Analyzing the Effects of National Income on Health Expenditures and Infant Mortality in Developed, Developing and In Transition Nations, 2005-2015

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Abstract

This study is a cross sectional analysis showing the relationship between a nation's wealth (Gross National Income per capita, GNI) and health expenditures. We decided to particularly focus on the effects of increased GNI on the health care expenditures as thus the effect of the expenditure on infant mortality rate for children under one year across nations. We also included a variable of developed, transition, or developing to analyze effects of development level of the nation as our research aims to compare the magnitudes of these relationships in different economies. Most past research has shown that there have been inverse relations between infant mortality and health care expenditure Subramaniam et al (2016). Thus our hypothesis was that developing countries would invest more in health care as the nation's income rose compared to in transition or developed nations. Based on data from the World Health Organization and World Bank, our model predicts that when GNI per capita increases by one dollar, a developing nation will increase health care spending per capita the most by by .10 (ten cents). The magnitude of the effect decreases as economies develop with in transition economies increasing health expenditure by .099 and developed economies by .097 respectively. Also based on previous research, we predicted an inverse relationship between health expenses per capita and infant mortality rates As anticipated, this inverse relationship was recognized in the data, however, surprisingly the effect was greatest in transition economies not developing as we hypothesized. Developing experience the second highest impact then developed with mortality dropping as health care expenditure increases.

Keywords: Gross National Income (GNI), Infant Mortality, Health Care Expenditure Per Capita

Introduction

Within the United States, it is known that those with higher levels of income tend to have better access to medical care and thus better overall levels of health. Access to quality health care is especially important to help one living longer, this is especially important at the beginning of one's life as early intervention in terms of medical treatment can greatly increase chances of survival for newborns. We wanted to see how does this play out on the international level with regards to the level of economic development of a nation. We specifically sought out to see how the level of a nation's wealth affect their health expenditures, especially in regards to the infant mortality rate in a nation. Does an increase in health expenditure automatically mean that infant mortality rates will decrease? We want to see whether there is a relation between health expenditure and infant mortality rate.

Background

According to Warren Thompson's Theory of Demographic Transition, there are four stages of population growth that a country must undergo. Stage one is representative of pre-industrial societies with both high birth and death rates. Stage two is representative of developing countries with falling deaths rates and high birth rates due to increased technological advancements and greater access to health services. Stage three and four is representative of in transition and developed countries with falling death and birth rates (Todaro and Smith 2003; Robinson 1981; National Academy of Sciences 1963), eventually reaching below replacement level birth and death rates. Despite its usefulness, Demographic Transition does not take into account the speed with which individual nations have gained economic growth due to changes in technology and social change (Subramaniam, Loganathan, Yerushalmi,Devadason and Majid

2016). Thus, this paper looks beyond examining infant mortality solely based on the stages of development but rather uses an approach based on Max Weber and Talcott Parsons' Modernization Theory, which suggests that increased economic wealth will bring about improvements in various social aspects of a nation such as health care services.

In 1993, Gbesemete and Jonsson in their study "*A comparison of empirical models on determinants of infant mortality: a cross-national study on Afri*ca" noticed an inverse relationship between a nation's infant mortality rates and it's level of income. Following which, studies have been conducted that imply a correlation between a countries per capita income and its infant mortality rate; these studies include Alves and Belluzzo (2004), Hakobyan et al. (2006) and Renton et al. (2012). Furthermore, endogenous growth models (Romer 1990) have highlighted the importance of health as an important determinant for economic growth and development (Mother 2005, WHO 2013). Essentially, stating that healthy human capital leads to increased productivity which eventually leads to higher national incomes overall (Piabuo & Tieguhong 2017). The importance of a nation possessing a healthy human capital has been emphasized time and time again (Riley 2012, Lucas 1998, Mankiw 1992) as this factor serves as an impetus for economic development. According to Selma Mushkin's article "*Health As An Investment"* (1962), the contribution of health expenditure on economic development issues from the health led growth hypothesis. Piabuo & Tieguhong (2017) go on to explain that Mushkin's hypothesis "considers health to be capital; therefore investments on health can lead to an increase in labor productivity" which eventually leads to increased incomes and "subsequent increase in the wellbeing of the population". This hypothesis is further emphasized by Bloom and Canning (2000) in their paper "*Population Health and Economic Growth"*, when they say

that when labor is healthy, there is an increased incentive to develop new skills due to the expectation of long term benefits; this spills over in the form of increased innovation. Conversely, when a nation's human capital or labor force is in poor health, there is an adverse effect on productivity, causing a development disparity between different regions of the world (Cole et al 2006). Fifty percent of divergence in economic growth between developing countries and developed countries is attributed to ill-health and low life expectancy (WHO 2013, Piabuo and Tieguhong 2017).

