered by the Trade Balance (Trade Balance/Trade Flow) and takes values between -100% and 100%, where -100% means that a country only imports, 100% means that a country only exports, whereas 0% means that a country has a balanced trade. The Balassa index is considered to be an important index that reveals the certain advantage or disadvantage of a country in a certain class of goods and services.

Chart 17 shows the import indices of the ICT products and all products respectively, for the period 2000-2007, as calculated from the data of Table 14.

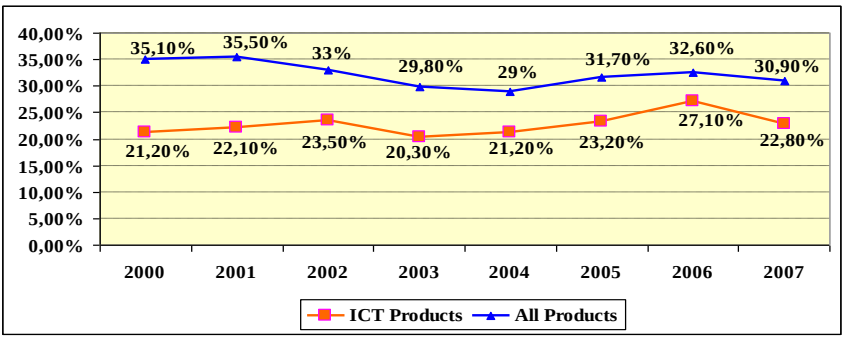


Chart 17. Import Index of ICT Products and All Products (Source : Eurostat)

We can see that the ICT products index is following the trend of all products index, however the first one is constantly at a lower level compared to the second one. Chart 17 reveals that the ICT Products imports are four times greater than the exports. The same conclusions can be made by examining Chart 18 of the Balassa indices of ICT products and all products, as calculated from the data of Table 14.

Both the Import and the Balassa indices reveal that the products of the Greek ICT market cannot be characterized as the comparative advantage of the country. It is an indirect confirmation of the results of our statistical analysis, which showed that the sector is introvert and dependent on the public sector expenditure.

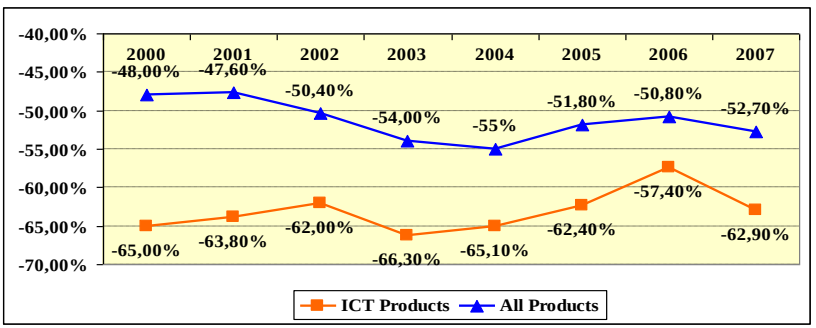


Chart 18. Balassa Index of ICT Products and All Products (Source : Eurostat)

Another factor that shows the absence of a policy concerning the export growth of the ICT market is that the top-4 export destination countries in 2007 are EU countries, as Table 15 displays [17]. Germany and the United Kingdom are the destination of almost one third of the Greek ICT exports. However, this also can be regarded as an indication that the Greek ICT products are high-quality products, because the EU markets, especially the German and the British ones, are demanding markets with high standards for their products.

Table 15. Most Important Export Destination countries of ICT Products (Source: Eurostat)

	2007	
	Country	**% of Total ICT exports**
	Germany	15.4%
	United Kingdom	15.2%
	Cyprus	8.7%
	Italy	6.5%
	UAE	5.1%

Nevertheless, it should be emphasized that there are no neighbor countries, Balkan, African or Asian (e.g. Turkey), among the top-4 export countries. Although Greece is the most developed country at the high-tech sector, compared to all its neighbors, it has not taken an advantage of it up to now. However, the new EU growth programs are focusing on the implementation of large IT projects for the new members of the EU, like Bulgaria and Romania, in order that the latter reach the EU average prosperity level. Since Greece is the nearest co-member, this gives an opportunity for the software sector to expand to its neighbor countries, by making use of its recent experience on relative projects.

