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DETERMINANTS OF PUBLIC HEALTHCARE EXPENDITURE IN SAUDI ARABIA

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ABSTRACT

Aim: Boosting health care expenditures is becoming a priority and a major health policy concern almost worldwide. To achieve solving that concern, it is crucial to know the main factors that underlie the growth in health care expenditures. This will help in supporting decision-makers to find best policies to manage health care costs. Here in this study, our aim is to examine the determinants of health care spending in Saudi Arabia over the period (1979-2013). **Material and Method:** Data used in this study have been collected from different sources that are mentioned in the text when come by. Variables included in this study include per capita GDP, number of physicians, population age structure variables; (population under 15 and/or over 65), infant mortality rate (IMR), population growth and lagged healthcare expenditure. These variables have been singled out by this study as the key determinants of health care expenditure. Variables have been displayed in their descriptive formats to check for their minimum, maximum, range, mean, standard deviation and coefficient of variation. A correlation matrix was produced to check for relationships between the variables. A stepwise regression method was adopted to described determine the factors that most affect and determine health care expenditure in KSA. **Results:** Our study findings revealed that the GDP per capita and the lagged health care expenditures (i.e. per capita healthcare expenditure of the previous year) are the major two factors that affect health care expenditure levels. Together, the two variables are responsible for 93.3% of the variations in the per capita health care expenditure. The regression model excluded all of the remaining variables because of the fact that they are statistically insignificant and do not fit with the model at a (0.05) level of significance. They do not contribute significantly to the explanation of the per capita health care spending variation. These variables are number of physicians, annual population growth rate, percent of the population aged 65 years and older, percent of the population under 15 years and infant mortality rate.

KEYWORDS: Determinants, Healthcare, Expenditure, Elasticity, GDP, Physicians, Regression, Hospitals, Hospital-beds, IMR, Population 65 and over, Population under 15.

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1. INTRODUCTION

Determinants of health care expenditure vary across countries. However, the literature review shows that there are common variables which have a direct and indirect effect on public health care expenditure which is, in this research, referred to as "expenditure" incurred by the Saudi government on health care services. Government resources have shown to be the most driving force that determines health care expenditure among developed and underdeveloped countries. Too many researchers supported this finding. The determinants of health care spending in 12 Asian countries (1995-2008), indicated that only two independent variables have significant relationship with healthcare expenditure in these countries. These variables are namely, the gross domestic product and the percentage of the population aged 65 and over. Each of the two variables reveals a positive correlation with the

amount of health care expenditure, i.e., the amount of health care expenditure is larger when the country's population proportion (65+) is high and income is high.

Results from one hundred forty-three developing countries showed that health expending does not grow faster than GDP if controlled for other factors. While no difference found in healthcare expenditure between taxes based and insurance based health government systems. Data for 4 southern Indian states between 1993-94 and 2009-10 showed a change in health spending of the southern Indian states which is mainly determined by the states' resource capacity and availability measured by central transfers because of increase in demand resulting from a pressure like that stemming from high IMR (infant mortality rate).
In the Saudi Arabia, health care services have improved significantly in terms of quantity and quality during the past decades due to the adoption of policies and measures that meet the increasing demand for health care services and the growing costs of these services. The government of Saudi Arabia makes every effort to provide high-quality health care services to the public, which lead to achieving substantial improvements in health care system (Almalki, Fitzgerald, and Clark, 2011).

The number of physicians, as one of the variables that assumed to determine government health care expenditure, has been increasing during the 1980s up to early 1990s, similar to the trends of per capita healthcare expenditure and per capita GDP. The annual population percentage change has been fluctuating with a sharp downward trend from the 1980s to mid-1990s after which the trend went upward till 2003 when it trended downward again. This fluctuation may be attributed to the increasing influx of non-nationals working in Saudi Arabia during the same period. The percent of the population aged 65 years or older has been increasing slowly with little fluctuations over the study period. The percent of the population under 15 years shows a downward trend during the study period. Whereas the trend of infant mortality rate has been sharply declining from a level of 75 in 1980 to 14 per 1000 live births in 2014. At a distance from advancements in social and health care services, the improved statistics of infant and child mortality rates is believed to be attributed to the compulsory childhood vaccination program implemented by the government since 1980 (Aldossary A, While A, & Barriball L 2008). Demand for necessary services and facilities, including healthcare, is projected ultimately creating new economic opportunities (Almalki, Fitzgerald and Clark, 2011).

