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MASTER'S THESIS

Impact of Public Health-care Expenditure on economic growth

Author: **Bc. Vijayshekhar Nerva**

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Supervisor: **doc. PhDr. Tomáš Havránek Ph.D.**

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, May 14, 2020 Vijayshekhar Nerva

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Abstract

This thesis serves to investigate the varying effects of public health-care expenditure and private health-care expenditure on economic growth in developed and developing countries. I have contributed to the literature by using an expansive geographical dataset, lagged variables to address endogeneity, and model averaging techniques.

I do so by first addressing the issue of model uncertainty, which is inherent in growth studies, by using Bayesian Model Averaging as the method of analysis in the thesis. Examination of 126 countries (32 developed and 94 developing) in the period 2000-2018 reveals that there is no variation in the impact of public health expenditure on economic growth between developed and developing countries. Contrary to public health expenditure, private health expenditure has a varying impact on both developed and developing countries. My analysis also reveals that the results hold when lagged variables are used in the model. Public health expenditure has unanimously a negative effect on economic growth in both developed and developing countries. Private health expenditure, on the other hand, has a positive impact on economic growth in developed and developing countries. Furthermore, I found that the results are robust to different model specifications.

JEL Classification	I15, O11, O2, O10, O50, C11
Keywords	economic growth, public health expenditure, private health expenditure, bayesian model averaging, health economics

Author's e-mail	44857719@fsv.cuni.cz
Supervisor's e-mail	tomas.havranek@fsv.cuni.cz

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Acronyms

GDP	Gross Domestic Product
MDG	Millennium Development Goals
OLS	Ordinary Least Squares
FMOLS	Fully Modified Ordinary Least Squares
DOLS	Dynamic Ordinary Least Squares
BMA	Bayesian Model Averaging
WHO	World Health Organization
HIV-AIDS	Human Immunodeficiency Virus Infection - Acquired Immune Deficiency Syndrome
GMM	Generalized Method of Moments
SAARC	South Asian Association for Regional Cooperation
ASEAN	Association of Southeast Asian Nations
CEEMAC	Central African Economic and Monetary Community
USD	United States Dollar
TFP	Total Factor Productivity
PMG	Pooled Mean Group
PIP	Posterior Inclusion Probabilities
PMP	Posterior Model Probabilities
SD	Standard Deviation
OECD	Organization for Economic co-operation and development
ANCOVA	Analysis of covariance
EOP	End of period

Chapter 1 INTRODUCTION

This section serves to introduce the topic of the thesis. I do so by first discussing the background of this topic, problems associated with the past investigation into the relationship, and how my study seeks to answer some of the unaddressed issues.

1.1 BACKGROUND OF THE STUDY

The health of a nation's inhabitants is critical to its economic growth, given the considerable positive correlation between the two (Sachs et al. 2001). Health, in this case, refers to the general state of fitness, wellness, or completeness of individuals and their ability to adapt to and achieve desired environmental changes. Ginsburg (2008) affirmed that both men and women rank health as their highest priority in life. Health-care expenditures, therefore, aim to improve people's overall health, longevity, and quality of life. There are significant positive externalities associated with health-care expenditure; hence, it is given due importance. Hence, this section provides a background on the topic of health-care expenditure and economic growth and why it is of relevance.

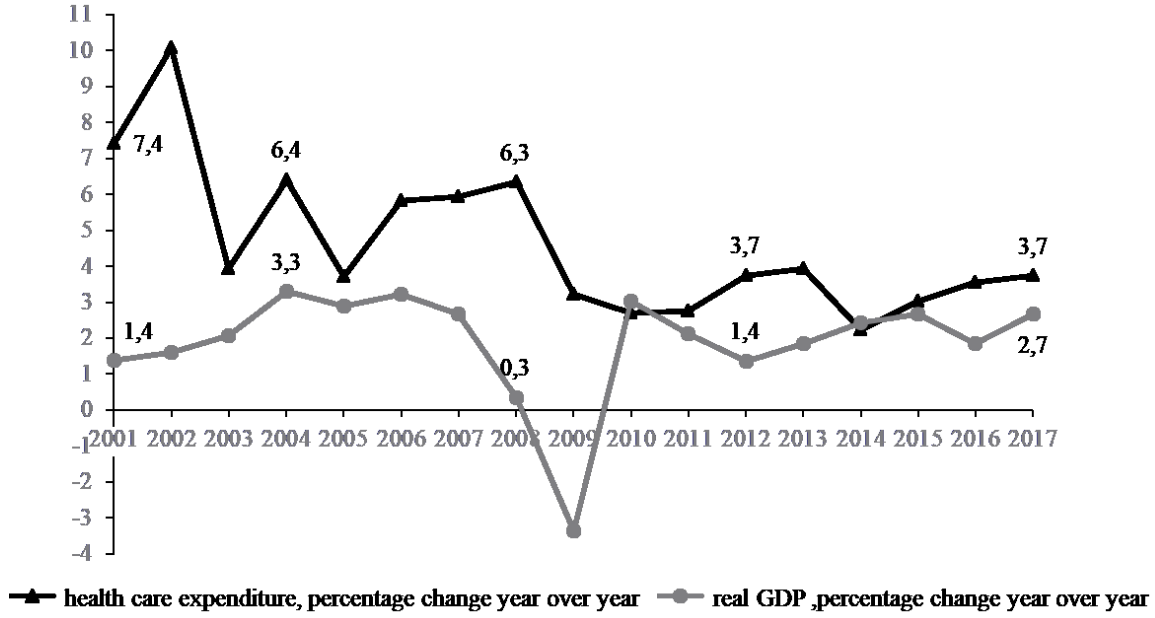
Furthermore, the socio-economic development of a country is linked quite significantly to the health and well-being of its people (Wahab, Kefeli, & Hashim, 2018). Long-term investments in health-care provide immediate short- and long-term benefits to citizens, which in turn enable a nation to realize eventual benefits for its initial investment. In other words, quality of life can be considered as an investment like any other asset or socio-economic factor (Sengupta, 2015). With this investment, economic advancement follows in lockstep as healthier, longer-living people lead to higher productivity and success.

Better health among adults means a reduction in mortality among those who are economically active and an improvement in retirement outcomes by minimizing premature retirement due to injury or illness. Work output is directly increased, thereby improving the economy. In contrary scenarios where adults have poor health outcomes, such as in underdeveloped parts of the world, countries experience lower productivity (Wahab, Kefeli, & Hashim, 2018).

Wahab, Kefeli, and Hashim (2018) stated that, due to education and health systems that are chronically underfunded and underequipped, developing countries find it difficult to sustain

economic growth. Communicable disease emergence is another issue that, while disproportionately impacting the developing world, challenges all economies (Hansen, 2012). Improved labor productivity can support all health outcomes, which can, in turn, lead to economic development and lasting growth (Clayton, 2010).

Figure 1: Health-care expenditure growth exceeding economic growth in OECD countries



Source: (OECD health spending, 2020)

Health-care cost around the world is growing at a faster rate than the economies of countries. Figure 1 supplements the above statement by comparing the growth rate of health-care expenditure against gross domestic product (GDP) growth rate in countries under the Organization for Economic Co-operation and Development (OECD). The graph shows that the health-care expenditure growth rate exceeds GDP growth rate almost every year between 2000 and 2017. In most countries, health-care expenditures are pegged as a percentage of GDP, which is expected to grow with time (Henry J. Kaiser Family Foundation, 2009).

According to the OECD (2020), there is an imbalance between the growth of health-care expenses and the GDP or income in both developing and developed countries, which raises concerns about how health-care needs will be met in the future.

Table 1: Current expenditure on health per capita and current prices in United States Dollar(USD)

Country	2012	2013	2014	2015	2016	2017
Australia	3854.19	4091.39	4190.68	4381.23	4565.87	4790.51
Austria	4588.34	4767.08	4858.59	4944.77	5139.92	5270.24
Belgium	4160.90	4349.43	4477.80	4526.60	4666.23	4832.27
Canada	4285.69	4365.62	4463.64	4550.83	4698.02	4811.79
Chile	1485.17	1656.26	1751.89	1837.69	1897.80	2095.28
Colombia	670.00	933.37	936.05	951.65	932.06	960.17
Czech Republic	2090.49	2448.53	2564.61	2545.51	2627.70	2850.41
Denmark	4315.13	4455.75	4536.24	4674.50	4774.27	5024.52
Estonia	1515.09	1636.09	1752.16	1868.24	2012.96	2120.49
Finland	3651.17	3794.53	3812.84	3990.64	4023.44	4126.72
France	4306.31	4557.34	4641.51	4675.80	4844.02	4930.78
Germany	4734.29	4947.77	5142.39	5291.28	5550.18	5847.68
Greece	2167.65	2091.00	2042.26	2100.34	2198.04	2207.06
Hungary	1766.54	1821.58	1863.75	1891.73	1965.02	1996.45
Iceland	3398.48	3497.72	3599.48	3735.25	3916.33	4153.87
Ireland	4373.29	4302.34	4251.48	4301.85	4470.75	4631.12
Israel	2223.35	2238.46	2237.46	2309.13	2551.40	2666.40
Italy	3110.56	3088.56	3075.43	3129.27	3264.37	3376.32
Japan	3970.77	4308.25	4328.36	4516.86	4512.85	4629.56
Korea	2079.91	2135.00	2235.72	2488.02	2678.23	2870.25
Latvia	1156.19	1229.69	1286.48	1405.02	1582.96	1649.28
Lithuania	1568.00	1662.58	1781.67	1917.59	2057.83	2182.47
Luxembourg	5207.36	4759.02	4809.24	4820.83	4873.86	4940.67
Mexico	1004.16	1028.09	1003.87	1075.43	1065.88	1104.97
Netherlands	4782.37	4923.88	4934.58	4928.37	5018.41	5155.04
New Zealand	3240.03	3388.25	3496.10	3513.38	3662.22	3742.23
Norway	5209.58	5485.87	5707.38	5728.33	5803.70	6063.61
Poland	1578.60	1670.78	1687.06	1803.00	1915.05	2047.73
Portugal	2345.63	2417.04	2450.89	2540.07	2667.69	2758.53
Slovak Republic	2097.40	2153.70	2010.11	2059.65	2187.37	2187.76
Slovenia	2431.00	2495.28	2499.11	2574.16	2682.92	2801.23
Spain	2726.37	2764.27	2852.74	3024.65	3105.65	3224.09
Sweden	4693.92	4750.50	4882.12	5027.33	5048.88	5264.40
Switzerland	5795.88	6188.22	6439.03	6760.51	6942.19	7146.84
Turkey	894.74	947.74	1006.77	1040.37	1126.76	1185.60
United Kingdom	2968.08	3573.58	3668.40	3703.08	3833.25	3942.90
United States	8423.31	8628.56	9042.28	9505.07	9903.65	10206.51
OECD Average	3212.70	3339.27	3414.06	3517.24	3642.37	3778.26

Source: (OECD Health Spending, 2020)

Table 1 shows the health expenditure of OECD countries between 2012 and 2017. The OECD health expenditure per capita average year over year indicates an upward trend. The United States has the highest rate of increase in health-care costs in the world; it also spends the most on health-care per capita (OECD Health Data, 2006). Economists, citizens, and health-care

providers are worried about the percentage of wealth that the United States spends on health-care as it is more than the expenditures of other developed countries like Canada.

1.1.1 Health-care

It was not until after World War II that the importance of the health sector to the economy became clear (Wahab, Kefeli, & Hashim, 2018). Today, numerous studies have shown that health-care and economic development, while linked, differ from country to country; in fact, even countries with a similar economic level face increasing health-care costs (Wang, 2011). Lower to middle-income countries partner with high-income countries to receive specific interventions necessary to lower costs for health services and make it more accessible (Ndedi, Metha, and Nisabwe, 2017). Thus, better accessibility and lower costs help improve labor productivity.

Also, compared to developed countries, developing countries suffer far more significant losses due to infectious diseases. Increased spending by all nations on fighting infectious disease and other contagions can, therefore, improve the living conditions of the next generations and improve the world economy through increased productivity and other benefits. Collaboration between neighboring nations also promotes the well-being of both, particularly regarding contagion. Hence, globalization helps prevent the onset of epidemics and pandemics (Martens, Akin, Maud, and Mohsin, 2010).

1.1.2 Health-care expenditure

Total health expenditure is the total of private and public health spending in a nation, including family planning, nutritional activities, and other factors. Calculated as a percentage of GDP, health expenditure as it relates to the economy of different countries has been a topic of much research (Zaman, Hossain, Mehta, Sharmin, and Mahmood, 2017). There is a lot of literature about the relationship between economic growth and health expenditure; however, results vary across different studies. Ndedi, Metha, and Nisabwe (2017) found that by increasing expenditures on health, countries, such as Cameroon, can increase their economic growth rate. On the contrary, some studies have found a negative correlation between GDP per capita and household expenditures. Sachs (2001), for instance, found that in developing

countries that have high health-care consumption and spending, there is a decrease in GDP per capita.

In most cases, wealth is considered the basic driver for health, not the other way around. Health expenditures are, therefore, regarded as human capital, which can be evaluated as both output and input for an economy. A healthy and educated population signals a policy environment that improves the economy (Alleyne and Cohen, 2002), with education and health influencing the creation of human capital. By achieving higher levels of education, a nation's populace is enabled to find better solutions to their health problems. Similarly, public awareness of health is improved.

Barro (1991) argued that education capital depreciation and health are inversely correlated, thus furthering education's positive impact on growth. A society's overall health can be gauged using requisite finance programs. Failure to develop adequate health infrastructure and a lack of technological advancement are results of financial incapacity.

Besides, the relationship between health and economic growth has been firmly established in the literature. Ginsburg (2008) conducted a study revealing positive associations between health-care investment and an economy's growth, particularly in developing countries. Bloom, Canning, and Sevilla (2004) concurred that health-care investment represents a significant form of human capital and that better health improves employee productivity and the physical capacity of the population.

To put it another way, an economy's output is determined by its workers' productivity, with production and productivity increasing together. Workers' productivity is defined as the value created per unit work output, which depends on both human capital and technological capacity, with the former representing the aggregate knowledge and skill set that an economy's workers possess (Bloom, Canning and Sevilla, 2004). As such, a high proportion of workers with a high level of education corresponds to higher human capital and productivity.

Furthermore, Technological advancement furthers higher productivity, showing how health-care expenditure relates to the overall income of a country. Technology combines leaps or advances in public knowledge and the pursuit of innovation. In developed nations, health is considered one of the highest priorities in technological development. Health-care expenditure promotes economic growth (Erçelik, 2018). Poor health among the population has the opposite

effect: lower overall productivity of a nation (Schultz, 2005; Erçelik, 2018). This link to productivity provides some evidence of a relationship between health and the economy.

Developed countries have taken advantage of this link by improving their health-care sectors and economies while developing countries are still lagging behind. In South Asia and Sub-Saharan Africa, for instance, health-care conditions are still poor. Poverty in these regions has led to medical debt. Public expenditure growth in South Asia has stalled, with no improvement in health-care conditions, whereas in nearby Southeast Asia, increases in health-care spending have led to improvements in the economy. Poverty makes it difficult to escape this cycle, which in turn poses concerns about a region's future health outcomes (Rahman, Khanam, and Rahman, 2018).

Human capital primarily serves as a vessel for economic development (Lucas, 1988; Mankiw, Romer, and Weil, 1990).Endogenous growth models (Romer, 1989) can be used to highlight the importance of economic development in relation to human capital. According to the World Health Organization (2005), higher productivity can only be achieved by a healthy population that builds healthy human capital. As such, the health of individuals is key to a nation's economic growth. Hence, developed nations can invest more to improve their citizens' health and, in turn, reduce poverty in and increase the overall productivity of the world. Such human capital growth and policy framework can be used by economists to understand the link between investments in health and increases in labor productivity (Sengupta, 2015).

