

Stationarity and Cointegration between Health Care Expenditure and GDP for Jordan

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Abstract: This paper explores the Granger-causality relationship between real GDP per capita and real health care expenditure per capita for Jordan during 1995 through 2013. The findings point out that the dominant type of Granger-causality is unidirectional. Furthermore, income elasticity of health expenditure is less than 1, which means that health care is a necessary good in Jordan. To this end, policies must be aimed at raising national income to improve eventually the well-being of the population.

Keywords: Health Care Expenditure, Granger Causality, GDP, Jordan

Introduction

The health care expenditure and Gross Domestic Product (GDP) relationship has been investigated extensively in literature of health economics. The presence of unit roots, co integration and panel unit root tests in the literature provided stimulus in the empirical testing for this relationship. As general notion, a variable is called Granger if a former and a present values are used to predict the former one (Devlin and Hansen, 2001). Therefore, causality between health care expenditure and Gross Domestic Product (GDP) can be in either or both directions. That is, if a significant percentage of change in per capita health care expenditure can be explained by variations in per capita GDP, it is then called direct causality (Erdil and Yetkiner, 2009). Accordingly, to test for the existence of causality requires first to test if present and former values of health care expenditure can be used in forecasting future values for GDP. If two variables were found to Granger cause the other and then a bi-directional Granger causality can be concluded. Attention is also paid in the literature on the concept of health spending elasticity on per capita GDP. The main question is whether health care spending is a necessary or a luxury services (Lago-Peñas *et al.*, 2013). The debate on this relationship was whether income elasticity of health care expenditure is more or less than 1. If income elasticity is less than one, then health expenditure and income are considered to be inelastic,

that is, a necessary good. On the other hand, if income elasticity is more than one, then health care expenditure is considered to be a “luxury” good.

Jordan is an upper middle income country, faced with constraints in natural resources, lack of adequate financial capital, rather investing heavily on its human capital. According to Mushkin, (1962) health is a form of human capital. In addition, the service sector in Jordan comprises 66.3 of the GDP (CIA, 2016). Therefore; any substantial growth of the GDP is dependent on the growth of services. Moreover, Jordan’s healthcare sector has been rising in attractiveness with the country being Well known as a leading medical tourism destination which ranked by the World Bank as a top ranking destination in the Arab world and fifth globally (Jordinvest, 2012).

In order to avoid the heterogeneity problem between causal relationships or between data processing, Granger causality test is applied. Therefore, it is the most effective and practical way to test the causality direction between health care spending and GDP. This study aims to supply evidence on the relationship between Jordan’s health care expenditure and GDP (on a per capita basis) by employing Granger-causality test.

The rest of the paper is structured as follows. Literature review on causality studies on health care expenditure in relation to GDP are provided in section 2. Data and methodology adopted are presented in section 3. Section 4 details main results and concluding remarks are presented in the final section.

Literature Review

The relationship between health care expenditure and GDP has been the focus of a large scale of literature (Kumar, 2013). Starting with Newhouse (1977) and afterwards in the 1980s studies as in Parkin *et al.* (1987; Leu, 1986) and in the 1990s as in Barros (1998; Posnett and Hitiris, 1992; Hansen and King, 1996). The literature has shown that the relation between health care expenditure and income can be either direct causation, reverse causation or a bidirectional one (Erdil and Yetkiner, 2009). Studies of the first strand of relationship are found in Erdil and Yetkiner (2009) where in low- and middle-income countries a one-way causality running from (GDP) to health was found and for high-income countries the reverse was found. Kiyamaz *et al.* (2006) indicated a one-way causality from per capita GDP to per capita private health care expenditure. Other studies in this streamline of research are also found in Magazzino and Mele (2012; Jochen and Jan-Egbert, 2014; Samadi and Homaie, 2013).

Akhmat *et al.* (2014) found that economic growth has significant causal effect on social health indicators in East Asia and Pacific, MENA, South Asia and Sub-Saharan Africa in the long run term and one of these social health indicators was out-of-pocket health costs. Mehrara and Musai (2011) concluded a strong evident causality from economic growth to health expenditures in oil exporting countries considered in their study. Alternatively, some studies, found significant positive effect of health care spending on economic development. In a way, the increase in health spending is translated into higher labour supply and productivity, which in the end raises output growth. This is often called reverse causation (Erdil and Yetkiner, 2009).

