PRODUCTIVITY OF THE HEALTH CARE SECTOR
IN GREECE

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Summary

In this paper, a model is presented, aiming to examine the existing relationship between indicators of mortality, health care services and socio-economic, sanitary and environmental factors. The model is based on the mathematical form of the Cobb–Douglas function. The function’s estimations of the model were made through the least squares method, using data from the time period between 1960 and 2000 as well as the Microfit 4.0 software.

Introduction

Lothgren 2001, supports more and more the case that, if health care level is measured according to mortality and malady indicators, there is no room for improvement uniquely based on the health care services offered. For example, Fuchs claims that the changes noted today between the health care levels of the U.S.A. and other developed countries shouldn’t be accredited solely to the quantitative and qualitative differences of their health care systems. Essentially, these differences are consequent to factors related to the environment and the personal behavior of each person.

Obviously, a large number of factors affects the mortality of a population, and these factors aren’t exclusively connected to the health care services offered. They are, at the same time, influenced by the environment and the way of living of a person, e.g. their nutrition, their habits of smoking or alcohol consumption, whether they exercise, whether they are under stress etc. (Schneider, Klein and Murphy 1981). One could argue that changes in the above mentioned factors could have greater influence on the decrease of mortality than any health care services.

Mathematical Model

In order to determine the effect of health care services on mortality, we will examine two basic hypotheses:

1. We assume that the health care level is influenced by two basic groups of factors:
   a) By the sanitary services provided and b) by the environment and the socio-economic development. These factors are considered to be exogenous.

2. We assume that not only the health care level of a population is affected by the overall offer of health care services, but also, the overall offer of health care services is at the same time affected by the health care level. This is happening because the
health care level depicts specific health care needs and thus, any services offered are supposed to be aiming at the coverage of these needs.

By the above mentioned hypotheses we can formulate the following model, which constitutes a simultaneous equation model. (Theil 1971, Koutsoyiannis 1977, Yfantopoułos 1985, Gujarati 1988, Maddala 1992.

\[ LH = f \left[ (X_1, X_2, \ldots, X_n) (Y_1, Y_2, \ldots, Y_n) \right] \]

\[ X_1 = f_1 (LH_1, LH_2, \ldots, LH_k) \]

\[ X_2 = f_2 (LH_1, LH_2, \ldots, LH_k) \]

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\[ X_n = f_n (LH_1, LH_2, \ldots, LH_k) \]

where:

LH : Represents the health care level depicted by an indicator of mortality.

X : Represents the different forms of health care services provided in a population.

Y : Represents the different factors (social, economic etc.) which affect the health care
In every health care system, just as in every social system, we should be aware of the possibilities of reducing the resources of a sector in order to direct them towards another. For example, it might be more effective socially to cut down on the resources of hospitals and direct them to primary health care.

**Relationship between mortality indicators and socio-economic and environmental factors**

This model uses some of the socio-economic factors as independent variables. These factors appear at an irreducible minimum for reasons of statistical importance of the results. The model is demonstrated in a Cobb-Douglas function form. For estimation reasons the exponential functions are transformed into their logarithmic form, in order to become linear.

\[
L_{Hi} = a_0 A_{Li}^{a_1} C_{Li}^{a_2} F_{Di}^{a_3} H_{Li}^{a_4} E_{Di}^{a_5} Y_{Di}^{a_6} e^{ui}
\]

where: \(a_0, a_1, a_2, a_3, a_4, a_5, a_6\) are the parameters to be estimated.

- \(L_{Hi}\) = health care level calculated with the \(i\) indicator.
- \(Y_D\) = per capita income.
- \(F_D\) = per capita consumption of comestibles.
- \(A_L\) = per capita consumption of alcohol.
- \(C\) = per capita consumption of cigarettes.
- \(H\) = per capita health care services offered.
ED = percentage of population with a high school degree.

u_i = residuals

i = mortality indicator (infantile, nursling, post-nursling, child births, general mortality) per 10.000 inhabitants.

\[ \frac{\partial L}{\partial D} < 0 \quad \frac{\partial L}{\partial L} > 0 \]

On the above mentioned table the expected signs are the following:

\[ \frac{\partial L}{\partial Y} < 0 \]
\[ \frac{\partial L}{\partial C} > 0 \quad \frac{\partial L}{\partial H} < 0 \quad \frac{\partial L}{\partial ED} < 0 \]

On table 1 we present the results taken from the application of the O.L.S method in the above model.

Where:

\[ R^2 \] = Coefficient of determination adjusted for degrees of freedom.

D-W = The Durbin – Watson (D-W) statistic.

F = The F statistic.

A = The Lagrange test for autocorrelation.

B = Ramsey’s RESET test for specification.

C = Test based on assymetry-cyrtosis for residuals normality.

D = Test for heteroscedasticity of residuals.
E = The Sargan test for the 2SLS method.

(      ) = t ratios in parentheses.

[    ] = Levels of signification between brackets.

The estimations above are generally tenable, according to the statistical and diagnostic tests of the estimations and the fact that the parameter signs coincide with the signs of the a priori constraints.

From the results of table 1 we can deduct the following:

1. The health level fluctuation illustrated by a mortality indicator is for all models between 77% - 92%.
2. In all functions we have seen that health care services (calculated by the overall expenses) have a smaller impact on the decrease of the mortality indicator compared to the income and the level of education.
3. By the independent variables the consumption of comestibles does not present in all functions the expected signs, while the variables that refer to alcohol and cigarette consumption are not statistically important in all functions. Of course, a minimum number of independent variables is included in the model, since there has been a problem of multi-collinearity between these variables.

In order to test the second hypothesis of the mathematical model, we have estimated a model based on the least square method in two stages (2SLS) viewing the health care services offered as an endogenous variable. The results of these functions are presented in tables 2 and 3.
From the results of tables 2 and 3 we can conclude the following:

1. The models can interpret from 81% to 97% of the dependent variable (i.e. the variable of diachronic mortality decrease).

2. A 10% income raise would reduce infantile mortality by 2.66%, nursling mortality by 2.99%, post-nursling mortality by 8.22%, child births by 4.72% and general mortality by 5.64%.

3. Also a raise of the educational level by 10% would reduce infantile mortality by 6.83%, nursling mortality by 2.7%, post-nursling mortality by 8.83%, child births by 2.22% and general mortality by 7.72%.

4. A relative decrease in mortality could be observed with a raise in health care services provided, but in a smaller percentage, whereas in the case of variables that refer to alcohol and cigarette consumption, we have the expected results.

**CONCLUSION**

After taking into consideration all socio-economic variables, we can conclude that the most influential factor in improving the health care level is that of education and then the available income and the health care services provided. The variables of alcohol and cigarette consumption, and even that of comestibles consumption have a much smaller influence. At this point we should emphasize that the number of observations examined was limited and that the only criterion for the state of the health care level was mortality indicators.

Despite these constraints the model has given us significant results on the diachronic
course of mortality, as well as the influence of socio-economic and educational factors.

Surely, a more advanced research on this field should be conducted, through more specialized health care indicators, deeper and more detailed study of the social and environmental factors, in order to better estimate their influence in the health state of the population.

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