Table 2: Summary of total effect coefficients by country group in Baldacci, Clements, Gupta, and Cui's (2004) study *Social Spending, Human Capital, and Growth in Developing Countries: Implications for Achieving the MDGs*

	Independent Variable (x)				
Dependent variable (y)	Composite primary and secondary enrollment (in percent of the school age group)	Under-5 child survival rate 2/ (per thousand live births)	Current education spending (one percent of GDP)	Current health spending (one percent of GDP)	Lagged education spending (one percent of GDP)
All developing countries					
Real per capita GDP growth	0.09	0.17	0.54	0.39	0.25
Composite enrollment rate	0.00	0.19	6.00	0.44	2.72
Under-5 child survival 2/	0.00	0.00	0.00	2.36	0.00
Low-income countries					
Real per capita GDP growth	0.12	0.11	0.59	0.48	0.27
Composite enrollment rate	0.00	0.19	6.54	0.54	2.96
Under-5 child survival 2/	0.00	0.00	0.00	2.88	0.00
Middle-income countries					
Real per capita GDP growth	0.08	0.29	0.50	0.34	0.23
Composite enrollment rate	0.00	0.19	5.54	0.39	2.51
Under-5 child survival 2/	0.00	0.00	0.00	2.07	0.00
Asia					
Real per capita GDP growth	0.08	0.24	0.53	0.48	0.24
Composite enrollment rate	0.00	0.19	5.84	0.54	2.64
Under-5 child survival 2/	0.00	0.00	0.00	2.88	0.00
Eastern Europe & Central Asia					
Real per capita GDP growth	0.06	0.46	0.44	0.24	0.20
Composite enrollment rate	0.00	0.19	4.80	0.27	2.17
Under-5 child survival	0.00	0.00	0.00	1.44	0.00
Latin America & the Caribbean					
Real per capita GDP growth	0.08	0.27	0.56	0.34	0.25
Composite enrollment rate	0.00	0.19	6.17	0.39	2.79
Under-5 child survival 2/	0.00	0.00	0.00	2.07	0.00
Middle East & North Africa					
Real per capita GDP growth	0.08	0.22	0.47	0.48	0.21
Composite enrollment rate	0.00	0.19	5.17	0.54	2.34
Under-5 child survival 2/	0.00	0.00	0.00	2.88	0.00
Sub-Saharan Africa					
Real per capita GDP growth	0.13	0.10	0.55	0.48	0.25
Composite enrollment rate	0.00	0.19	6.02	0.54	2.72
Under-5 child survival 2/	0.00	0.00	0.00	2.88	0.00

Source: (Baldacci, Clements, Gupta, and Cui, 2004)

Investment in health-care alone is not enough to stimulate a sustainable economy. Health-care expenditures must be made alongside other social investments. Baldacci, Clements, Gupta, and Cui (2004) detailed the overall impact of health expenditure on the economy (see Table 2):

> The impact of education capital on growth is more pronounced in low-income countries where an increase of 1 percentage point in the composite enrolment rate is associated with 0.1 percentage point increase in per capita GDP growth. This effect is 1.5 times than in middle-income countries. Geographically, the

> impact is highest in sub-Saharan Africa and lowest in Eastern Europe and Central Asia (p. 16)

Data from 120 developing countries between 1975 and 2000 showed that slower social expenditure, including education and health, correlate to slower economic growth.

Health-care systems thus must consider a variety of factors, including a country's political system, its people's lifestyles, and the social and cultural conditions in which the population lives (Lalonde, 1975). A health-care system that considers all possible factors generally makes health-care efficient in the country while having a positive impact on human capital and productivity.

1.1.3 Hypothesis on health-care expenditure

Many theories have affirmed the correlation between health-care expenditures and a nation's economy. The Harrod-Domar model (Hochstein, 2017), for instance, highlights the importance of capital accumulation to economic growth. The model proposes proportionality between economic growth and capital accumulation rate at a given technological level. Romer (1986) and Barro (1991) concluded that human capital itself has a considerable effect on economic growth.

Barro's (1991) theory is relevant in most literature on human capital in developing nations. Solow's (1956) model has a similar significance. Both are endogenous models that do not assume constant human capital based on its ability to influence short- and long-term growth. The Grossman (1972) model has been used alternatively to calculate labor supply as a function of individual health. Health is assumed to be endogenously determined in this model. Education is also endogenous, but it can be considered exogenous in relation to labor supply. Health capital thus requires continuous investment as it decreases over time (Barro, 2001). The Grossman (1972) model considers human capital as an essential input to the market and in non-market production.

Solow (1956) and Swan (1956) proposed a neoclassical, exogenous growth model. Labor is included in the model as a factor of production, following the Harrod-Domar model (Hochstein, 2017) in analyzing a nation's economic growth. This theory was criticized due to its lack of accounting for long-term economic growth; hence, Romer (1986) and Lucas (1988) developed an endogenous growth theory, suggesting that economic growth factors should be

investigated within the system. This generated a controversy in measuring growth rate since it changes because of human capital, which influences health-care expenditure and a country's economic growth (Bedir, 2016).

1.2 Problem statement

Several researchers have investigated the relationship between health-care expenditure and economic growth using various empirical methods. Results from these studies vary, depending on the type of health expenditure, characteristics of the country, empirical methodology, duration of the study, and control variables, among many factors.

Due to the varied results of these studies, policymakers are often perplexed on how to optimize their budgetary allocations in different sectors of the economy, including health-care. However, the health-care sector is often very complex. While some countries have a more developed public health-care system, others rely on private health-care, and this poses another issue for countries that want to improve the health of their population while limiting negative impacts on their GDP per capita.

1.3 Scope and objective of the study

While most studies on health-care expenditure and economic growth focus on specific countries or a group of developed or developing countries, I aim to make comparisons to determine whether health-care expenditure has varying effects in developed and developing countries. I also segregated the health-care sectors to determine whether there are differences between the effects of private health-care expenditure and public health-care expenditure in 32 developed and 94 developing countries.

To reduce the effect of business cycles, I grouped and averaged 19 years of data from 2000 to 2018 into five-time brackets of three years each and one-time bracket of four years. To address and mitigate endogeneity, I utilized and showed the varying effects of lagged variables in the model. Growth studies often require the utilization of commonly used growth factors in the form of control variables; hence, I used some control variables that have been mentioned in previous studies in the model. Furthermore, I performed a sensitivity analysis by removing and adding control variables and perform OLS with clustered standard errors at the country level on explanatory variables with Posterior Inclusion Probability(PIP) greater than 0.5 as a robustness check.

Researchers have used different techniques, such as ordinary least squares (OLS), fully modified ordinary least squares (FMOLS), and dynamic ordinary least squares (DOLS), to understand the relationship between health-care expenditure and economic growth; however, I decided to use Bayesian model averaging (BMA) to address the uncertainty between health-care expenditure and economic growth.

Following this approach, I have addressed some of the open questions on the relationship between health-care expenditure and economic growth. The entire study seeks to get answers to three main hypotheses. First, I try to hypothesize that BMA is a good method for estimating the relationship between public health-care expenditure and economic growth by introducing existing literature on various techniques used to analyze the above relationship and how BMA is more advantageous than some techniques. Later in the study, I have also compared BMA results of the above relationship with OLS results to explain further why BMA is a better fit. Second, I assume that the impact of public health expenditure on economic growth varies among countries based on their level of development and analyze this relationship by using BMA as a method in both developed and developing countries. Next, I introduce private health expenditure into the study and further try to understand the varying impact of private health expenditure in developed and developing countries using the same methodology as above.

The study contributes to the existing literature and departs by addressing different limitations and gaps. The study differentiates from most studies, such as by Piabuo and Tieguhong (2017) that used dynamic ordinary least squares(DOLS)and ordinary least squares(OLS) and addresses uncertainty which is inherent in the relationship between health expenditure and economic growth through Bayesian model averaging. Furthermore, while some studies concentrate on only a particular geographical area such as the Group of Eight (G8) countries (Öztürk and Topcu, 2014), the European Union (EU) (Dieleman, 2003) or only single countries like Tanzania(Byaro and Musonda, 2017), this study has used an expansive dataset of 126 developed and developing countries. Another differentiating factor where this study contributes especially is private health expenditure, which has often been ignored in most studies or has been used separately in growth studies. I could find very few studies that analyze the varying effect of public and private health expenditure together (Dinçer, Yüksel, and Adalı, 2017). Moreover, I further depart from existing literature by using different model

specifications, lagged variables to address endogeneity, robustness checks, and an exhaustive dataset.

The entire study is structured as follows: Chapter 2 discusses the literature on the relationship between health-care and economic growth. Chapter 3 explains the BMA and its advantages. Chapter 4 describes the hypothesis, data, and research methodology. Chapter 5 presents and discusses the results. Chapter 6 concludes the study.

Chapter 2 LITERATURE REVIEW

This section provides a comprehensive view of the literature surrounding the topic of this study. I first review existing studies on health expenditure, then move on to literature on health and how it has been used in growth studies. Next, I talk about empirical evidence from past studies and lastly how health-care expenditure has been studied with economic growth in previous literature.

2.1 Determinants of health expenditure

The world economic guidelines have taken significant considerations regarding health investments, following the recent financial crisis and the meltdown experienced by various nations. Governments acknowledge the significance of public investment, particularly in the health and welfare sectors, as important growth determinants, and this section of the chapter seeks to explore what constitutes and determines investment in the health sector.

The debate on whether health is a necessity or a comfort good is ongoing. Health is generally deemed superior since an increase in income leads to a rise in health expenditure (Hall and Jones, 2004). Health is not similar to other consumable goods. When health becomes costly, people get health insurance policies (Fuchs, 1998). Health expenditure has been rising year over year owing to various factors that dictate it.

Table 3: Current health expenditure as a percentage of gross domestic product

WHO Region	2010	2011	2012	2013	2014	2015	2016	2017
Africa	5.73	5.59	5.44	5.57	5.76	5.89	5.73	5.65
Americas	6.91	6.96	6.94	6.92	6.96	7.11	7.13	7.04
Eastern Mediterranean	4.65	4.78	4.73	4.89	5.05	5.45	5.54	5.69
Europe	7.78	7.67	7.8	7.85	7.82	7.83	7.84	7.78

South-East Asia	3.62	3.54	3.66	3.83	4.02	4.39	4.54	4.27
Western Pacific	6.91	6.91	6.64	6.95	7.02	7.04	7.21	7.09

Source: (WHO, 2020)

Table 3 outlines the current health expenditure as a percentage of GDP across different regions. Health expenditure in Europe was as high as 7.78% of the GDP in 2017, followed by the Americas with 7.04% in 2017. According to WHO (2009), "Globally in 2006, expenditure on health was about 8.7% of gross domestic product, with the highest level in the Americas at 12.8% and the lowest in the Southeast Asia Region at 3.4%" (p. 107).

As a luxury good, the elasticity of expenditure income on health-care is possibly higher. As Dewar (2017) stated,

> A normal good is a good for which income elasticity is positive but less than 1. This means that, if income increases by a given percentage, the quantity of the good consumed increases but at a lower percentage than associated with the income increase. If the percentage increase in the quantity consumed is greater than the associated percentage increase in income, the good is called a superior good (p. 53).

Newhouse's (1977) study estimated income elasticity to be 1.4, thereby confirming that health-care is a luxury good. It is argued, therefore, that spending on health-care is for caring, not healing. New studies in OECD nations have further revealed that health-care is essential since income resilience is less than 1 (Sen, 2005). Getzen (2000), however, solved this debate on whether health-care is a necessity or a comfort good by concluding that health-care is a necessity at a personal level, while it is a comfort good at the country level.

Numerous studies have been conducted in developing nations that address the topic of health expenditure. Farag et al. (2012) investigated income resilience in low-income countries and found it to be quite low, which means that increasing spending on health-care has low responsiveness to economic development. Various factors determine an increase in health expenditure in a nation. Among such critical factors is an aging population. Based on the norm,

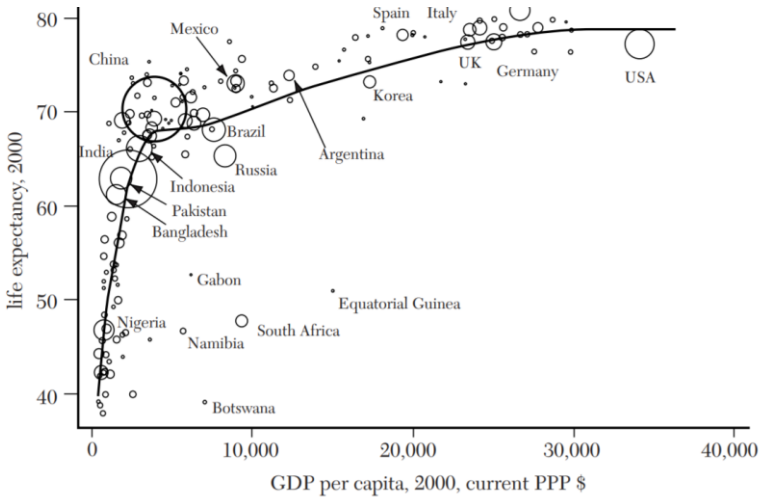
an increase in age leads to a rise in health-care monetary expenditure (Newhouse, 1992). In their paper, Breyer, Costa-Font, and Felder (2010) discussed the significant impact of an elderly population on the economy and argued that aging caused significant health-care expenditure.

Technological change is another crucial determinant of health-care expenditure. Current technological developments prompt continuously increasing spending, which has positive effects on longevity (Cutler and Zeckhauser, 2004). Moreover, new health-care technology does not cut costs but increase costs (McGuire and Serra, 2005). Karampli et al. (2014) theorized that the significant health-care expenses hike of 50% in the past five decades is connected to technological developments. They discussed important reasons for this, such as insurance policies, development of new health-care technologies, increased needs, and lifestyle changes that greatly predispose young adults to health disorders. The researchers also stressed the importance of having an in-depth understanding of the interaction between technology and health since a significant increase in health expenses had occurred parallel to significant technological advancements in past years.

Technological advancements in the health sectors mainly focus on discovery innovations to treat major illnesses, such as HIV/AIDS and cancer. However, these medications do not guarantee good health; therefore, marginal gain in health due to these developments is zero for most patients (Chandra and Skinner, 2012).

With the progressive population increase in nations, there has been a rapid increase in the percentage of elders. There is usually the propensity to increase health-care demand when an individual approaches death. This, coupled with advanced technology, dramatically increases health-care costs (Serra-Sastre and McGuire, 2009).

Figure 2: The Preston (1975) curve: Life expectancy versus GDP per capita



Source: World Development Indicators, World Bank (2002)

Figure 2 shows the Preston curve of how life expectancy increases as GDP per capita increases. A nation's population also influences health expenditure, and its impact varies based on the rate of infant mortality and life expectancy. Expenses are at the highest for infants and young children and the elderly. According to Aprile and Palombi (2006), as the GDP increases, countries tend to increase their health-care budget. Due to the progressive increase in public health spending, there is a tendency to boost private spending (Bosanquet, 2008).

Urbanization is another factor that determines health expenditure. Various studies have revealed a promising relationship between increasing health expenses and growing urbanization. This trend places a nation in an advantageous position but also poses disadvantages, such as inadequate hygiene facilities, because of overpopulation in urban areas as a result of further industrialization. Gugler et al. (1978) affirmed that all these factors, coupled with the industrialization of the health sector, ultimately increase health-care expenditure.

Furthermore, literacy rate positively influences health-care expenditure to some degree. It is said that the more learned individuals are, the more they tend to spend on their health both as a cure and as a means of prevention. In Toor and Butt's (2005) study of health-care expenditure determinants, "Literacy rate and urbanization have been found significant. Literacy rate, with a positive and significant coefficient, indicates that educated people demand more health facilities compared to the less educated and those with no education" (p. 137).