Another critical factor for the Greek Software Sector is the high quality of the Engineers of the country. According to Economist [10], Greece is among the top-20 countries globally, in terms of ICT human resources. It is out of doubt that it would be a big waste, the quantity and quality of such a workforce, to be consumed only for the needs of such a small market, like the Greek one. Moreover, Greek engineers are the ones with the lowest annual salaries [28] among the developed countries as we can see in Chart 19.

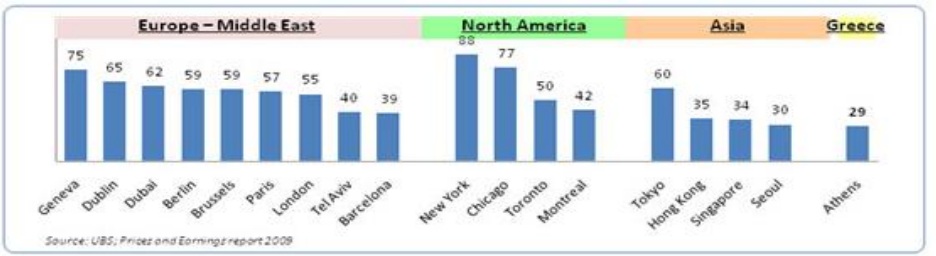


Chart 19. Gross Annual Income of Engineers at Key ICT Clusters (Thous.$). (Source: UBS, Prices and Earnings Report, 2009)

Greece has its own example of a successful story in software market. One of its companies, INTRALOT, has become the champion of the lottery sector, having presence in more than 53 countries and giving job to more than 5400 employees [35]. Moreover, INTRALOT has achieved a raise of 7.8% of its turnover on 2011 [18], a year where the Software Turnover has fallen by 7.1, according to [2]. The key factors of INTRALOT success [12], which are specialization, innovation and focus on customer satisfaction, provide perhaps the right roadmap for the rest of the sector.

5.3 What the Industry Counts as Important

According to a study by the Observatory for the Greek Information Society [16] that was conducted among ICT Companies, their executives were asked to evaluate the importance of nineteen different factors on the demand and supply of ICT products and services and to rate the influence of these factors, either positive or negative, on the ICT sector growth. The results are quite revealing and shown in Table 16.

Table 16. ICT Factor Supply and Demand Determinants
(Source: Observatory of the Greek Information Society)

Factor Description	Influence Rate
Implementation of the Information Society Program	21.1
Expansion of the ICT to other economy sectors	15.3
Level of high-level technical education concerning ICT	10.2
Investment to foreign countries by the ICT companies	9.1
Adequacy and high quality of specialized personnel into the domestic market of ICT sector	3.8
Supporting policy of innovation	1.6
Access ability to foreign markets	1.0
Macroeconomic policy	-1.7
Adequate banking funding	-3.2
Quality of Communications infrastructure	-12.0
Electronic Transactions	-12.2
Tax motives for the spread of ICT use to population and companies	-12.7
Competition regulatory context	-12.8
Cost of acquisition ICT equipment	-16.1
Organization level of companies-users	-17.1
"IT culture" level of private users	-22.5
Loan capital cost	-30.6
Internet connection cost	-37.3
Size of the domestic market	-38.6

The factor with the greatest value of positive influence is the "Implementation of the Information Society Program", a fact that confirms the results of our statistical analysis, as it reveals the dependence of the ICT sector on the expenditure of the public sector and the incoming EU funds.

Moreover, it can be considered as an oxymoron the fact that, although the "Size of the domestic market" is ranked as the most negative factor for the ICT

growth, showing that the companies are aware of the limited growth potential of the internal market, on the other hand the "Investment to foreign countries by the ICT companies" is ranked at the fourth place of positive factors, revealing perhaps the unwillingness of the management to take the risks and expand abroad.

6. Discussion and conclusions

The analysis of the characteristics of the Greek Software Industry, from start-up until today, and the statistical examination of its dependency upon the Greek public expenditure resulted to very useful conclusions about the sector route and its future perspectives.

The birth of the Greek Software sector took place at the same period when the EU funding started, through the implementation of EU Regional Policy. The next 20 years (1990-2010) were exhibited by a continuous growth of the sector, claimed to owing to the incoming EU funds. This assumption was actually confirmed by our econometric analysis that ended up to the dependency of the Software Sector Turnover upon the Public Investment Program expenditure. The latter perhaps pushed the sector to the adoption of wrong strategic decisions, as the expansion levels to foreign markets are lower than the total average and the market can be considered introvert.