Along with income, Gbesemete and Jonsson (1993) also analyzed an "inverse relationship between infant mortality with access to health care". Subramaniam et al (2016) discusses how this relationship is further supported by "Hanmer et al. (2003) who had concluded that a greater number of doctors per people reduce infant mortality". In 1999, Zakir and Wunnava confirmed Gbesemete and Jonsson's finding by asserting that "the broader the access to health care, the lower will be the infant mortality in a cross-sectional analysis of 117 countries" (Subramaniam et al 2016). However, in spite of the general consensus that there is a positive relationship between national wealth and health care expenditures as well as a negative relationship between health care access and infant mortality, a study by Matsaganis (1992) found the opposite to be true. The author cited that Athens and Salonica, at the time considered to be prosperous cities with high access to education and health care services, experienced very high levels of infant mortality.

Few studies such as those of Dorling, Mitchell and Pearce (2007) as well as Ward and Viner (2017) are starting to systematically investigate the effect of national wealth on early-life mortality rates, outside of the Western or Developed nations. Earlier work conducted by

Newhouse 1992 focused on the effect of technological changes as a major determinant for increases in health care expenditures. This was empirically verified by Fuchs (1996), "whereby 85% of a sample of health economics scholars confirmed that technical change accounted for the rapid growth in health care expenditure in the country" (Piabuo and Tieguhong 2017).

Data and Model

The data collected and analyzed was gathered from the World Health Organization (WHO) as well as the World Bank. This was done due to ease of availability as well as the fact that the comprehensive dataset provided is up-to-date and is continuously revised. The estimates also identify global trends, allowing for cross nation and cross period comparisons. Using terminology from the United Nations (UN), economies are classified as developing, in transition, and developed. Countries are categorized into these three types using gross national income (GNI) per capita and other data. For the chosen research, we randomly selected 10 countries from each category, with an attempt to choose countries from different regions of the world. A country was not considered if the desired data was unavailable for the years in question. The years 2005-2015 were chosen based on data availability and at least 10 years of data to provide the most relevant information. Data was gathered for three variables: gross national income(GNI) per capita in current US dollar (GNI), current health expenditure per capita in current US dollar (hepc), and probability of infant mortality between birth and age one out of 1000 live births (infmor). To assess the relationship between these variables, we used a multiple linear regression model. To properly analyze the differences in results for different country data,

we used dummy variables to represent the three country categories with developing nations as the reference category.

Results

One of the relationships we tested was the effect of increases in GNI on different economies. Based on review of similar research, our hypothesis was that developing countries would invest more in health care as the nation's income rose compared to in transition or developed nations. One potential explanation for this observation is that as developing countries increase in wealth, they begin to build a health care infrastructure that may already be in place in more developed economies. Additionally, developing nations, in general, have higher infant mortality rates. Spending more on health care usually means investing in immunization programs that decrease infant mortality rates, which benefits both the people and the economy. Using the regression models, results shows that as economies develop, the effect of GNI on health care expenditure decreases. For example, our model predicts that when GNI per capita increases by one dollar, a developing nation will increase health care spending per capita by .10 (ten cents). The magnitude of the effect decreases as economies develop with in transition economies increasing health expenditure by .099 and developed economies by only .097.

Fig 1: reg hepc gni

$$Yi(hepc) = -117.4414 + (0.1004495)(gni)$$

hepc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gni	.1004495	.0016522	60.80	0.000	.0971992	.1036999
_cons	-117.4414	44.35807	-2.65	0.008	-204.7036	-30.17925

Fig 2: reg hepc trans gni Yi(hepc) = -73.70756 -85.57825(trans) + (0.0996787)(gni)

hepc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
trans	-85.57825	80.65547	-1.06	0.289	-244.2473	73.09083
gni	.0996787	.0018046	55.24	0.000	.0961285	.1032288
_cons	-73.70756	60.54601	-1.22	0.224	-192.8164	45.40129

