ECONOMETRIC MODELING FOR PUBLIC HEALTH EXPENDITURE. THE CASE OF GREECE.

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ABSTRACT
On this paper is conducted a study on the procedure of total public health expenditure for Greece for the period 2013-2015. The estimations were made, using an econometric model designed specifically to describe and estimate the public health expenditure, for this country. The variables that have been used to make the econometric analysis were: Public pharmaceutical expenditure, debt-payments of hospitals during the previous accounting period, the cost of raw materials, the cost of intangible materials, other liabilities, consumable materials and the age of population. Along with the estimation, in order to be a comprehensive picture of the course of public health expenditure in Greece we proceeded with a presentation of data for the period 2009-2012 (the period of debt crisis). The case of Greece has all the background for a complete experiment, presenting the course of public health expenditure in a country, which is in the midst of debt crisis and has to cut its spending. To accomplish this the country will not avoid expanding the austerity policy in the public health sector, resulting a further reduction of (relatively low) public health expenditure. In the end we make some useful conclusions on Greece’s public health expenditure, presenting a reliable solution in order to be avoided any further decline of public health services.

Keywords: Health economics; public health expenditure; public pharmaceutical expenditure, econometric model; economic crisis

Jel codes: C05, H51, I15, I18, I19, I38

Introduction
As public health expenditure, we consider the health care and pharmaceutical expenditure provided by public funding. Greece provides health care and medicine care services to all its residents by the National Health Service.

The National Health Service (NHS) of Greece was established in 1982 and it was designed to cover primary, secondary and tertiary health care to its citizens. For the first time in the modern history of Greece healthcare facilities were created, which were designed to provide free services to citizens in every corner of the country. An idea that already existed from the late 19th century it became a reality. With the creation of the NHS was also launched a modernization of the existing health facilities combined with the creation of new, so that the entire population would have direct access to health services. The design of NHS was based on the British model for providing health services. However, the incomplete and inefficient administrative structures of the country combined with the rough design showed several...
problems in the later course. Although there have been attempts to reform the NHS in order to be able to meet the needs of the time, these efforts were not able to make it. The lack of substantial research in conjunction with corruption and ineffective control made the NHS a problematic health system. The high number of public pharmaceutical expenditure, the indebted pension funds, the complete waste of the resources without being inspected by the responsible bodies, gradually led the national system into deep decline. Despite the low rates that the public expenditure on health was historically recording the majority of it was costs to cover events of over-prescriptions, excessive increases of medicines’ prices and over-invoicing of various operating expenses. The overspending in public health stood as a pretext for the systematic reduction of the costs since the beginning of the crisis, worsening the quality of health services provided to citizens.

1. The Case of Greece
It is generally accepted that expenditure on public health has been considered low, compared with other developed countries from the European Union (EU), as shown in Figure 1. Tables 1 and 2 respectively show the public pharmaceutical expenditure as a percentage of GDP and public health expenditure as percentage of GDP during the period 1990, 2000 and 2010. It is noteworthy that the public pharmaceutical expenditure during the decades, is recording a sizable upward trend. In 2010 Greece exceeded by 50% the average of the EU countries in public pharmaceutical expenditure. In recent years, with the fiscal consolidation, taking place, there’s been a gradual reduction in government spending on public health. According to a research by the OECD, Greece in 2010 held the 18th position among the Member States of the European Union in public health expenditure as percentage of GDP. Specifically, Greece spends on public health expenditure 5.6% as a percentage of GDP Eurostat, OECD health data 2012, (2012). The countries which are located below Greece in expenditure on public health (Hungary, Estonia, Romania, etc.) have a much smaller GDP and their health services are considered inadequate. It is evident that despite the high pharmaceutical expenditure, the expenditure on public health is one of the lowest. Since the debt crisis of 2009, the reduction of fiscal deficit had been set as a primary target. As a consequence, measures were taken for the health service also. The cuts of around 1 billion euros that were made brought dramatic consequences on the welfare state of the country. Although the Health Minister has achieved his objectives, he did not calculate the collateral damages. These were the people, who now due to their economic status prefer the NHS for their healthcare. According to estimates the visits to outpatient departments of public hospitals have risen about 30%, and visits to private clinics have been respectively limited to what is strictly necessary Kiriopoulos