Devlin and Hansen (2001) have tested the association between health care spending and gross domestic product for some of the 20 OECD countries and revealed that for some of the latter countries, health care spending Granger causes GDP and vice versa for other countries. Esteve and Martinez-Zahonero (2007) pointed out to the evidence of a long-run relationship between per capita health spending

and GDP per capita in Spain within two structural breaks in 1971 and 1991. Wang (2011) focused on the relation between an increase in health care spending and economic growth and found a direct causation from HCE to GDP. Whereas Dritsakis (2005) confirmed a long- run relationship between health spending and GDP.

The link between health spending and GDP is vital for policy making, as health is considered as an investment in human capital that contributes to economic growth. It is also assumed that high levels of health spending can lead to an increase in output levels, through higher labor supply and productivity (Kumar, 2013).

In general, health status in a country affects its economic growth (dubbed by GDP per capita) through different mechanisms. First, economic growth signals rising per capita income, hence part of this increased income is reflected into consumption of higher quantity of and better quality of nutritious foods. Then, economic growth is fueled by technological progress and part of this progress passes through improvements and advancements in medical sciences (Wang, 2011). In the end, an enhancement in population health enables the country to produce more with given economic resources.

In other stem of studies, bi-directional causality between health and income exists. That is healthier people can work harder Amiri and Ventelou (2012) and improvements in income can lead to higher consumption of healthy food, of healthier behavior traits and of medical follow ups and examinations. Abbas and Hiemenz (2013) demonstrated a two-way causality between income and health care spending for Pakistan during the period (1972-2009). Kumar (2013) revealed a bi-directional causality between health spending and gross domestic product in 10 OECD countries over the period (1960–2007), whereas Amiri and Ventelou (2012) observed for a 20 OECD countries through the period (1970–2009) a bidirectional granger causality between GDP and healthcare expenditure.

Summary on literature review of different causality studies between health care expenditures and income are presented in Table 1.

Table 1. Review of causality studies between HCE and GDP

Study	Aim of study	Country (Time line)	Variables used	Methodology	Conclusion
From GDP to HCE					
Erdil and Yetkiner (2009)	Tested bidirectional causality between real per capita GDP and real per capita health expenditures.	19 Low-income 22 Lower middle-income 10 Upper middle income 24 High-income countries (1990-2000)	1.Real per capita GDP 2.Real per capita health expenditures.	Macro panel data set with VAR representation	1. One-way causality runs from GDP to health in low- and middle-income countries, while the reverse is true for high-income countries.
Kiyamaz <i>et al.</i> (2006)	Examined long-run relationship between per capita private, public and total health care expenditure and per capita gross domestic product and population growth.	Turkey (1984-1998)	1.Per capita private health care expenditure. 2.Per capita public health care expenditure. 4.GDP per capita 5. Population growth rate.	Cointegration	1. One-way causality from per capita GDP to various definitions of health care expenses.
Jochen and Jan-Egbert (2014)	Disclosed strong explanatory variables for health care expenditure growth.	33 OECD countries (1970–2010)	Macroeconomic and institutional variables of health care expenditure.	Extreme Bounds Analysis (EBA)	1.GDP growth 2.Baumol's 'cost disease' is statistically significant determinants of health care expenditure growth.

