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# The Causality between Healthcare Resources and Health Expenditures in Turkey. A Granger Causality Method

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***Abstract*** *The aim of this study was to evaluate the causality between healthcare resources and health expenditure in Turkey over the period from 1975 to 2013. The empirical modeling was based on how GDP per capita, the number of doctor and number of hospital beds had an impact on the growth of health spending per capita. Data were gathered from the statistical databases of Turkstat, World Bank Indicators and OECD Health Data. Granger Var method was used to investigate causality between variables. Eviews 9 software was performed for the tests. At the end of the analysis, it was found out that, health expenditures per capita were affected by the number of physician per 1000 to population and it had an effect on GDP per capita. These results are expected to provide important information to health policymakers to understand which variables have an impact on dynamics of health expenditures in Turkey while they plan and control their limited resources.*

***Key words*** Granger causality, health expenditures per capita, GDP per capita, number of physicians, number of beds

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## 1. Introduction and literature review

Health is one of the main factors to determine the economic development level of countries. Because healthily peoples are more productive, robust and active than sick ones. They earn higher wages and salaries and less likely to be absent from work. In this regard, they provide the more economic benefits to country's economy (Bloom, Canning and Sevilla, 2003). So policymakers and decision makers of countries try to achieve good health in the way of increasing the investment on health (Imoughele and İsmaila, 2013). This situation is lead to an increase in health expenditures over the world.

Health expenditures generally include all the spending made for improving and protecting health status (Liu, Çelik and Şahin, 2005; Akar, 2014). In Turkey, health expenditures have been substantially increased year by year. Total health care expenditures as a percentage of GDP have grown by 2.2% in 1975 to 5.1% in 2013. Per capita health care expenditures have also risen from 45$ to 941$ in the same period. However, health care expenditures of Turkey are lowest around OECD countries. According to 2013 data, health care expenditures as a percentage of GDP and per capita health care expenditures of Turkey are lower than the rest of all OECD countries 1.75 times and 3.5 times respectively (OECD Health Data, 2015). These differences occurred in the volume of health expenditures can be attributed to variations in such factors as economic, demographics, social, environment and health care systems related issues (Payne et al., 2015; Martinez, Gonzalez and Garcia, 2011).

Healthcare system related factors that have an impact on health expenditures are health outputs and health inputs. Health outcomes are the main health indicators such as life expectancy, infant and maternal mortality rate i.e. Health inputs include the health care resources which increase the availability of medical care. These resources can be classified as the quantity of money that comes from national income, health manpower such as number of physician per 1000 to population and, other material resources like number of hospital beds per capita (Weil, 2005; Joumard *et al*., 2008; Kabane *et al*., 2006, Martinez, Gonzalez and Garcia, 2011).

In the macroeconomics term, health expenditure is related to the income level of countries (Christiansen et al, 2006). This relationship was found by Newhouse (1977) firstly and it is still the subject of discussions among both economics and healthcare researchers (Gerdtham and Jönsson, 2000). As a result of these studies, health spending depends on the capability of expenditure (Bilgel and Tran, 2013). GDP growth rate and GDP per capita are mostly used to explain the relationship between the income and health expenditures (Üçdoğruk, 1996).

Human resources for health are also one of the key indicators to determine health expenditures. The numbers of health worker cause to reduce the negative health outcomes and to improve positive outputs. Also, especially number of doctor plays a major role the demand and supply side of health services. But these changes require the more investment in human resources for health (Amiria and Gerdtham, 2013). And the more human resource for health means leads to higher health expenditures.

Another factor that affects to health spending is the number of hospital beds per 1000 population. Hospital costs have a big share of healthcare expenditures. So increase in hospital beds can cause to increase in health expenditures (Üçdoğruk, 1996). Giannoni and Hitiris (2002) indicated that the number of hospital beds has a positive contribution to the expenditure of healthcare with a coefficient of 0.05.

Based on the analyses, studies indicated that there is a strong relationship between health expenditure, GDP per capita, number of doctors, and hospital beds, health outcome (Martinez, Gonzalez and Garcia, 2011; Gerdtham and Löthgren, 2002) To determine which factor is the most important for explaining health expenditures at the national, regional or international, several analyses techniques are used to measure over the years (Gerdtham and Jönsson, 2000) Some studies were made by regression, correlation analysis (Karatzas, 2000; Koening *et al*., 2003; Stearns and Norton, 2004). The panel data analysis model was also used in some research (Hitiris and Posnett1992, Di Metteo and Di Metteo, 1998). However Granger causality was not applied very common (Babatunde, 2014; Barlow and Vissandjée, 1999).