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This shows that in the early months of 2009 imports were increased in public hospitals. With the passage of time, more people are choosing public hospitals for their healthcare. According to Professor of Social Medicine Alexis Benos, demand for public and free health services grows exponentially, following the loss of income and loss of insurance coverage of households Galanopoulou (2012). The infrastructures of the NHS could not operate effectively when there was economic growth, meaning that it does not have the necessary requirements to be able to function properly within a period of recession and cuts on public funding. Because of the staff shortages the quality of services that provided to the patients is poor. The government has set a target to reduce pharmaceutical expenditure by 800 million euros for the years 2013 to 2014, while in the 2012 have reached the reduction target of pharmaceutical spending by 1 billion euros. Furthermore, 30% of people did not receive any health benefits because they are uninsured. Shortages of pharmaceutical resources in health centers are due to huge debts that accumulated towards suppliers. As a result, many patients who are in high risk do not have the proper and necessary care that the NHS has to offer them. Households for primary health care services pay from their own pockets the amount of 62.1%, while 28.6% are covered by pension funds and 9.3% by the state. Laboratory Management and Evaluation of Health Services, University of Athens (2011). On the other side, sections in hospitals are facing subfunction due to lack of personnel (3000 positions in key medical staff and nurses in 25000), the rise in demand for public health centers and simultaneous cuts due to the economic crisis in the health sector. Today the 133 public hospitals in the country are facing huge shortages of basic materials. Another negative aspect, which demonstrates the lack of organization in the health sector, is the ignorance of the exact number of staff employed in the public health sector till 2010. In 2010-2011 for the first time the workers employed in this sector were recorded. Therefore, the salary costs of personnel of the NHS were undetermined since the employees had not been reported before.

A commitment that existed after the signing of the loan agreement in 2010 was the systematic and effective control of the expenditure on public health. This obliges the seven Health Districts (H.D.) of the country to capture fully the financial situation (income-expenses) through the installation of double-entry system. The H.D., which implemented the cost accounting in total only touching 11% for 2011. Table 3 presents the percentages from the implementation of the cost accounting at the health district.
2. Empirical Approach

It is difficult to decide which econometric approach to use. The case of Greece is a country that despite the association with the European Union, in terms of public health has significant differences from other national health systems. Greece is a country which, due to its poor financial position forced into this period of recession (2010-2015) to make cuts at public health services because of chronic and irrational wasting and significant staff shortages (medical-nursing). Another peculiarity of Greece is the low expenditure of public health, which is close to countries that are considered as developing countries and have a lower standard of living and problematic health systems (such as Romania, Latvia, Lithuania) whilst pharmaceutical expenditure is very high and it is compared to pharmaceutical expenditure in France, Germany, England who have a well-organized healthcare system. We conclude that the NHS in Greece and therefore the estimate of the total costs of public health is a special case.

Several approaches for modeling health care expenditure have been made. A first distinction concerns the type of data used. Some studies used household data while others used aggregated macroeconomic data.

2.1 Linear Regression Model

The model of linear regression is suitable for calculating the cost of health care \( \mathcal{C} \) as it calculates the true cost of health care in billions of euros. As we define the variables that determine the overall cost of health care.

\[
Y_i = \alpha_0 + \alpha_1 \beta_1 + \alpha_2 \beta_2 + \alpha_3 \beta_3 + \ldots + \alpha_n \beta_n + \epsilon_i \quad (1)
\]

Where \( \beta_1 \) consider the public pharmaceutical expenditure in the time period of \( t \), \( \beta_2 \) debts-payment of hospital units in the time period of \( t-1 \), \( \beta_3 \) as costs of raw materials of the hospitals in the time period of \( t \), \( \beta_4 \) the costs of intangible materials of the hospitals (fixed costs e.g. fuel, building rent, Public Utility Companies etc.) in the time period of \( t \), \( \beta_5 \) as the spending obligations, services, consumable materials of the hospitals at time \( t \), and \( \beta_6 \) as the age of population at time \( t \).