Table 1. Continue

Samadi and Rad (2013)	Surveyed determinants of health expenditures.	Economic cooperation Organization countries Armenia Azerbaijan Iran, Kazakhstan, Kyrgyzstan Pakistan, Tajikistan, Turkey Turkmenistan Uzbekistan (1995-2009)	1. Health care expenditures per capita at purchasing power parity. 2. Gross domestic product per capita 3. Population below 15 years old. 4. Private healthcare expenditures to total healthcare expenditures (in %). 5. Number of physicians per 1000 people. 6. People who live in urban regions to total population (in %). Sixteen social indicators: 1. Infant mortality, 2. Child abuse. 3. Child poverty. 4. Teenage suicide. 5. Teenagers drug abuse. 6. High school dropouts. 7. Unemployment. 8. Weekly wages. 9. Health insurance coverage. 10. Elderly living in poverty 11. Out-of-pocket health-care costs among the elderly. 12. Homicides. 13. Traffic fatalities related to alcohol. 14. Food insecurity. 15. Affordable housing. 16. Income inequality. 17. GDP per capita.	1. Pesaran cross sectional dependency test. 2. Panel unit root tests. 3. Westerlund panel cointegration test 4. Continuous-updated fully modified estimator. 5. Fixed effects estimator.	1. Long term relationship between and GDP per capita, and health expenditures per capita.
Akhmat <i>et al.</i> (2014)	Investigated a two-way statistical relationship between social health indicators and economic growth.	Four regions East Asia and Pacific Middle East and North Africa South Asia Sub-Saharan Africa (1975–2011)	1. Infant mortality, 2. Child abuse. 3. Child poverty. 4. Teenage suicide. 5. Teenagers drug abuse. 6. High school dropouts. 7. Unemployment. 8. Weekly wages. 9. Health insurance coverage. 10. Elderly living in poverty 11. Out-of-pocket health-care costs among the elderly. 12. Homicides. 13. Traffic fatalities related to alcohol. 14. Food insecurity. 15. Affordable housing. 16. Income inequality. 17. GDP per capita. 1. Real health expenditure. 2. Real GDP per capita. 3. Real oil revenues.	Co-integration and Granger causality tests.	1. Economic growth has long run casual effect on social health indicators in all regions.
Mehrara and Musai (2011)	Tested causal relationship between health expenditure and GDP.	11 selected oil exporting countries Iran Kuwait Saudi Arabia U.A.E Oman Bahrain Algeria Nigeria Venezuela Mexico Ecuador (1971-2007)	1. Real health expenditure. 2. Real GDP per capita. 3. Real oil revenues.	1. Panel unit root tests. 2. Panel cointegration analysis.	1. Significant causality from oil revenues (economic growth) to health expenditure.
From HCE to GDP					
Wang (2011)	Explored causality between increase in health care expenditure and economic growth.	31 countries Belgium Canada Czech Republic Luxembourg Denmark Finland France Iceland Germany Italy Poland Greece Hungary Netherlands Norway Ireland Korea Japan Mexico New Zealand Portugal Republic of China Taiwan Slovak Republic Spain Sweden Switzerland Turkey UK US	1. International total expenditure on health. 2. International total expenditure on personal health care. 3. International total expenditure on health per capita. 4. National income (GDP).	1. Panel regression analysis. 2. Quantile regression analysis.	1. Health care expenditure growth will affect economic growth.
Devlin and Hansen (2001)	Explored relationship between health care expenditure and gross domestic product.	20 OECD countries (1960-1987)	1. Per capita health care expenditure (in real terms) 2. GDP.	Granger causality tests.	1. Health care spending Granger causes GDP.
Dritsakis (2005)	Investigated relationship between health expenditures and gross domestic product.	15 member-countries of EU (1960-1998)	1. Real health care expenditures. 2. Gross domestic product. 3. Relative prices of health care expenditure.	1. Unit root test. 2. Engel-Granger and Johansen. 3. Juselius cointegration tests. 4. Error correction model.	1. Long run relationship between health expenditures and gross domestic product.
Esteve and Martinez-Zahonero (2007)	Examined long-run relationship between per capita health expenditures	Spain (1960-2001)	1. Per capita health expenditures. 2. Per capita national income.	Unit roots Stock-Watson-Shin cointegration test.	1. Long -run relationship between Health Expenditures (HE) (on per capital basis) and national income(per capita)
Bi-directional between GDP and HCE					
Abbas and Hiemenz (2013)	Estimated factors affecting public health expenditures	Pakistan (1972-2009)	1. Real per capita health care 2. Demographic, social, economic and health care services variables.	Unit root and Johansen cointegration methods.	A Two-way causality between income GDP and health care spending
Kumar (2013)	Examined link between health spending and GDP.	10 OECD countries (1960–2007)	1. Real per capita health spending. 2. Real per capita GDP.	Systems generalized method of moments SGMM.	
Amiri and Ventelou (2012)	Tested causality between GDP and health care expenditure.	20 OECD countries (1970–2009)	1. Real per capita healthcare expenditure. 2. Real per capita income.	Modified version of Granger test.	A bi-directional Granger causality between GDP and health care expenditure.

