An Empirical Analysis of the Effect of Wealth on Health Indicators

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Abstract:

This paper uses regression analysis with panel data in order to investigate the relationship between income and health indicators in ten high income countries. The purpose of this study is to investigate if income has a significant and positive effect on the health of a nation's population. In theory, the health of the population in high income countries should be positively correlated to the country's income because the wealthier a nation, the more available resources the nation has to allocate to health care spending. The dependent variables in this study are life expectancy at birth and infant mortality rate. The independent variables are GDP per capita, government expenditure on health care, government expenditure on education, unemployment rate, alcohol consumption, and pollution. The data covers a ten-year time frame from 2004-2013. The regression results indicate that GDP per capita does have a positive and significant effect on health indicators for these countries.

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1.0 INTRODUCTION

Several studies aim to explain why the health status of citizens in some nations supersedes the health status of those in other nations. Generally speaking the health status of citizens in first world countries tends to be dramatically better than that of those who do not reside in first world countries. A first world country is a country that is developed and industrialized. Thus, the income of first world countries is also dramatically higher than incomes of countries that do not meet this categorization. Is there a correlation between the health of the citizens and these countries and the high income levels that these countries have achieved? In theory, it would make sense that the health of the citizens in these high-income, first world countries would be better than that of those in other countries because these countries are able to allocate a greater amount of spending to improve their health care systems, health care facilities, and health care research.

Aside from the national level, many economic studies have been conducted to attempt to explore the relationship between income and health on the individual level. Individuals with higher incomes have the ability to make choices about how they will allocate their spending, and how much they are willing to spend in certain markets. While many of the nations included in this study have public health care systems, health care is also both a public and private good in several of the countries as well. In the nations where health care is both a public and private good, individuals with higher incomes have greater opportunity to purchase better health coverage, and afford more diverse options of care. Therefore, these individuals are likely to be healthier than those who do not have the ability to make such choices.

This study aims to explore the relationship of income and health in ten different countries. The countries included in this study are Australia, Canada, China, Germany, Great Britain, Italy, Japan, Switzerland, Sweden, and the United States of America. These ten countries are considered high income countries because they have a gross national income per capita above $12,735 United States dollars. Furthermore, these ten countries are known for having healthy citizens, and generally effective health care systems with the exception of the United States. Because health care is a public good in some of these countries, and a mixed good (both public and private) in others, income should have a significant and positive effect on the health indicators for the people of these nations.

In Australia, health care is both a public and private good, however it is more public than private. The Australian government provides universal access to free public hospital care and also aids doctor's fees. All Australian citizens have access to Medicare. Medicare in Australia covers in-hospital services at government funded hospitals, tests and examinations by doctors to diagnose conditions, eye tests, most surgical procedures by doctors, some dental surgical procedures and subsidized prescriptions. It does not cover private patient hospital costs, dental services, ambulance services, cosmetic surgery, hearing aids, glasses, and several other non-traditional medical services; however these services are generally affordable to the Australian citizen. Therefore, in Australia the health of an individual should be, at least, somewhat correlated to their income.

Canada's health care system is known for its socialist design. In general, it is a group of socialized health insurance plans that enables all Canadian citizens to be covered. The system is publicly funded and administered based on a geographical basis that the Federal government oversees. However, doctors and hospitals are not employed by the

government. Canadian health care providers bill the government instead of citizens for services. Citizens are responsible for paying for dentistry, optometry, and prescription drugs; however these services are mostly affordable to Canadian citizens.

China is currently partaking in a health-care reform to fix the broken Chinese health-care system that was highly costly and ineffective for Chinese citizens. The government provides health insurance for ninety percent of the population, and the government reform is also building new medical infrastructure. Currently, Chinese citizens must be sure to make considerations when allocating their income to health care, because the system is still fairly costly. However, the Chinese citizens are also known to be some of the healthiest in the world, so while their health care system is costly, it is also effective.