Fig 3: reg hepc developed gni Yi(hepc) = -128.6265 + 202.9162(developed) + (0.096273)(gni)

hepc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
developed	202.9162	123.6029	1.64	0.102	-40.24097	446.0735
gni	.0969273	.0027054	35.83	0.000	.0916052	.1022494
_cons	-128.6265	44.7654	-2.87	0.004	-216.691	-40.56195

We also analyzed the effect of increases in health care expenditure on infant mortality rates. Since we concluded that there was a positive correlation between GNI and health care spending, the GNI was not included as a variable in the regression models. We predicted an inverse relationship between health expenses per capita and infant mortality rates since increases in spending on programs such as immunization should decrease the number of infant deaths. As anticipated, this inverse relationship was recognized in the data, however, the increases in health care expenditure had the most effect of infant mortality rates in transition economies. For every additional dollar spent on health per capita in transition nations, infant mortality decreased by .0056. Similarly, mortality dropped by .0044 in developing nations and only .0013 in developed nations.

Fig 4: reg infmor hepc Yi(infmor) = 27.38505 - 0.004448(hepc)

infmor	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
hepc	-.004448	.0004351	-10.22	0.000	-.005304	-.0035921
_cons	27.38505	1.177513	23.26	0.000	25.06862	29.70148

Fig 5: reg infmor trans hepc Yi(infmor) = 34.15356 -13.68822(trans) - 0.0056202(hepc)

infmor	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
trans	-13.68822	2.096028	-6.53	0.000	-17.81163	-9.564823
hepc	-.0056202	.0004474	-12.56	0.000	-.0065004	-.0047399
_cons	34.15356	1.518064	22.50	0.000	31.16715	37.13996

Fig6: reg infmor developed hepc Yi(infmor) = 29.15749-19.36319(developed)-

infmor	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
developed	-19.36319	3.12886	-6.19	0.000	-25.51843	-13.20796
hepc	-.0013112	.0006534	-2.01	0.046	-.0025966	-.0000258
_cons	29.15749	1.151953	25.31	0.000	26.89132	31.42367

.0013112(hepc)

Discussion & Further Research

While previous studies have also focused on determining the relationships between health care, GNI, and infant mortality rates, this research aims to compare the magnitudes of these relationships in different economies. One model's purpose is to quantify the amount health spending increased per capita as a function of GNI in different economies. The result was: as GNI increases, so does the amount spent on health care, however this effect is greater in developing and transition economies than developed nations. Non-developed countries are likely establishing infrastructure, as well as attempting to decrease infant mortality rates.

The other model's purpose is to determine the decrease in infant mortality as health care spending increases. Unlike the first model, the greatest effect was shown in transition economies.

According to this prediction, increases in health care spending in these nations will have the most effect on infant mortality with developing nations close behind and developed nations last. One possible explanation is after the basics of health care infrastructure are developed, each dollar that nation is spending is going directly to things like immunizations and hiring doctors, rather than building hospitals and buying supplies. While this is necessary and useful, it does not necessarily directly affect the population until it has been more fully developed. Another potential reason for the disparity between developing and in transition economies is corruption in the government. Previous studies have demonstrated that this can affect the effectiveness of increased spending, because there is less monitoring of how the money is spent. In developing nations, there is likely decreased corruption, and an increased likelihood that spending will benefit the whole economy. An avenue of further research can be explaining the reasoning behind why transitioning nations are experiencing the greatest impact in decreasing infant mortality rates from increased health care expenditure.

This model could help policy makers predict the effect of increases in health care spending. Noticing a large discrepancy between what is happening in their country and predictions made by models might mean that health care spending is not being used as efficiently as possible or that there are other underlying issues that would need to be considered. While differences can be seen between the different types of economies, they are relatively slight and could be influenced by addition of other variables. More research is needed on effectiveness of policies in each type of economy. For example, while spending more on immunizations may be good for a developing nation, it may not be what is best for other economies. Additional research is also needed to see what other factors influence the effectiveness of health care spending on

lowering infant mortality rates such as corruption or income inequality. Data from more countries or different regions could potentially improve the accuracy of the results.

Despite the need for more comprehensive research for additional information, it is important developing and transition nations to focus on creating a healthy economy. Unfortunately and paradoxically, it is easier to facilitate increased health care spending when GNI increases, but GNI may also increases when there are more healthy citizens who can participate in the economy which is affected by infant mortality. Due to the intricate dependencies between these variables, it is difficult for one to happen without the other. For this reason, it is often necessary for many developing nations to receive outside aid. With further research, we can identify the best ways to increase the health of the world's economy, by focusing on the health of its people.