Assessment the impact of healthcare resources on health expenditures is major important policy to determine priorities for health to allocate the resources and to make an efficiently decision on health investment (Babatunde, 2014). Most studies which were done in this field have examined the relationship between GDP and health (Martinez, Gonzalez and Garcia, 2011; Gerdtham and Löthgren, 2002; Akar, 2014; Bilgel and Tran, 2013). But unfortunately, only a few studies have investigated the link between health spending and other health resources (Karatzas, 2000; Gerdtham *et al*., 1998; Christiansen *et al*., 2006; Wang, 2009). Therefore, the aim of this study was to assess the causality between health care resources and health expenditure in Turkey. The results of this study are expected to provide important information on how policymakers should formulate the availability of health care resources for planning their limited resources.

## 2. Methodology of research

Sample period was from 1975 to 2013. In order to examine the causal relationship between healthcare resources and healthcare expenditure, four variables were used. Definitions and data sources of variables were depicted in Table 1. All variables were converted into a natural logarithmic form to achieve theory meaning (Ahmed and Zaman, 2014). Quantitative secondary data were collected from statistical databases of Turkish Statistic Institute and World Bank and OECD. Annual healthcare expenditure per capita and the number of physician per 1000 to population were obtained from 2015 edition of the OECD Health Database. GDP per capita data was taken from the World Development Indicators. The number of bed per 1000 to population was gathered from Turkstat which is statistics and data sources of Turkish Statistic Institute.

*Table 1.* Variables in Research

| Variable | Description | Source |
|---|---|---|
| Ln HEX | Log of Health expenditure, per capita | OECD Health Data |
| Ln GDP | Log of Gross Domestic Product per capita | World Development Indicators |
| Ln PHY | Log of Physicians per 1000 to population | OECD Health Data |
| Ln HOS | Log of Hospital beds per 1000 population | Turkstat |

To test the association between dependent and independent variables, Eviews 9 software program was used. In order to prevent autocorrelation problem, Augmented Dickey–Fuller and Phillips–Perron unit root tests were performed to determine stationary of variables. Testing for integration, Johansen Co-integration test was applied and finally, Granger Var analysis used to examine the bidirectionality of variables. The model of this study can be written as:

$$LnHEX = \beta 0 + \beta 1 LnGDP + \beta 2 LnPHY + \beta 3 LnHOS + \varepsilon \quad (1)$$

## 3. Results

Descriptive statistics of variables were given in Table 1. Health expenditures per capita were on average $ 325.46 with a range from $ 40 to $ 941 years over the 1975-2013. The mean of GDP per capita was nearly $4129. The average number of doctors, the number of bed to population and were reported as 1.077, and 2.287, respectively.

*Table 2.* Descriptive statistics of the variables in Turkey, 1975-2013

| Variables | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|
| Health expenditure, total (% of GDP) | 40.00 | 941.00 | 325.4615 | 296.77724 |
| GDP per capita (current US$) | 1139.19 | 10975.07 | 4128.864 | 3225.45542 |
| Physicians per 1000 to population | .50 | 1.80 | 1.0769 | .39501 |
| Hospital beds to population | 2.03 | 2.64 | 2.2874 | .21128 |

To apply the co-integration and Granger Var analyses, firstly the series have to be stationary in the same ordered differences. In this study, to test stationary of variables, Augmented Dickey-Fuller and Phillips–Perron test were performed (Dickey and Fuller, 1981; Phillips and Perron, 1988). They are used as most commonly methods to determine unit root (Audu, 2012). The results of these tests were represented in Table 3. According to this, all the variables were stationary at their first ordered differences.

*Table 3.* Unit Root Tests Results

| **Augmented Dickey-Fuller (ADF)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **None** | | **Intercept** | | **Trend+İntercept** | | **Conclusion** |
| | **Level** | **First Difference** | **Level** | **First Difference** | **Level** | **First Difference** | |
| Ln HEX | 0.9127 | **-35878 | -0.671 | **-6.8127 | -3.1203 | **-6.7112 | 1(1) |
| Ln GDP | 2.2207 | **-6.0213 | -0.3061 | **-6.7595 | -2.3693 | **-6.7176 | 1(1) |
| Ln PHY | -0.3863 | *-2.3592 | -0.8005 | **-4.7813 | -1.9972 | *-4.7498 | 1(1) |
| Ln HOS | 1.64 | **-6.5220 | -0.7113 | **-6.9270 | *-4.092 | **-6.8207 | 1(1) |
| **Phillips–Perron (PP)** | | | | | | | |
| **Variable** | **None** | | **Intercept** | | **Trend+İntercept** | | **Conclusion** |
| | **Level** | **First Difference** | **Level** | **First Difference** | **Level** | **First Difference** | |
| Ln HEX | 0.8551 | **-6.4099 | -0.7173 | **-6.7043 | -2.4208 | **-6.6158 | 1(1) |
| Ln GDP | 2.3975 | **-6.0482 | -0.3061 | **-6.7573 | -2.4411 | **-6.7063 | 1(1) |
| Ln PHY | 0.8551 | *-2.1578 | -0.7526 | **-4.7572 | -1.4033 | *-4.7210 | 1(1) |
| Ln HOS | 3.6763 | **-6.1956 | -0.8835 | **-13.1561 | -3.3778 | **-13.5894 | 1(1) |

