INCOME RELATED ELASTICITY OF HEALTH EXPENDITURE: SOME EMPIRICAL EVIDENCE FOR BULGARIA

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Abstract: *The aim of this study is to be presented and analyzed the trends of the household health expenditure dynamics and its source – the income considering the elasticity for the period 1990-2017. The elasticity is assessed trough OLS estimates of the slope coefficient of the linear health expenditure model built with income as an independent variable.*
The results reveal the existence of low level of the income elasticity of the households health expenditure (it is estimated on 2% of the real income changings). This general finding could be explained with a common nature of the health goods which consumption are often imperative and cannot be delayed. Other factors like the crisis and transition to the social insurance financing with definite out-of-pocket payments could cause the relatively low income related elasticity measures.

Key words: *household health expenditure, household income, health financing, income elasticity, crisis effects.*

1. INTRODUCTION

The health expenditure is studied at least by two major points of view with strong economic and financial sense: The first is their impact and relation to the economic growth – this is may the oldest problem discussed broadly in the field of Health Economics helping to rise it as a relatively independent discipline [1]. The second is the financing effects on the income inequality or redistributive evidences caused by the different financing methods [3], [4]. Some of the latest research of health expenditures which is focused on the determinants (demographic and non-demographic) proves that 1% increase of the income (measured by the GDP) can be associated with 1.1% increase of health care expenditure in OECD countries [2]. That finding reveals that health expenditures have growth rates bigger than that of GDP in developed. The other studies explain part of the nature of health goods with the reaction of the expenditure on them relevant to the income changings [5]-[8].

The income elasticity can be referred directly to the area related to the income and also indirectly to the financial burden, consumption of health services and to the nature of the health goods. In a narrow sense the income elasticity can be expressed with that reaction of the health costs due to the changings of the income of the economical agents.

According to the complex nature of the health goods and variety of methods for health financing, it can be classified different income elasticities – for example:

- the income elasticity of the total health expenditure considering the relation with the GNP or the GDP;

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- the income elasticity of the public health expenditure accounting the relation with the general budget revenue or with the GDP;
- the income elasticity of the private health costs assessed trough the household budgets measures.

The purpose of the study is to be estimated and analyzed the income elasticity of household expenditure on health in Bulgaria for the period 1990-2017 in terms of linear combination between the variables. Generally, the elasticity is assessed through the OLS estimate of the slope coefficient from the simple linear regression model of household health expenditure on health built with the household income as an independent variable.

In the course of the study the following phenomena play a restrict role and affect significantly the potential results:

1) The unusual and very high inflation with strong effect over the real income, consumption and costs of all economical agents for the period 1990-1997;
2) The introduction of a currency board in the middle of 1997 and the denomination of the national currency in the next year;
3) Fast running restructuring processes embracing whole the national economy after 1998;
4) The reorganization of the financing of the health sector passing from government budget to compulsory social insurance mixed with considerable direct payments (1999-2000 till nowadays).

As a response to these restrictions the whole period from 1990 (the beginning of the transition) to the last year 2017 is conditionally divided on two sub-periods – the first 1990-1998 and the second 1999-2017. The inflation is assumed through the annual inflation rates with base period the December of 1990. All of the observed values of the household health expenditure and income are recalculated from nominal to real. The analyses are conducted with the real health costs and the real income. Finally, for the purpose of better comparability the data is presented in non-dominated BGN i.e. the health costs and the income for 1998 and after are multiplied by 1000. This calculation does not change the elasticity estimates it affects only the constant of the suggested models.

2. DATA AND METHODS

The data sources for the health expenditure are the Average Household Expenditures on Health (AHEH) and the data for the income are obtained from the Average Total Household Income (AHI) that are reported by the National Statistical Institute of Bulgaria of its Statistical Yearbooks. The inflation rates have got the same source. This allows to be built two dynamic rows with length of 28 years from 1990-2017:

- $RAHEH_t$ – real average household expenditures on health;
- $RAHI_t$ – real average total household income.