Another important factor that promotes the development of the health sector is market power or market leverage. Leading nations have more developed health-care management, which ensures that their insurance industry has appropriate risk management approaches that directly mirror the economy. These nations guide developing countries in formulating different policies and developing other services. The market today plays a very crucial role by offering advanced services in health-care, properly spreading information to the whole community, responding to crises and severe illnesses, tracking current technology, and assisting individuals, which in turn help hospitals, doctors, and other health workers to update existing or legacy regulations quickly. The technological developments arising from this change help the market improve its power while adding further costs to the health sector. In a report for the New York State Health Foundation, Gorman Actuarial, Inc. (2016) stated that market power, not quality, is linked to higher health-care costs. According to Liu et al. (2007), a nationwide amalgamation of market power can result in an economic increase of 5% or more.

2.2 Impact of health on economic development

Health-care expenses have become a significant challenge in maintaining financial stability in both developing and developed nations. Researchers and governments tirelessly work to define, understand, and investigate the effects of health factors on the global economy. Some relevant factors have been identified in the literature: per capita income, a system of health-care of the nation, population, urbanization, technology, among other factors. Nevertheless, some or all these factors may have significant differences in various countries or even regions, depending on decision-makers (Serra-Sastre and McGuire, 2009). Hence, this section of the chapter summarizes some studies that have discussed the impact of health on economic growth.

Of the various statistical models that have investigated the complicated relationship between health investment and a nation's economic snapshot, the neo-classical model revealed a strong positive correlation between them. Human capital mainly includes the education and health sectors. Rahman, Khanam, and Rahman (2018) in their study stated, "According to the neoclassical growth model, growth in human capital, in terms of education and health, positively affects per capita income in the long run" (p. 1). Similarly, many authors believe that education constitutes a more significant proportion of human capital; hence, many studies on human capital only focus on education.

Health is often considered as a vital component of human existence and growth. According to Grossman (1972), health is both a consumption good and a capital good. Health is considered a capital good in production because a healthy individual can offer more productive working days and thus helps boost the economy. Health is thus integral to the utility and productivity of humans (Ehrlich and Chuma, 1990). The positive effects of a healthy population on the economy have compelled nations to invest in their health sector to improve productivity (Rahman, Khanam, and Rahman, 2018).

The relationship between health and economic development depends on two competing hypotheses. The first hypothesis is the absolute income hypothesis, which depicts the causality between economic development and health. Low income per capita suggests poor health, while higher income per capita implies good health (Deaton, 2003).

Numerous theoretical studies have discussed the impact of the health sector on economic development. Some of those studies, discuss the importance of consuming excellent quality, nutritious food to boost health. Fogel's (1997) findings affirmed that an increase in individual income increases individual health and nutrition investment, which in turn influences a country's economic growth. Other factors like modern technology and urbanization of the health infrastructure further expedite the growth of the health sector and lead to the comprehensive development of the nation. In addition to the above factors, Innovation in medical science is also a contributing factor that improves the economic status of individuals and accelerates the health of the entire population (Elmi and Sadeghi, 2012).

The impact of economic development is concave and not linear in nature; hence, as income increases, so does the population's health initially. After the population of a nation has achieved a particular health status, an increase in income per capita ceases to improve health any further because it stagnates. The quality and standard of health-care, therefore, has a direct relationship with the improvement of a nation's economy (Preston, 1975).

The second hypothesis regarding the relationship between health and economic development is based on relative income. According to this hypothesis, health results in development. Improving health leads to economic growth.

Based on this hypothesis, increased health-care spending results in higher individual income. The healthier the individual, the more productive they become. Individuals are incentivized to invest in learning and attaining more skills as they reap the benefits from the

same over an extended duration, thereby effectively contributing to the economy (Elmi and Sadeghi, 2012).

Furthermore, improved health significantly boosts the supply of labor. Workers have fewer sick leaves and work more hours, increasing productivity. Workers feel more physically and economically safe since they can appropriately decide on distributing their income between investments (i.e., savings) and consumption (Dormont et al., 2006). While good health results in better productivity, ill health adversely affects labor and worker productivity, individual income, and the GDP (Cole and Neumayer, 2006).

According to studies conducted by Novignon et al. (2012), poor health hinders the development of present and future households and adversely impacts economic growth. Bedir (2016) conducted a critical exploration of developing economies between 1995 to 2013 using a statistical model. A converted version of Granger Causality tests was applied in an in-depth investigation of vast information regarding the topic, which revealed a bidirectional causality in the studied countries. Furthermore, the study demonstrated that health expenditure positively impacts economic development firmly and significantly in some nations, while there is a strong significant reverse causality in some countries.

Various researchers affirmed that economic growth generally results in better health in developing countries. As countries develop, reverse causality between growth and health arises (Deaton, 2003). As such, various nations experience different optimal levels for improving health based on their development level. After a country attains its optimum level, any additional health-care expenditure has little effect on its economic development (Deaton, 2003).

Other studies have been conducted to determine the relationship between health investment and economy and to understand the trend in health-care expenses in developing countries. For example, Xu, Saksena, and Holly (2011) used an extensive panel data set of 143 countries from 1995 to 2008 and examined common facts in health and economy. The study revealed that health expenditure could not grow faster than GDP. The authors also found an insignificant difference between tax-based and health insurance financing mechanisms in investments across most of the studied countries.

As evident in the above studies, health is essential for economic growth. Significant differences in the development and growth of developing and developed economies depend on

the status of their health-care. The real power behind a strong health-care system consists of physicians, health employees, infant care (e.g., scheduled immunization system), women's education, and geriatric care (Akinkugbe and Mohanoe, 2009).

2.3 Empirical evidence

As I have discussed above, there have been a significant number of studies that have investigated the topic of health and economic growth or development. It is crucial to understand what various authors have found while investigating this relationship. Thus, through this section, I want to share empirical findings of different studies that tried to examine the relationship between health and economic growth.

A report from the Commission on Macroeconomics and Health (2001) indicated that health is among the most vital determining factors of economic growth. The 2000 Abuja Declaration argued that malaria prevalence in African nations slowed the economic growth process. Current empirical literature affirmed that health-care and management expenses directly affect humans and economic growth. This is manifested in various channels, such as technology (Okunade and Murthy, 2002), population (Felder et al., 2000), and others. Bloom et al. (2004) studied this relationship and concluded:

> Our model accounts for economic growth by the growth of factor inputs, technological innovation, and technological diffusion. Our main result, which is consistent with our theoretical argument and with the microeconomic evidence, is that health has a positive and statistically significant effect on economic growth (p. 11).

Wang (2015) analyzed the health-care system of OECD countries for almost two decades (1990–2009). Using the generalized methods of moments(GMM) method, he found that increasing health-care (i.e., when it does not attain the optimum level) triggers economic growth. Meanwhile, Kumar (2013) used GMM to study 10 OECD countries between 1960 to 2007 and found the effect of real GDP on health-care to be positive and significant. The Granger causality tests were used for the statistical interpretation of the interrelationship between health expenses and economic growth, concluding that a bidirectional casualty exists between the two. Fedeli (2015) empirically investigated the same relationship in 20 regions in Italy between 1982 to 2009. The paper highlighted the occurrence of co-integration in spending

on health and GDP. The author used the Granger causality tests to justify his study and establish the existence of a relationship between health and economy in the short and long term.

Similar research was conducted in Portugal, using time series data from 1960 to 2005 and vector autoregressive models. Morgado's (2014) study aimed to investigate the present causality between health and economy and disproved the existence of bilateral causality. Accordingly, health does not affect economic growth, but economic growth positively and greatly impacts health. In a different study, Strittmatter and Sunde (2013) empirically investigated causality in 12 Western European nations between 1820 to 2010. The study results showed that there is a relationship between the economy of a country and health-care investment. The authors also found that spending on health positively impacts economic development.

Policymakers and reformers in developing countries have tried to establish near-universal health coverage packages similar to those implemented in OECD nations. For example, in Australia, a significant shift from optional to mandatory universal coverage was enacted with the introduction of the countrywide policy known as "Medicare." Switzerland took similar measures by imposing a mandatory private health coverage policy resulting in a comprehensive insurance system. Significant growth in insurance coverage was eventually achieved in other countries, such as Spain, the Netherlands, and France, with 98% of the populace shifting from a near-universal to universal coverage by 2020. Nevertheless, the policy did not cover dental care, psychological health-care, rehabilitation care, post-acute care, and infertility treatment in OECD nations. Notably, only a few Eastern European countries have incomplete health policies, resulting in pocket expenses, which their economies also reflect (Stepovic, 2019).

Dieleman's (2003) study analyzed the relationship between economic growth and health expenditure in 15 European Union countries. He observed a significant and positive relationship between the two variables. There was a U-shaped relationship between GDP and health in a sample of global nations, which has a partial similarity with the positive relationship between health and economic growth. Meanwhile, Hansen (2012) used the unified growth theory to analyze panel data in his study to demonstrate the U-shaped relationship between GPD per capita (i.e., wealth) and life expectancy (i.e., health).

Numerous researchers have focused their studies on developing nations. Rahman, Khanam, and Rahman (2018) concentrated on 15 developing countries of the South Asian Association for Regional Cooperation-Association of Southeast Asian Nations (SAARC-ASEAN) regions between 1995 and 2014. Their research determined that economic development significantly boosts the health of individuals; therefore, both public and private health spending should be promoted. Similarly, Kelly (1997)'s paper underlined that the contribution of public investment, including public health spending, to positive economic development in a nation.

Further research on this relationship between health and economic development was conducted in developing countries between 1990 and 2009 (Elmi and Sadeghi, 2012) . The panel cointegration tests and Granger causality methods were again used in the investigation, which concluded that there is a bilateral causality between the economy and health expenditure in the long term. They found that GDP growth affected health-care spending in the short term, but there was no observation of reverse causality.

Research conducted by Apergis and Padhi (2013) in various Indian states also concluded that "Increasing investment and spending in health is required either through direct intervention policies in the health sector or by increasing the economy's income across states" (p. 14). Additionally, the authors stated that health-care expenditure inequalities in different states should be reduced for effective outcomes. Merely focusing on health expenditure without practical guidelines may not reflect on the economy and may result in a skewed distribution in space and time. The current health-care expenditure scenario is compensated by the private sector that largely focuses on health frameworks and delivery systems that favors only a particular populace, thereby leaving the underprivileged socially deprived, which consequently results in adverse impacts on societal care, labor, newborn care, the economy, and the nation (Stepovic, 2019).

Local research focusing on the African nations investigated the impact of the country's investment in the health-care system on the GDP. The economic methods used in the study revealed a positive and significant relationship between the two variables, respectively in the short and long term (Piabuo and Tieguhong, 2017)

Mojtahed and Javadipoor (2004) also investigated 33 developing countries to understand the link between health and economic development. The authors determined a

positive and significant effect of health, physical, and human capital) on an economy's growth. Similarly, Ashraf et al.'s (2008) paper determined that increasing health expenditure or eliminating diseases positively impacts economic growth at a deficient level. The study recommended that a nation should invest in the health sector from a humanitarian point of view and not from an economic point of view.

In their study, Raghupathi and Raghupathi (2020) aimed to examine the effect of health expenditure on the economic growth of the United States. The study analyzed data from 2003 to 2014 and employed "visual analytics based on the belief that it offers an effective tool to comprehend health-care expenditure at a national level and analyze its impact on economic performance" (p. 3). The study concluded that health-care expenditure has a negative effect on working hours but a positive effect on labor productivity, personal spending, and economic growth. Meanwhile, Novignon et al.'s (2012) study of some sub-Saharan countries between 1995 and 2010 indicated a significant increase in health expenditure, which positively influenced the overall health situation of the nations. This was an indirect result of coupling factors, such as lower rates of infant mortality, higher life expectancy, and lower number of deaths.

Contrary to previous findings, Akinkugbe and Mohanoe's (2009) investigations revealed insignificant effects of economic growth on health status and, consequently, on health expenditure. A study conducted by Ogundipe, Adeniyi, and Lawal (2011) in Nigeria, a developing country, found that health expenditure has a negative impact on economic growth, and this is contrary to the findings of Oni (2014).

2.4 Health-care expenditure and economic growth

Many countries consider good health as a national goal, exclusive of its direct relationship with the country's income. The connection between health-expenditure and economy is essential in drafting national policy. Countries that invest in health-care aim to enhance human health and formulate a strategy to improve the nation's economy, and thus, this section of the study explores this relationship through reviewing various literature on this topic.

Today, arguments about the significance of health investment in the context of the economy are linked to its cost-effectiveness and applicability. Health policies enhance the

health status and well-being of the population (Bloom et al., 2008). Although various studies have analyzed the relationship between public health expenditure and economy, there are gaps in the literature that are attributed to policy differences, funds allocation, and democracy in countries (Sisko et al., 2014).

Gerdtham, Jönsson, Macfarlan, and Oxley (1998) studied the extensive association between health expense and GDP of 22 OECD countries over a 20-year period using the Solow growth model. The authors found that there is a positive correlation between health expenses and a country's GDP. They also found that health-care expenditure is highly responsive to income, movement, and demographic changes. Lago-Peñas, Cantarero-Prieto, and Blázquez-Fernández (2013) reported similar findings in their study that investigated 31 OECD countries. The study highlighted how "health expenditure is more sensitive to per capita income cyclical movements than to trend movements" (p. 14), such as time, which the study considered as a proxy for technology. Wang (2015) also had similar findings, underlining the importance of developing relevant policy framework systems that consider the macroeconomics of a country and the link between economics and health expenses. As a result, policymakers can better allocate available resources to benefit the public.

Ogunjimi (2019) used the Toda-Yamamoto causality test to understand the relationship between health expenses and the economy in Nigeria. The study found a reverse correlation between health expenses and the economy. However, the study had surprising findings revealing that "a unidirectional causal relationship exists between economic growth and health outcomes in Nigeria, indicating that causality runs from economic growth to health expenditure" (p. 138). As such, it was recommended that the government of Nigeria use collaborative and cross-country efforts to improve health-care policies to conform to the WHO provisions and the frameworks of developed countries. The study also recommended that a minimum of 13% of the annual budget be allotted to the health-care sector to achieve desired health outcomes. The authors also argued that the country should endorse and employ current technology in medicine and health to meet global standards and enhance the current situation of health workers and the health sector of Nigeria.

Dinçer & Yüksel (2018) conducted a study of emerging countries using the Pedroni panel co-integration method and Dumitrescu Hurlin panel causality analysis to examine the relationship between health expenditure and economic growth. The study found that there is a long-run relationship between public health expenditure and economic growth. However, this

relationship did not hold for private health expenditure and economic growth. The results of the Dumitrescu Hurlin panel causality analysis found no causality relationship between health expenditure and economic growth. It is also revealed that economic growth is the primary cause of total public and private health expenditure. The study recommended the use of private health expenditure in emerging countries to drive economic growth as these countries already have a large share of government or public health expenditure.

Similarly, Piabuo and Tieguhong (2017) found a long-run relationship between health-care expenditure and economic growth while analyzing Central African Economic and Monetary Community (CEMAC) and five other countries that achieved the Abuja target. The study used panel OLS, FMOLS, and DOLS to analyze the relationship between the two variables and found that a unit change in health expenditure translates to GDP per capita increases of 0.38 units for the five African countries and 0.30 units for CEMAC countries. Furthermore, the study established a long-run relationship between health-care spending and economic growth.

Kuloglu and Topcu (2016) also used the panel co-integration and causality method to analyze annual data from 1995 to 2014 and examine the causal relationship between health-care expenditure and Iran's GDP. The results indicated a long-run relationship between the two variables. The study also examined causality and concluded that there is a bidirectional relationship between health-care expenditure and economic growth both in the short and long run.

Similarly, Mehrara and Musai (2011) analyzed data from 1970 to 2008 to examine the relationship between health-care expenditure and Iran's GDP. The results showed a long-term correlation between these variables, and the income elasticity of health-care expenditures after the Islamic Revolution (1979–2008) is greater than 1. The Granger's causality test confirmed that "There is an instantaneous and unidirectional causal link running from GDP to health spending" (p. 18). The study does not support the view that health-care spending promotes long-term economic growth.

The literature on healthy growth usually includes research on developing countries. Contrary to previous literature on health expenditure and growth, Öztürk and Topcu's (2014) study examined this issue within a framework in the context of developed countries, G8 countries using annual data from 1995 to 2012. Using Kao's panel co-integration method, the

study found that there is a long-run equilibrium between health and economic growth. The results of the analysis showed evidence of a relationship between health expenditures and economic growth in the long run.