References

Alice Abou Nader, Ciro de Quadros, Claudio Politi, Michael McQuestion, (2015) An Analysis of Government Immunization Program Expenditures in Lower and Lower Middle Income Countries 2006–12, Oxford, UK, Oxford University Press.

Alves, D., & Belluzzo, W. (2004). Demand for child health in brazil: A household decision model. In Final Seminar on Child Health, Poverty and the Role of Social Policies, IDB, Washington, DC.

Bloom, D. E., & Canning, D. (2009). Population health and economic growth. Health and growth, 53.Cole MA, Neumayer E. The Impact Of Poor Health On Total Factor Productivity. J Dev Stud. 2006;42(6):918–938.

Dorling, D., Mitchell, R., & Pearce, J. (2007). The global impact of income inequality on health by age: an observational study. bmj, 335(7625), 873.

Fuchs V . (1996) Economics, values, and healthcare reform. American Economic Review , *86* (1): 1 –24

Gbesemete, K. P., & Jonsson, D. (1993). A comparison of empirical models on determinants of infant mortality: a cross-national study on Africa. Health policy, 24(2), 155-174.

Hakobyan, M., Mkrtchyan, A., & Yepiskoposyan, L. (2006). Infant mortality in Armenia, 1992–2003. Economics & Human Biology, 4(3), 351-358.

Lucas R. (2015) On the Mechanics of Economic Development. Journal of Monetary Economics, New York, USA

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. The quarterly journal of economics, 107(2), 407-437.

Matsaganis, M. (1992). Maternal mobility and infant mortality in Greece: A regional analysis. Social science & medicine, 34(3), 317-323.

McLaughlin, J. M., McGinnis, J. J., Tan, L., Mercatante, A., & Fortuna, J. (2015). Estimated human and economic burden of four major adult vaccine-preventable diseases in the United States, 2013. The journal of primary prevention, 36(4), 259-273.

Mother, M. E. (2005). Child count: The World Health Report. Geneva: WHO, 219.

Mushkin, S. J. (1962). Health as an Investment. Journal of political economy, 70(5, Part 2), 129-157.

Nader, A. A., de Quadros, C., Politi, C., & McQuestion, M. (2014). An analysis of government immunization program expenditures in lower and lower middle income countries 2006–12. Health policy and planning, 30(3), 281-288.

National Academy of Sciences. (1963). The growth of world population. Washington, DC: National Academy of Sciences

Newhouse, J. P. (1992). Medical care costs: how much welfare loss?. Journal of Economic perspectives, 6(3), 3-21.

Piabuo, S. M., & Tieguhong, J. C. (2017). Health expenditure and economic growth-a review of the literature and an analysis between the economic community for central African states (CEMAC) and selected African countries. Health economics review, 7(1), 23.

Renton, A., Wall, M., & Lintott, J. (2012). Economic growth and decline in mortality in developing countries: an analysis of the World Bank development datasets. Public Health, 126(7), 551–560.

Riley, P. 1983. A structurationist account of political culture. Administrative Science Quarterly, 28(3): 414-437.

Robinson, H. (1981). The Growth of World Population. In Population and Resources (pp. 7-19). Palgrave, London.

Romer, P. M. (1990). Endogenous technological change. Journal of Political Economy, 98(5, Part 2), S71-S102.

Sinha, A., Levine, O., Knoll, M. D., Muhib, F., & Lieu, T. A. (2007). Cost-effectiveness of pneumococcal conjugate vaccination in the prevention of child mortality: an international economic analysis. The Lancet, 369(9559), 389-396.

Subramaniam, T., Loganathan, N., Yerushalmi, E., Devadason, E. S., & Majid, M. (2018). Determinants of Infant Mortality in Older ASEAN Economies. Social Indicators Research, 136(1), 397-415.

Todaro, M. P., & Smith, S. C. (2003). Economic Development (8th ed.). Boston, MA: Addison Wesley.

Ward, J. L., & Viner, R. M. (2017). The impact of income inequality and national wealth on child and adolescent mortality in low and middle-income countries. BMC public health, 17(1), 429.

World Health Organization (Ed.). (2013). Global tuberculosis report 2013. World Health Organization.

Zakir, M., & Wunnava, P. V. (1999). Factors affecting infant mortality rates: evidence from cross-sectional data. Applied Economics Letters, 6, 271–273.