Johansen co-integration method was performed to test for the presence of co integration relationship between health expenditures and other variables in the long term (Table 4). Optimal lag length was determined as 3. Results showed that there were at least two co integration linkages between the variables.

Granger Var causality analysis was performed to investigate the causality relationship between health expenditures and other variables. Causality test results were given in Table 5. As a result, the null hypothesizes that spending in healthcare expenditures did not cause or precede GDP per capita and the number of physician per 1000 to population did not cause or precede healthcare expenditures per capita

were rejected. Thus, there was a unidirectional causal linkage between healthcare spending and GDP and number of doctor per capita. So health expenditures were affected by GDP per capita and the number of physician per 1000 to population affect the health expenditures in Turkey.

*Table 4.* Johansen Cointegration Test Results

| Hypothesized | Eigenvalue | Trace Statistic | Max-Eigen Statistic | Prob.* |
|---|---|---|---|---|
| r=0 | 0.0670450 | 81.68048 | 38.85091 | **0.0012** |
| r≤1 | 0.507589 | 42.82957 | 24.79549 | **0.0145** |
| r≤2 | 0.26044 | 18.03409 | 10.56203 | 0.1776 |
| r≤3 | 0.192238 | 7.472056 | 7.472056 | 0.0630 |

**MacKinnon-Haug-Michelis P values*

*Table 5.* Causality Test Results

| Variables | Chi-sq | P |
|---|---|---|
| Δ*Ln HEX* ⇒ Δ*Ln GDP* | 0.148099 | 0.9286 |
| Δ*Ln GDP* ⇒ Δ*Ln HEX* | 6.697609 | **0.0351** |
| Δ*Ln HEX* ⇒ Δ*Ln PHY* | 6.511492 | **0.0386** |
| Δ*Ln PHY* ⇒ Δ*Ln HEX* | 0.199895 | 0.9049 |
| Δ*Ln HEX* ⇒ Δ*Ln HOS* | 0.260739 | 0.8778 |
| Δ*Ln HOS* ⇒ Δ*Ln HEX* | 1.128848 | 0.5687 |

## 4. Discussions

In this study, it was aimed to examine the effect of healthcare resources on health expenditures. At the end of Granger var analysis, it was found out that there were positive relationships between health spending, GDP per capita and, the number of physician per 1000 population.

An increase in GDP per capita causes to an increase in health expenditures. Erdil and Yetkiner (2004) also demonstrated that one-way causality runs from income to health expenditures in low- and middle-income countries. Gerdtham *et al.* (1998), Christiansen *et al*. (2006), found out that there were high positive correlation between health care expenditure and GDP per capita. Gerdtham and Löthgren (2002) and Öztürk and Topçu (2014) also indicated that health expenditure and GDP were co integrated. In Turkey, Üçdoğruk (1996), Kar and Ağar (2003) and Akar (2014) performed co-integration analysis on health expenditures and GDP per capita and their results confirmed to this linkage.

Number of doctor per 1000 population was positively affected by health expenditures. Although some authors report that more numbers of doctor have an important effect on health expenditures (Gerdtham *et al*., 1998), the others demonstrate there was no relationship between them (Imoughele and İsmaila, 2013; Karatzas, 2000; Hartwig and Sturm, 2014).

However, there is no relationship between the number of beds per capita and growth in health expenditures. Also, previous studies showed the consistent result with this study (Karaztaş, 2000; Hartwig and Sturm, 2014, Mosca, 2007). In contrast, in some studies, it was found out that, the number of hospital beds had an impact on health expenditures (Gerdtham *et al*., 1998; Christiansen *et al*., 2006; Wang, 2009).

## 5. Conclusions

As a result, health expenditure in Turkey is very low but it affects the main health resources. The results of this study are expected to provide important information to health policymakers to understand which variables have an impact on dynamics of health expenditures in Turkey while they plan and control their limited resources. Further research is also recommended in order to identify determination of heath expenditures with Granger Var analysis in Turkey. These researchers need to include the other variables such as population, urbanization, age structure.

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