The real values are determined by the following formula:

$$RAHEH_t = \frac{AHEH_t}{(1 + i_t)} \quad (1)$$

$$RAHI_t = \frac{AHI_t}{(1 + i_t)} \quad (2)$$

where:

i_t – inflation rate for the year 't' with a based period the December of 1990.

The study is conducted with the help of graphical analysis (plotting time series with lines and scatters), regression analysis using OLS estimates of the slope coefficients as an elasticity explanation. The model sustainability is explored with Chow test. The residuals are analyzed for autocorrelation, normality and homoscedasticity with Box-Pierce Q test, Jarque-Bera and Breusch-Pagan tests. Finally, for the whole period it is suggested the income elasticity of health expenditure derived from two models. The first model is specified with first order differenced data and the second with dummy and time as independent variables.

3. RESULTS AND DISCUSSION

After transformation of built time series from a non-denominated nominal to real values the following time movements become visible, as they are shown on figures 1 and 2.

Figure 1. RAHEH in non-denominated BGN and base period for the annual inflation rates Dec. 1990.

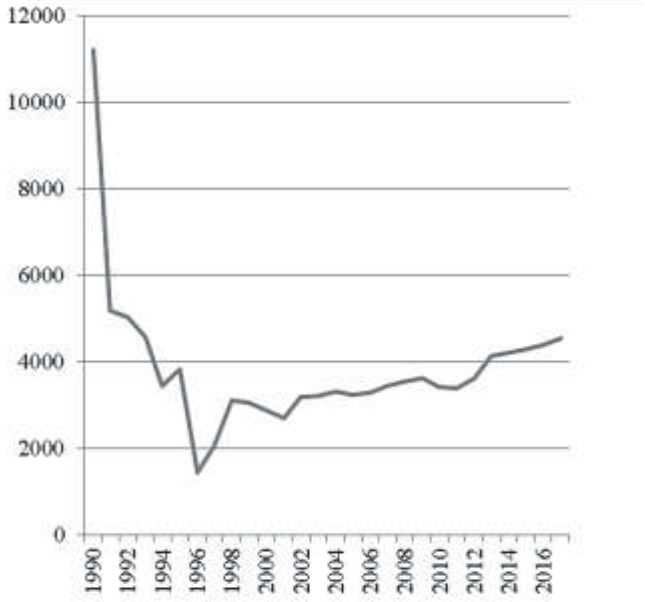

Figure 2. RAHI in non-denominated BGN and base period for the annual inflation rates Dec. 1990.

It is exists dramatic decrease of real health expenditure and not less drop of the real income over the first seven years. This tendency broke in 1997 and it is followed by the rapid upward trend of the health expenditure which continues to the end of the observed period. This tendency can be explained with put in control of inflation in the middle of the same year with introduction of the currency board and applying a conservative and restrictive fiscal policy for the next years.

Favorable uprising trend exists for the average real household total income after 1997 and 1998 but its increase is not so considerable like the health expenditure growth for the same sub-period. Hence, it could be considered that the health costs remarkably affect the household budgets. The next figure presents the series line of the real average household health expenditure as a percentage share of the real average total household income. This line expresses the financial burden of health for the households (not considering the social health

insurance contributions or taxation) i.e. the reported health costs are essentially direct payments made for health services and for pharmaceutical goods when it is necessary. Since the average health expenditure of households is obtained by the National Statistical Institute through the yearly conducted surveys (included more than 3 000 households) it has to be known that the data suffer from recall error.