The expenditures take different values from period to period. Jones Manning, Basu, MullahyCantoni and Ronchetti through experimentation, proved the validity and the possibility of deviation from reality (Jones 2000, Manning, Basu, και Mullahy 2005, Cantoni...
Therefore variables $\alpha$ hold a special role in the outcome of the results because their prices are considered constants. These constants indicate the degree of involvement of each variable on the overall effect. In our case $\alpha_0$ the price of 1 since Greece is a European country. Elola J Daponte A. and Navarro V. (1995)

$$\ln \left( \text{positive expenditures} \right) \neq \ln \left( \text{average expenditures} \right),$$

In the majority of these models, positive expenditures have an exponential conditional mean, $E(\, y \mid y > 0, \, X) = c \times \exp (X \beta)$, where $c$ is a scale factor. These models include OLS on log (positive) expenditures, nonlinear least squares (Mullahy 1998), and GLM with a log-link function. Because these models are multiplicative, the incremental effects (in levels) for each condition depend on other conditions. Therefore, summing condition-specific AFs will double-count attributable expenditures and overestimate the reduction in expenditures associated with the set of conditions. Interest lies in predicting costs on the original scale and, (given $\ln(\text{mean} \text{expenditures})$), this relies on retransforming to give

$$E(\ln (\text{expenditures})) = \ln (E(\text{expenditures})).$$

Then we have:

$$F_1 = \rho_1 \left[ \exp (\beta_1) - 1 \right] / (1 + \rho_1 \left[ \exp (\beta_1) - 1 \right])$$

$$F_2 = \rho_2 \left[ \exp (\beta_2) - 1 \right] / (1 + \rho_2 \left[ \exp (\beta_2) - 1 \right])$$

(3)

In F1 we calculate the cost of the effect of age on the total costs of public health expenditure, while in F2, we calculate the costs of diseases that present significant increase lately.
3. Results and Data Analysis

3.1 Analysis of the Period 2009-2012

The analysis presents the results from the estimation of the cost of public health for the years 2013-2015. In order to be more meaningful the presentation of data and the overall state expenditure of public health, it has been also analyzed the period 2009-2012 as shown in Table 4 and Figure 1. As mentioned above, the Greece was and continues to be a country that features a very small percentage of GDP in public health (which is below the EU average) and a sizable percentage of GDP in pharmaceutical expenditure (which exceeds by far the EU average\(^5\)). Table 4 and Figure 2 helps us get a general picture of the expenditure of public health since 2009, the starting year of the crisis. The country significantly reduces the cost of health within the four years of recession. Since 2009 efforts have been made to reduce pharmaceutical expenditure that is paid by the pension funds for the health of its residents. During the period 2009-2010 the total public health expenditure is reduced by 2 billion, while the costs paid by the insurance funds decreased by 2.3\% (400 million). As the country goes deeper into recession expense of public health continues to decline rapidly while a large percentage of citizens turned to public health. In 2010-2011 the total public health expenditure fell by 1.7 billion, while the costs paid by the insurance funds decreased by 0.4\% (80 million) compared to the previous period. Due to the large number of citizens who turned to public health in that period, begins at a robust pace to be displayed deficiencies in the public hospitals which apart from the lack of nursing and medical staff, they have also problems with the materials essentials, such as deficiencies in the medical and laboratory equipment. Furthermore the aging population and the increase in diseases in recent decades (cancers) do not allow the reduction of social security contributions and of public health expenditures. Despite the problems of shortages that Greece’s NHS is facing (due to the significant reductions made in recent years of crisis), in 2011-2012 the expenditure of public health fell by 3 billion. In 2012 the National Organization of Health Services (N.O.H.S.) was created, in an effort to unify the insurance funds, to contain and reduce the excessive expenditure of funds. This venture had positive results especially in the part of pharmaceutical expenditure, which in 2012 ended within the target of 2.88 billion euros (1.05 billion decrease from the previous year).
3.2 Presentation of the Data Used for Research