Source: Author compilation. GDP: Gross domestic Product. HCE: Health care expenditure.

Data and Methodology

This study attempts to identify the causality relationship between GDP and health expenditures in Jordan. The data used in this study are Per Capita Health Care Expenditures (PCHCE) and per capita GDP (PCGDP). Total health expenditure includes the sum of public and private health expenditures. It contains the provision of health services (both preventive and curative), family planning activities, nutrition activities and emergency aid designated for health, but does not include availability of water and sanitation. The yearly data from 1995 until 2014 of PCHCE (in constant 2011 US\$) and PCGDP (in constant 2005 US\$) are compiled from the World Bank.

The time series plots of PCHCE and PCGDP are depicted in Fig. 1, while Table 2 shows descriptive statistics of these two series. As seen in Fig. 1, the PCGDP was having an upward trend through the years from 1995 to 2013. However, PCHCE is increasing steadily from 1995 until 2011, but dropped dramatically from 2012 until 2014. Overall from Table 2 both series have leptokurtic peak and lack of symmetry which show non normality.

In order to model the bidirectional relationship, two tests need to be conducted. The two tests are stationary test and the cointegration test. Commonly unit root test likes the ADF and PP tests will be used to investigate the stationarity of a series. However, in this study, because of the small sample the p-value from the unit root test are unreliable. Therefore, the KPSS test by Kwiatkowski *et al.* (1992) will be applied with the null hypothesis of stationary versus non-stationary. The KPSS test specification is given in Equation 1:

$$Y_t = \beta t + \eta_t + a_t \quad (1)$$

where, Y_t represent the two series, PCHCE and PCGDP, $\eta_t = \eta_{t-1} + \mu$, μ are *i.i.d.* with mean 0 and variance σ_μ^2 and a_t are *i.i.d.* with a mean 0 and a variance $\sigma_a^2 = 1$. Rejecting or accepting the null hypothesis is based on the value of σ_μ^2 where if $\sigma_\mu^2 \geq 0$ the null hypothesis cannot be rejected. Results in Table 3 indicate both series are non-stationary at the level data where the null hypothesis is rejected, whereas both series became stationary after first differences where the null hypothesis is not rejected. This result indicates both series are stationary at the same level, which is integrated. Hence, the assumption for further test and research of long term relationships between specified variables is met.

Next, cointegration test is carried out to investigate if the two series are cointegrated or not. Cointegration test helps to specify whether there is any relationship between the series in the long run. Vector Autoregression (VAR) analysis will be performed at first

difference if the variables under study are cointegrated, otherwise, Vector Error Correction Model (VECM) analysis will be carried out at the level. In this study, the Johansen test going to be executed. The Johansen test is based on two test statistics, the Trace statistic and Max-eigen statistic (Johansen and Juselius, 1990; Johansen, 1988).

The cointegration test only provides information regarding the existence of causality between a two series, but it does not indicate the direction of the causality relationship. Hence, the Granger causality test needs to be run to capture the direction of causal relationships. Engle and Granger (1987) showed that if the two series are cointegrated, therefore the vector-error correction model for the PCGDP and PCHCE series are given as in following Equation 2 and 3:

$$\Delta PCHEA_t = \alpha + \sum_{i=1}^k \beta_i \Delta PCHEA_{t-i} + \sum_{i=1}^k \gamma_i \Delta PCGDP_{t-i} + \delta \varepsilon_{t-1} + \mu_t \quad (2)$$

$$\Delta PCGDP_t = \alpha + \sum_{i=1}^k \beta_i \Delta PCGDP_{t-i} + \sum_{i=1}^k \gamma_i \Delta PCHEA_{t-i} + \delta \varepsilon_{t-1} + \mu_t \quad (3)$$

where, ε_{t-1} refers to the error correction term derived from long-run cointegrating relationship.