The rest of this article is organized as follows: Section 2 deals with the determinants of public health care expenditures model that includes model variables, data sources, and model specification. Section 3 reports the major empirical results. Finally, the last section (5) deals with the summary of findings.

2. The Determinants of Public Healthcare Expenditures

2.1 Literature Review

How much of resources are to be devoted to supplying a nation with its medical and health care needs. Numerous studies worldwide have been conducted to check for the determinants of health care expenditure in a country. This section of the paper reviews some of the literature in this regard.

According to Hitiris, T. (1999), the rise in health care expenditure comes because of consumer and producer choices underlying demand and supply. His argument relies on the fact that a person's demand for health care would depend on his/her health status, income, the price of health care and sometimes health insurance. Paul, M. (1986) preceded this argument when he stated that a person's demand for health care is not only dependent on price, private budgetary considerations or his ability to pay. Busse, R. (2001) suspected that other factors like aging, growth in output, health care resources like hospital beds, staff, etc., could be regarded as ones that influence healthcare expenditure of a country.

In 1977 Newhouse, J. P., found that over 90 percent of the variation in per capita healthcare expenditure is explained by variation in per capita GDP. However, some other researchers consider healthcare expenditure itself as having an explanatory power on GDP. Researchers name it "reverse causation". Reverse causation is the situation where changes in GDP comes because of healthcare expenditure patterns; a healthy population increases productivity. Similarly, the research findings of Siddiqui R., Usman, A. and Rashida, H. (1995) support the arguments that changes in per capita GDP have a significant effect on health care resources. Again, they found urbanization and education to be important variables for the determination of healthcare expenditure. Other variables as public infrastructure investment, life expectancy, rates of public revenues and expenditures, literacy rate, and pollution are variables that proved to have a positive impact on levels of healthcare expenditure in a country.

Gross domestic product (GDP) of a country is widely found to be the variable that most responsible for the changes in levels of expenditure on health care. GDP per capita and healthcare expenditure per capita have the strongest relationship amongst all other factors. This fact is proved by research outcomes of Costa, J. S., Elson, R. W., and Martin, R. C. (1987), Sturm, J. E. (1998) in the Netherlands, Hitiris, T. (1999) and Toor, I. A. and Butt, M. S., (2005) in Pakistan.

2.2 Model Variables and Sources of Data

In health economics literature, per capita GDP, Number of physicians, population age structure variables (population under 15 and/or over 65), infant mortality rate (IMR), population growth and lagged healthcare

expenditure have been identified as key determinants of health care expenditure

1. Per capita GDP: Per capita GDP is the main driver of healthcare expenditure in many countries (See for example Di Matteo, 2005; Sen, 2005; Souliotis et al 2014; Maciejewski, Liu, Kavee and Olsen, 2012; Kowalski, 2013). All these studies used total GDP or GDP per capita as explanatory variables of the healthcare expenditure whether per capita or total.

2. Number of physicians: Many researchers regard this variable as a determinant of health care expenditure representing the induced demand for health (Murthy and Ukpolo, 1994; Huang, 2004; Souliotis et al 2014). Therefore, as the number of physicians grows the healthcare expenditures increases.

3. Population age structure: Many regression models included age structure variables as predictors. Namely, the proportions of the young and old population (Leu 1986; Leu 1986; Hitiris & Posnett 1992; Di Matteo & R. Di Matteo 1998; Huang, 2004; Souliotis et al 2014; Murthy and Ukpolo, 1994). The inclusion of these variables is attributed to the increasing health cost of these two categories (Murthy and Ukpolo, 1994, Rechel et. al., 2009). This study is no exception; it uses the same two variables as explanatory variables for the same reason.

4. Infant Mortality rate (IMR): Numerous studies have considered IMR as one of healthcare expenditure determinants. For example, Anyanwu and Erhijakpor (2007), Akinkugbe and Afeikhena (2006), Novignon, Olakojo and Novignon (2012) and Zakir and Wunnava (1999) found that an increase in healthcare expenditure decreases infant mortality rates.

5. Population growth: Some studies have shown that healthcare expenditure is related to population growth, as the amount of investment in public healthcare in many countries increases with the increase of population (Sülkü and[i] Caner2009; Kiymaz, Akbulut and Demir, 2006; Olubunmi, SakaandOke, 2012).