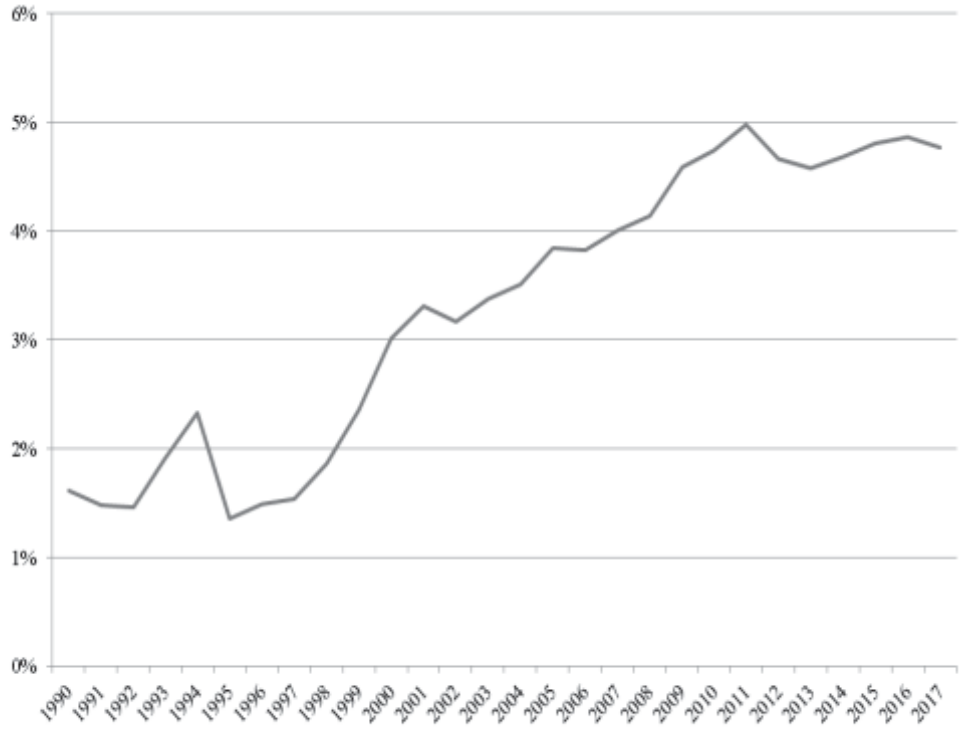

Figure 3. RAHEH as a percentage share from RAHI.

The series line of the financial burden of health has got well developed upward trend. However, for the last six years the small decrease is observed and variation of the share between 5% and 4.6% which stop the steady growth. The increase of the financial burden is more sensible after the reforms of health sector (1999-2000). Major parts of the reforms considered transition from government budget financing adequate for the old 'Semashko' system to introduction a compulsory social health insurance with definite out-of-pocket payments.

Considering the time series from the plots above it could be suggested that the income elasticity of health expenditures of households in Bulgaria derived from real average data would have not great value. In other words the health costs do not react largely to the income changes over the period 1990-2017. Another hypothesis could sounds credibly – the income elasticity for the first seven/eight years and for the next twenty years could differ significantly. If could be found enough proofs then the income elasticity of health costs would have two measures – one for the first sub-period 1990-1998 and the second for the period after the reforms in health system.

To confirm or to reject the above mentioned suggestions the analysis can be deepened with scatter plots. Figure 4 represents the variation of the real household health expenditure caused by the real income. The point labels help to recognize that the first eight years are positioned lowest and closest to the center of the plot area. This is quite sideward to the tendency formed from the next 19 observed years. This is another graphical proof for the not so strong reliability and it is very possible to have two estimates of the income elasticity of health expenditure.

