The Determinants of Public Health Spending in the Philippines

Review of Integrative Business & Economics Research

Jaycar P. Espinosa
University of Santo Tomas

Micholo Andrei Gabriel I. Cucio*
University of Santo Tomas

Ean Dominique R. de Castro
University of Santo Tomas

ABSTRACT

This paper examines the factors affecting the changes in the public health expenditure in the Philippines, from 2001 to 2015, namely income (Gross Domestic Product per capita growth rate), elderly population (population 65 and above as a percentage of the total population), and urban population (urban population growth rate). Using multivariate Ordinary Least Squares regression, the results show that elderly population and urban population are significant parameters of public health expenditure, with the overall model being highly significant and shows no evidence of multicollinearity, serial correlation, and heteroscedasticity. Moreover, it also finds out that public health in the Philippines is more of a necessity than a luxury good.

Keywords: Public health expenditure, Gross Domestic Product per capita growth rate, population 65 and above, urban population growth rate.

1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The World Health Organization (WHO) defines *health* as a condition of complete physical, mental and social well-being and not just the mere absence of illness or infirmity. Health is essentially linked with economic matters. Primarily, it is a significant factor that contributes to the productivity and the people's ability to accumulate human capital to become productive. The status of an individual's health condition affects his or her future earnings, since it significantly determines his or her educational attainment. Also, the procedures that are being used by countries in terms of financing and providing health care services bring forth various important economic issues. Furthermore, the costs of health care extremely impact the financial status of both the people and the countries. For the people, especially the deprived individuals, the case of large out-of-pocket expenditures can drive them to poverty. For the countries, health is a major account of national expenditures (Jones & Barlett, 2006).

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Aside from knowing the significant relationship between health and economy, understanding health in economics through the process of quantification is also of significance. In terms of measurement, it is dependent more on the quantity of life or the number of life-years remaining than on the quality of life. Likewise, health produces a flow of goods and services in the form of health or medical care, which can serve as a measurement for it. But procuring a precise measurement for every unit of health care is difficult because it is naturally heterogeneous and most of them are services rather than goods. Berkowitz et al. (1989) distinguished four characteristics that contribute to the immeasurability of health care services – *intangibility*, *inseparability*, *inventory*, and *inconsistency*. Intangibility refers to the incapability of health care services to be evaluated through sight, smell, hearing, taste, and touch. Inseparability refers to the simultaneous production and consumption of a health care service that results to the inability of health care providers to maintain an inventory of the health care services. The composition and quality of health care services rendered differ widely refer to the inconsistent characteristic of health care services. Moreover, Donabedian (1980) enumerated the quality differences of health care that are also challenging to quantify – *structural quality*, *process quality*, and *outcome quality*. Structural quality considers the physical and human resources of the health care providers. Process quality includes access, data collection, communication with the patient, and diagnosis and treatment. The effect of health care on the welfare of the patients is under the outcome quality (Santerre & Neun, 2010).

Nonetheless, the complex method of quantifying health has not hindered various economists to conduct studies and create models for better apprehension of several economic phenomena. In fact, one of the well-known models in health economics is Michael Grossman's demand model for good health. Grossman (1972) argues that health is demanded by consumers as either a consumption or investment commodity. As a consumption commodity, health care directly enters the consumer's preference function, but being sick is a source of dissatisfaction. As an investment commodity, he points out that stock of health is a distinctive human capital that determines the total amount of time a person can used in the production of commodities and earnings.

The problem with the aforementioned model is that it only focuses on the microeconomic perspective of understanding health as a vital aspect of the economy. Aside from knowing the rationale of investing to personal health, it is also pivotal to know the total amount of economic resources that a nation dedicates to the provision of health care, and the presumed consequences of health care expenditure for well-being (Newhouse, 1977), particularly in the contemporary era due to the severe

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

effects of rapid development, urbanization, and climate change that transpires throughout the globe, including the risks associated with environmental degradation, disasters, aging population and emerging and re-emerging diseases. Due to the spurring needs for health care and the endeavors of world government to improve collective health status, the global health spending increases. According to Organization for Economic Cooperation and Development (OECD) Health Statistics (2016), over the last few decades, health care expenditures have been soaring higher than the overall economic growth in most developed nations and majority of nations have seen their expenses on health care, as a proportion of Gross Domestic Product (GDP), rise over time.

In the recent years, the Philippines has substantially invested in health (WHO, 2017). From the 1950s, compared to other developing countries, there was a steady advance in patient care, medical education, and public health in the country. Its rapid growth has contributed to the improvement of Filipinos' life expectancy, maternal and child health services, and the access to and provision of preventive, diagnostic and treatment services for communicable diseases have, and to the reduction of illness and death due to non-communicable diseases (NCDs). Nevertheless, the difficulties anchored to equality and equity in health care access and outcomes persist.

Throughout the years, several reforms were instituted to improve the poor's access to health care services, concentrating on health service delivery, health regulation, and health financing (Romualdez et al., 2011). In 1945, the Rural Health Act embarked the transformation of the puericulture centers into rural health units (RHUs) in municipalities and to city health centers in cities. In 1979, primary health care was adopted. In 1983, under the Executive Order (EO) 851, the integration of public health and hospital services under the integrated public health office (IPHO), and the appointment of municipal health office under the regulation of the chief of hospital of the district hospital were initiated. Republic Act (RA) 6675 or the Generics Act of 1988 was enacted. In 1991, Local Government Code (RA 7160) introduced the devolution of health services to Local Government Units (LGUs), thus giving them the responsibility for the financial management of their own health activities, under the guidance of DOH. In 1995, as a replacement for the Medicare Act of 1969, the National Health Insurance Act (RA 7875) was enacted. Through this law, the National Health Insurance Program (NHIP) was institutionalized and signaled the movement towards a single-player premium-based insurance system, however it remains a dual financing system. Philippine Health Insurance Corporation (PHIC or PhilHealth) was established to manage the NHIP with an aim to ensure universal coverage with

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

financial access to affordable and quality health care for all Filipinos. Recently, the coverage of NHIP increased to 92% of the country's population (WHO, 2017).