In Germany, citizens are required to purchase health insurance from private and non-profit funds, and these funds are not allowed to deny coverage to anyone. These funds are financed by Germans and their employers paying into a sickness fund. The top ten percent of wealthy German citizens have the ability to opt out of the plan and find their own coverage. Many German doctors are underpaid as a result of not enough money being pooled in the sickness funds. Therefore, an individual's income in Germany does affect the type of health coverage they are able to purchase.

Great Britain has socialized medicine. In Britain, the government pays for the insurance of all citizens as well as the medical infrastructure and medical employees. The government also covers all services citizens receive when they seek health care. British citizens are solely responsible for paying for prescription drugs, and these drugs are extremely affordable.

Italian health care is a mixed private-public system. The most public element of the Italian health care system is family doctors. Italians can choose their family doctors, and family doctors have the ability to diagnose disease, prescribe drugs, and recommend treatments by specialized doctors or hospitals. When the family doctor recommends higher treatment, or prescribes a drug, these services are usually subsidized by the government. Italians also have the option to seek health care in a free market of health care providers, and costs in this market are entirely out of pocket. Therefore, income should effect the health care and coverage Italians obtain.

Japan's health care system includes a social insurance program which requires citizens to have health insurance through their employers or the national health care system. Insures are non-profit and do not compete. All insurance companies cover the same services and drugs for the same price. Patients also have the option to seek doctors and hospitals in the private sector. Japan's system covers outpatient care, home care, dental care, prescriptions, long-term care, and home nursing. Japanese citizens are required to pay for physical exams, some dental services, and over the counter drugs; however the prices of these services are highly regulated by the Japanese government. In Japan, health care is affordable and accessible, and income should have a relatively small effect on one's ability to receive care.

Switzerland has universal health care coverage that is not provided by the government, however it is the second most expensive system in the world. Citizens choose from private plans, and under-earning citizens receive subsidies from the government. The premium costs for all of these plans is the same. Insurance companies in Switzerland do not profit from basic health care, but do profit from special services such as dental care and

alternative medicine. Overall, Swiss citizens must be sure to allocate a certain level of spending to health care coverage in order to ensure they have access to health care.

In Sweden, health care is tax-funded and everyone has equal access to health care services. The central government establishes principles to guide health care, and the local governments are responsible for actually providing the care. There is a maximum amount that all citizens can pay for all services in the Swedish health care system. However, individuals are responsible for paying these amounts up to the maximum. Furthermore, Swedish citizens must make economic decisions about allocating the proper amount of income to cover health care costs. Therefore, one's access to health care in Sweden is somewhat based off of the individual's ability to pay.

The United States has a private and public health care system. The public system covers the elderly and low-income families. Everyone else is responsible for obtaining their own coverage either through their employer, or through the private insurance market. Each insurance plan is different, and provides coverage for different services and drugs. However, the United States is renowned for having high costing health care services and prescription drugs that financially burden its' citizens. Therefore, United States citizens must be sure to allocate the appropriate amount of income to health care in order to be sure they can receive the care they need. Often times, this share is not enough, and individuals face bankruptcy because of their inability to pay the large and unregulated prices in the United States health care system. This system is high costing and ineffective, and many citizens feel their access to health care is limited by their income.

Several past studies have been done on this topic and many of them have found that income does have a significant effect on health. However, other studies have found that its

effect is insignificant. Previously conducted studies have aimed to explore other variables that may have a significant effect on the health indicators of a nation, and many of these variables have been included in this study. These variables include government expenditure on health care, government expenditure on education, alcohol consumption, air pollution, and unemployment. All of these variables have been found to significantly impact health indicators in at least one historic study. The measure of income in this study is GDP per capita. If GDP per capita is found to have a significant and positive effect on health, then careful consideration needs to be taken by the governments of these countries.

In recent years especially, the topic of whether or not health care is a basic human right has gained increasing popularity. Many people argue that since it is a ubiquitous belief that people have the right to life, health care is necessary in order to ensure and strengthen this right. If real GDP per capita does have a significant and positive effect on health, the question of whether or not health care is affordable for all becomes prevalent. If health care is unaffordable for some people because of their inability to afford the care and coverage they need, then several may argue that their right to life is being compromised.