However, the current growth model of the Greek Software market has to come to an end soon. A growth model that was based on the public expenditure cannot go on, as the country struggles to escape from a default and it is in the implementation process of a very painful cut down procedure, which is estimated to last at least for a decade. Moreover, even if the macroeconomic environment was not so bad, it is admissible that the Greek market size is very small for the current size and the potential of the Greek ICT sector. Hence, it seems necessary for the sector to realize the changes that need to be done and go on with implementing these, in order to survive in a market that is actually global and that perhaps has the least barriers than any other type of market.

A first approach towards this is *specialization*. Every company must recognize its comparative advantage towards its competitors and focus on one or two specific segments, as the "we can do anything" tactic is not viable any longer in a mature market. The next inevitable step is *expansion*. The ICT market has the privilege and the curse to be the most global market compared to all other ones. The next revolution of the software sector, which is considered to be the "cloud computing", will make the purchase of all software products as easy as doing a few clicks over the internet and will smash the few last frontiers of software market. Another great change is the continuous technological merge of the Communications and the IT sector, which creates new potential clients, new market segments and great opportunities for the ones that are aware and ready to take advantage of them. On the other hand, the Greek authorities must establish an active policy towards sector's growth, not by transferring funds to the domestic companies for implementation of projects that have doubtful effectiveness, but by *promoting and funding innovative ideas*. There are many cases of successful ideas

that came up from Greek professionals and were implemented to foreign countries due to lack of funding and support from the Greek government.

Greece has the advantage of a large and qualitative workforce in the software sector. The workforce have knowledge and skills that should be used as the foundation of the reborn Greek software industry in order to gain recognition in the global market. It is up to the future researcher to examine the implementation of these potential changes of the sector's strategy, perhaps by re-examining the dependency of the sector's turnover on the PIP expenditure and also by examining the level of the sector's expansion.

References

1. EETT (2012), "Annual Reports", http://www.eett.gr/opencms/opencms/EETT_EN/ Publications/ Proceedings/, [accessed 07/01/2012]
2. ELSTAT (2012), "Annual rates of change of the turnover indices by activities of the services sector",http://www.statistics.gr/portal/page/portal/ESYE/PAGE-themes?p_param=A0999&r_ param=DKT54&y_param=TS&mytabs=0, [accessed 14/01/20 12]
3. ELSTAT (2012), "Main Macroeconomic Aggregates", http://www.statistics.gr/port al/page/portal/ ESYE/PAGE-themes?p_param=A0702&r_param=SEL24&y_param=TS&mytabs=0, [accessed 15/01/2012]
4. ELSTAT (2012), "Quarterly rates of change of the turnover indices by activities of the services sector",http://www.statistics.gr/portal/page/portal/ESYE/PAGE-themes?p_param=A0999&r_param =DKT54&y_param=TS&mytabs=0, [accessed 15/01/2012]
5. ELSTAT (2012), "Quarterly GDP - Expenditure Approach (Constant Prices)", http://www. statistics. gr/portal/ page/ portal/ESYE/PAGE-themes?p_param=A0704& r_param= SEL84& y_param=TS&mytabs=0, [accessed 15/01/2012]
6. EOMMEX: Hellenic Organization of Small and Medium Enterprises (2008), Software Sector
7. General Secretariat of Investment and Development (2011), "Public Investment Program", http://www.ggea.gr/ap/ pde. htm, [accessed 17/12/2011]
8. ICAP (2008), Sector Study: Software
9. ICTPlus (2011), "History of more than 30 years", http://www.ictplus.gr/ files/ [accessed 17/12/ 2011]
10. InvestInGreece Agency (2012), "ICT: Embracing New Technologies", http://www.investingreece. gov.gr/default.asp? pid=36&sectorID=39&la=1, [accessed 18/02/2012]
11. IOBE (4th Quarter 2011), "ICT Newsletter", http://www.iobe.gr/index.asp?a_id=814, [accessed 10/01/2012]
12. Lakafosis, K. (2012), "Intralot: Turnover Raise - Loan Reduction", To Vima, April 8th 2012, page 40
13. Ministry of Development, Competitiveness and Shipping (2011), "NSRF 2007-2013", http://www. espa.gr/ en/Pages/ Default.aspx, [accessed 11/12/2011]