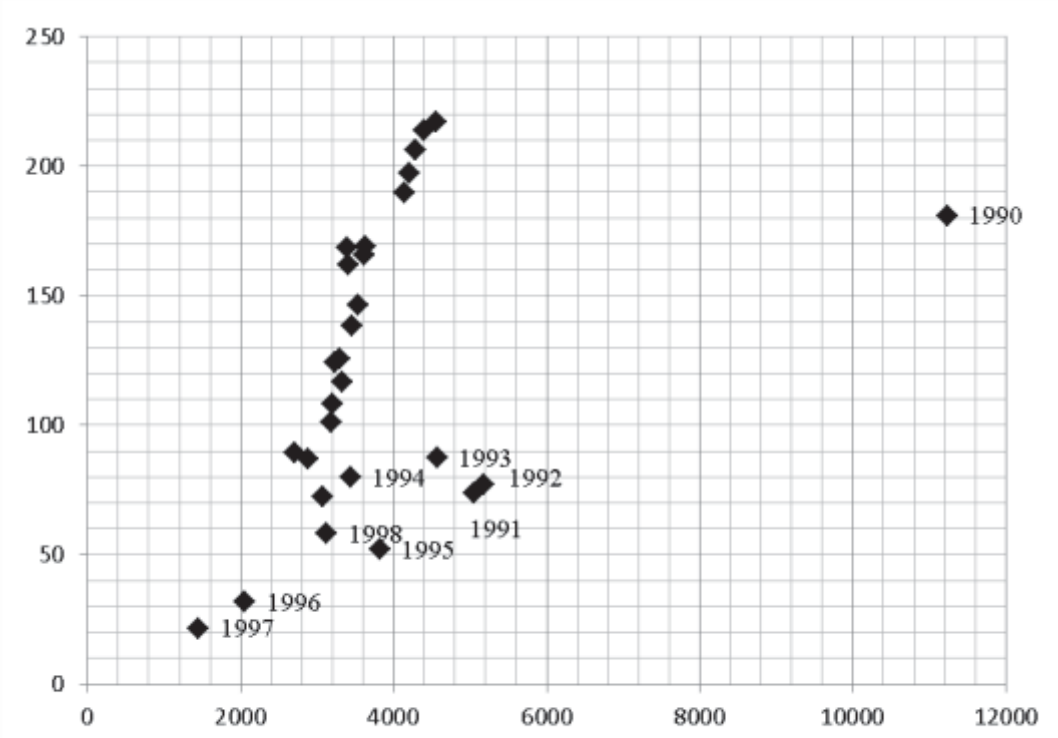

Figure 4. RAHEH and RAHI for the period 1990-2017.

The OLS estimates of the simple linear functional form of the health expenditure as a dependent variable and income as an independent variable are summarized in table 1.

Strength of model		**Coefficients**	**Estimate**	**t-value (S.E.) [p-value]**
R	0.402	β_0	70.94	2.773 (25.579) [0.001]
R^2	0.162	$RAHI_{90-17}$	0.0137	2.238 (0.0061) [0.0252]
RSS	72989.13			
Overall F-test [p-value]	5.01 [0.034]			

Table 1. OLS estimates of the simple regression model of real health expenditure.

The strength of the model of health expenditure is not so convincing. The statistics reveals that just 16.1% of the dispersion of the expenditure can be explain with the changings of the income. The overall F-test also cannot satisfy the 1% level of significance. If we relay to these results then the income elasticity for the whole period will be assessed on 0.0137 of real health expenditure. It means that the real health expenditure moves with BGN 1.37 on each BGN 100 changings of the real income of the household budget.

The residuals from the above model are normally distributed (Jarque-Bera test = 2.158; p-value = 0.3399) and homoscedastic (Breusch-Pagan test = 0.1744; p-value=0.676) but they are autocorrelated (Box-Pierce Q(1)=23.34; p-value = 0.000).

The denomination does not affect the income elasticity. If the regression analysis is conducted with the denominated BGN then the constant will be the same just divided by 1000 and the slope coefficient keeps the equal value.

If the tested model is not sustainable then the whole dynamic row is divided on two subsets (1990-1998 and 1999-2017) with the purpose to be achieved better estimates. The OLS estimates of two subset models are presented in table 2.

Strength of models	**1990-1998**	**1999-2017**
R	0.97	0.938
R^2	0.941	0.879
RSS	991.75	4451.51
Overall F-test [p-value]	112.52 [0.000]	123.97 [0.000]
Coefficients	**Estimate**	**t-value (S.E.) [p-value]**
1990-1998		
β_0	4.059	0.53 (7.661) [0.613]
$RAHI_{90-98}$	0.0157	0.001 (0.0015) [0.000]
1999-2017		
β_0	-138.68	-5.34 (25.952) [0.000]
$RAHI_{99-17}$	0.08	11.13 (0.0072) [0.000]

Table 2. The estimates of two subsets models with slope coefficients as a measure of the elasticity.

The two separated subsets models have got relatively higher determination coefficients and it seems that they have more explanatory power.

It is easy to check for model sustainability for the whole period through Chow test. The test value equals 148.9. The relative critical value of F (2;24) is 5.614 with 1% significance level. The test confirms that the slope or the elasticity coefficients are significantly differ for the two sub-periods, i.e. the value of 0,0137 is not a substantial measure of the elasticity.