Despite the above initiatives, Romualdez et al. (2011) stressed that implementation has been challenged by the decentralized environment and the presence of a dominant and independent private sector. The high percentage share of out-of-pocket health spending and the high cost of accessing and using health care contribute to the persistence of inequity. Also, DOH (2011) enumerated several factors contributing to the inequalities in the country's health outcomes. Geographically, the Philippines is situated in the Pacific Ring of Fire and typhoon belt, which makes the country susceptible to natural calamities, and many localities are viewed as geographically isolated and disadvantaged areas (GIDA). Demographically, the size of the country's young population, which positively increases its pool of labor force, is not parallel to the available resources, and the high fertility rate among poor Filipinos has serious consequences in allocating and financing health services. Socio-economically, the size of urban poor in highly urbanized cities is contributed by low inclusive growth, high urbanization rate, and migration from rural to cities. Politically, the devolution of implementing bodies resulted to service fragmentation and contributed stimulating opportunities for the local government units (LGUs) to perform. And psychologically, the "bahala na" or complacent attitude of some Filipinos contributes to the complications.

Aiming to address the persisting issues, influenced by the vision of President Rodrigo Roa Duterte and under the motto "All for Health Towards Health for All," DOH created the Philippine Health Agenda 2016-2022 that aims to ensure financial protection for the poorest among the poor, to improve health outcomes with no disparities, and to build a health service delivery networks for more responsiveness. Likewise, there is an ongoing process of integrating Sustainable Development Goals (SDGs) into the Philippines' 25-year vision "AmBisyon Natin". Guided by the CCS 2017-2022, WHO supports the Philippine government to enrich well-being through action by health sector and across. It also takes the roles in convening platforms for health involving multiple stakeholders and in addressing the social, economic and environmental determinants of health, and in coordinating with other health partners to ensure all stakeholders are aware of health issues and activities.

Aside from the aforesaid explanations about the drivers of the persisting issues on the Philippine health sector, the problem could also be rooted from the unawareness of the government authorities and policymakers about what constitutes

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

to the trends of the public health spending. It is essential to know the factors that determine the changes in the country's health spending for it allows the authority to be aware of what should be prioritized and what should be given enough consideration to make marginal progress in solving the issues of inequity and inequality in regulating and financing the public demands for health care.

1.2 STATEMENT OF THE PROBLEM

Given the concurrence of inequity and inequality in health care access and outcomes and relatively substantial investment of the Philippine government on health, it is evident that the allocation of financial resources on health is inefficient. Accordingly, better understanding of the determinants of Philippine public expenditures will guide the country's policymakers on creating a more efficient health financing system. Thus, the researchers sought to answer the following questions:

a. Is health care a luxury or necessity good in the Philippines?
b. Is there a significant relationship between public health expenditure and the following variables in the Philippines?

b.1 income
b.2 elderly population
b.3 urban population

1.3 HYPOTHESIS OF THE STUDY

The null hypotheses of this study are the following:

Ho1: There is no significant relationship between public health expenditure and income.
Ho2: There is no significant relationship between public health expenditure and elderly population.
Ho3: There is no significant relationship between public health expenditure and urban population.

1.4 SIGNIFICANCE OF THE STUDY

Analyzing the determinants of public health spending in the Philippines is significant to the following:

Department of Health (DOH). One of the main goals of this research is to support the government to improve the provision of public health care services in the

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

country. Since this research analyzed the significant determinants of public health expenditure to the Philippines, it can serve as guide for DOH in terms of identifying the components and necessities that are needed to be prioritized. The results of this research can also contribute to finding out ways and processes that can solve the health and economic issues that the country is currently facing.

Private Health Sector. Despite the fact that this paper did not tackle the trends and contributing factors that affect the changes in the variability of private health spending, still the lessons from the regulation of public health spending could help the regulation of the private health spending. This paper could also encourage the private entities to coordinate with the government in terms of providing a more accessible health care service.

Local Government Units (LGUs). Under the Local Government Code or RA 7160, the devolution of the provision of health services to LGUs was introduced, giving them the responsibility for handling their own health activities. Given this statement, this research paper can guide LGUs in managing the financial aspect of their health programs, giving them insights of what should be highly prioritized among the array of their people's health care demands.

Households. Even though this study is specifically focused on health spending in the national perspective, still it can be beneficial to the household level for it can provide them proper information of what factors highly affect the changes in the public health expenditure. It can also make them cognizant of how the government has behaved throughout the years, and how it will work in the following years.

Future Researchers. This research is also significant for the future researchers of Philippine public health expenditure for it can serve as a guideline for their studies. The new discoveries, findings, and information in this research is relevant for the future economist and may help them to improve and lead for the future generation.

1.5 SCOPE AND LIMITATIONS OF THE STUDY

The study focuses on the analysis of various indicators of public health expenditure in the Philippines, including income, elderly population, and urban population. Other non-income determinants that were used in the previous studies, which are not considered by this study's theoretical framework were not dwelled and probed by the researchers. The data used were annual and aggregate. In this case,

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

regional data were disregarded and regional analysis of the determinants was not considered. The time-series data were collected from the website of World Bank, gathering observations from 2001 to 2015 (15 samples in total).