Chapter 3 BAYESIAN MODEL AVERAGING

This section introduces Bayesian model Averaging(BMA). I first talk about how BMA has been used across various studies. Next, I talk about how and why growth studies have used BMA as a method. Finally, I introduce the theoretical methodology of BMA.

3.1 Bayesian model averaging in previous studies

BMA is a technique for combining different possible probability models to fit the same data sets using Bayes theorem. BMA has many benefits compared to single model selection techniques. It is easily workable and less erroneous. It also produces less risky predictions and a straightforward model, yet it has been used sparingly. BMA is a simplified Bayesian inference applied in macro- and microeconomics to predict and estimate economic models. The model aims to actuate factors that help in establishing variances in the growth of GDP in different parts of a country. A systematic approach is essential to understand factors, such as health expenditure, demography, and healthy growth. The model is particularly important when working with minimal to large sets of data (Blazejowski and Kwiatkowski, 2020). BMA has been applied in meta-analysis, Analysis of covariance (ANCOVA) designs, and network designs (Max Hinne et al., 2019).

According to Moral-Benito (2015), the first step in any empirical research is selecting a model from all probable models. After selecting the model, the authors proceed as if they selected data using the chosen model; therefore, they tend to ignore uncertainties during the model selection process. Moral-Benito (2015) argued that model averaging could be used to account for these uncertainties. Their study further stressed the importance of BMA and other model averaging techniques in addressing the shortcomings of traditional research methods.

Similarly, Leon-Gonzalez and Montolio (2015) affirmed that BMA could be used effectively to analyze panel data growth. The authors stated that BMA is particularly useful, where there are many models that increase the sensitivity of results to model assumptions. Comparable sentiments were also shared by Arin and Braunfels (2018), who reported mixed evidence regarding the impacts of oil rents on economic advancement. According to the authors, mixed evidence can be explained using model uncertainty, so they used BMA techniques. They demonstrated the use of BMA in studying economic growth and discovered that oil rents had robust positive impacts on long-term economic growth in organizations.

3.2 Use of Bayesian model averaging in growth studies

Several authors have used BMA to examine factors of economic growth. In a research conducted to investigate factors of growth in developing Asian countries, Leon-Gonzalez and Vinayagathasan (2015) used BMA to overcome the uncertainties of control variable choices. They used a Bayesian algorithm to analyze several competing models. Their explanatory variables included a non-linear function that allowed for threshold effects. After using BMA on an unbalanced data set of Asian nations, the authors discovered a positive correlation between investment ratio and economic growth of a country. The study also found a non-linear relationship between economic growth and inflation and a negative correlation between terms of trade and government consumption expenditure. Their study demonstrated how BMA can be used to explore the correlation between key factors of economic growth.

Asatryan and Feld (2015) also conducted research using BMA. Their research was different from the one conducted by Leon-Gonzalez and Vinayagathasan (2015) since they focused on the relationship between economic growth and financial federalism, which deals with the monetary relationships among different levels of government and the division of government functions. Using the BMA approach, the authors analyzed data from 23 OECD member countries. Their research found no robust correlation, neither negative nor positive, between fiscal federalism and output growth. Nevertheless, their work demonstrated the use of BMA to investigate the determinants of economic growth. They stressed a need to solve causality and endogeneity issues.

Using BMA, Leon-Gonzalez and Montolio (2004) conducted twofold studies on the development determinants of Spain and the intricate factors that growth relied on. The authors underlined categories of private and public economy capitals, emphasizing how Spanish provinces focused on the economy. The study revealed sensitive factors of health that have a direct impact on the economy and economic development and highlighted the significant effect of public investments in health and transportation on the economy.

Masanjala and Papageorgiou (2008) conducted a study on Africa's economic growth and the impact of investments in the public health sector on the continent. The authors used posterior coefficient estimates of BMA, which revealed that factors that affect economic growth are different between countries. Some of the factors that were used in their study showed that the impact Africa's economic development was mainly because of the

exportation of goods, mining, and literacy. They mentioned that this could be due to the lack of effective policies and nationwide health coverage. Nonetheless, they stated the significance of making adequate investments in the health sector for driving economic development.

BMA has been used to evaluate the universal health package in Bangladesh. According to the study of Ibtehaz and Rahman (2020), health ailments among citizens constitute a significant cause of the high health expenditure in Bangladesh at both national and individual levels. The study emphasized the need for more robust risk management plans, such as implementing proactive measures to reduce the financial liabilities of the government. The treatment and management of non-communicable diseases also puts direct pressure on the economy. It is, therefore, important that health-care professionals focus on the most vulnerable members of the community, such as the elderly and people with chronic conditions, by reducing consultation, management, and therapy costs.

BMA has the potential to eliminate uncertainties through model averaging. This review provided a consolidated global picture of health expenditure and policy implementation in countries across the world.

This empirical review of the relationship between economy and health expenditure also provided a better understanding of how one influences the other. The studies reveal how global policymakers can use the relationship between these two variables to accelerate economic growth and enhance the well-being of the population.

3.3 BMA as a theoretical methodology

Uncertainty in model selection is addressed in BMA (Raftery, 1993) by combining all possible candidate models. The Bayesian rule shows how prior beliefs (θ) are updated with the availability of new data to arrive at posterior probabilities (i.e., p(θ)).

Arin, Braunfels, and Doppelhofer (2015) used the following methodology in their study, which I utilized and modified according to the specifications of my study(see sub-chapter 4.5). The standard empirical growth model is as follows:

$$\Delta y_{i,t} = \theta' x_{t-8} + v_{i,t}$$

(Equation 3.3.1)

where i denotes the growth rate of the country, t denotes year as a function of growth determinants x, and $\Delta y_{i,t}$ denotes the annual growth of GDP per capita. $\Delta y_{i,t}$ has been approximated by its log difference to meet the criterion of the formula.

Distribution p(θ|D) is then calculated using BMA. It is calculated as the proportionally weighted average for the distributions of control parameters taken conditionally with respect to the model. As such, for K possible number of regressors, there is a set of

$$J = 2^K$$

(Equation 3.3.2)

M_j (j = 1, 2, …J) represents the model weight. Each of these models represents "a subset of the candidate regressor" (p. 6), as mentioned by Eicher, Papageorgiou, and Raferty (2009).

The posterior mean of control parameter vector θ is calculated as follows:

$$E(\theta|D) = \sum_{j=1}^{2^K} P\,(M_j|D)\hat{\theta}_j$$

(Equation 3.3.3)

The posterior mean described above denotes the weighted sum of model-specific control parameter's expectation.

Posterior probability of the model M_j is represented by $P\,(M_j|D)$, which is used as the control parameter's model weight. $\hat{\theta}_j$ in the above formula is the estimated parameter vector for the model j. I then measure uncertainty with the posterior variance parameter as follows:

$$Var(\theta|D) = \sum_{j=1}^{2^K} P\,(M_j|D)(Var(\hat{\theta}_j|M_j, D) + (\hat{\theta}_j - E(\theta|, D))^2)$$

(Equation 3.3.4)

Using Bayes rule, I calculate the posterior model probabilities as below:

$$P(M_j|D) = \frac{P(M_j)L(D|M_J)}{\sum_{l=1}^{2^K} P\,(M_l)(L(D|M_l)}$$

(Equation 3.3.5)

where $P\,(M_j)$ represents the prior model probability and $L\left(D\middle|M_J\right)$ is the marginal likelihood of the corresponding model (M_j). Integration over the model parameters generates the marginal likelihood of model (M_j):

$$L(D|M_j) = \int L\left(D\middle|\theta_j, M_j\right)P\left(\theta_j\middle|M_j\right)d\theta_j$$

(Equation 3.3.6)

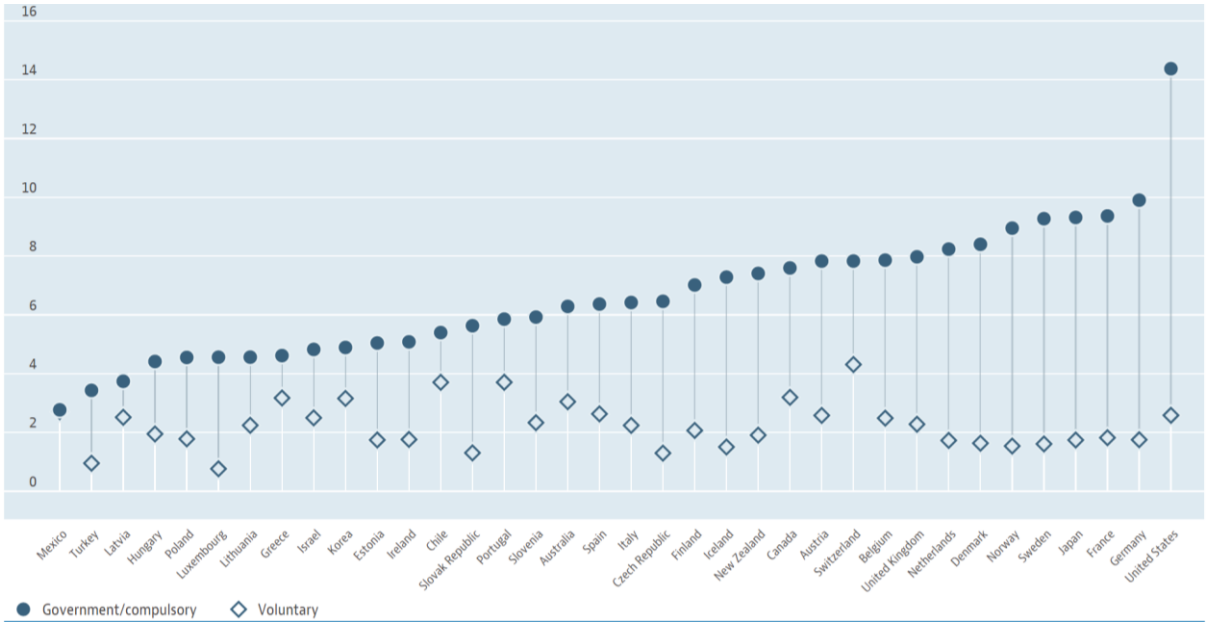
Chapter 4 EMPIRICAL ANALYSIS

This section presents the empirical part of this study. I first talk about my motivation to investigate the topic of the study and my hypothesis. Next, I introduce the dataset and rationale behind my method selection. Finally, I present the modeling methodology for this study

4.1 Motivation

As countries try to become developed, governments of such countries are encouraged to implement various strategies to improve the standard of living in the country. The government does so by investing in various socio-economic initiatives. Health-care is one such initiative, and as the study reviewed above, there is extensive literature on how a healthy population positively affects productivity and, in turn, economic growth. Still, there are some aspects that have either been left out or are yet to be explored by other studies, and hence this section talks about my motivation to study this relationship.

Figure 3:Health-care expenditure percentage of GDP – Government and voluntary (2019)



Source: (OECD, 2020)

Figure 3 shows us that while some economies focus on privatization of the health sector, others rely partly on the public health-care system and partly on the private health-care system.

Over the years, the importance of health-care expenditure has transformed into a debatable topic as there is quite a contrast or conflicting views on how this expenditure impacts economic development. Particularly governments and national health authorities are investigating further on how to drive economic growth best. Similarly, how governments choose to invest and in which sector, private or public, varies as well. It is crucial to understand which kind of health expenditure drives economic growth in developed and developing countries so that governments and policymakers can focus on the right strategies that target the correct type of health expenditure, be it public or private.

This study focuses on generating insights on the impact of health-care expenditure on economic growth. The study goes further to understand whether private or public health expenditure impacts economic development in countries. Furthermore, the study also analyses how this impact varies based on developed and developing countries. Health expenditure is a component of GDP. GDP is used as an indicator of economic growth or development (OECD, 2020), which assumes developed countries to have higher health-care expenditures, public or private, or both, as compared to developing countries.

The health status of human capital and life expectancy of the section of the population that makes up the labor force has a crucial role in the economic development of a nation. This study, therefore, highlights the importance of healthy human capital and its effect on the productivity of labor and, in turn, economic development. Hence, in this study, health is considered as capital. Healthy human capital is more apt at developing new skills and adapting to changing economic conditions and is hence able to drive better productivity.

The objective of the paper is to understand the relationship health-care expenditure and economic development hold. Additionally, it emphasizes on the role public and private health-care sectors play in the economic development of a nation. Furthermore, the study discusses whether BMA is an appropriate econometric method for estimating the relationship between health expenditure and economic growth.

4.2 Hypothesis

The first hypothesis that I test is, ‘Public health-care expenditure's impact on economic growth varies among countries based on their level of development.’ I have split the dataset containing 126 countries and classified them by developed and developing countries. The dataset also

consists of control variables which include Export of goods and services, Import of goods and services, Life expectancy at birth, Consumer price index inflation, Population % chg y-o-y, Population 0-15 years, % of total population, population 65+ years, % of total population.

Once the data has been split, I then apply BMA to understand the variation in the relationship between developed and developing countries with regards to public health-care expenditure and economic growth.

Through the second hypothesis, I seek to investigate further the varying impact of public and private health expenditure on economic growth based on whether the countries are developed or developing

Additionally, the study looks to understand whether BMA is a good method to estimate the relationship between public health-care expenditure and economic growth.

4.3 Data

This study utilizes datasets of 126 countries obtained from Fitch Solutions (Fitch solutions country risk and industry research, 2020) which is a credit and macro-intelligence company and an aggregator of datasets for different countries, industries, and organizations. Though the database might not be able to cover all aspects of such data, it is still one of the best available sources to find data at such a large geographic scale and this section serves to introduce the dataset I have used in this study and it's specifics.

Table 4:List of variables and definitions used in the study

Indicator	Definition	Source
Inflation	Consumer price index inflation, eop, % chg y-o-y	Fitch Solutions
Export	Export of goods and services, USD	UN, Fitch Solutions
Public health expenditure	Govt. health spend, USD	World Health Organization (WHO), Fitch Solutions
Import	Import of goods and services, USD	UN, Fitch Solutions
Life expectancy at birth	Life expectancy at birth, average, years	UN, Fitch Solutions

Population 0-15 yrs	Population 0-15 yrs total, % of total population	UN, Fitch Solutions
Population 65+ yrs	Population 65+ yrs total, % of total population	UN, Fitch Solutions
Demographics	Population, % chg y-o-y	UN, Fitch Solutions
Private health expenditure	Private health spend, USD	World Health Organization (WHO), Fitch Solutions
Economic growth	Real GDP growth, % y-o-y	World Health Organization (WHO), Fitch Solutions

Source: (Fitch solutions, 2020)

I have used 126 countries, which consists of 32 developed and 94 developing economies, contrary to the proposal of 30 developed and 30 developing countries to bring more diversity in the dataset. The countries were chosen as per the availability of data required to run the analysis, which not only includes the dependent variable economic growth represented by GDP but also independent variables such as public health expenditure % of GDP, private health expenditure % of GDP and other control variables(Table 4).

Additionally, I decided to split the 126 countries into developed and developing to understand further the varying effects on each group. The dataset spans from the year 2000 to the year 2018 and is grouped into five average time periods of 3 years each and one time period of 4 years, thereby spanning 18 years. Arin, Braunfels, & Doppelhofer (2015) stated that by "averaging over five years can help to eliminate business cycle effects and to focus on the relation with long term growth"(p. 17). I include Real gross domestic product (GDP) growth rate as an indicator of economic growth and it is represented by $GDPgrowth_{it}$ in the model. I use government health-care spending in USD as an indicator for public health expenditure, and it is represented by β_1 as it's coefficient. β_2 Is the coefficient of private health expenditure or spend in USD. I have fixed both the health expenditure variables in the model, as these are the variables of primary interest for this study.