The main objective of this paper that differs from the several other past studies that have been done to investigate the significance of income on health is that it focuses on ten countries known for both their unique health care systems, and the health of the citizens living within these countries. It is also unique in that it uses regression analysis to determine the significance of income on health because many of the other previously done studies attempt to find the causal relationship, and also seek to evaluate if there is reverse causality. Examining the relationship between income and health allows policymakers to have a better understanding of the types or laws and reforms needed in health care in order to

ensure that citizens have access to care. It is necessary to make sure that one's right to life is not limited because they cannot afford the care they need in order to protect their life. If income does have a significant and positive effect on health, then the governments of nations of high-income countries should make health care, at the least, accessible to all citizens.

The combination of variables included in this paper is also unique. None of the papers reviewed when conducting this study used all of the variables that this paper examines in one model. Several papers use GDP per capita and some combination of the other independent variables, however this paper is unique in that it combines the variables of GDP per capita, government expenditure on health care, government expenditure on education, alcohol consumption, air pollution, and unemployment in one model. The aim of doing this is to increase the overall significance of the model as whole.

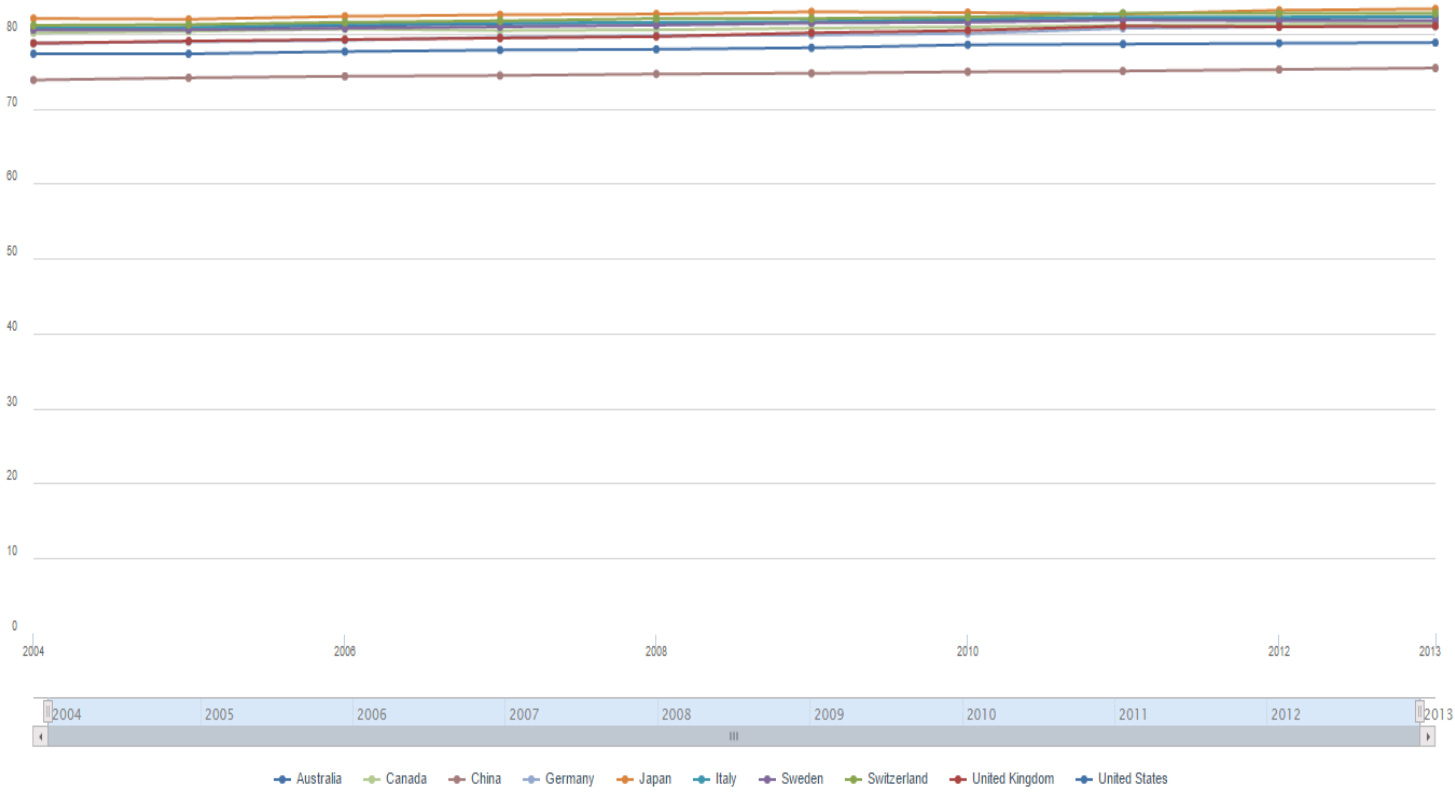
The rest of the paper is organized as follows: Section 2 illustrates a few trends in regard to the issue of income and health. Section 3 gives a brief literature review. Section 4 outlines the empirical model and methodology. The empirical results are discussed in Section 5. Section 6 gives brief concluding remarks, and Section 7 contains policy recommendations and recommendations for a future studies.