Public health expenditure is measured using current public health expenditure per capita. It includes all public health expenditures as a ratio of total population, in current U.S. dollars, including the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health. It does not include the provision of water and sanitation. This includes both recurrent and capital expenditure allocation by the central government to the health sector in the country.

Income is measured using GDP per capita growth rate. It is the annual growth rate of the total economic output of the country, divided by the total population. This study also tackled the responsiveness of public health expenditure to a unit change in national income.

Elderly population is the annual total population ages 65 and above of the country. In this study, the variable used to signify this determinant is the annual percentage share of the population 65 and above to the total population. It is one of the demographic indicators of public health spending. The other demographic indicator, which is used in this study, is urban population. It refers to the total number of people living in urban areas. It is measured using the urban population growth rate.

The researchers considered working on this study to find out if there are significant relationships among the identified variables and to formulate a multiple regression model for the Philippine public health expenditure. Moreover, the researchers maximized the econometric functions of EViews (Econometric Views) to conduct the needed econometric tests to check the significance of the model.

2. REVIEW OF RELATED LITERATURE

In this chapter, an overview of the extant related literature and econometric analysis of various substantial factors affecting the development of health care expenditure is surveyed. Moreover, an elucidation of several related economic concepts and theories, and the paradigm of the study are provided.

2.1 RELATED STUDIES

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Since the introduction of econometric analysis of the relationship of health expenditure and Gross Domestic Product (GDP) by Newhouse (1977), most economists have become interested with the cross-country study of the relationship of the two variables. Even though Kleiman (1974) conducted a similar analysis, the paper of Newhouse became more plausible by analyzing data from the early period of 1970s, gathered from 13 developed countries. He determined the strong positive relationship of per capita health expenditure and per capita GDP, with over 90 percent of the variations between countries in the former variable could be explained by the variations in the latter one. Furthermore, Newhouse procured an income elasticity for health from 1.15 to 1.31, determining that health is a luxury good.

Leu (1986) reported the same findings, but with some modifications on the initial methodology. He examined the impacts of GDP and various non-income factors (proportion of the population under 15, urbanization. public finance/public beds share, direct democracy, and the presence of a centralized national health system) to the changes in the trends of health expenditure of 19 OECD countries for years around 1974. Moreover, he also found out that the proportion of public expenditure in total health expenditure and the presence of a centralized national health system are significant parameters.

The earlier findings about health care as a luxury good are subject to obvious issues due to studies' reliance on small sample sizes and cross-sectional data. The former issue prevents any benefits from asymptotic properties and the latter makes it impossible to control the unobserved time-specific shocks that affect all countries at the same time (Sen, 2005). Hitiris and Posnett (1992) managed to analyze a total of 560 observations from 20 OECD countries from 1960 to 1987 to overcome the issues. They replicated some of Leu's alterations to Newhouse's methodology and introduced the use of country fixed effects to control the probable effects of unobserved country specific factors, resulting to a similar finding with an income elasticity of around one and the proportion of population over 65 as one of the significant parameters. Sen mentioned that the absence of year fixed effects and the relative lack of appropriate explanatory variables could be the suspect to their result. By using data from 15 OECD countries from 1990 to 1998 and introducing the use of two-way fixed effects models and the inclusion of several demand and supply-based determinants of per capita health expenditure, Sen procured income elasticities from 0.12 to 0.51. His endeavors to use other econometric methods – Weighted Least Squares (WLS), Generalized Least Squares, and Instrumental Variables (IV), aside from Ordinary Least Squares (OLS), determined the same results.

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By conducting an analysis of data from 44 African nations for year 2001 with the use of specific explanatory variables (real GDP per capita, physician-patients ratio, proportion of population over 65, real per capita foreign aid, and maternal mortality per 1000 persons), the result of the work of Murthy and Okunade (2009) supports the notion of health care as a necessity, suggesting that the goal of health system in Africa is curative rather than caring. Furthermore, by equipping OLS and robust least absolute error (LAE) estimators, they found out that real per capita GDP and real per capita foreign aid resources are both statistically significant and exert positive effects to real per capita health care expenditure. To further scrutinize the validity of the luxury health care hypothesis, Costa-Font, Gemmil, and Rubert (2011) examined the heterogeneity of the results of existing related studies using a meta-regression analysis (MRA). The employment of such method helped them to recognize the role of publication selection and aggregation bias in the generation of biased estimates and procure a corrected income estimates that range from 0.4 to 0.8.

A more recent collection of related cross-country studies focus on the use of various complex methodologies, the validation of the significance of several non-income determinants of health expenditure, and the comparison of health expenditure trends, beyond OECD and African regions. Just for instance, Xu, Saksena, Holly (2011) applied standard fixed effects and dynamic models, using panel data from 143 developing countries from 1995 to 2008, to determine the contributing factors affiliated with the development of total health spending, and its two major components, government health expenditure and out-of-pocket payments. Their findings suggest that health expenditure does not grow faster than GDP, considering other factors (demographics and health system characteristics); the two components of total health expenditure follow different paths and the pace of expenditure development in countries at various levels of economic development is also different. They also confirmed the existence of fungibility, where health-specific aid reduced government domestic expenditure on health, but increased total government spending on health. Moreover, their income elasticity results support that health care is a necessity.