Furthermore, I use control variables (Table 4) such as Exports of goods and services in USD, Imports of goods and services in USD, Life expectancy at birth years, Consumer price index inflation(eop) % change year over year, population % change year over year, Population 0-15 years % of total population, Population, 65+ years, % of total population. The selection of control variables has been based on existing studies and growth theory that have used similar variables to control for determinants of economic growth.

Demographics play a vital role in determining economic growth. Prskawetz, Kögel, Sanderson, & Scherbov (2007) in their study supplemented this statement by finding that the age structure of the population is a crucial determinant in the magnitude and direction of economic growth. Huang, Lin, & Lee (2019) had very similar findings in their study when they found that an aging population has a negative effect on economic growth due to lower total factor productivity(TFP). Furthermore, Bloom, Canning, Fink, & Finlay (2007) found that including age structure improved their forecasts for economic growth. Hence, I have included age structure variables as control variables (Population 0-15 years % of total population, Population, 65+ years, % of total population) in the study.

Similarly, life expectancy can have varying effects on economic growth. While in some countries, longer life expectancy can put downward pressure on the economy, in other countries, longer life expectancy can positively affect economic growth. Fioroni, 2008 "states that the net effect of life expectancy depends on the initial mortality's level of the country. In the poor ones, where life expectancy is low, a reduction in the mortality rate has a positive effect on economic growth, in the rich ones, where instead life expectancy is high, the effect of a further increase in the average life on economic growth can be null or negative" (p. 12). Hence, I have used Life expectancy at birth years as a control variable.

Other commonly used control variables include exports and imports of goods and services, investment to GDP ratio, education level, government expenditure to GDP ratio. Sharma (2018) used a few of these control factors in his study, which analyzed the effect of health expenditure on economic growth and stated that "choice of control variables is dictated by growth theory in which these variables along with measures of human capital are found to be the most robust determinants of economic growth" (p. 4 and hence I have used Consumer price index inflation(top) % change year over year, Exports of goods and services in USD and Imports of goods and services in USD following the study's recommendation.

Thus, since there hasn't been any consistency in how to control variables that have been chosen, I have decided to include control variables that have most commonly been used in previous literature and for which data was available for all the 126 countries in the study.

Additionally, as a robustness check and due to the risk of multicollinearity between population % change year over year and Life expectancy at birth years, Population 0-15 years,% of total population, Population, 65+ years, % of total population, I have decided to

perform two instances of the analysis one with Life expectancy at birth years, Population 0-15 years % of total population, Population, 65+ years, % of total population excluded and one with population % change year over year excluded to avoid multicollinearity. This serves to give us two varying sets of results based on control variables that have been included or excluded. Ghosh & Ghattas (2015) in their study, highlighted that "summaries of the posterior distribution based on marginal and joint distributions may give conflicting results for assessing the importance of strongly correlated covariates" (p. 1).

4.4 Method selection

This section talks about the various methodologies that have been used to analyze data in growth studies and seek to understand the current study's choice of methods. I also talk about the reasoning behind the selection, thereby addressing our third hypothesis of this study.

The relationship between health expenditure and economic growth can be described using endogenous growth models. These models exemplify the importance of human capital to achieve economic growth. Traditional growth models (Sala-I-Martin, 1997) explain economic growth through savings and population growth. Solow (1956) highlighted that higher per capita income is a direct result of higher savings in counties. Hashmati (2001) further investigated Solow's model and showed that in Solow's model, population and rate of savings were key determinants of per capita income across nations.

Consequently, Buchanan (1965) developed another study which was reported by (Boettke and Marciano, 2017) who found that Buchanan stressed on the need to increase spending on health irrespective of demand. The Buchanan theory expresses the need to understand inefficiency in health-care through diminishing quality such as poor infrastructure, inefficient distribution of staff and not due to the lack of supply.

There have been many models that have tried to address the relationship between human capital and economic growth. One such, Mincer (1981) stated that human capital was a critical determinant of economic growth. Most existing endogenous models do not fix human capital in the model. However, these models assume human capital to impact economic growth only in the short and long-run.

Furthermore, while studying the relationship between Health Expenditure and economic growth in some African states, Piabuo and Tieguhong (2017) reviewed various methods that had been used in growth regressions. The authors mentioned that:

> several methods can be used for estimation in a panel framework with co-integration, amongst which we have: OLS, Fully Modified OLS (FMOLS), dynamic OLS(DOLS), and Pooled Mean Group (PMG). Analysis of the properties (the finite sample proprieties of the OLS estimator, the t-statistic, the bias-corrected OLS estimator, and the bias-corrected t-statistic) of the OLS estimator by Chen, Mccoskey, andKao (1999) analyzed shows that the bias-corrected OLS estimator does not generally improve over the OLS estimator. Other alternatives such as the FMOLS estimator or the DOLS estimator can be more appropriate in co-integrated panel regressions. FMOLS is well known in conventional time series econometrics because it is believed to eliminate serial correlation in the errors and endogeneity in the regressors. However, Kao andChiang (1999) demonstrated that both the Fully Modified OLS (FMOLS) and OLS both show signs of small sample bias and that the dynamic OLS (DOLS) estimator can outperform both estimators. (p. 6)

Hence, I use BMA, which is an extension of the Bayesian inference. BMA is apt for combined model estimation, model selection, and prediction (Fragoso et al., 2018). It uses multiple candidate models and combines their estimates. Furthermore, due to the focus on all possible weighted scenarios, BMA is a lot more advantageous than the single model selection approach. Bayesian model averaging addresses uncertainty in model selection by combining all possible candidate models(Chuang et al., 2010). According to Hinne, Gronau, Bergh, and Wagenmakers (2019), BMA offers several advantages when compared to single model selection:

> 1. BMA reduces the overconfidence that emerges when model uncertainty is ignored. Analyses based on the BMA respect the uncertainty i have about the models.
>
> 2. BMA results in optimal predictions under several loss functions, such as the logarithmic or the squared error loss. This may seem counter-intuitive; after all, surely the optimal predictions come from using the true model instead of a

weighted average? However, as we just saw, we have no way to consistently identify the correct model. The error that this induces is mitigated by BMA.

3. BMA avoids the all-or-nothing mentality that is associated with classical hypothesis testing, where a model is either accepted or rejected wholesale. In contrast, BMA retains all model uncertainty until the final inference stage that may or may not feature a discrete decision.

4. BMA gracefully updates its estimates as the data accumulate, and the resulting model weights are continually adjusted. In contrast, procedures based on the selection of a single best model may yield sudden changes in estimates when the observation of new data lead to the selection of a different best model. Even the addition of a single observation can cause a discrete shift in the estimates. A related problem is that the observation of new data may require the resuscitation of a model that was previously rejected, which appears to be incoherent.

5. BMA is relatively robust to model misspecification. If we do select a single model, then we had better be sure we are correct. Using BMA, a range of rival models also contribute to our estimates and predictions, and chances are that one of the models in the set is at least approximately correct. (p. 2)

BMA has also been extensively used to address uncertainty in growth regressions. Regression is a statistical process to estimate and understand the relationship between an outcome, which in our study is Economic growth, and one of the more variables that are used as regressors or independent variables. This can be dynamic as well as linear or non-linear.

BMA helps in addressing two levels of uncertainty in growth regressions (Culka, 2014):

- First, uncertainty associated with the conditional parameters of the model
- Second, uncertainty in the empirical model specification.

In conclusion, the section presented above reveals the advantage of BMA over the traditional empirical research methods and is hence the choice of empirical analysis in this study.

4.5 Modeling Methodology

4.5.1 Overview

Through this section, I want to study the impact of health-care expenditure on economic growth in the 126 countries the study focuses on. We group the countries into two parts- developed and developing. The categorization of countries is based on the United Nation's list of country classification (United Nations, 2020). We then analyze the data using Bayesian model averaging (BMA) to understand whether there is a substantial impact on economic growth based on the dependent variables of health-care expenditure and other control variables.

The control variables used are Exports of goods and services in USD, Imports of goods and services in USD, Life expectancy at birth, years, Consumer price index inflation(eop) % change year over year, population % change year over year, Population 0-15 years % of total population, Population, 65+ years, % of total population. As a Robustness check and to avoid multicollinearity, i run two instances of analysis. This has been discussed extensively in the data section of this study.

Furthermore, i use models for developed and developing country groups, including the two instances, with lagged variables and without lagged variables to mitigate the risk of endogeneity between health-care expenditure and economic growth. The entire study seeks to answer three primary hypotheses: First, it serves to identify the relationship between health expenditure and economic growth (% change in GDP). The second hypothesis helps to understand the varying impact between public and private health expenditure and economic growth in the two different sets of countries. The third hypothesis proves to validate BMA as a good method for analyzing the relationship between public health expenditure and economic growth.

4.5.2 Modeling framework

To analyze the first instance of this study, formally; I considered:

$$Economic\ growth\ =\ f(health\ expenditure)\ +\ (\ Import, Export, inflation,\ life\ expectancy, population\ 0-15, population\ 65+)$$

(Equation:4.5.2.0)

Thus, this can be translated as an econometric relation involving the following fixed and control independent variables:

$$GDPgrowth_{it} = \alpha_i + \beta_1 public\ health\ expenditure_{it} + \beta_2 private\ health\ expenditure_{it} + \gamma_1 Import_{it} + \gamma_2 Export_{it} + \gamma_3 Inflation_{it} + \gamma_4 population\ (0-15)_{it} + \gamma_5 population\ (65+)_{it} + \omega_k Year\ Bracket_{it} + \varepsilon_{it}$$

(Equation:4.5.2.1)

where i is the country component and t is the time component for (2001 – 2018), $\alpha_i, \beta_1, \beta_2$ are the ith country economic growth, coefficient of fixed health expenditure variables, $\gamma_1 - \gamma_5$ are the coefficients for the control variables, ω_k are the coefficients for the six term brackets (2000 – 2002, 2003 – 2005, 2006 – 2008, 2009 – 2011, 2012 – 2014, 2015 – 2018) and ε_{it} is the error term.

4.5.3 Testing endogeneity

Endogeneity occurs when a variable that must be observed in the model to explain the dependent variable is not included in the model. This variable develops based on other similar variables in the model. Hence, an endogenous variable is a variable that is dependent on other factors within a model. One of the most cited ways of overcoming endogeneity is to employ lagged explanatory variables (Hasan, Horvath, & Mares, 2015). I use Lag 1 to address endogeneity in the model. I couldn't exceed Lag 2, as starting Lag 3, the model complained of singularity.

Model (1) does not correct for the endogenous relationship between public health and economic growth for which implications are reported by (Abdallah, Goergen, & O'Sullivan., 2015) and the use of lagged independent variable reported in (Bellemare, Masaki, & Pepinsky, 2017) to mitigate the problem.

$$GDPgrowth_{it} = \alpha_i + \beta_1^{t-1} public\ health\ expenditure_{it-1} + \beta_2^{t-1} private\ health\ expenditure_{it} + \gamma_1^{t-1} Import_{it} + \gamma_2^{t-1} Export_{it} + \gamma_3^{t-1} Inflation_{it} + \gamma_4^{t-1} population\ (0-15)_{it} + \gamma_5^{t-1} population\ (65+)_{it} + \omega_k Year\ Bracket_{it} + \varepsilon_{it}$$

(Equation:4.5.3.1)

where β_1^{t-1} and β_2^{t-1} are the coefficients of the first lag of public and private health expenditures, $\gamma_1^{t-1}, \dots, \gamma_5^{t-1}$ are the coefficients of control variables.

4.5.4 Testing robustness: Sensitivity analysis

A robustness check has often been used in empirical studies to validate how the main explanatory variables in a model behave with the change to model specification. Hence, i performed a sensitivity analysis and thereby i included population (% change year over year) represented by $Demographics_{it}$ and excluded Life expectancy at birth (years), Population 0-15 years (% of total population), Population, 65+ years (% of total population) due to the risk of multi-collinearity.

Therefore, i considered:

$$Economic\ growth = f(health\ expenditure) + (Import, Export, inflation, Demography)$$

This thus again be translated as an econometric relation involving the following fixed and control independent variables:

$$GDPgrowth_{it} = \alpha_i + \beta_1 public\ health\ expenditure_{it} + \beta_2 private\ health\ expenditure_{it} + \gamma_1 Import_{it} + \gamma_2 Export_{it} + \gamma_3 Inflation_{it} + \gamma_4 Demographics_{it} + \omega_k Year\ Bracket_{it} + \varepsilon_{it}$$

(Equation:4.5.4.1)

where i is the country component and t is the time component for (2001 – 2018), $\alpha_i, \beta_1, \beta_2$ are the ith country economic growth, coefficient of fixed health expenditure variables, $\gamma_1 - \gamma_4$ are the coefficients for the control variables, ω_k are the coefficients for the six term brackets (2000 – 2002, 2003 – 2005, 2006 – 2008, 2009 – 2011, 2012 – 2014, 2015 – 2018) and ε_{it} is the error term.

Model (1) does not correct for the endogenous relationship between public health and economic growth as mentioned above and hence i include the first lag of all covariates into the Model (1), and thus, Model (2) is:

Thus, i include the first lag of all covariates into the Model (1), and thus, Model (2) is;

$$GDPgrowth_{it} = \alpha_i + \beta_1^{t-1} public\ health\ expenditure_{it-1} + \beta_2^{t-1} private\ health\ expenditure_{it} + \gamma_1^{t-1} Import_{it} + \gamma_2^{t-1} Export_{it} + \gamma_3^{t-1} Inflation_{it} + \gamma_4^{t-1} Demographics_{it} + \omega_k Year\ Bracket_{it} + \varepsilon_{it}$$

(Equation:4.5.4.2)

where β_1^{t-1} and β_2^{t-1} are the coefficients of the first lag of public and private health expenditures, $\gamma_1^{t-1}, \dots, \gamma_4^{t-1}$ are the coefficients of control variables.

Model uncertainty was accounted for in all 8 models through Bayesian Model Averaging (BMA) by sampling 2000 best models of various dimensions.

4.5.5 Testing robustness- Ordinary least squares

In addition to the sensitivity analysis, I performed an OLS regression with clustered standard errors at the country level on lagged explanatory variables with PIP greater than 0.5(see Table 13-A, 14-A) as a robustness check following Vlach (2016) who mentioned: "Following the rule of thumb suggested by Jeffreys (1961) and applied, among others, by Eicher et al. (2012), PIP lower than 0.5 is considered as evidence against an effect, while PIP exceeding 0.5 is considered as evidence for an effect ."(p. 35).

Chapter 5 RESULTS AND DISCUSSION

The results of the BMA model analysis with and without correction for endogeneity are presented in this chapter. The study has partitioned both the results and the robustness test into two models showing the varying effect of the relationship between health-care expenditure and economic growth in developed and developing countries. According to Hespanhol, Vallio, Costa, and Saragiotto (2019) :

> the outcome of a Bayesian analysis is the posterior distribution. The posterior distribution can be summarized by measures of central tendency (e.g., median, mean or mode) and measures of uncertainty (e.g., variance or standard deviation). One of the most used measures of uncertainty in Bayesian inference is the Bayesian credible interval (CrI). (p. 297-298)

Hence, the results of "Bayesian models are interpreted within credible intervals, and the relationship between explanatory variables and dependent variables is understood through the signs of the posterior summaries (mean and 95% credible intervals). The sign of the posterior summary should be all positive or negative to achieve the association between the explanatory variable and dependent variable" (Byaro and Musonda, 2017,p. 79). Therefore if the credible interval of an explanatory variable does not include zero (0), the study considers it important and is marked in bold in model summary tables(See Table 5 and Table 7)

5.1 Results and discussion - Model 1 and 2, excluding demographics (population growth %)

Here the study presents the results of the BMA analysis excluding demographics (population change %). Model 1 represents the model with taking lagged variables, whereas Model 2 represents the model with lagged variables. Public β_1 and Private health expenditure β_2 are fixed in both the models as these are the primary variables of interest in this study.

Control variables used in the study as discussed above are Life expectancy at birth years, Population 0-15 years % of total population, Population, 65+ years, % of total population and are represented by, $\gamma_1 - \gamma_5$ in the model.