The econometric estimation of expenditure of public health in Greece for the years 2013-2015 becomes evident in Figure 2 and Table 5. Due to lack of data on public expenditure in Greece, it is taken for granted that for each period the target set for reducing pharmaceutical expenditure will be achieved and that the Health Districts of the country will honor their commitments to repay their debts over creditors. Furthermore it was set as a realistic assumption that spending on consumables (fixed maintenance costs hospitals) will be reduced because of mergers in some health sectors and by the repealing of clinics across the country.6 Another assumption is that the repealed clinics will significantly reduce the number of the cost of raw materials. Finally, during this period it is included the assessment of security and salary workers, the costs for cleaning the buildings, and the catering, which they will have a decline. Due to mergers, staff will be transferred to other clinics with shortages, and the new intakes will become under the regime of 1/10 (ten leave one enters). Age is a factor that has been also examined, because the more elderly the people are higher is the burden of the expenditure on public health. In Greece a large part of society is over 65 years and due to the low birthrate the ratio of over 65 increases.

3.3 The estimation results for 2013-2015

For the year 2013, it is noted a decrease compared to last year because it is estimated that the total public health expenditure will be reduced by 1.2 billion euros. This reduction will occur if the government achieves the target set for reducing pharmaceutical expenditure, which according to the agreement should not exceed 2.3 billion euros. Furthermore the Health Districts are going to repay the debts of the previous accounting period (2011-2012), as the costs for supplies are estimated to grow exponentially (due to the increase in the age of population and the common diseases that the country's population is facing). Finally, the raw materials are reduced as expected, due to cuts in hospitals.

For the period 2013-2014 it is noted a further reduction of 2.2 billion euros in total public expenditure for public health. This reduction will occur if the government achieved the target set for reducing pharmaceutical expenditure, which according to the target for the year 2014 should not exceed 1.99 billion euros. Also, the Health Districts are going to repay the debts of the previous accounting period (2012-2013) and the spending on consumables and raw materials will be decreased due to mergers of departments and clinics, and the degradation of several hospitals to health centers. In a similar way with the previous year, we calculate the age of the population. For the period 2014-2015 it is estimated that the total public health expenditure will be reduced by 88 million and the government will succeed in reducing
pharmaceutical expenditure by 80 million. Finally it is calculated the age of population and the first results of merging departments and hospitals are estimated to have yielded results (expected reduction of consumables and raw materials and reduction of staff due to retirement.).

4. Conclusions
From this survey, after presenting the data from the later years and recording the estimations, derives the following conclusion: The continuous reduction of the expenditure of public health in Greece is occurring as a result of the economic crisis. As mentioned above, however, the country spent a very little for the expenditure of public health (compared to the other developed countries of the EU). These continuous reductions will result a greater impact on the already troubled NHS and also at the health of the population, because in times of economic crisis, more and more people are turning to public health.

The NHS has too many problems to resolve such as the chronic fragmentation, the nursing shortage, and the inability provide primary care due to shortages in medicines and healthcare equipment. The problems continue with the increase in demand due to an aging population, having as a result the patients to be waiting in queue for surgery or they end up in a ranch in the hallway of a hospital. Finally the mismanagement of all these years and the waste of resources have resulted the huge deficits of hospitals and health insurers to be skyrocketed.

Greece is going through a period of economic crisis. This has lead people to resort to public health. The political personnel instead keeping (if not increase) the public expenditure at the same levels as it was before the crisis in order to provide the necessary health services, it applies a policy of cuts in health sector resulting the exclusion of a large number of citizens. Instead of cuts, the government officials could proceed to a rise on the public health expenditure by reducing the exorbitant pharmaceutical expenditure and transferring the leftover monetary units in other factors of total public health expenditure.