Giving importance to the impact of ageing population to the variability in the trends of health expenditure, Kei (2014) explored a panel data of 25 OECD countries under several model specifications, resulting to an insignificant proxy variable for population – ratio of the population aged 65 and over. But upon checking their robustness estimation, the variable becomes positive and significant. Aside from

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

ageing population and national income, Lin-Lan and Mirelman (2014) scrutinized the impacts of certain socio-political determinants, international aid, debt and tax financing on public health spending, by applying a fixed-effects two-stage least squares regression on a panel dataset of 120 countries from 1995 to 2010. Their findings suggest that democratic accountability has a non-linear relationship, and that government stability has a positive correlation with the government health expenditure. They also give another evidence of the existence of fungibility of the foreign aid to government to the public health spending, with a higher degree of fungibility to countries with higher incidences of corruption and ethnic tensions.

By employing the same two-stage least squares regression analysis, Sagarik (2016) studied a panel dataset of 10 Association of Southeast Asian Nations (ASEAN) member countries from 2002 to 2011. The results of the analysis suggest that health expenditure as a share of GDP is positively significant with foreign direct investments and value added output of industry as percentage of GDP (industrialization), and negatively significant with urban population growth rate, but insignificant with GDP annual growth rate, trade as a percentage of GDP, and ageing population. On the other hand, Akca, Sonmez, and Yilmaz (2017) organized a decision tree model by using 2014 data from 35 OECD countries to investigate the effects of various determinants to health expenditure. The countries were categorized into 6 groups with classification accuracy rate and precision of estimation of 80.56% and 81.25% respectively, based on the CART algorithm. Their findings assert that GDP per capita, life expectancy at birth, age dependency ratio, number of hospitals and percentage of the population with a bad perceived health status were identified as the major variables in the estimation of health expenditure.

Regional and country-specific studies of the determinants of public health spending also gained the attention of several researchers. Peñas and Prieto (2001) investigated various factors affecting the regional health-care expenditure in Spain. The coexistence of several models concerning the degree of spending power decentralization and financing systems makes Spain a singular case. It also allowed the researchers to draw conclusions relevant to other countries in decentralizing their health-care systems, and to understand cross-country differences with estimated parameters. Using data from the Spanish regions for the period 1992–2005, the study showed that the estimated health public expenditure income elasticity does change depending on the omission of relevant variables, econometric specifications and techniques, and institutional arrangements. Furthermore, multicollinearity existed making the model biased, even though the demographic structure is a very relevant

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

factor when explaining health-care expenditure dynamics.

Toor and Butt (2005) analyzed the determinants of health care expenditure in Pakistan using time series data. This is an extension of the research work, which has studied the determinants of health expenditure using conventional log-linear model and the cointegrating technique to find the short-run and long-run relationship between health expenditure and socioeconomic factors in Pakistan. The empirical modeling is based on a multivariate model that allows for trending data as well as an intercept and a trend in the cointegrating relation. The results of the paper show that socio-economic factors such as per capita GDP, urbanization, literacy rate, crude birth rate, and foreign aid play an important role in determining health care expenditure in Pakistan.

Chaabouni & Abednnadher (2001) analysed the determinants of health expenditures in Tunisia during the period 1961-2008, employing ARDL approach by Pesaran et al. (2001). The results showed that there is a stable long-run relationship between per capita health expenditure, GDP, population ageing, medical density and environmental quality. There are results which emphasize that health care is a necessity, not a luxury good. On the other hand, results of the causality test conducted revealed that there is a bi-directional causal flow from health expenditures to income, both in the short and in the long run.

Murthy & Okunade (2016) also applied the ARDL approach in identifying some major drivers of health spending in the United States, using data from 1960 to 2012. The findings in this study revealed that per capita real income, the population percent above 65 years, and the level of health care technology measured as the level of Research & Development expenditure in health care are cointegrated. All factors exert positive effects on U.S. health expenditure per capita. This paper presented new empirical evidence indicating that the U.S. health care is a necessity, with an income elasticity of 0.92.

2.2 THEORETICAL FRAMEWORK

2.2.1 Wagner's Law

This paper is highly anchored to Wagner's Law. It is a model of public expenditure growth, made by Adolf Wagner, which explains the changes in levels of public expenditure. It states that if the nation become more progressive, market

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

failures would push the government to become more monitoring in nature, thus expanding its role and this would probably cause to higher public spending.

Increasing salaries in the society translates to significant demand for education, equitable distribution of income, entertainment, and public services. Industrialization, urbanization, and growing population are the main causes that fuel the increase of a country's public spending. In other words, to meet the people's needs, the government expands their functions and activities.

2.2.2 Interest Group Theory

According to Garrett and Rhine (2006), interest groups can be defined as any organized group of individual voters or businesses having the same preference for a specific policy. Through lobbying activities, an interest group can obtain a desired policy that has direct benefits for the group but the costs of the policy must be shared by all taxpayers. Those groups who can organize and lobby for a policy at the cost less than a certain amount are termed as 'demanders' and individual tax-payers as 'suppliers' as they would have to spend more if they want to lobby against losing that same amount of money. Elected officials will, therefore, target unorganized suppliers with low losses from any transfer while pleasing demanders who are organized and active in the political process. Due to this, costs are shared by a great number of tax-payers but the benefits are concentrated within the interest group. If we consider the elderly as the interest group, then one can expect their demand on higher health expenditures.