2.0 TREND OF THE GIVEN TOPIC

Life expectancy at birth is the expected age until which a child born in that year is expected to live. In 2013, the global measure for life expectancy at birth was estimated to be 71 years. This average of 71 years was a 6 year increase since 1990. The following chart from World Development Indicators summarizes the life expectancy at birth for the ten countries included in this study over the last ten years. The lines for each of the ten

countries exhibit an upward slope, which indicates the health status of the citizens has been improving.

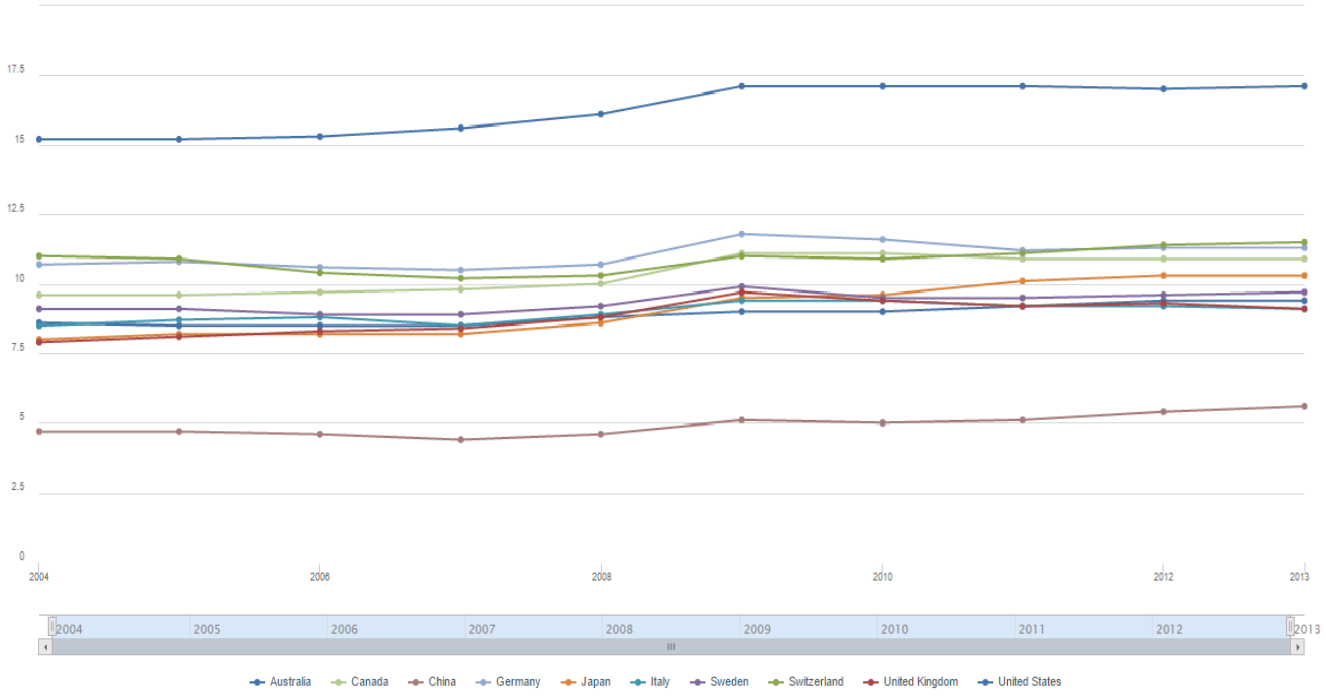
Life Expectancy At Birth



A primary goal of the leaders of all nations is to maximize the living conditions and health of the citizens within the country. As illustrated by the above chart, the health of the citizens in these ten countries has been steadily improving over the last ten years. It is important to determine what factors go into improving the health of these citizens in order for leaders to continue to make improvements. While all of the above countries have a similar life expectancy, the amount that these countries spend on their health care systems is vastly different.

The below table from World Development Indicators denotes the amount of GDP each of the ten countries included in this study spend on health care.

Health Care Expenditures as a Percent of GDP



The above table illustrates that the United States spends a dramatically larger portion of GDP on health expenditure, however when looking at the chart that exhibits the life expectancies, it is clear that United States citizens do not have a dramatically higher life expectancy. Therefore, it becomes clear that there are other factors that influence the health of a nation's citizens. Could one of these factors be income?

In the previous section of this paper, a general overview was given about the structure of the health care systems in these ten countries. In all but two of the countries, citizens of these nations are held accountable for some portion of costs in relation to health care. People are only able to pay these costs if they have the appropriate level of income to allocate enough spending to these costs. From an economic perspective, people