14. Ministry of Economy and Finance: Information Office (2011), "Hellas: Cofinanced Development Programs", http://www.hellaskps.gr.en_2000-2006.htm, [accessed 11/12/2011]
15. Ministry of Finance (2012), "Budget Execution Bulletins", http://www.minfin.gr /portal/ en/resource/contentObject/contentTypes/genericContentResourceObject,file Resource Object, arrayOfFileResourceTypeObject/topicNames/budgetExecutionBulletin/resource Representation Template/contentObjectListAlternativeTemplate, [accessed 11/02/2012]
16. Observatory of the Information Society (Sep.2006), Study of the ICT sector in Greece: Current Situation and Future Trends
17. Observatory of the Information Society (2008), Study of the ICT sector in Greece: Current Situation and Future Trends
18. Sampaniotis, T. (2011), EU Structural Funds in Greece: more necessary than ever, http:// www. eurobank.gr/ Uploads/Reports/GREECE%20MACRO%20FOCUS%20December%2022% 202011. pdf, [accessed 04/12/2011]
19. Armstrong, J. Scott (1970), An Application of Econometric Models to International Marketing, J. of Marketing Research
20. Dornbusch, R. and Fischer, S. (1993), Macroeconomics, Irwin: McGraw-Hill.
21. European Central Bank (2012), "Key ECB interest rates", http://www.ecb.int/stats/monetary/ rates/ html/index.en.html, [accessed 04/01/2012]
22. European Commission (2012), "Stability and Growth pact", http://ec.europa.eu/economy_finance/ economic_governance/sgp/index_en.htm, [accessed 18/02/2012]
23. European Commission (2012), "Financial and economic support package for Portugal", http://ec. europa.eu/economy_finance/eu_borrower/portugal/ index_en. htm, [accessed 18/02/ 2012]
24. European Commission (2012), "Financial assistant package for Ireland", http://ec.europa.eu/ economy_ finance/ eu_borrower/ireland/index_en.htm, [accessed 18/02/2012]
25. European Union (2011), "Regional Policy: Bridging the prosperity gap", http://europa.eu/ pol/reg/ index_en.htm, [accessed 29/11/2011]
26. Eurostat (2011), "Annual National Accounts",http://epp.eurostat.ec.europa.eu/ cache/ITY_SDDS/ en/nama_esms.htm, [accessed 27/12/2011]
27. Eurostat (2012), "Real GDP growth rate", http://epp.eurostat.ec.europa.eu/ tgm/table.do?tab= table&init= 1&plugin=1& language=en&pcode=tsieb020, [accessed 29/02/2012]
28. Felipe, J. and Kumar, U. (2011), Working Paper No.651: Unit Labor Costs in the Eurozone: The Competitiveness Debate Again, Levy Economics Institute
29. Gerard E. Dallal, Ph.D (2012), "The Little Handbook of Statistical Practice - Simplifying a Multiple-Regression Equation", http://www.jerrydallal.com /LHSP/ simplify.htm, [accessed 09/02/ 2012]
30. Gujarati, D. (2004), Basic Econometrics 4th Edition, London: The McGraw-Hill Companies
31. Keynes, J. (1936), General Theory, Ch.11, http://homepage.newschool.edu/~het/ texts/keynes/ chap11.htm, [accessed 25/01/2011]
32. Mankiw, G. (2007), "Brief Principles of Macroeconomics", USA: Southwestern Educational Publishing

33. Wikipedia (2011), "Software", http://en.wikipedia.org/wiki/Software, [accessed 10/11/2011]

34. Livepedia (2011), "Information Technology", http://www.livepedia.gr/index.php/ Πληροφορική, [accessed 15/11/2011]

35. InvestInGreece Agency (2012), "ICT: Embracing New Technologies", http://www.investingreece. gov.gr /default.asp ?pid=36&sectorID=39&la=1

36. Georgopoulos, D. (2012), "Greek Software Industry: Current Status, Prospects of Expansion and Examination of its Dependency on the Greek Public Investment Program". MBA Thesis, Hellenic Open University, Patra, Greece, 71 pp.