2.3 CONCEPTUAL FRAMEWORK

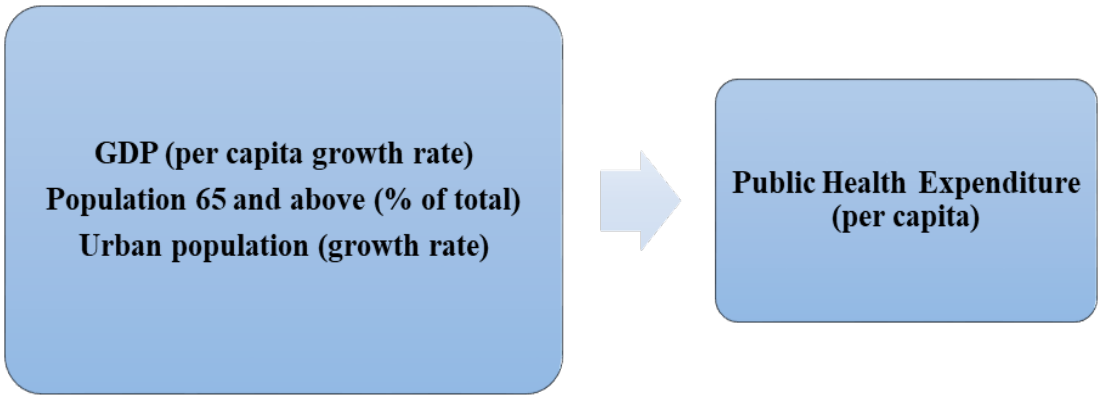

Figure 1. Conceptual Framework

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Given Wagner's Law and Interest Group Theory, this study follows the conceptual framework below. As indicated by *Figure 1*, this study used GDP per capita growth rate, population ages 65 and above (as a % of the total population), and urban population growth rate as the explanatory variables that determine the changes in per capita public health expenditure of the Philippines.

3. METHODOLOGY

3.1 DATA

The time-series data for public health expenditure per capita, GDP per capita growth rate, population ages 65 and above (as % of the total population), and urban population growth rate of the Philippines, covering the period 2001 to 2015, were collected from the website of World Bank. For the raw data, see *Appendix A.*

3.2. EMPIRICAL MODEL

This study adopts a multivariate Ordinary Least Square (OLS) regression model presented as:

$$\mathbf{Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots + \beta nXn + \varepsilon}$$

The econometric model shown below describes how public health expenditure (HEXPC) is affected by the explanatory variables (YG, POP65, and URBG):

$$\mathbf{HEXPC = \beta 0 + \beta 1YG + \beta 2POP65 + \beta 3URBG + \varepsilon}$$

whereas:

HEXPC	=	f (Y, POP65, URBG) public health expenditure per capita, in constant U.S. dollar
YG	=	GDP per capita growth rate
POP65	=	population ages 65 and above (as a % of the total population)
URBG	=	urban population growth rate
ε	=	error term

3.3 STATISTICAL TREATMENT

The researchers utilized the EViews (Econometric Views) to conduct the multivariate OLS regression and the following: coefficient of determination (R^2);

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

individual hypothesis testing, T-test and P-values; overall significance test, F-test and P-value; test for multicollinearity, test for serial correlation, Durbin-Watson Test and Breusch-Godfrey Test; and test for heteroscedasticity, White Test.

Natural logarithm of all the variables (both regressand and regressors) was employed since the coefficients on the natural-log scale are directly interpretable as elasticities, which can be useful to meet the paper's first objective of finding out whether public health in the Philippines is a luxury good (if the coefficient of YG is greater than 1) or a necessity (if the coefficient of YG is less than 1). The benefit of treating the variables in their log form is that small changes in the natural log of a variable can be directly interpreted as percentage changes, to a very close calculation that gives it a substantive sense (Gelman & Hill, 2007). In this case, the earlier multivariate OLS regression model changes to:

$$\textit{log}\ \mathbf{HEXPC} = \beta 0 + \beta 1\ \textit{log}\ \mathbf{YG} + \beta 2\ \textit{log}\ \mathbf{POP65} + \beta 3\ \textit{log}\ \mathbf{URBG} + \varepsilon$$

The following operations and tests were completed according to the procedures provided by Studenmund (2017):

a. **COEFFICIENT OF DETERMINATION**

The R^2 also known as the coefficient of determination measures the impact of the variability of the regressors (YG, POP65, and URBG) on the regressand (HEXPC). It is normally employed as an instrument to measure the accuracy of the econometric model. If the value of R2 is approximately close to 100% or 1, it implies a robust econometric model.

b. **HYPOTHESIS TESTING**

Usually, T-test is employed for individual variables to examine whether the regression coefficient is significantly different from zero and if it has a significant impact on the regressand. In this method, in order to conclude that the individual regressor is significantly different from zero, it must reject the null hypothesis of the regression coefficient is equal to zero ($\beta n = 0$). To reject the null hypothesis, the T-statistics must be greater than the critical value of T. But a more simplified method was used in this paper, using the p-value. It is the probability of finding a value of the T-statistic that is extreme than the computed value when the null hypothesis is true. Using this method, the computed p-value must be less than the level of significance in

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

order to reject the null hypothesis.

In examining the significance of the overall model, on the other hand, was completed using the F significance. In order to reject the null hypothesis of R^2 is not equal to 0, the F significance must be less than the level of significance.

c. **TEST FOR MULTICOLLINEARITY**

One of the econometric issues that make a model biased is the existence of multicollinearity. It occurs when one of the explanatory variables can be linearly predicted from the other variables with a significant degree of accuracy. In order to test if the model has a multicollinearity issues, the Variance Inflation Factor (VIF) and Tolerance statistics (TOL) were employed.