6. Lagged healthcare expenditure: The healthcare expenditure in a particular year depends not only on the above-mentioned explanatory variables but also on levels of healthcare expenditure in the previous year(s). Therefore, in this research, one year lagged healthcare expenditure was included as an explanatory variable. Healthcare expenditure figures for the Ministry of Health (MoH), and Red Crescent (RC), were collected from the statistical yearbooks (1979-2013).

This paper employed nine explanatory variables as follow

1. Healthcare expenditures per capita (in SR)

Public expenditure on health refers to expenditure on health care incurred by public funds. Public funds are state, regional and local Government bodies and social security schemes. (OECD Health Data 2001). Healthcare expenditure per capita is the sum of public healthcare expenditure as a ratio of total population, computed by dividing total budget by total population (in this study it means a budget of MOH & RC in Saudi Riyals).

The statistical yearbooks published by the central department of statistics & information and health statistics annual books published by the Saudi Ministry of Health (covering the period 1979 – 2013) are the main sources of budget figures used in this study for the Budget of MOH & RC.

2. GDP per capita (SR)

Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a specific time (http://www.investopedia.com/). GDP per capita is (GDP) divided by the total number of people in that country. Source of figures use in this study were collected from the World Bank database.

Number of Physicians per 1000 population

This entry gives the number of medical doctors (physicians), including generalist and specialist medical practitioners, per 1,000 of the population. Medical doctors are those who study, diagnose, treat and prevent illness, disease, injury and other physical and mental impairments in humans through the application of modern medicine. They also plan, supervise and evaluate care and treatment plans by other health care providers. The World Health Organization estimates that fewer than 2.3 health workers (physicians, nurses and midwives only) per 1,000 would be insufficient to achieve coverage of primary health care needs (https://www.cia.gov/). Data for this variable are from the Statistical Yearbooks published by the central department of statistics & information and health statistics annual books published by the Saudi Ministry of Health (covering the period 1979 – 2013).

3. Total population

Selected in the model to mean the total number of populations inhabiting the Kingdom of Saudi Arabia at a specific year. Population data used in this study are derived from the Population and Housing Censuses of the years (1394, 1413, 1425 and 1431), published by the central department of statistics & information (CDSI). For missing population estimates, the population was projected by the researcher using different growth rates assuming inter-census growth rates to project populations of each year within that period.

4. Percent of population under 15

It includes infancy and comprehensive schooling age population. Authors obtained the estimates of this variable from WHO and World Bank database, (http://data.worldbank.org/).

5. Percent of population aged 65+
This variable indicates total population aged 65 and above as a percentage of the total population. Widely but not unanimously, this variable is accepted as a definition of 'elderly' or older person. According to the WHO, this definition does not adapt well to the situation in Africa, for example. While this definition is somewhat arbitrary, it is many times associated with the age at which one can begin to receive pension benefits. There is no United Nations standard numerical criterion, but the UN agreed cutoff is 60+ years to refer to the older population. (http://www.who.int/). We obtained data for this study variable WHO and World Bank database found in (http://apps.who.int/) and http://data.worldbank.org/).

6. Infant mortality rate: (probability of dying between birth and age 1 per 1000 live births)
Infant mortality rate is the probability of a child born in a specific year or period dying before reaching the age of one, given that he or she has been subjected to age-specific mortality rates prevailing during that period. It is a probability of death derived from a life table and expressed as a rate per 1000 live births. The data used here are estimates generated by the UN Inter-agency Group for Child Mortality Estimation (IGME) in 2014, (http://data.unicef.org/).

7. Under 5 Mortality Rate: (probability of dying before reaching age 5 per 1000 live births)
The probability of a child born in a specific year or period dying before reaching the age of five if being subjected to age-specific mortality rates of that period. Statistics for this variable are estimates and are found in the previous website.