Table 5:Final model summary of the posterior distribution for Model (1) and Model (2) in developing and developed countries

Variables / Lag 1 variables	Developing Countries		Developed Countries	
	Model 1(Without Lag)	Model 2 (With Lag)	Model 1(Without Lag)	Model 2 (With Lag)
	Posterior Mean	Posterior Mean	Posterior Mean	Posterior Mean
	(95% Credible Interval)	(95% Credible Interval)	(95% Credible Interval)	(95% Credible Interval)
Public health expenditure	**-1.3327**	**-1.1911**	**-1.0677**	-0.4679
	-1.8402 -0.9436	**-1.6127 -0.8488**	**-1.7198 -0.4151**	-1.5634 0.4808
Private health expenditure	0.0619	**0.4267**	0.0462	**1.7763**
	-0.3637 0.4496	**0.0721 0.8247**	-0.4646 0.5530	**0.9637 2.7869**
Export	**0.3048**	0.0014	**-4.5707**	**-6.9983**
	0.3146 1.4848	-0.1318 0.2818	**-6.4541 -2.8236**	**-8.4734 -4.6273**
Import	**1.1629**	**0.8076**	**5.4643**	-0.3039
	0.9921 2.1354	**0.4348 1.2033**	**3.4632 7.6647**	-4.8658 0.0791
Inflation	**-0.0296**	-0.0006	0.0017	**-0.2772**
	-0.0409 -0.0166	-0.0229 0.0011	-0.0387 0.1226	**-0.3569 -0.1980**
Life Expectancy	**-0.0246**	**-0.0067**	0.0014	**0.8800**
	-0.1016 -0.0266	**-0.0845 -0.0122**	-0.0579 0.1379	**0.6140 1.1452**
Population (0-15)	**0.0081**	**0.0015**	0.0051	**-0.8929**
	0.0198 0.0838	**0.0058 0.0649**	-0.0314 0.1883	**-1.1403 -0.6623**
Population (65+)	**0.1857**	**0.1062**	0.0120	0.0419
	0.1473 0.5269	**0.0956 0.4590**	-0.0907 0.5523	-0.1030 1.1867

Bold: *implies important variables.*

Table 5 shows that there is a substantial improvement between the models with lag compared to the models without lag. For developing countries, private health expenditures do not have robust effects on economic growth for Model without lag (Model 1), while it does have robust effects for the Model with lag (Model 2). In contrast, Model 1 shows that public health expenditure has robust effects on economic growth in both developed and developing countries. However, public health expenditure is not robust in Model (2) for the developed countries.

There are more important variables in Model (2) compared to Model (1). The results of Model (2) are more acceptable as most of the control variables are robust for developed and developing countries. Control variables used in Model (2), show that import has the most robust effect, among all important control variables in the model, on economic growth in developing countries and is positive, meaning as import increase, so does economic growth (GDP) in those countries. Contrary to developing countries, developed countries show an inverse effect of import on economic growth. In developed countries, export has the most robust effect on

economic growth among the important control variables and this relationship is inverse meaning as export increase, economic growth is impacted negatively

Table 6:Comparison between the effect of public and private health expenditure on the growth rate for developed and developing countries using Model (2)

Countries	Public Health Expenditure	Private Health Expenditure
	Posterior Mean (95% Credible Interval)	Posterior Mean (95% Credible Interval)
Developed	-0.443 (-1.563, 0.481)	1.934 (0.964, 2.787)
Developing	-1.123 (-1.613, -0.849)	0.36 (0.072, 0.825)
Developed - Developing	0.679 (-1.106, 2.464)	1.573 (0.405,2.742)

Table 6 shows the results of the main variables of interest in the study. For public health expenditure, the absolute effect on economic growth is larger in developed countries compared to developing countries, and likewise, for private health expenditure, the absolute effect on economic growth for developed countries is bigger than developing countries.

Furthermore, the 95% credible interval of (Developed – Developing) implies there is no variation between public health expenditure on economic growth for developed and developing countries (interval includes zero). There is variation between private health expenditure on economic growth for developed and developing countries (interval does not include zero), meaning the effect of private health expenditure on economic growth for developed and developing countries is positive and variating. The effect of private health expenditure on economic growth is positive and larger in developed countries when compared to developing countries. Contrary to private health expenditure, public health expenditure has a negative effect on both developed and developing countries, and this effect has no variation in either set of countries.

Figures 4 and 5 capture the average model size and convergence plots. The average model size for developed countries is 10, while developing is 22 for Model 1. In contrast, for Model 2, the average model size for developed countries is 29 while developing is 19.

Figure 4:Model size plot for developing countries (Model 2)

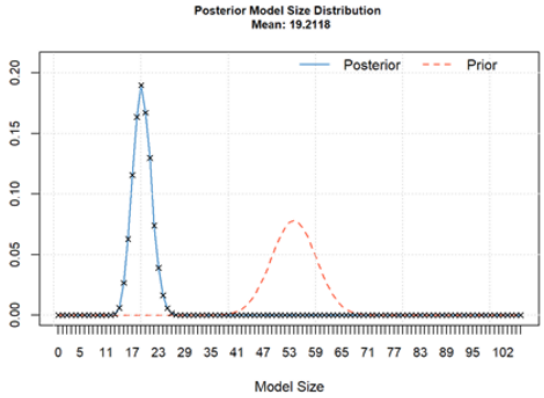
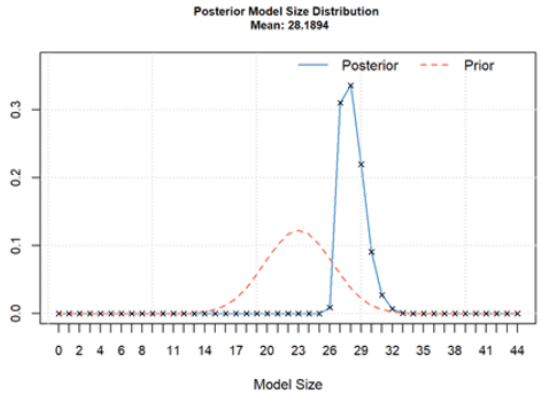


Figure 5:Model size plot for developed countries (Model 2)



Model uncertainty results were captured using the plot of the posterior inclusion model probabilities in Figure 6 – 7. In Figure 6 and Figure 7, "the blue color corresponds to a positive coefficient, red to a negative coefficient, and white to non-inclusion (a zero coefficient). On the horizontal axis, it shows the best models, scaled by their Posterior Model Probabilities (PMPs)" (Zeugner, 2011,6).

Figure 6:Cumulative model probability plot for developing countries (Model 2)

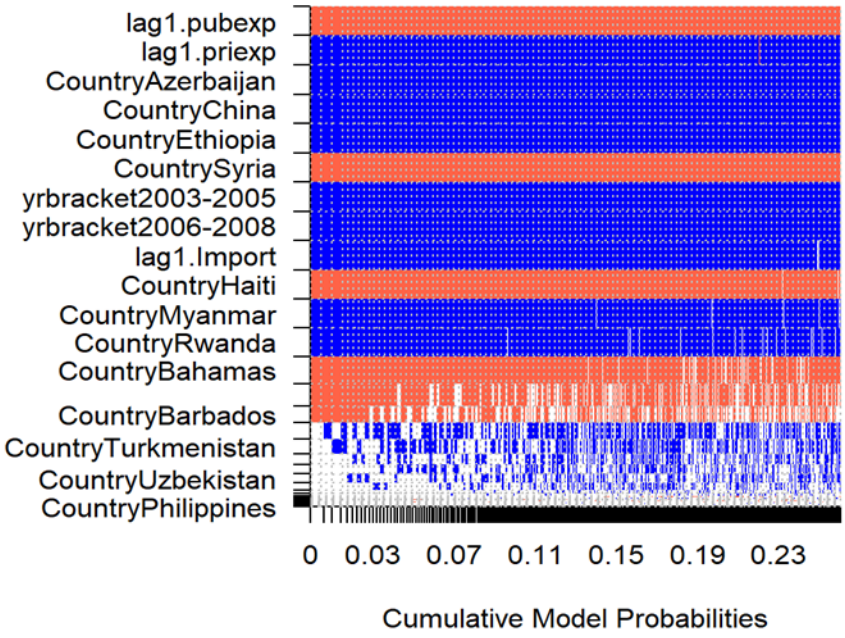


Figure 6 plot shows the best Model with most mass for developing countries. The plot shows that the best Model with most mass includes public health expenditure and private health expenditure when the two variables were held fixed in the models. Public health expenditure is included in virtually all model mass, and unanimously with a negative coefficient. In contrast, Private health expenditure is also included in all models, and its coefficient sign is mostly positive.

Figure 7:Cumulative model probability plot for developed countries (Model 2)

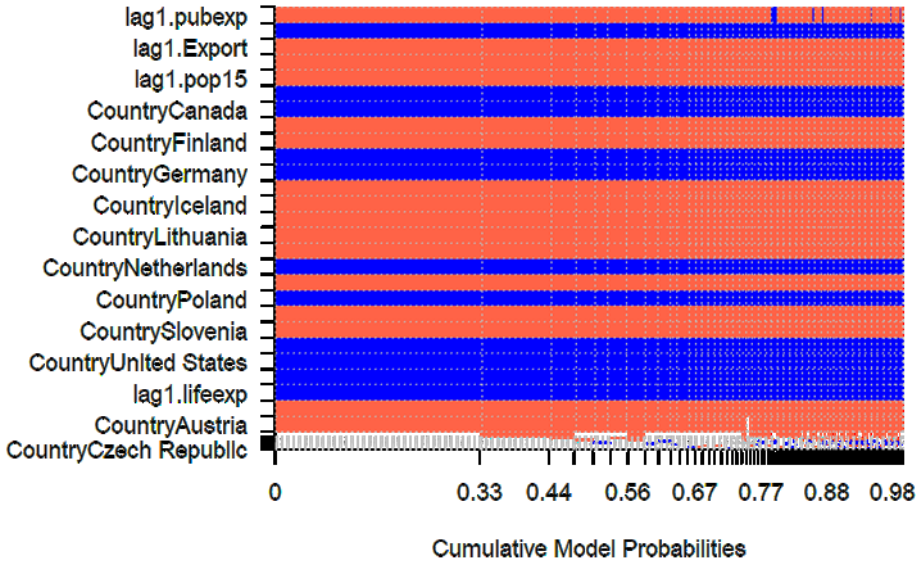


Figure 7 plot shows that the best Model with most mass includes both Public health expenditure and private health expenditure unanimously when the two variables are held fixed in the models for developed countries. However, Public health expenditure is included with a negative coefficient sign in most of the model mass, whereas Private health expenditure is included unanimously with a positive coefficient sign.

5.2 Testing- Model 1 and 2 including demographics (population growth %)

Below are the results from the sensitivity analysis to check the robustness of the model, which involved removing Life expectancy at birth, years, Population 0-15 years % of total population, Population, 65+ years, % of total population and including demographics $Demographics_{it}$ (population growth %). This test serves to prove the robustness of the model when different variables that affect economic growth are included or excluded.

I will focus predominantly on the interpretation of results of the main health expenditure variables, as the other control variables' PIPs remain widely similar to model specification without demographics $Demographics_{it}$..

Table 7:Final model summary of the posterior distribution for Model (1) and Model (2) in developing and developed countries

Variables / Lag 1 variables	Developing Countries		Developed Countries	
	Model 1(Without Lag)	Model 2(With Lag)	Model 1(Without Lag)	Model 2(With Lag)
	Posterior Mean	Posterior Mean	Posterior Mean	Posterior Mean
	(95% Credible Interval)	(95% Credible Interval)	(95% Credible Interval)	(95% Credible Interval)
Public health expenditure	**-1.4648** **-1.9148 -1.0266**	**-1.2085** **-1.6148 -0.8528**	**-1.0620** **-1.7190 -0.4137**	-0.6733 -1.4410 0.1020
Private health expenditure	0.0867 -0.2505 0.4734	**0.4233** **0.0592 0.8115**	0.0490 -0.4623 0.5560	0.5410 -0.0595 1.0829
Export	**0.0377** **0.0263 1.3254**	0.0009 -0.0897 0.4277	**-4.5737** **-6.4469 -2.8312**	**-0.7242** **-3.9790 -0.2579**
Import	**1.5100** **0.9667 2.1727**	**0.7960** **0.4364 1.1862**	**5.4570** **3.4624 7.6600**	0.2718 -1.0518 4.2746
Inflation	**-0.0279** **-0.0393 -0.0157**	-0.0004 -0.0228 0.0011	0.0019 -0.0388 0.1226	**-0.1727** **-0.2674 -0.0890**
Demographics	**0.2891** **0.1632 0.5275**	**0.1037** **0.0935 0.4582**	0.0159 -0.0877 0.5559	0.0073 -0.1554 0.5318

Bold: *implies important variables.*

Table 7 shows that there is no substantial improvement between the models with lag compared to the models without lag. For developing countries, private health expenditure does not have robust effects on economic growth for Model (1), while it is robust in Model (2). In contrast, Model (1) shows that public health expenditure has robust effects on economic growth in both developed and developing countries.

There are more important variables in Model (1) compared to Model (2). The results of Model 1 are hence more acceptable as most of the control variables are robust for developing countries, while some of the control variables are robust for developed countries. Control variables used in Model (1), show that import has the most robust effect, among all-important control variables in the model on economic growth in developing countries, and is positive, which is similar to the model specification without demographics. The effect of import on economic growth is even more robust in developed countries and is positive.

Table 8:Comparison between the effect of public and private health expenditure on the growth rate for developed and developing countries using Model (1)

Countries	Public Health Expenditure	Private Health Expenditure
	Posterior Mean (95% Credible Interval)	Posterior Mean (95% Credible Interval)
Developed	-1.425 (-1.719, -0.414)	0.089 (-0.462, 0.556)
Developing	-1.502 (-1.915, -1.027)	0.017 (-0.251, 0.473)
Developed - Developing	0.076 (-0.331, 0.484)	0.072 (0.006, 0.139)

Table 8 shows the results of the main variables of interest in the study that is being tested. For public health expenditure, the absolute effect on economic growth is larger in developing countries when compared to developed countries. However, for Private health expenditure, the absolute effect is larger in developed countries when compared to developing countries.

Furthermore, the 95% credible interval of (Developed – Developing) implies there is no variation between public health expenditure on economic growth for developed and developing countries (interval include zero). However, there is a variation between private health expenditure on economic growth for developed and developing countries (interval does not include zero).

Figures 8 and 9 capture the average model size and convergence plots. The average model size for developed countries is 10 while developing is 22 for Model 1. In contrast, for Model 2, the average model size for developed countries is 11 while developing is 19.

Figure 8:Model size plot for developing countries (Testing: Model 1)

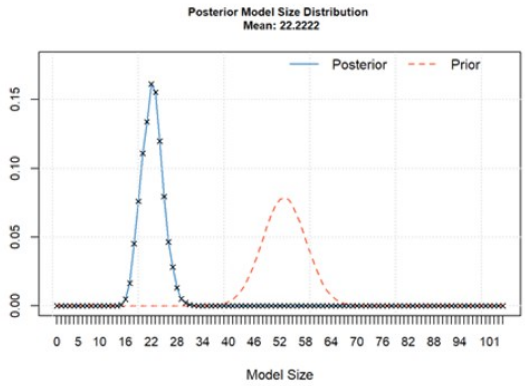
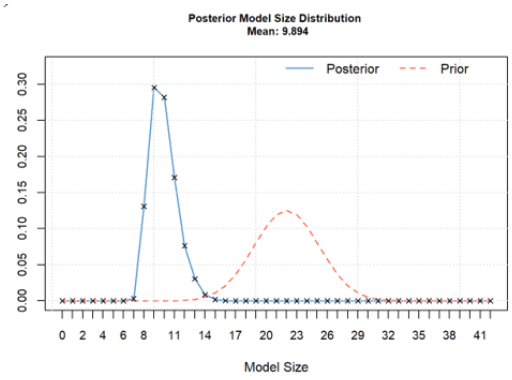


Figure 9:Model size plot for developed countries (Testing: Model 1)



Model uncertainty results were captured using the plot of the posterior inclusion model probabilities in Figure 10-11. In Figure 10-11, “the blue color corresponds to a positive coefficient, red to a negative coefficient, and white to non-inclusion (a zero coefficient). On the horizontal axis, it shows the best models, scaled by their PMPs” (Zeugner, 2011,6).