VIF is computed by 1 divided by (1-R^2), where R^2 is measured by conducting an auxiliary regression of each the regressors. This can be done by regressing the regressor of interest onto the other regressors in the regression model. Using VIF, in order not to reject the null hypothesis of having no multicollinearity, the computed value of VIF must not be greater than 10.

TOL is computed by the reciprocal of VIF. The closer the TOL statistics to 1, the higher is the possibility to not reject the null hypothesis of having no multicollinearity.

d. **Test for Serial Correlation**

Another econometric problem that violates one classical assumption on econometrics is the existence of serial correlation or also known as autocorrelation. It occurs when that the value of the error term (residual) from one period hinges on in some systematic way on the amount of the error term in other periods. In order to detect whether a model has a serial correlation issue, Durbin-Watson test and the Breusch-Godfrey test are usually employed.

Durbin-Watson test is the ratio of the sum of squared differences in successive residuals to the Residual Sum of Squares (RSS). The Durbin-Watson statistic (d-stat) indicates whether an autocorrelation occurs or not at lag 1 in the residuals. In this test, the decision rule is to reject the null hypothesis of having no serial correlation if d-stat is less than dL, or not to reject the null hypothesis if d-stat is greater than dU. The critical values of dL and dU can be obtained by using the d-stat table, considering the

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

number of observations (n) and of the regressors (k).

On the other hand, the Breusch-Godfrey test is based on the principles of the Lagrange Multiplier testing. It is sometimes called as the LM test for serial correlation. Breusch-Godfrey test allows for: (1) nonstochastic regressors, such as the lagged values of the regressors; (2) higher-order autoregressive schemers, such as AR(1), AR(2), etc.; (3) simple or higher-order moving averages of white noise error terms. In this test, in order to not reject the null hypothesis of having no serial correlation, the p-values of the regressors estimated in the test should be greater than the level of significance.

e. **TEST FOR HETEROSCEDASTICITY**

Aside from multicollinearity and serial correlation, heteroscedasticity is also one of the critical issues that violate the classical assumption on econometrics. It occurs when the error terms are derived from a distribution with a constant variance. In detecting its existence in the model, the White test was utilized. It specifically checks pure heteroscedasticity or specification error or both. It has been claimed that if there is no employment of cross-product terms in the White test, then it is a test of pure heteroscedasticity. If cross-product terms are employed, then it is a test of both heteroscedasticity and specification bias.

Following the rule that the squared of the residuals would serve as the predicted variable (Y) in a new equation that includes all the regressors (Xn) from the original equation, the square of each regressor, and the product of each regressor times every other regressor. In this case, the new regression equation has nine explanatory variables:

$$\mathbf{Y = X1 + X2 + X3 + (X1)^2 + (X2)^2 + (X3)^2 + (X1)\,(X2) + (X1)\,(X3) + (X2)\,(X3)}$$

In order to not reject the null hypothesis of homoscedastic residuals, the p-values of the regressors estimated in the White test should be greater than the level of significance.

4. RESULTS AND DISCUSSION

4.1 REGRESSION RESULTS

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Dependent Variable: LOG(HEXPC)
Method: Least Squares
Date: 10/15/18 Time: 00:55
Sample: 2001 2015
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.565106	0.290877	-5.380642	0.0002
LOG(YG)	0.040318	0.044546	0.905083	0.3848
LOG(POP65)	3.439956	0.211583	16.25815	0.0000
LOG(URBG)	-0.541736	0.165442	-3.274467	0.0074

R-squared	0.977007	Mean dependent var	3.024785
Adjusted R-squared	0.970736	S.D. dependent var	0.444932
S.E. of regression	0.076114	Akaike info criterion	-2.090002
Sum squared resid	0.063726	Schwarz criterion	-1.901188
Log likelihood	19.67501	Hannan-Quinn criter.	-2.092013
F-statistic	155.8002	Durbin-Watson stat	1.672764
Prob(F-statistic)	0.000000		

Table 1. Regression Results

As shown by *Table 1*, the model has an R^2 of 0.977. This indicates that 97.7% of the changes in the variability of HEXPC can be explained by YG, POP65, and URBG in the model. It also implies that the model is a robust econometric model since the R^2 is closer to 1 (100%).

Moreover, based on the results above the values for the proposed multivariate OLS regression model is:

$$\textit{log}\ \textbf{HEXPC} = -1.565 + 0.040\ \textit{log}\ \textbf{YG} + 3.440\ \textit{log}\ \textbf{POP65} - 0.542\ \textit{log}\ \textbf{URBG}$$

This model indicates that:
If the values of YG, POP65, and URBG are zero, the value HEXPC is -1.565.

For every 1 percent increase in YG, holding POP65 and URBG constant, HEXPC increases by 0.040 percent, vice versa.

For every 1 percent increase in POP65, holding YG and URBG constant, HEXPC increases by 3.440 percent, vice versa.

Lastly, a percentage increase in URBG will incur a 0.542 percent decrease in HEXPC, holding the other regressors constant, vice versa.

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Moreover, following that the regression coefficient of YG (0.040) is less than 1, it implies that the public health in the Philippines is a necessity good.

4.2 Hypothesis Testing for the Individual Significance of Parameters

From the results shown by *Table 1*, the p-values (Prob.) of *log* YG, *log* POP65, and *log* URBG are 0.3848, 0.0000, and 0.0074 respectively. Following the decision rule for p-value of individual parameters that if the p-values of the individual parameters are less than the level of significance (0.05), reject the null hypothesis of $\beta n = 0$. Therefore, only POP65 and URBG are not statistically different from zero.