Notes
1 Had been preceded by the introduction of pension funds (in an early form) at the same time.
2 However, Greece has one of the most costly systems for pharmaceutical expenditure in the 27 countries of the EU spent 4.45 billion euros annually by 2010 Eurostat, OECD health data 2012, (2012). These costs make it the 5th place among EU countries. This fact can be characterized as oxymoron because the pharmaceutical expenditure, are added in the expenditure on public health.
3 In Greece the nursing staff is not sufficient to meet the needs of patients. First of all it is much less than the needs of each hospital (the number of nurses per capita was among the lowest with 3.3 per 1,000 2010 Eurostat, OECD health data 2012, (2012)). Secondly it is not
sufficient also for the fact that in most nursing departments on duty service nurses come from secondary education (assistant nurse) and they don’t not have the necessary knowledge and the jurisdiction to deal with the situations that might occur wisely. The framework defines a compulsory of at least one nurse from technological or university education.

4 It is noteworthy that before 2010 there was no effective cost control with the result that there is valid data, especially in expenditure on public hospitals.

5 Total health expenditures include public pharmaceutical expenditure.

6 Several of the hospitals in the country will be renamed health centers. So the clinics will be transferred to other nearby hospitals and patients cannot be accommodated there over 3 days.

7 Cancers of the colon, stomach, lung, larynx, heart disease, asthma, strokes.

References


2) Andrew J. (2010), Models for Health Care, University of York, January 2010

3) Baros P. (1998), The Black Box of Health Care Expenditure Growth Determinants, Economics of Health Care System


16) Laboratory of Management and Evaluation of Health Services, University of Athens (2011)


Trogdon J. Finkelstein E. and Hoerger T. Use of Econometric Models to Estimate Disease-Specific Shares of Medical Expenditures
### Appendix

#### Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Pharmaceutical Expenditure(% GDP)</td>
<td>0.5</td>
<td>0.9</td>
<td>1.8</td>
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Source: Eurostat, OECD health data 2012

#### Table 2

<table>
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<th>Year</th>
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<th>2000</th>
<th>2010</th>
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<tr>
<td>Public Health Expenditure (% GDP)</td>
<td>3.5</td>
<td>4.7</td>
<td>5.6</td>
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Source: Eurostat, OECD health data 2012

#### Table 3

<table>
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<tr>
<th>Hospitals who Applied Analytical Accounting in 2011</th>
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<tr>
<td>1st H.D.</td>
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<tr>
<td>2nd H.D.</td>
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<tr>
<td>3rd H.D.</td>
</tr>
<tr>
<td>4th H.D.</td>
</tr>
<tr>
<td>5th H.D.</td>
</tr>
<tr>
<td>6th H.D.</td>
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<tr>
<td>7th H.D.</td>
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Source: Analytical Accounting: Schedule of Implementation, Ministry of Health 2012

#### Table 4

<table>
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<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<tbody>
<tr>
<td>Public Health Expenditure</td>
<td>16,100,000,000.00</td>
<td>14,100,000,000.00</td>
<td>12,500,000,000.00</td>
<td>9,500,000,000.00</td>
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<tr>
<td>Pharmaceutical Expenditure</td>
<td>4,391,200,000.00</td>
<td>3,992,000,000.00</td>
<td>3,500,000,000.00</td>
<td>2,880,000,000.00</td>
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#### Table 5

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<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>Estimates of Public Health Expenditure</td>
<td>8,294,820,445.24</td>
<td>6,069,018,682.21</td>
<td>5,189,378,559.12</td>
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Table 6

<table>
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<th></th>
<th>Estimate</th>
<th>Standard Error</th>
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<tr>
<td>Health care expenditure</td>
<td>-0.26</td>
<td>(0.073)</td>
</tr>
<tr>
<td>Pharmaceutical expenditure</td>
<td>0.11</td>
<td>(0.06)</td>
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<td>National Health System</td>
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<td>(0.004)</td>
</tr>
<tr>
<td>R²</td>
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<td></td>
</tr>
<tr>
<td>p</td>
<td>0.1</td>
<td></td>
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<tr>
<td>Age</td>
<td>0.65</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Common diseases of the national system</td>
<td>-0.39</td>
<td>(0.9)</td>
</tr>
<tr>
<td>p</td>
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<tr>
<td>T</td>
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</tr>
<tr>
<td>R²</td>
<td>0.54</td>
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</table>

Figure 1

![Public Health Expenditure (in billions euros)](image)

Figure 2

![Estimates of Public Health Expenditure](image)