8. Hospitals per 100,000 Population
According to the Wikipedia definition, a hospital is a health care institution that provides patient treatment with specialized staff and equipment. The best-known type of hospital is the general hospital, which has an emergency department. A district hospital typically is the major health care facility in its region, with large numbers of beds for intensive care and long-term care. Specialized hospitals include trauma centers, hospitals, children's, seniors' (elderly) hospitals, and hospitals for dealing with specific medical needs such as psychiatric problems and certain disease categories. Specialized hospitals can help reduce health care costs compared to general hospitals. A teaching hospital combines assistance to people with teaching to medical students and nurses. A clinic is a medical facility smaller than a hospital. Hospitals are usually funded by the public sector, by health organizations (for profit or nonprofit), by health insurance companies, or by charities (https://en.wikipedia.org/).

Data of hospital numbers used here in this study are derived from the statistical books published by the central department of statistics & information and health statistics annual books published by the Saudi Ministry of Health (covering the period 1979 – 2013). Hospitals per 100,000 are the ratio of total hospitals of the kingdom divided by its total population and multiplied by (100,000).

9. Hospital beds
The term "hospital beds" is set to mean all hospital beds which are regularly maintained and staffed and immediately available for the care of admitted patients. According to the Organization for Economic Co-operation and Development (OECD), beds in all hospitals, including general hospitals, mental health and substance abuse hospitals and other specialty hospitals, occupied and unoccupied. The term excludes surgical tables, recovery trolleys, emergency stretchers and beds for same-day care, cots for healthy infants, beds in wards which were closed for any reason, provisional and temporary beds and beds in nursing and residential care facilities (OECD Health Data 2007: Statistics and Indicators for 30 Countries, OECD, Paris, 2007, Data sources, definitions and methods).

Statistics for this table are collected from statistical the corresponding yearbooks published by the central department of statistics & information and health statistics annual books published by the Saudi Ministry of Health (covering the period 1979 – 2013). Hospital beds per 10000 are ratios. Authors used these ratios to indicate the number of hospital beds in the public sector available per 10000 inhabitants of the area.

2.3 Model Specification
The model is trying to inspect the main determinants of healthcare expenditure and to test the relationship between healthcare expenditure and its determinants in Saudi Arabia. The study calculated the Pearson correlation coefficients for the study variables before building the regression model. The public healthcare expenditure is a function of the factors determining the expenditures, as follow.

$$\ln(\text{pche})_t = \beta_0 + \beta_1 \ln(\text{gdp})_t + \beta_2 \ln(\text{phy})_t + \beta_3 \text{popg}_t + \beta_4 \text{p65}_t + \beta_5 \text{p15}_t + \beta_6 \text{imr}_t + \beta_7 \ln(\text{pche})_{t-1} + \varepsilon_t$$

Where:
$\ln(\text{pche})_t$ = natural logarithm of per capita healthcare expenditure in Saudi Riyals at year t (t = 1980 - 2013).
$\ln(\text{gdp})_t$ = natural logarithm of GDP per capita in Saudi Riyals at year t
$\ln(\text{phy})_t$ = natural logarithm of total number of physicians at year t
$(\text{Popg})_t$ = Annual population growth rate at year t
$(\text{P65})_t$ = Percent of population aged 65 years and older at year t
$(\text{P15})_t$ = Percent of population under 15 years at year t

IMR_t= Infant mortality rate at year t
Ln $(pche)_{t-1}$ = natural logarithm per capita healthcare expenditure in Saudi Riyals (lagged variable) at year t-1; lag variable.

ε_t = white noise error term.

In this study, per capita healthcare expenditure (dependent variable), per capita GDP and number of physicians (independent variables), are all transformed into natural logarithms. The objective is to reduce the problem of heteroscedasticity following the same track of many other researchers (Chatterjee and Hadi, 2013; Fahrmeir, Kneib, Lang and Marx, 2013). The second objective is to ease interpretation of the estimated parameters, which, in this case represent elasticity of healthcare expenditure.

Stepwise regression method is used to determine the predictors of per capita healthcare expenditure, as the results of correlation analysis show that there is interdependence between the explanatory variables that might cause the problem of multicollinearity. This is similar to that procedure followed by Black, 2010; and Wheeler, Shaw and Barr, 2013.

3. RESULTS

3.1 Descriptive Statistics of the Study Variables

Table (1) below shows the descriptive statistics of the research variables. It includes the minimum and maximum values, range, mean and standard deviation. Looking at the coefficient of variation of the described variables in Table 1, one can conclude that number of hospitals per 100,000 populations comes at the lowest end. It stands as the least (lowest) of all variables to witness a variation during the study period, with a coefficient of (0.1332%). The coefficient for beds per 10,000 (0.1566%), and number of physicians per 1000 populations (0.2360%) follow. The highest variation scored is that by the infant mortality rate (58.2%),

tracked by GDP per capita (46.7%) and per capita healthcare expenditures (46.1%). The number of physicians and the annual population change variables excluded by the model of the study.