are forced to make choices in order to maximize their utility. Many people believe that people should not face financial burden to ensure that they are healthy and able to live.

Furthermore, recent health care reform bills have been proposed in several of these nations in order to attempt to make health care more accessible and more affordable. In a study conducted by the 2011 Washington Post, the United States health care system was ranked the highest costing and least effective. However, the health of the people in the United States is at a level which coincides with the other countries included in the study. Therefore, it is likely that because a majority of the people in the United States have income stability, they are, at least, somewhat able to afford health care and coverage; thus improving their health. The results of the survey are included below.

Washington Post Survey Results

	AUS	CAN	FRA	GER	NETH	NZ	NOR	SWE	SWIZ	UK	US
OVERALL RANKING (2013)	4	10	9	5	5	7	7	3	2	1	11
Quality Care	2	9	8	7	5	4	11	10	3	1	5
Effective Care	4	7	9	6	5	2	11	10	8	1	3
Safe Care	3	10	2	6	7	9	11	5	4	1	7
Coordinated Care	4	8	9	10	5	2	7	11	3	1	6
Patient-Centered Care	5	8	10	7	3	6	11	9	2	1	4
Access	8	9	11	2	4	7	6	4	2	1	9
Cost-Related Problem	9	5	10	4	8	6	3	1	7	1	11
Timeliness of Care	6	11	10	4	2	7	8	9	1	3	5
Efficiency	4	10	8	9	7	3	4	2	6	1	11
Equity	5	9	7	4	8	10	6	1	2	2	11
Healthy Lives	4	8	1	7	5	9	6	2	3	10	11
Health Expenditures/Capita, 2011**	$3,800	$4,522	$4,118	$4,495	$5,099	$3,182	$5,669	$3,925	$5,643	$3,405	$8,508

Notes: * Includes ties. ** Expenditures shown in $US PPP (purchasing power parity); Australian $ data are from 2010.
Source: Calculated by The Commonwealth Fund based on 2011 International Health Policy Survey of Sicker Adults; 2012 International Health Policy Survey of Primary Care Physicians; 2013 International Health