Figure 10:Cumulative model probability plot for developed countries (Testing: Model 1)

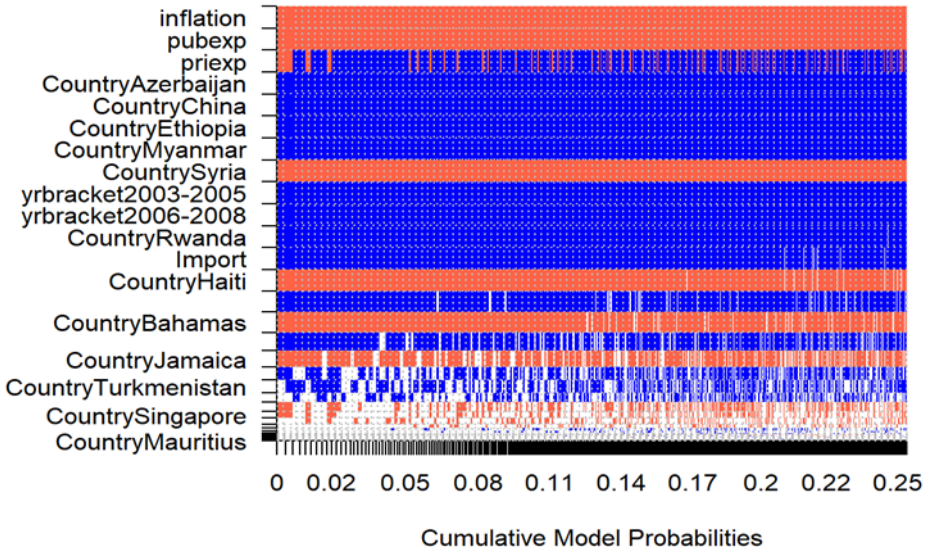


Figure 10 plot that the best Model with most mass includes Public health expenditure, and it always includes private health expenditure when the two variables were held fixed in the models for developing countries. Public health expenditure is included in virtually all model mass, and unanimously with a negative coefficient. Similarly, Private health expenditure is included in all models, and its coefficient sign is mostly positive, but it changes according to the model.

Figure 11:Cumulative model probability plot for developed countries (Testing: Model 1)

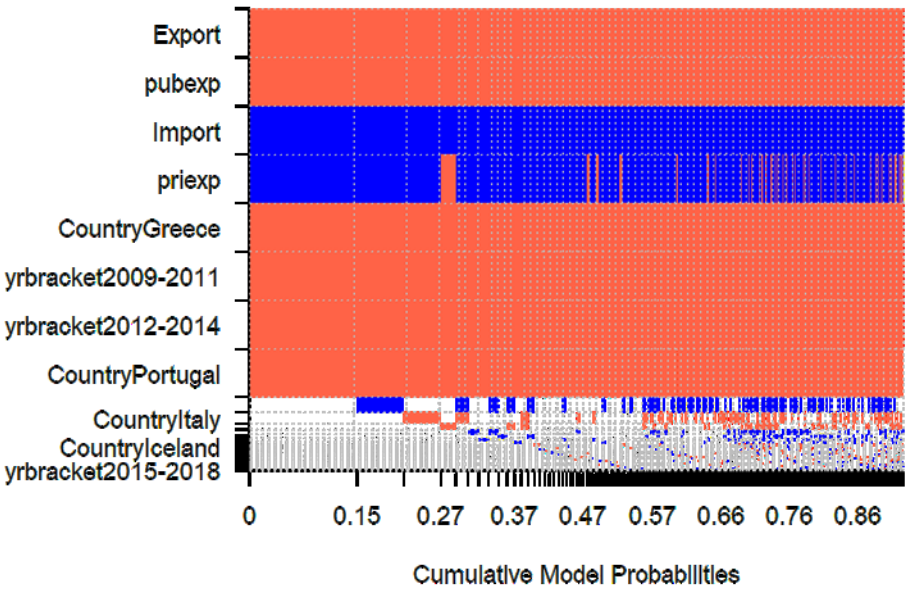


Figure 11 plot for developed countries shows that the best Model with most mass includes Public health expenditure while it also does always include private health expenditure when the two variables were held fixed in the models. I found out that Public health expenditure is included in virtually all model mass, and unanimously with a negative coefficient. Also, Private health expenditure is included in all models, and its coefficient sign is mostly positive, but it changes according to the model like in developing countries(Figure 10)

The results of the model with demographics indicate a similar relationship between health-care expenditure and economic growth in developed and developing countries and are consistent with the model without demographics. While there is no variation between public health expenditure on economic growth in developed and developing countries and coefficients indicate that this relationship is negative, there is a variation for private health expenditure's effect on economic growth in developed and developing countries.

5.3 Testing- Ordinary Least Squares

This section explores the results from the OLS regression analysis that I performed as a robustness check on lagged explanatory variables with PIP above 0.5(see Table 13-A , 14-A) by clustering standard errors at the country level. Since the objective of the study is to understand the variation in effects of public and private health expenditure on economic growth in developed and developing countries, I have segregated the results again into developed and developing countries.

Table 9:Results from Pooled OLS regression analysis on lagged variables with PIP above 0.5 in Developing countries (Std.Error clustered at country level)

Response Variables: Economic growth	Coef.	Std. Error	p- value
Constant	8.26933	4.95273	0.095175
lag1.pubexp	-1.12805	0.38336	0.0033
lag1.priexp	0.5413	0.28341	0.056307
lag1.Export	-0.03187	0.13077	0.80751
lag1.Import	0.7231	0.37991	0.057164
lag1.inflation	-0.01411	0.00555	0.011122
lag1.lifeexp	-0.0808	0.04087	0.048209
lag1.pop15	-0.0639	0.06615	0.334206
lag1.pop65	0.44564	0.39747	0.26237
yrbracket2003-2005	1.81593	0.48642	0.000195

yrbracket2006-2008	2.17592	0.54842	7.56E-05
yrbracket2009-2011	0.1203	0.68825	0.861264
yrbracket2012-2014	0.01545	0.72296	0.982952
yrbracket2015-2018	-0.41871	0.67003	0.53211

Table 9 reports the results from the pooled OLS regression analysis in Developing countries. Almost all variables have the same corresponding sign of regression coefficients as from the BMA estimation except Export and Population 0-15 years. While the magnitude of the coefficients of the main variables of this study (health expenditure) remain more or less robust, the coefficients of the control variables vary. In developing countries, the effect of public health and private health expenditure on economic growth is significant at 5% and 10% significance levels.

Public health expenditure has a significant negative effect on economic growth; private health expenditure and import show a positive effect. Also, inflation, life expectancy, and population, 65+ years have a significant negative effect on economic growth.

Table 10:Results from Pooled OLS regression analysis on lagged variables with PIP above 0.5 in Developed countries (Std.Error clustered at country level)

Response Variables: Economic growth	Coef.	Std. Error	p- value
Constant	46.5276	9.5588	1.5E-06
lag1.pubexp	0.46057	0.40157	0.2519
lag1.priexp	0.0675	0.27998	0.80959
lag1.Export	0.06718	1.15458	0.95362
lag1.Import	-1.16372	1.31844	0.3778
lag1.inflation	-0.18791	0.12642	0.13773
lag1.lifeexp	-0.45998	0.1038	1.1E-05
lag1.pop15	-0.03776	0.08387	0.65269
lag1.pop65	1.1828	0.42252	0.0053
yrbracket2003-2005	0.8731	0.15702	4.2E-08
yrbracket2006-2008	1.42977	0.30084	2.56E-06
yrbracket2009-2011	-2.11067	0.49377	2.2E-05
yrbracket2012-2014	0.01359	0.27364	0.96041
yrbracket2015-2018	1.70569	0.33609	5.3E-07

Table 10, on the other hand, reports the results from the analysis in Developed countries. The effect of public health and private health expenditure on economic is not significant at either 5% or 10% significant levels. Only life expectancy has a significant negative effect on economic growth. The signs and the magnitude of most of the regression coefficients are not robust to the BMA estimation.

The estimation above shows that the analysis of health expenditure and economic growth using OLS does not yield any reliable results.

5.4 Summary and Discussion

Through this subchapter, I try to establish the relationship between health expenditure, public or private, and economic growth in developed and developing countries.

PIP or Posterior inclusion probability indicates the "probability of a given regressor belonging into the correct model of long-term economic growth" (Horvath, 2011,p 2670) and is a measure of the importance of the regressor that explains economic growth. The coefficients' sign and value reflect the strength and nature of the relationship the covariate has with the response or dependent variable. The coefficients' posterior standard deviation (Post SD) further reveals the sign or nature of this relationship. The coefficients' sign can also be understood through the value in column 'Cond.Pos.Sign', which is the ratio of how often its' expected values were positive conditional on inclusion and which, when closer to 0 reflects a negative relationship.

As discussed and understood from the BMA results in the previous subchapter 5.1 (See Table 5), we choose the Model with lag (Model 2) as there are more robust variables when compared to Model without lag (Model 1). The summary statistics of the main variables and control variables in the Model with lag (Model 2) are shown in two tables below. Testing for the robustness of the model reveals that the results of the sensitivity analysis are more or less consistent with the main results of the study.

Table 11:Summary of PIP for developing countries excluding demographics (Model 2)

Developing countries	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
lag1.pubexp	1.0000	-1.1911	0.2330	0.0000	1

lag1.priexp	1.0000	0.4267	0.2229	0.9896	2
lag1.Export	0.0186	0.0014	0.0215	0.8953	3
lag1.Import	0.9616	0.8076	0.2715	1.0000	4
lag1.inflation	0.0484	-0.0006	0.0028	0.0000	5
lag1.lifeexp	0.1385	-0.0067	0.0184	0.0000	6
lag1.pop15	0.0478	0.0015	0.0081	0.9690	7
lag1.pop65	0.3747	0.1062	0.1504	1.0000	8

Table 11 infers that 100% of all posterior model mass includes public and private health expenditure in developing countries. Import has a PIP of 96% while the rest of the variables do not seem to matter much as their PIP and coefficients are very low.

Table 12:Summary of PIP for developed countries excluding demographics (Model 2)

Developed countries	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
lag1.pubexp	1	-0.4679	0.5266	0.0251	1
lag1.priexp	1	1.7763	0.4709	1	2
lag1.Export	1	-6.9983	0.9268	0	3
lag1.Import	0.1304	-0.3039	0.9068	0	4
lag1.inflation	1	-0.2772	0.0406	0	5
lag1.lifeexp	0.9998	0.88	0.1382	1	6
lag1.pop15	1	-0.8929	0.1234	0	7
lag1.pop65	0.0787	0.0419	0.1714	1	8

In contrast, Table 12 infers that 100% of all posterior model mass includes public and private health expenditure, export, inflation, life expectancy, and population age below 15 years while the rest of the variables do not seem to matter as their PIP is very low.

The results from the modeling help us understand the relationship between health expenditure and economic growth. Firstly, Table 6. from sub-chapter 5.1(Results) shows us that there is no variation in the effect of public health expenditure in developed countries and developing countries as the interval includes zero. This relationship is negative and can be inferred from the signs of the coefficients in both developed and developing countries as well as the coefficients' posterior standard deviations. Furthermore, as discussed above, the Cond.Post.Sign indicates that this relationship is indeed negative as well. Most studies that

examine Public or government health expenditure and its effect on economic growth have found the relationship to be either negative or insignificant. The negative relationship of public health expenditure with economic growth in this study can be understood in different ways. Developing countries often have the urge to provide health-care to its citizens at minimal cost so that the greatest proportion of the population is included. However, there are several downsides of doing so; such countries often end up spending more than the health sector can contribute towards economic growth due to recurring disease, skilled human resource constraints, poor opportunity to increase cost, among other constraints. In developed countries, public health expenditure has a negative effect on economic growth too. This negative effect on economic growth in both developed and developing countries could also be caused due to the growing proportion of the health-care expenditures in the GDP. This could be explained by inefficient allocations of the Government budget towards different sectors of the economy. Furthermore, this negative relationship could also be caused by inefficient health expenditure allocations. Quality and innovation are extremely important determinants of economic growth. A healthy population alone does not ensure better productivity. A health population also requires sound infrastructure to work, live, and recreate to drive productivity. Additionally, developed countries have a higher share of population above 65 years, and their health treatments put significantly more burden on the public health sector. Increased longevity and non-participation in the working capital adds to this burden.

Contrary to the above, Table 6. from sub-chapter 5.2(Results) shows that there is variation in the effect of private health expenditure on economic growth in developed and developing countries. The effect is positive and is larger in developed countries when compared to developing countries. The Cond.Post.Sign indicates this positive relationship. Most developed countries already have an established public health sector. However, the private health sector is often considered a luxury on top of this established public sector. The positive effect of private health expenditure can be explained by several reasons. One such reason could be efficiency. The privatization of various sectors of the economy have been studied, and many studies by authors such as Shi and Sun (2016) found increased productivity and profitability. Private sectors are often characterized by higher costs and hence higher expenditures due to their voluntary nature. These are some possible explanations for the positive relationship between private health expenditure and economic growth in developing and developed countries. However, one must note that the effect of private health expenditure in developing countries is far lesser than developed countries on economic growth.

Hence, we reject both the first and second null hypothesis that the impact of both public and private health expenditure varies among countries based on their level of development and can conclude that while the impact of public health expenditure on economic growth does not vary among developed and developing countries, the impact of private health expenditure varies and is larger in developed countries than developing countries. These results are also robust to the sensitivity analysis in subchapter 5.2(Testing). The results are not robust to the sensitivity analysis in subchapter 5.3, which uses pooled OLS regression on lagged explanatory variables with PIP over 0.5 while having the standard errors clustered at the country level.

5.5 Limitations

While the dataset comprising of 126 countries used in this study provides a very comprehensive understanding of the relationship between health-care expenditure and economic growth, there are certain limitations to the study and must be further addressed or improved. First is the selection of control variables. Despite the sensitivity analysis to check the robustness of the model, due to the availability of data for such a vast number of countries, I have been restricted to using only certain control variables for which data was available and had been used in similar literature. Second is the panel length, which is 19 years. Again, here I was restricted to data that was available and more observations would help improve the study. Third, data quality is one of the biggest contributors to an effective analysis. Different countries have different methodologies of collecting and classifying data. This poses as a limiting factor, but there is very little room to get around this problem. Fourth, endogeneity is a big issue and an inherent problem in growth studies. I have used lagged variables in the model to mitigate or overcome this issue following previous studies; however, there is no way to eliminate endogeneity.

Future research should address these limitations, but I believe that the analysis provides a very interesting investigation into the dynamics of the relationship between health-care expenditure and economic growth in different countries.

Chapter 6 CONCLUSION

Through this study, I have reinvestigated the relationship between health-care expenditure and economic growth across 94 developing and 32 developed economies from the years 2000 to 2019. I have done so by grouping and averaging 19 years of data into 5-time brackets of 3 years and 1-time bracket of 4 years to reduces the effects of business cycles and mitigate measurement error (Arin, Braunfels and Doppelhofer, 2015). Additionally, to mitigate endogeneity issues, I used lagged variables in the model to compare the results with and without lag.

I have first explored why BMA is an appropriate technique for exploring the relationship between health expenditure and economic growth and then analyzed and interpreted the nature and degree of this relationship. Analysis of data reveals that there is no variation in the relationship between public health expenditure and economic growth in both developed and developing countries. The analysis also reveals that this relationship between public health expenditure and economic growth is most certainly negative. Contrary to public health expenditure, private health expenditure shows a variation in effects on economic growth between developed and developing countries. Although positive, the effect of private health expenditure on economic growth varies and is significantly larger in developed countries when compared to developing countries.