4.3 Hypothesis for the Overall Significance of the Model

From the results presented by *Table 1*, the F significance or Prob (F-statistics) is 0.0000. Following the decision rule for p-value of the overall model that if the Prob (F-statistics) is less than the level of significance (0.05), reject the null hypothesis of $R^2 = 0$. Since 0.000 is less than 0.05, the null hypothesis is not rejected. Thus, the model is implied to be statistically significant.

4.4 Test for Multicollinearity – Variance Inflation Factor and Tolerance Statistic

Auxiliary Regression	R^2	VIF	TOL
YG	0.110557	1.1243	0.88944
POP65	0.295596	1.41964	0.7044
URBG	0.264255	1.35917	0.73575

Table 2. VIF & TOL Results

As presented by *Table 2*, the YG, POP65, and URBG auxiliary regressions (see *Appendix C* for the complete regression results for each) produced an R^2 of 0.11057, 0.295596, and 0.264255 respectively; all being lesser compared to the R^2 of the original regression (0.977).

Following the rule of thumb, if the value of VIF is greater than 10, reject the null hypothesis of there is no multicollinearity. Since the VIF of each regression is less than 10, there is no multicollinearity issue in the model. Moreover, if the value of TOL is closer to 1, the null hypothesis of no multicollinearity cannot be rejected; since this is the case on each auxiliary regression, it further supports that the model

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has no issue on multicollinearity.

4.5 TEST FOR SERIAL CORRELATION- DURBIN WATSON TEST

As shown by *Table 1*, the Durban-Watson statistics (d-stat) of the regression is 1.672764. Following the decision rule that if the d-stat is less than dL, reject the null hypothesis of having no positive serial correlation, or not to reject the null hypothesis if d-stat is greater than dU. Considering the level of significance (0.05), the number of observations (15), and the number of regressors (3), dL = 0.814 and dU = 1.750 based on the d table. Since d-stat = 1.672764 is greater than dL = 0.814, the null hypothesis of having no positive serial correlation cannot be rejected. Thus, there is no evidence of positive serial correlation in the model.

4.6 TEST FOR SERIAL CORRELATION- BREUSCH-GODFREY TEST

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 3 lags

F-statistic	0.622314	Prob. F(3,8)	0.6202
Obs*R-squared	2.838177	Prob. Chi-Square(3)	0.4173

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/15/18 Time: 01:00
Sample: 2001 2015
Included observations: 15
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.145579	0.361150	0.403100	0.6974
LOG(YG)	-0.014991	0.050326	-0.297871	0.7734
LOG(POP65)	-0.080001	0.247541	-0.323182	0.7548
LOG(URBG)	-0.082773	0.205289	-0.403204	0.6974
RESID(-1)	-0.058362	0.395417	-0.147597	0.8863
RESID(-2)	-0.013320	0.395202	-0.033704	0.9739
RESID(-3)	-0.538326	0.397693	-1.353623	0.2129

Table 3. Breusch-Godfrey Test Results

In Breusch-Godfrey test, the decision rule is to reject the null hypothesis of no serial correlation at up to 3 lags if the p-value (Prob.) of the regressors as estimated in this test is less than the level of significance (0.05). As shown by *Table* 3, since the p-values of YG, POP65, and URBG are 0.7734, 0.7548, and 0.6974 respectively, they imply that the null hypothesis cannot be rejected. Thus, it further supports that there is no evidence of serial correlation in the model.

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4.7 TEST FOR HETEROSCEDASTICITY – WHITE TEST

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	2.207626	Prob. F(9,5)	0.1984
Obs*R-squared	11.98415	Prob. Chi-Square(9)	0.2142
Scaled explained SS	3.656440	Prob. Chi-Square(9)	0.9325

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/15/18 Time: 01:01
Sample: 2001 2015
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.207339	1.469487	1.502116	0.1934
LOG(YG)^2	-0.005626	0.005813	-0.967707	0.3776
LOG(YG)*LOG(POP65)	-0.120248	0.078905	-1.523957	0.1880
LOG(YG)*LOG(URBG)	-0.047017	0.052323	-0.898597	0.4101
LOG(YG)	0.178323	0.104486	1.706666	0.1486
LOG(POP65)^2	1.362450	0.762600	1.786587	0.1341
LOG(POP65)*LOG(URBG)	-0.168078	0.202983	-0.828040	0.4454
LOG(POP65)	-3.482376	2.112916	-1.648138	0.1602
LOG(URBG)^2	-0.184700	0.133327	-1.385314	0.2246
LOG(URBG)	0.304926	0.245022	1.244480	0.2685

Table 4. White Test Results

In White Test, the decision rule is to reject the null hypothesis of homoscedastic residuals if the p-values of all regressors estimated in this test are less than 0.05. As presented by *Table 4*, the probabilities of all independent variables are greater than 0.05. Thus, there is no issue of heteroscedasticity in the multivariate OLS regression model.

5. CONCLUSION AND RECOMMENDATIONS

The findings of this study prove that public health is a necessity good rather than a luxury good in the Philippines. This implies that health is more “curative” than “caring” in the Philippine setting. It also reveals that elderly population is a positively related and significant parameter to public health expenditure. Urban population, on the other hand, is found to be inversely related and significant to public health spending. It means that as the urban regions of the Philippines become more populated, its public health spending decreases. This is a contrary to Wagner’s idea but the results of some previous studies imply the same case (Sagarik, 2016). Even though income is found to be insignificant, still as dictated by Wagner’s law and several related studies, it is an important determinant of public health expenditure. In fact, majority of the previous studies labelled income as its major determinant.