3.0 LITERATURE REVIEW

Several past studies have been conducted to explore the determinants impacting the health indicators of nations, many of which have looked into income in one or more ways. While many studies have aimed to find whether or not income and income inequality have

a significant impact on health indicators, other studies have looked into the causal relationship between income and health. The results of these studies have shown mixed findings. This paper is primarily based off of the model formulated by Asafu-Adjaye. According to Asafu-Adjaye's findings, income inequality has a significant effect on health. Regression analysis was used in this paper. Another study that has looked into the effect of income inequality on health was done by Wilkinson in 1996. This study found that there was a significant correlation between the degree of income inequality and the health of a nation's people (Wilkinson, 1996). Both of the previous studies looked at income inequality and health on a global level, however in 1996 Kaplan et al. examined the relationship between income inequality and health in the United States. This study examined income inequality on a state to state basis. This study did not measure health using health indicators, however it was found that income inequality did have a significant effect on the amount states were willing to invest into areas that are believed to impact health.

Aside from income inequality as the main variable, several studies have aimed to discover what other variables have a significant effect on health. These studies were utilized when forming the model for this paper because it is important to look at all factors that can affect the health of a nation's people in order to improve the overall significance of the model. In 1996, Dressler found that unemployment rates have a significant effect on health indicators, as well as income inequality. Dressler explains this because many higher income societies view it as socially unacceptable to be unemployed. Therefore, those that are unemployed in these societies suffer negative physical and mental health consequences, in turn affecting their health indicators (Dressler 1996). Parkin et al. sought to discover if

health care was considered a luxury or necessity in high income countries, and found that while health care is a necessity according to the views of citizens, economically speaking it is viewed as a luxury because many people cannot readily afford it. Furthermore, this study found that because health care is a luxury good in certain high income countries, income inequality does have a significant effect on the health of the people because of their ability to afford the care they need (Parkin et al., 1987).

Despite the above studies which have found a significant relationship between income and health, there have been studies that have not found any significant correlation between income inequality and health status. Daly et al. found no significant relationship between income and mortality (Daly et al. 1998). Similar to this study, Deaton examined income inequality in high income countries, and also did not find there to be a significant relationship (Deaton, 2001). In 1995, Ettner examined the causal relationship between income and health, as well as the reverse causal relationship, and did not find there to be a significant correlation in either of the two (Ettner, 1995). Ettner also examined several other variables, many of which have been implemented in the model used in this paper. These variables include air pollution, alcohol consumption, and unemployment rates (Ettner, 1995). Another study that was not conducted on the national level, but instead within the United States also failed to find that income inequality had a significant effect on the health status of the states' inhabitants (Mellor and Milyo, 2001).

Despite the fact that there have been mixed findings on the relationship between income and health, this paper uses a unique model, and a unique set of countries, therefore it is necessary to analyze the results of its' findings.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

The study uses panel data from 2004 to 2013. Data was obtained from the World Data Bank website and the World Health Organization website. The data for all ten countries was publically available information. Summary statistics for the data are provided in Table 1.

Table 1 Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
LIFEXPCT	110	79.53929	3.0713	71.352	83.33195
INFTMORT	110	6.241818	4.971153	2.1	22.2
GDP	110	39304.06	19108.43	1498.174	88002.61
UNEMPL	110	6.338182	1.930156	3.4	12.2
CO2E	80	10.24584	4.928446	4.080139	19.68358
HLTHXPND	110	7.362696	1.23561	4.354222	9.670875
EDUXPND	74	4.994419	.8285884	3.44024	6.85779
ALCCONS	102	8.66049	2.117121	2.92	12.3

4.2 Empirical Model

Following Asafu-Adjaye (2002) this study adapted and modified the model used in this paper for the purpose of regression analysis. The variables in this model have been slightly modified where the measure for income is GDP per capita as opposed to the GINI coefficient. Several other variables have been added such as CO2 emissions, health expenditures as a percent of GDP, unemployment, and alcohol consumption. The model could be written as follows:

$$HEALTH = \beta 0 + \beta_1 GDP + \beta_2 EDUXPND + \beta_3 HLTHXPND - \beta_4 UNEMPL - \beta_5 ALC - \beta_6 POL + U$$