Interesting fact is that for the second sub-period the elasticity coefficient is quite bigger than the obtained for the period 1990-1998. It can be explained with more sensible reaction of the health expenditure on the dispersion of the household income after the passing from budget to social insurance financing with defined direct payments.

Two strategies are possible to be built one unit model of RAHEH considering the structural changes presenting one income elasticity coefficient. The first strategy is to be specified a model built on the first order differences of the observed data. The second one is to be used artificial variable and time as additional independent variables. The first order differencing model which envelops whole the period are presented on the next table proposing one elasticity coefficient.

Strength of model		**Coefficients**	**Estimate**	**t-value (S.E.) [p-value]**
R	0.909	β_0	5.54	2.72 (2.033) [0.012]
R^2	0.827	$\Delta RAHI_{90\text{-}17}$	0.017	10.94 (0.0016) [0.000]
RSS	2690.13			
Overall F-test [p-value]	119.62 [0.000]			

Table 3. First order differencing model estimates.

The differencing strategy ensures more reliable estimates with comparison of the based model described in table 1. Less standard error of the slope/elasticity coefficient estimate is obtained and in the same time the measures of the determination and the correlation are higher. It seems that the differencing model has got better explanatory power. The residual tests give information that the autocorrelation is insignificant (Box-Pierce Q(1) = 0.77; p-value = 0.3799), homoscedastic (Breusch-Pagan test = 0.7727; p-value = 0.379) but not normally distributed (Jarque-Bera test = 74.06; p-value = 0.000).

The next opportunity is to be used a dummy variable. If one dummy is included with ‘0’ value for all the observations in the period 1990-1998 and ‘1’ for the next years and in addition the time is used as an independent variable then the following estimates will be available.

Strength of model		Coefficients	Estimate	t-value (S.E.) [p-value]
R	0.988	β_0	-46.787	-7.767 (6.024) [0.000]
R^2	0.977	$RAHI_{90\text{-}17}$	0.0203	18.554 (0.0011) [0.000]
RSS	2014.60	Dummy variable	7.1001	1.112 (6.3863) [0.266]
Overall F-test [p-value]	337.66 [0.000]	Time	6.038	16.540 (0.365) [0.000]

Table 4. Model with one dummy variable and time estimates.

It is achieved best explanatory properties – greatest value of the coefficients that measure the strength of the relation between the independent and dependent variables. It is clear that 98% of variation of the health expenditure can be explain with the income, time and included artificial variable. This model also ensures lowest standard error of the slope coefficient which can be assumed as an elasticity measurement for the whole of the period after 1990. In addition the residuals of the suggested model have not got statistically significant autocorrelation (Box-Pierce Q(1)=1.23; p-value = 0.266), they are homoscedastic (Breusch-Pagan test = 16.581; p-value = 0.000) and not normally distributed (Jarque-Bera test = 8.927; p-value = 0.012). It has to be known that the same model but specified with log transformed data ensures almost the same estimates and analogical residual tests outcomes therefore it is not presented and discussed here. Relying on the last table data the income elasticity for the period after 1990 can be expressed with 2% changings of the health expenditure caused by the one unit change of the household's incom e, considering the inflation.

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4. CONCLUSIONS

The correct measure of the income related elasticity in terms of simple linear regression model which assume the income as an independent variable is connected with many difficulties. For the particular Bulgaria case the factors like the enormous inflation rates for the first seven years and the fast conducted reforms and reorganization of the economy put the question of finding empiric strategies exploring the relation between the health expenditure and the income considering the elasticity. The empirical strategy based on micro data from the household budgets survey applied in this study assuming the inflation and the structural changes in health sector ensures reliable results assessing the income elasticity of health expenditure.

For the whole period marked by the dramatic transition the household health costs have got low income elasticity close to zero. If we consider the characteristics of health goods and their consumption then this fact does not surprise. Since the observed period includes crisis and post crisis years the obtained results could be connected with the income stagnation and this could be suggested as an additional explanation of the crisis effects on the heath expenditure and households income distribution.

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