Table 1: Descriptive statistics of the study variables

Variables	Minimum	Maximum	Range	Mean	Std. Deviation	COV.
Healthcare expenditure per capita (SR)	402.7 (1994)	1949.0 (2012)	1546.3	788.5	363.8	46.1%
GDP per capita (SR)	23973.0 (1987)	94274.0 (2011)	70301.0	44680.4	20869.2	46.7%
Number of Physicians	3793 (1979)	35841 (2012)	32048	14314	8117	56.7%
Annual population change (%)	1.1 (1996)	12.4 (2012)	5.3	3.3	1.6	48.6%
% Population < 15	29.7 (2012)	44.5 (1979)	14.8	39.0	4.7	12.0%
% Population 65+	2.6 (1984)	3.5 (1999)	0.9	2.9	0.3	9.7%
Infant Mortality Rate	14.0 (2012)	75.0 (1979)	61.0	32.2	18.7	58.2%
Hospitals per 100,000 population	0.623 (1982)	1.08 (1986)	0.458	0.887	0.118140	0.1332%
Hospital-beds per 1000 population	0.682 (2011)	1.783 (1986)	1.1009	1.372	0.2148451	0.1566%

Source: Derived from the research data
(Figures in parentheses are years of occurrence)

3.2 Correlation Analysis of the Study Variables

Table (2) shows the correlation matrix of all research variables. The results show a high significant positive correlation between healthcare expenditure per capita and GDP per capita ($r = 0.895$; p-value < 0.01), revealing a strong tie between the two variables. This strong correlation supports the observation of Newhouse (1977) when he stated that over 90 percent of the variation between countries in per capita health care expenditure could be explained by variations in per capita GDP.

There is also a high significant positive correlation between healthcare expenditure per capita and the number of physicians ($r = .616$, p-value < .01). This shows that as GDP per capita and number of physicians grows spending on health increases. However, health per capita is significantly negatively correlated with proportion of population under 15 years and infant mortality rate per 1000 live births with $r = - 0.822$, p-value < .01 and $r = - 0.366$, p-value < .05 respectively. The relationship between healthcare expenditure and health outcomes is of concern to health policy makers in the light of stable increases in health care spending.

It is important to mention that establishing causal relationships is not a simple matter because the health care expenditure is the one of many quantitative and qualitative factors that contribute to health outcomes. Similar to the other variables of this study, our analysis examines infant mortality as the 'output' of the health care system (John Nixon and Philippe Ullmann, 2006). This means that as spending on health increases, percent of the population under 15 years and infant mortality rate per 1000 live births decrease. Moreover, there is no significant correlation between per capita healthcare expenditure and annual population percent change and between per capita healthcare expenditure and the population aged 65+ years at .05 level of significance; the respective p-values are > .05. The correlation results show also there is high interdependence between the explanatory variables; particularly there is a high significant correlation between number of physicians and

population growth rate, percent of the population under 15 years and infant mortality rate per 1000 live births.

Table 2: Correlation matrix of the research variables

Variables	% of Pop. < 15 years	% of population aged 65+ years	Population growth rate	Number of physicians (log)	GDP per capita in SR (log)	health per capita in SR (log)
GDP per capita in SR (log)	.895 (.000)***					
Number of physicians (log)	.616 (.000) ***	.459 (.006) ***				
Population growth rate	-.242 (.167)	-.138 (.435)	-.695 (.000) ***			
Percent of population aged 65 years and above	.315 (.070) *	.341 (.048) **	.038 (.830)	-.695 (.000) ***		
Percent of population under 15 years	-.822 (.000) ***	-.736 (.000) ***	-.844 (.000) ***	.038 (.830)	-.455 (.007) ***	
Infant mortality rate	-.366 (.033) **	-.242 (.000) ***	-.771 (.000) ***	-.844 (.000) ***	-.414 (.015) **	.785 (.000) ***