From previous section, KPSS test specify that both series, PCHCE and PCGDP are of order 1 of 1st difference stationary. Therefore, the Johansen cointegration test is conducted to test whether the two series are co-integrated. From Table 4, Trace statistics show that the two series, i.e., PCHCE and PCGDP, have one equation for cointegrating ($H_0: r = 0$ is rejected at 1% level). However, Max-eigen statistics display that both series are not cointegrated. Usually in cases of contradicting results between these two tests, Trace statistics is preferred. The optimum lag length for Johansen cointegration test is based on AIC at its minimum where the value is 2.

Based on the result of Trace statistics, both series are cointegrated, hence the analysis proceed with modelling the relationships by utilizing Vector Error Correction Model (VECM). Table 5 tabulated the estimation VECM while Table 6 presented several specification tests on the residuals. All the specification tests for the vector error correction model (testing for the presence of serial correlation and heteroskedasticity) tend to indicate that the model is well-specified. In addition, it can be seen from Table 5 that the estimation VECM includes the cointegration relation (denoted by Coint Equation 1) built into the specification so that relationship between the variables are not spurious and indicates that there is a theoretical association within the variables. Moreover, this will restrict the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics.

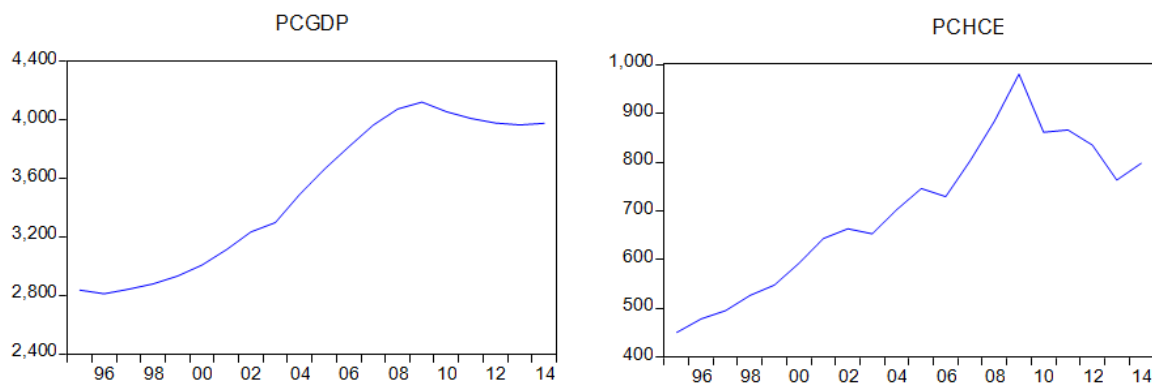


Fig. 1. Time Series Plot of PCHCE and PCGDP

Table 2. Descriptive statistics for PCHCE and PCGDP

Statistics	PCGDP	PCHCE
Mean	3502.363	700.9048
Median	3575.711	715.7172
Maximum	4120.396	980.2639
Minimum	2809.926	450.6589
Standard deviation	506.1488	151.4339
Skewness	-0.164510	-0.070710
Kurtosis	1.338916	1.994383
Observations	20	20

Table 3. Results of KPSS test

Variables	Levels	1 st differences
PCHCE	0.534**	0.236
PCGDP	0.554**	0.176

Note: ***, **, * denotes significance at 1, 5 and 10% levels respectively

Table 4. Johansen co-integration test

H ₀	Trace statistics	Max-Eigen statistic
r = 0	21.123**	13.616
r ≤ 1	7.507	7.507

Note: ***, **, * means significance at 1, 5 and 10% levels, respectively

Table 5. Vector error correction model

Variables	D(PCHCE)	D(PCGDP)
CointEq1	-0.454225	-0.464173
D(PCHEA(-1))	-0.147623	-0.261912
D(PCGDP(-1))	0.323999	0.857769
C	-0.076458	15.48120

Table 6. The results of specification tests

Specification test	H ₀	Statistics
VEC residual serial correlation LM test	No serial correlation at lag order h	3.006
VEC residual heteroskedasticity test	Residuals are homoskedastic	21.222
VEC residual normality test	Residuals are multivariate normal	18.676**