I tested the result from BMA for robustness by doing two sensitivity analyses. The first analysis involved removing and adding control variables in the BMA model (see sub-chapter 5.2). I found the results from this analysis to be robust to the BMA results. I conducted a second sensitivity analysis by running an OLS regression on the lagged explanatory variables with PIP greater than 0.5(see Table 13-A, 14-A) clustering standard errors at the country level. While the signs and magnitude of the main coefficients from the OLS regression were robust to the BMA results for developing countries, the results from the estimation for developed countries were not robust to the BMA estimation. Hence, I found the results of the OLS regression not to yield any reliable results, thereby further confirming the need and advantage of using BMA in estimating the relationship between health expenditure and economic growth.

The study recommends that solely concentrating on investing in the public health sector does not guarantee positive economic growth. On the other hand, private health expenditure, which is represented by the private health sector, shows a positive effect on both developed

and developing countries. The study discusses in brief, how privatization of sectors often leads to better productivity and profitability due to efficiency gains and hence has a positive effect on economic growth. There are other factors that affect economic growth, and hence efficient budgetary allocation is crucial when policies are formulated.

This study has contributed to the existing literature on health-care expenditure and economic growth but has differentiated in many ways. First, it pivots from conventional methods such as DOLS, FMOLS,OLS (Piabuo and Tieguhongl, 2017) used in the existing literature to estimate this relationship. The study uses model averaging technique to address uncertainty, which is common in growth studies. Next, it uses a widespread geographical area of 126 developed and developing countries which other authors such as Öztürk and Topcu (2014) who used G8 countries, Dieleman (2003) who used EU, Byaro and Musonda (2017) who used Tanzania limit. Furthermore, while most studies use only public health expenditure or private health expenditure separately in growth studies, this study includes both public and private health expenditure together to understand the varying effects on both developed and developing countries. Moreover, the study further departs from existing literature by using different model specifications, lagged variables to address endogeneity and robustness checks.

Future studies could include factors such as the breakdown of public and private health expenditure to understand further the underlying effect of factors that determine health expenditure and its effect on economic growth.

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APPENDIX A

Table 13-A-Summary of regression mode for Model 2(sub-chapter 5.1) with developing countries.

	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
lag1.pubexp	1.0000	-1.1911	0.2330	0	1
lag1.priexp	1.0000	0.4267	0.2229	1	2
lag1.Export	0.0186	0.0014	0.0215	1	3
lag1.Import	0.9616	0.8076	0.2715	1	4
lag1.inflation	0.0484	-0.0006	0.0028	0	5
lag1.lifeexp	0.1385	-0.0067	0.0184	0	6
lag1.pop15	0.0478	0.0015	0.0081	1	7
lag1.pop65	0.3747	0.1062	0.1504	1	8
CountryAngola	0.0279	0.0420	0.3053	1	9
CountryArgentina	0.0211	-0.0243	0.2314	0	10
CountryArmenia	0.0572	0.1265	0.5794	1	11
CountryAzerbaijan	1.0000	5.4250	1.0468	1	12
CountryBahamas	0.8217	-2.9887	1.6722	0	13
CountryBarbados	0.4356	-1.3975	1.7348	0	14
CountryBelarus	0.0090	0.0091	0.1399	1	15
CountryBelize	0.0141	-0.0171	0.1900	0	16
CountryBenin	0.0222	-0.0064	0.1600	0	17
CountryBolivia	0.0134	0.0111	0.1526	1	18
CountryBotswana	0.0113	0.0032	0.1131	1	19
CountryBrazil	0.0072	-0.0074	0.1283	0	20
CountryBulgaria	0.0093	-0.0027	0.1073	0	21
CountryBurkina Faso	0.0701	0.1510	0.6152	1	22
CountryBurundi	0.0160	-0.0155	0.1833	0	23
CountryCambodia	0.2559	0.6817	1.2730	1	24
CountryCameroon	0.0101	-0.0124	0.1625	0	25
CountryChad	0.0911	0.2097	0.7335	1	26
CountryChile	0.0061	0.0019	0.0831	1	27
CountryChina	1.0000	5.1172	1.0619	1	28
CountryColombia	0.0143	0.0195	0.2045	1	29
CountryCongo, Democratic Republic of the	0.0098	-0.0012	0.1050	0	30
CountryCosta Rica	0.0148	0.0138	0.1703	1	31
CountryCote D'Ivoire	0.0201	-0.0346	0.2847	0	32
CountryDjibouti	0.4187	1.3096	1.6926	1	33
CountryDominican Republic	0.0131	0.0102	0.1457	1	34
CountryEcuador	0.0128	-0.0041	0.1237	0	35
CountryEgypt	0.0050	-0.0018	0.0766	0	36
CountryEl Salvador	0.0368	-0.0598	0.3641	0	37
CountryEquatorial Guinea	0.0582	0.1426	0.6445	1	38
CountryEthiopia	0.9933	4.4779	1.0831	1	39
CountryFiji	0.0345	-0.0668	0.4082	0	40
CountryGabon	0.1002	-0.2279	0.7570	0	41
CountryGambia	0.0473	-0.0888	0.4597	0	42
CountryGeorgia	0.0126	0.0031	0.1310	1	43
CountryGuatemala	0.0177	-0.0241	0.2250	0	44
CountryGuinea	0.0119	-0.0095	0.1415	0	45
CountryGuinea-Bissau	0.0117	-0.0113	0.1548	0	46
CountryHaiti	0.9406	-3.8021	1.3874	0	47
CountryHonduras	0.0091	-0.0049	0.1094	0	48
CountryHong Kong	0.0611	-0.1256	0.5635	0	49
CountryIndia	0.0387	0.0817	0.4589	1	50

CountryIndonesia	0.0189	0.0122	0.1667	1	51
CountryIran	0.0166	-0.0160	0.1813	0	52
CountryIsrael	0.0201	-0.0018	0.1475	0	53
CountryJamaica	0.6295	-2.0977	1.8059	0	54
CountryJordan	0.0078	0.0010	0.0970	1	55
CountryKazakhstan	0.1608	0.4178	1.0390	1	56
CountryKuwait	0.0194	-0.0085	0.1803	0	57
CountryKyrgyzstan	0.0077	0.0011	0.0909	1	58
CountryLebanon	0.0195	-0.0233	0.2215	0	59
CountryMadagascar	0.0592	-0.1007	0.4727	0	60
CountryMalawi	0.0135	0.0146	0.1752	1	61
CountryMalaysia	0.0187	0.0181	0.2025	1	62
CountryMauritania	0.1956	0.5478	1.2145	1	63
CountryMauritius	0.0061	-0.0043	0.1005	0	64
CountryMexico	0.0806	-0.1788	0.6717	0	65
CountryMicronesia	0.0936	-0.2731	0.9397	0	66
CountryMoldova	0.0137	0.0152	0.1813	1	67
CountryMongolia	0.5538	1.7977	1.7891	1	68
CountryMorocco	0.0102	-0.0036	0.1085	0	69
CountryMyanmar	0.9737	4.1328	1.2541	1	70
CountryNamibia	0.0111	-0.0008	0.1092	0	71
CountryNepal	0.0034	-0.0009	0.0618	0	72
CountryNicaragua	0.0155	-0.0080	0.1423	0	73
CountryPakistan	0.0064	-0.0025	0.0877	0	74
CountryParaguay	0.0045	-0.0014	0.0714	0	75
CountryPeru	0.0303	0.0488	0.3276	1	76
CountryPhilippines	0.0055	0.0016	0.0791	1	77
CountryRussia	0.0061	0.0005	0.0840	1	78
CountryRwanda	0.8954	3.4594	1.5360	1	79
CountrySaudi Arabia	0.0116	0.0095	0.1430	1	80
CountrySingapore	0.0208	-0.0271	0.2459	0	81
CountrySolomon Islands	0.3445	1.0499	1.5855	1	82
CountrySouth Africa	0.0548	-0.1067	0.5147	0	83
CountrySouth Korea	0.0069	-0.0012	0.0875	0	84
CountrySri Lanka	0.0191	0.0253	0.2298	1	85
CountrySuriname	0.0205	-0.0263	0.2355	0	86
CountrySyria	1.0000	-6.8471	1.0335	0	87
CountryTaiwan	0.0049	-0.0027	0.0814	0	88
CountryThailand	0.0089	0.0015	0.1071	1	89
CountryTogo	0.0118	-0.0126	0.1608	0	90
CountryTonga	0.0891	-0.2270	0.8054	0	91
CountryTrinidad & Tobago	0.0217	-0.0251	0.2258	0	92
CountryTunisia	0.0079	-0.0064	0.1150	0	93
CountryTurkey	0.0502	0.0984	0.4867	1	94
CountryTurkmenistan	0.5227	1.6738	1.7643	1	95
CountryUganda	0.0658	0.1343	0.5735	1	96
CountryUkraine	0.0263	-0.0414	0.3026	0	97
CountryUruguay	0.0138	-0.0022	0.1243	0	98
CountryUzbekistan	0.4008	1.1900	1.5905	1	99
CountryVietnam	0.1128	0.2643	0.8181	1	100
CountryZambia	0.0242	0.0315	0.2560	1	101
yrbracket2003-2005	1.0000	1.8793	0.2941	1	102
yrbracket2006-2008	1.0000	2.2919	0.2882	1	103
yrbracket2009-2011	0.0231	0.0083	0.0701	1	104
yrbracket2012-2014	0.0050	0.0010	0.0249	1	105
yrbracket2015-2018	0.0766	-0.0370	0.1489	0	106

Table 14-A-Summary of regression mode for Model 2(sub-chapter 5.1) with developed countries.

	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
lag1.pubexp	1	-0.4679	0.5266	0.025	1
lag1.priexp	1	1.7763	0.4709	1.000	2
lag1.Export	1	-6.9983	0.9268	0.000	3
lag1.Import	0.1304	-0.3039	0.9068	0.000	4
lag1.inflation	1	-0.2772	0.0406	0.000	5
lag1.lifeexp	0.9998	0.88	0.1382	1.000	6
lag1.pop15	1	-0.8929	0.1234	0.000	7
lag1.pop65	0.0787	0.0419	0.1714	1.000	8
CountryAustria	0.9765	-2.43	0.7344	0.000	9
CountryBelgium	1	4.0203	0.7315	1.000	10
CountryCanada	1	4.0554	0.704	1.000	11
CountryCzech Republic	0.0228	-0.0035	0.1011	0.065	12
CountryDenmark	0.0502	0.0301	0.1942	1.000	13
CountryEstonia	1	-9.2307	1.0799	0.000	14
CountryFinland	1	-4.973	0.7186	0.000	15
CountryFrance	1	6.7345	0.9313	1.000	16
CountryGermany	1	8.4283	0.9857	1.000	17
CountryGreece	1	-12.4457	1.2437	0.000	18
CountryHungary	0.0536	0.0549	0.2943	0.999	19
CountryIceland	1	-14.8705	1.6627	0.000	20
CountryItaly	0.0451	-0.0352	0.2185	0.000	21
CountryJapan	0.0279	0.005	0.1355	0.861	22
CountryLatvia	1	-10.3347	1.238	0.000	23
CountryLithuania	1	-5.223	0.8534	0.000	24
CountryLuxembourg	0.0303	-0.0305	0.2429	0.000	25
CountryMalta	1	-15.5769	1.8447	0.000	26
CountryNetherlands	1	6.8874	0.8899	1.000	27
CountryNew Zealand	1	-5.1808	0.8384	0.000	28
CountryNorway	0.0233	0.0045	0.114	0.851	29
CountryPoland	1	3.5272	0.6796	1.000	30
CountryPortugal	1	-9.738	1.0119	0.000	31
CountryRomania	0.0393	0.0331	0.2202	1.000	32
CountrySlovakia	0.0354	-0.0219	0.1649	0.000	33
CountrySlovenia	1	-11.8619	1.323	0.000	34
CountrySpain	0.1545	-0.2052	0.5511	0.000	35
CountrySweden	0.0334	0.0198	0.1533	1.000	36
CountrySwitzerland	0.3355	-0.6072	0.9591	0.000	37
CountryUnited Kingdom	1	8.8158	1.0558	1.000	38
CountryUnited States	1	14.2145	1.7169	1.000	39
yrbracket2003-2005	0.0465	0.0185	0.1087	1.000	40
yrbracket2006-2008	1	1.964	0.2976	1.000	41
yrbracket2009-2011	0.9999	-1.8843	0.2867	0.000	42
yrbracket2012-2014	0.0221	-0.0032	0.0601	0.079	43
yrbracket2015-2018	0.0841	0.0424	0.1712	1.000	44

Master's Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author:	**Vijayshekhar Nerva**	Supervisor:	**doc. PhDr. Tomáš Havránek Ph.D**
E-mail:		E-mail:	
Phone:			
Specialization:	MEF	Defense Planned:	2020

Proposed Topic:

Impact of Public Health-care expenditure on economic growth.

Motivation:

The advancement of economies generally leads to a better standard of living. As countries develop, their GDP per capita grows as well. It has been observed that a growing economy often leads to more development, and an essential part of this economic and social development is health.

Mushkin(1) suggested the role health-carer spending plays on stimulating economic growth.
The health-led growth hypothesis suggests that there is i a positive correlation between health expenditures and economic growth. As per the hypothesis, health is claimed to be a capital. Any investment in health increases income and, in turn, economic growth.

A healthy population drives productivity and higher income per capita, which in turn leads to higher economic development in a country. However, an unhealthy working population harms productivity and hence impacts overall economic development in that country. Hence, the government has a huge role to play while setting budgets to allocate enough proportion towards increasing health-care through adequate health-care expenditures.

There have been some studies done in the area of health expenditure and its impact on economic growth. However, not many studies comparing different sets of countries based on their level of development. Elmi, Z. M., & Sadeghi, S. (8) found that there were a bilateral causality and long-run relationship between economic growth and health spending. The findings indicated that income was an important factor across countries. Another aspect that is missing from most research papers is the varying impact that public health expenditure and private health expenditure have on the economy. Novignon, Olakojo & Nonvignon(2012) found that while both private and public sources of health-care expenditure had a significant impact on health, public health-care expenditure had a relatively more substantial impact in Sub-Saharan Africa. However, even they fail to show any relationship with how that would impact economic growth.
It is essential to understand which kind of health-care system a more significant impact on the economy has so that policymakers could re-focus on the system that has a more significant impact on an economy's growth.

Hypotheses:

1. Hypothesis: Public health-care expenditure's impacts on economic growth vary among countries based on their level of development.
2. Hypothesis: The impact of public health-care expenditure and private health-care expenditure on economic growth varies among countries based on their level of development.

3. Hypothesis: BMA is good at estimating the relationship between public health-care expenditures and economic growth.

Thesis Methodology:

Health expenditure can be seen as an indicator of economic development, and hence, it is expected that developed countries will have higher health expenditures. In this study, by dividing the countries into two groups, I would like to understand the different impacts health-care expenditures have in developing countries versus developed countries.

I want to analyse public health expenditures of 30 developed and 30 developing countries from 2000-2018 and would try to identify the impact of public health expenditure on economic growth through Bayesian Model Averaging.BMA has been successfully applied in empirical growth literature to overcome the sensitivity of results to different model specifications and assumptions.

I will use the World bank's database to gather data. Data analyzed shall not be limited to expenditure and GDP/GNP growth figures, but I shall also use Production index, Inflation, Demographics, Public spending, FDI, export, import, economic openness, trade restrictions, geography, foreign aid and other common factors that affect growth as control variables.

Expected Contribution:

Public health-care expenditure's impact on economic growth has been well researched. However, the variation or differentiation between developed and developing countries in terms of health expenditure impact on economic growth is something that has not been touched upon. Also, it is essential to understand the varying impacts of public and private health-care expenditure on economic growth.

Outline:

1. Introduction
2. Literature Review
3. Data
4. Methods
5. Results
6. Conclusion

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Vijayshekhar Nerva

Author

doc. PhDr. Tomáš Havránek, Ph.D.

Supervisor