***significant at (0.01) level, **significant at (0.05) level, *significant at (0.1) level.

3.3 The Regression Model specification

Table (3) shows estimates of the healthcare expenditure determinants' model. It reveals that per capita healthcare expenditure in the previous year and the GDP per capita are the only two variables that determine annual per capita healthcare expenditure in Saudi Arabia. Number of physicians, annual population growth rate, percent of the population aged 65 years and older, percent of the population under 15 years and infant mortality rate do not contribute significantly to the explanation of the per capita health care spending variation at .05 level of significance. The fitted regression model is as follows

$$pche = (-1.976) + (0.456)gdp/capita_t + (0.570)\ pche_{(t-1)}$$

Checking the fitted model against the linear regression assumptions of normality, homoscedasticity, autocorrelation and no multicollinearity, the results shown in Table (3) and Figure (1) confirms violation of not a single assumption. Hence, the model fits the data very well (Figure 1).

Table 3. Regression model results; dependent variable: log healthcare expenditure per capita.

Predictor	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	$\hat{\beta}$	Std. Error	Beta		
Constant	-1.976	.469	-	-4.214	.000
GDP per capita in SR (log)	.456	.082	.496	5.592	.000
pche (log) (lag1)	.570	.099	.510	5.746	.000

F = 208.232, p-value =.000; R^2 =0.933; $\bar{R}^2$ =0.928

The two variables, previous year (lagged) per capita healthcare expenditure and GDP per capita, explain (92.8%) of the annual variation in the per capita healthcare expenditure. This is clear from the value of the $\bar{R}^2$ (adjusted R squared) beneath the table above. The analysis here opted for $\bar{R}^2$ and not R^2 because one can artificially get higher R^2 by increasing the number of explanatory variables (X_{i-n}) in the model. Adjusted R square is used instead to neutralize this effect. The results show that as GDP per capita goes up by (1.0%), on average the per capita healthcare expenditure goes up by (0.456%) percent holding the previous year spending on health constant. Similarly, as previous per capita healthcare expenditures increases by (1.0%) the per capita healthcare expenditure of the current year increases by (0.57%). This result concludes that health care in the Saudi Arabia is a necessity and not a luxury good because of the fact that a unit increase in one explanatory variable leads to a less than one unit increase in the dependent variable. Figures 2-a and 2-b below are scatter plots that reveal the relationship between each of the two explanatory variables and the dependent variable.

The two variables, previous year (lagged) per capita healthcare expenditure and GDP per capita, explain

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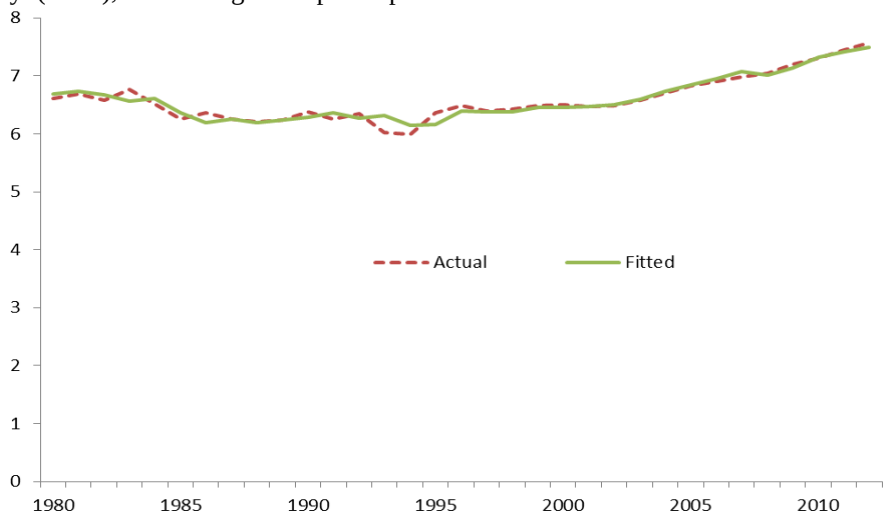
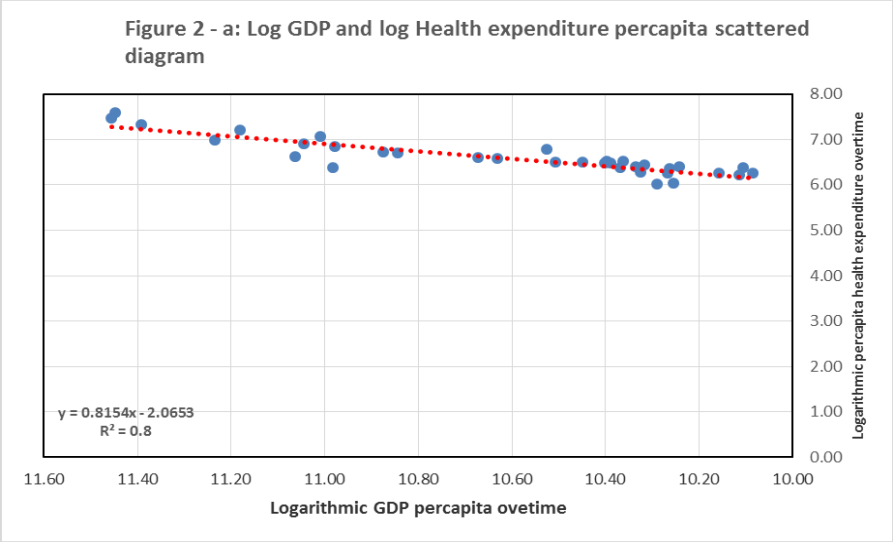