HEALTH is one of two different health indicators that will be used when running separate regressions. In one regression health will be average life expectancy at birth in years. In another study health will be infant mortality rate. Both of these health indicators are used to indicate the overall health of a population. In general, the healthier a nation's population, the larger the life expectancy, and the smaller the infant mortality rate. The reverse is true for nations that are considered to be less healthy.

Independent variables consist of five variables obtained from various sources. Appendix A and B provide data source, acronyms, descriptions, expected signs, and justifications for using the variables. First, *GDP* is a measure of Real GDP per capita measured in United States dollars. This is the measure for wealth in this study. *HLTHXPND* represents the percentage of total GDP that a nation spends on health expenditures. *EDUXPND* represents the percentage of total GDP that a nation spends on education expenditures. Both health expenditures and education expenditures also have to do with the wealth of a nation. *CO2E* represents the total carbon dioxide emissions of a nation in metric tons of a country. *UNEMPL* represents the percentage of the labor force that is unemployed. *ALCCONS* represents the amount of alcohol consumed by a nation in liters per capita.

5.0 EMPIRICAL RESULTS

The empirical estimation results are presented in Tables 2 and 3. Table 2 illustrates the results when infant mortality is used as the dependent variable, while Table 3 shows the results when life expectancy is the dependent variable. The empirical estimation shows the positive relationship between GDP per capita and the life expectancy at birth which indicates that the health of a nation is related to the wealth of a

nation. The results also indicate that when infant mortality rate is used as the dependent variable, only one of the independent variables is significant.

Table 2: Regression results Infant Mortality

	I
GDP	-.00000384 (.000173)
HLTHXPND	.1841201 (.1841201)
EDUXPND	.4271753 (.112536)
UNEMPL	-.0716359* (.0952918)
CO2	.1961217 (.0268643)
ALCCONS	.1457941 (.0689998)
R^2	.3557
F-statistics	0.000
Number of obs.	60

Note: *** , **, and * denotes significance at the 1%, 5%, and 10% respectively. Standard errors in parentheses

Table 3: Regression Results Life Expectancy is dependent variable

	I	II
GDP	.0000464*** (.0000157)	.0000561*** (.0000135)
HLTHXPND	.1640653** (.2324269)	.4290005* (.2161416)
EDUXPND	-.7828407 (.2111368)	-.9729393 (.1700989)
UNEMPL		-.0912013* (.1324272)
CO2		-.0935775** (.0370081)
ALCCONS		-.4237551*** (.0932379)
R^2	.2221	.5973

F-statistics	.0015	0.000
Number of obs.	65	60

Note: *** , **, and * denotes significance at the 1%, 5%, and 10% respectively. Standard errors in parentheses

When life expectancy at birth was used as the dependent variable in the regression, all of the independent variables were significant except for government expenditures on education. Total GDP was significant at the one percent level, which indicates that there is a positive relationship between income and the health of a nation. Alcohol consumption was also significant at the one percent level, which indicates that alcohol consumption negatively affects health. Government expenditure health was significant at the five percent level, which indicates that there is a positive relationship between government expenditures on education is positively correlated to health. Finally, unemployment was significant at the ten percent level, which indicates that there is a negative correlation between the unemployment rate as a percent of the total labor force and the health of a nation. Because the coefficient on total GDP is small, the relationship between health and income for the ten countries in this study is small.