Note: ***, **, * denotes significance at 1, 5 and 10% levels respectively

Table 7. Pair-wise granger causality test using VECM model

Null hypothesis	χ^2 statistic	Casual inference
PCGDP does not granger cause PCHCE	3.738**	Causality
PCHCE does not granger cause PCGDP	1.357	No causality

Note: ***, **, * means significance at 1, 5 and 10% levels, respectively

Next the analyses continue by executing the pair wise Granger causality tests in the VECM specification. Results in Table 7 shows that there exists a unidirectional causality where PCGDP Granger causes PCHCE. Whereas the reverse causality, PCHCE does not Granger causes PCGDP.

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Discussion

The present study estimated the relationship between real per capita GDP and real per capita health care spending for Jordan during 1995 through 2014. The study found a unidirectional causality moving from per capita gross domestic product to per capita health care expenditures. This implies that household sector when they start to have income and subsequent income increments occurs; they have more accessibility to healthcare providers, i.e., clinics, hospitals and to use more healthcare services leading eventually to a higher healthcare expenditures.

The unidirectional causality found in the case of Jordan as an upper middle income country (The World Bank, 2016) is in consistent with results found in low- and middle-income countries as in Erdil and Yetkiner (2009) and for a 10 countries in Economic Cooperation Organization (ECO), Samadi and Homaie (2013) pointed out for a long term relationship between and GDP per capita and health expenditures per capita. The above results stands true in 33 OECD countries where government share in GDP is a potent explanatory variable for Health Care Expenditure (HCE) growth as mentioned in Jochen and Jan-Egbert (2014). In Turkey, Kiyamaz *et al.* (2006) showed a one-way causality moving from per capita gross domestic product to various definitions of health care expenses and a study among Middle East and North Africa region emphasized economic growth Grange causes out-of-pocket health costs according to Akhmat *et al.* (2014). Therefore, for policy makers they can induce growth in GDP that will eventually raise HCE growth. From a macroeconomic policy, it can target increase in the growth of real wages or increase labour productivity which will increase HCE.

For Jordan, income elasticity was found to be less than 1, that is health care expenditure is a necessary good, which is in contradiction to Newhouse (1977) study for 13 of developed countries, with Moscone and Tosetti (2010) for the US, with Kiyamaz *et al.* (2006) for Turkey and with Okunade and Murthy (2002). Where the reverse is true as found in Samadi and Homaie (2013) for ECO countries, with Abbas and Hiemenz (2013) for Pakistan. This implies that the demand for

health care services is rising less than proportionate to income. In other words, if income increases by 1% the demand for health care services increases by less than 1%. This is due to the fact that 55% of the population in Jordan are insured mainly by Ministry of Health (MoH), Royal Medical Services (RMS), the private sector and United Nations Relief and Works Agency UNRWA (DS, 2016).

Concluding Remarks

In this study we have used Garner casualty approach to investigate the association between per capita health expenditure and per capita GDP for Jordan. We find a one way-directional Granger-causality moving from PCGDP to PCHCE as the leading type of causality for Jordan. That means households with high incomes tend to spend more on health care. This finding is somewhat in tendency with Erdil and Yetkiner (2009; Kiyamaz *et al.*, 2006; Magazzino and Mele, 2012; Jochen and Jan-Egbert, 2014; Samadi and Homaie, 2013; Akhmat *et al.*, 2014) and with Mehrara and Musai (2011). An implication of this finding is that Jordan would be successful in their public policies and programmes to create a conducive environment for economic growth and in raising GDP. This may in the end improve the well-being of the population in the long run. In addition, we estimated the income elasticity of health spending and were less than 1 during study period. That is, the percentage increase in Increase in health care spending (in percentage) is less than increase in income (measured in percentages too). This implies that health care spending (both public and private) can be characterized as a necessity in Jordan.

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Author's Contributions

Rasha M.S. Istaiteyeh: Data collection, Write up, Review.

Mohd Tahir Ismail: Methodology, Review.

Ethics

This manuscript is original and contains unpublished materials. The author have no conflicts of interest in the development and publication of current research.

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