Figure 1: Actual and fitted data of the per capita health-expenditure regression model

Similarly, as previous per capita healthcare expenditures increase by (1.0%) the per capita healthcare expenditure of the current year increases by (0.57%). This result concludes that health care in the Saudi Arabia is a necessity and not a luxury good.



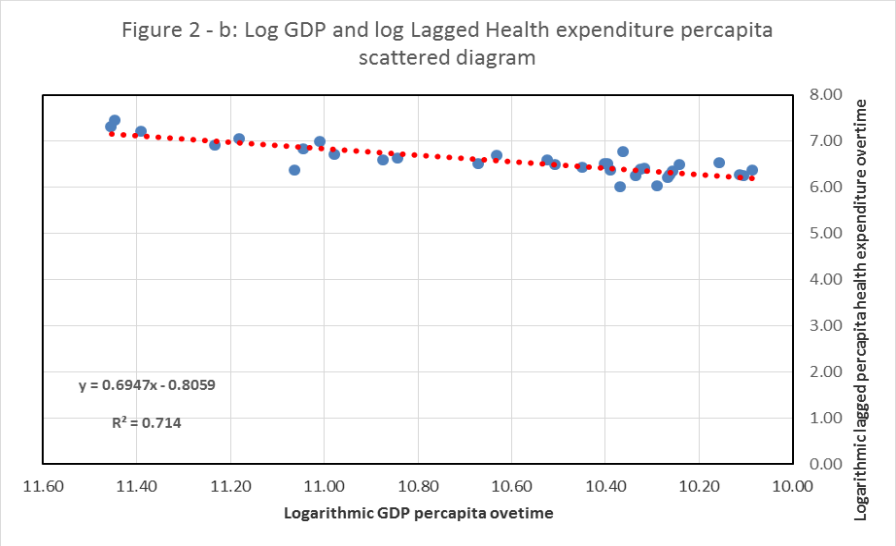


Table 4: Regression model diagnostic tests

Assumption	Test	Test statistic	P-value
Normality	Jarque-Bera	$\chi^2 = 1.86$	.394
Homoscedasticity	Breush-Pagan-Godfrey	F-statistic = 1.35	.274
Homoscedasticity	White	F-statistic = .798	.561
No autocorrelation	Durbin-Watson	DW = 2.155	$d_U < DW = 2.155 < 4 - d_U$
No autocorrelation	Breusch-Godfrey	F-statistic=1.12	.341
No multicollinearity	Variance Inflation factor (VIF)	VIF=3.51	VIF< 10

4. Summary of Findings

- The highest variation is scored by the variable infant mortality rate (58.2%), followed by GDP per capita (46.7%) and per capita healthcare expenditures (46.1%).
- There is a high significant positive correlation between healthcare expenditure per capita and GDP per capita. Spending on health depends primarily on GDP and previous spending levels. One percent increase in GDP leads to (0.456%) increase in healthcare expenditure.
- The two variables, per capita healthcare expenditure and GDP per capita, explain (92.8%) of the annual variation in the per capita healthcare expenditure.
- Elasticity less than 1 implying that health care in Saudi Arabia is a necessity good.

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