6.0 CONCLUSION

In summary, when life expectancy at birth is the dependent variable used, five out of the six independent variables are significant. When infant mortality rate is used as the dependent variable, only one of the independent variables was significant. Unemployment rate was the independent variable that showed a significant impact on both life expectancy and infant mortality rate. For both dependent variables, unemployment was

significant at the 10% level. There is a positive significant relationship between a country's total GDP per capita and life expectancy, which indicates a positive significant relationship between income and health. Alcohol consumption is also significant at the one percent level when life expectancy is the dependent variable. The coefficient of alcohol consumption was also larger than the coefficient of income, which indicates that the magnitude of its impact on health is larger. This coincides with past studies that have been conducted that indicate that the higher the aggregate alcohol consumption of a nation's population, the less healthy the people are overall. All of the significant variables had very small coefficients which denotes that the magnitude of their effect on health is retrospectively very small. This makes sense because there are countless factors that impact the health of a nation. Furthermore, the coefficients could be small due to the limited scope of the data available.

7.0 POLICY RECCOMMENDATIONS

Because income has a significant and positive effect on health, it should be the responsibility of the government to ensure that health care is affordable and accessible for the people of a nation. If health care and coverage is affordable, the people will be healthier. Health Care reform will benefit countries where care is not affordable for all people. One interesting finding is that the countries in this study whose health care systems are the most public, and most government funded, are the countries with the highest life expectancies on the chart in Section 3. These countries are Canada, the United Kingdom, Japan, and Sweden. The United Kingdom and Sweden also ranked in the top three for the overall ranking of their health care system in the survey conducted by the Washington Post. Therefore, it is evident that income and health are related, and

the government must ensure that at least some of health care is publically available for the citizens of a nation. Additionally, because the consumption of alcohol had a significant, negative impact on the health of a nation's population, with a larger coefficient than that of income, it may be beneficial for the governments of countries to regulate the amount of alcohol that citizens consume. This can be done through adjusting the legal limit in nations that have a legal limit, and adding a legal limit in countries that do not have a legal limit.

In order to improve this study in the future, additional countries could be examined. Also, the collecting of data could be taken back more into the future in order to have more observations. Other variables could also be added as independent variables to use in the regressions when life expectancy and infant mortality rate are the dependent variables. Additional variables to consider would be drug consumption, caloric intake, and some type of measurement for the quality of care. Another measure could also be used for wealth such as the GINI coefficient. A final way to improve this study, and improve its' policy recommendations as well, would be to specifically compare the significance of income on health in countries with government-funded health care versus private health care systems.

Appendix A: Variable Description and Data Source

Acronym	Description	Data source
LIFEXPCT	Average Life expectancy at birth in years.	World Data Bank
INFTMORT	Average infant mortality rate.	World Data Bank
GDP	Gross Domestic Product per capita measured in United States dollars.	World Data Bank
UNEMPL	Unemployment rate as a percent of the labor force.	World Data Bank
CO2E	Carbon Dioxide emissions in metric tons per capita	World Data Bank
HLTHXPND	Percent of total GDP on health expenditures.	World Data Bank
EDUXPND	Percent of total GDP on education expenditures	World Data Bank

ALCCONS	Alcohol consumption measured in liters per capita.	World Health Organization

Appendix B- Variables and Expected Signs

Acronym	**Variable Description**	**What it captures**	**Expected sign**
LIFEXPCT	Life Expectancy at Birth in years.	Life expectancy at birth is a health indicator. Higher life expectancy at birth indicates higher overall health of a nation.	+
INFTMORT	Infant Mortality Rate	The infant mortality rate is a health indicator. Low infant mortality indicates lower overall health of a nation.	+

GDP	Real GDP per capita in USD.	The income of a nation.	+/-
UNEMPL	Unemployment rate as a percent of the labor force	Unemployed citizens typically have lower overall health.	-
CO2E	Carbon dioxide emissions in metric tons per capita.	Carbon dioxide emissions are a measure of pollution, and pollution has a negative effect on health.	-
HLTHXPND	Percent of GDP spent on health expenditures	Increased health expenditures should lead to a healthier population.	+
EDUXPND	Percent of GDP spent on education expenditures	Citizens with more education tend to be healthier.	+
ALCCONS	Alcohol consumption in total liters per capita.	Alcohol consumption negatively affects a nation's health	−

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