Appendix A The data and the prediction values

Table 1. Data and Results of Regression Analysis

Quarter	RC	YD	i	ALC	GDP	PIP	SST index (turnover)	Prediction SST-est	Residual
					447	24	8		
2005/1	2	46775.39	.00	482	16.51	47.045	5.5	6.67	1.17
2005/2	21	46576.53	2.00	1726	47599.88	2195.191	85.8	100.66	14.86
2005/3	18	46623.16	2.00	1726	51028.26	2137.939	81.8	82.09	0.29
2005/4	48	46048.11	2.09	1983	49705.2	2081.476	146.8	138.95	-7.85
2006/1	65	46787.37	2.29	1504	46678.8	2062.604	94	82.06	-11.94
2006/2	72	46395.96	2.54	1758	51130.8	2160.734	107.9	99.35	-8.55
2006/3	73	46167.01	2.93	1763	53021.11	2162.888	84.6	83.04	-1.56
2006/4	118	45735.95	3.31	2035	52919.61	2199.626	158.5	143.44	-15.06
2007/1	135	48650.99	3.51	1542	49106.5	2331.097	103.1	92.26	-10.84
2007/2	138	48275.84	3.80	1818	52647.3	2389.442	118.7	108.04	-10.66
2007/3	143	48179.79	4.00	1823	54979.98	2682.802	89.2	102.80	13.60
2007/4	113	47739.76	4.00	2100	53120.89	2300.895	163.5	147.28	-16.22
2008/1	108	49782.37	4.00	1598	49187.73	2180.416	107.3	86.54	-20.76
2008/2	121	49397.35	4.00	1865	52927.77	2512.393	138.8	112.71	-26.09
2008/3	65	49162.59	4.27	1874	54971.89	2216.353	95.5	85.07	-10.43
2008/4	196	48261.79	3.59	2113	52437.61	2406.522	176.6	151.30	-25.30
2009/1	122	49490.78	1.97	1660	47024.25	2940.91	90.4	115.43	25.03
2009/2	124	48885.09	1.13	1995	50605.16	2877.997	111	126.60	15.60
2009/3	41	48781.02	1.00	2010	53062.7	2724.128	113.9	104.37	-9.53
2009/4	123	49140.46	1.00	2196	52021.51	2387.069	136.5	150.56	14.06
2010/1	122	48175.01	1.00	1712	47201.74	2043.593	84.9	81.34	-3.56
2010/2	66	47949.28	1.00	1964	50227.98	1734.448	77.5	83.15	5.65
2010/3	49	47758.47	1.00	1858	50605.22	1730.975	57.9	66.63	8.73
2010/4	99	47206.54	1.00	2074	47549.48	1997.399	87.4	135.75	48.35
2011/1	67	44335.83	1.00	1705	43273.21	1763.412	62.2	70.69	8.49
2011/2	32	43587.42	1.22	1859	46496.06	1604.55	71.4	78.21	6.81
2011/3	45	43270.45	1.48	1843	48094.55	1514.274	61.8	58.39	-3.41

BRC : Broadband Connections Change (in Thou. connections)
YD : Disposable Income (in million €)
i : ECB interest rate (%)
ALC : Average monthly Labor Cost (in €)
GDP : Gross Domestic Product (in million €)
PIP : Public Investment Program expenditure (in million €)

Table 2. Microsoft Excel Regression Analysis output on the data of Table 1

SUMMARY OUTPUT

Regression Statistics	
Multiple R	.854451
R Square	0.730086
Adjusted R Square	0.681011
Standard Error	18.01046
Observations	27

ANOVA

	df	SS	MS	F	Significance F
Regression	4	19302.82	4825.705	14.8768492	5.00283E-06
Residual	22	7136.29	324.3768		
Total	26	26439.11			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	59.85173	23.15943	2.584335	0.016922041	11.82201367	107.8814
Q1	-56.1663	10.02286	-5.60382	1.23768E-05	-76.95249587	-35.3802
Q2	-42.6051	10.02169	-4.25129	0.0003266	-63.38883571	-21.8214
Q3	-58.9978	10.03857	-5.87711	6.49545E-06	-79.81654157	-38.1791
PIP	0.038151	0.009853	3.871894	0.000823886	0.017716358	0.058585