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Given that this paper only conducted Ordinary Least Squares (OLS) method, still the findings of this study can assist the Philippine policymakers and concerned government agencies in terms of properly allocating all the economic resources that the nation apportions to public health. Also, the researchers would like to encourage the future researchers to explore more on understanding the contributing factors of public health spending in the country, through employing different econometric strategies.

APPENDIX

APPENDIX A – Raw Data

	HEXPC	YG	POP65	URBG
2001	11.45436	2.893992	3.305713	1.556641
2002	10.12552	3.645898	3.350022	1.527349
2003	11.67994	4.970364	3.391216	1.470735
2004	12.21128	6.697636	3.432097	1.387107
2005	15.42350	4.777663	3.476023	1.291382
2006	17.62368	5.242953	3.602112	1.182727
2007	20.53174	6.616669	3.730330	1.091538
2008	23.30119	4.152757	3.858473	1.032165
2009	24.35626	1.148330	3.991020	1.016597
2010	29.29929	7.632268	4.137490	1.026924
2011	26.10417	3.659752	4.213580	1.114304
2012	29.68984	6.683810	4.297360	1.192804
2013	32.30044	7.064033	4.385966	1.257093
2014	33.09042	6.145299	4.477284	1.307420
2015	39.84221	6.066549	4.571913	1.340767

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APPENDIX B – Descriptive Statistics

Sample: 2001 2015

	HEXPC	YG	POP65	URBG
Mean	22.46892	5.159865	3.881373	1.253037
Median	23.30119	5.242953	3.858473	1.257093
Maximum	39.84221	7.632268	4.571913	1.556641
Minimum	10.12552	1.148330	3.305713	1.016597
Std. Dev.	9.257198	1.799075	0.444735	0.180208
Skewness	0.197589	-0.636519	0.130335	0.243123
Kurtosis	1.915803	2.661437	1.538566	1.887139
Jarque-Bera	0.832281	1.084532	1.377337	0.921810
Probability	0.659588	0.581429	0.502244	0.630713
Sum	337.0338	77.39797	58.22060	18.79555
Sum Sq. Dev.	1199.740	45.31339	2.769048	0.454647
Observations	15	15	15	15

APPENDIX C – Auxiliary Regressions Results

Dependent Variable: LOG(URBG)
Method: Least Squares
Date: 10/15/18 Time: 01:05
Sample: 2001 2015
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.986524	0.420115	2.348224	0.0368
LOG(YG)	0.066316	0.075332	0.880322	0.3960
LOG(POP65)	-0.647179	0.318425	-2.032439	0.0648

R-squared	0.264255	Mean dependent var	0.215966
Adjusted R-squared	0.141630	S.D. dependent var	0.143347
S.E. of regression	0.132808	Akaike info criterion	-1.022966
Sum squared resid	0.211656	Schwarz criterion	-0.881356
Log likelihood	10.67225	Hannan-Quinn criter.	-1.024475
F-statistic	2.154995	Durbin-Watson stat	0.322730
Prob(F-statistic)	0.158623		

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Dependent Variable: LOG(POP65)
Method: Least Squares
Date: 10/15/18 Time: 01:04
Sample: 2001 2015
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.331589	0.098677	13.49448	0.0000
LOG(YG)	0.066802	0.057636	1.159041	0.2690
LOG(URBG)	-0.395690	0.194687	-2.032439	0.0648

R-squared	0.295596	Mean dependent var	1.350064
Adjusted R-squared	0.178196	S.D. dependent var	0.114553
S.E. of regression	0.103846	Akaike info criterion	-1.514959
Sum squared resid	0.129408	Schwarz criterion	-1.373349
Log likelihood	14.36219	Hannan-Quinn criter.	-1.516467
F-statistic	2.517845	Durbin-Watson stat	0.297551
Prob(F-statistic)	0.122160		

Dependent Variable: LOG(URBG)
Method: Least Squares
Date: 10/15/18 Time: 01:05
Sample: 2001 2015
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.986524	0.420115	2.348224	0.0368
LOG(YG)	0.066316	0.075332	0.880322	0.3960
LOG(POP65)	-0.647179	0.318425	-2.032439	0.0648

R-squared	0.264255	Mean dependent var	0.215966
Adjusted R-squared	0.141630	S.D. dependent var	0.143347
S.E. of regression	0.132808	Akaike info criterion	-1.022966
Sum squared resid	0.211656	Schwarz criterion	-0.881356
Log likelihood	10.67225	Hannan-Quinn criter.	-1.024475
F-statistic	2.154995	Durbin-Watson stat	0.322730
Prob(F-statistic)	0.158623		

ACKNOWLEDGEMENT

The researchers would like to express their sincerest gratitude to the following people who have been a great help in the success of this research.

Our sincerest acknowledgement to our adviser Ms. Lean Estacio for imparting her knowledge and expertise in the field of econometric and research, as well as her for supporting our endeavors for the completion of our study.

The researchers would also like to acknowledge the support of the Artlets Economics Society (AES) for supporting this project. In addition, the researchers would like to the administration of the Faculty of Arts and Letters of the University of Santo Tomas.

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In addition, the researchers would also like to thank give their utmost appreciation for their families who have provide them the means in order for this research endeavor to be a success. Lastly, the researchers would like to give their acknowledgement to the Almighty Father, for bestowing the researchers the strength, knowledge, and wisdom to finish this paper.

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