Effects of Private and Public Health Expenditure on Health outcome

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Abstract:

The current level of health spending in the U.S. is the highest in the world. However, the outcomes of the health spending are among the lowest for developed countries. Therefore, for policy development purpose, it is necessary to determine which direction of healthcare spending results in better output, private or public. This paper investigates the effect of private and public health expenditure on life expectancy, infant mortality at birth, and infant mortality under age 5 among 11 OECD countries. Hausman test is performed to confirm the fixed effects models. Fixed effects GLS and GMM are used for data analysis. We find that both public and private healthcare spending are not meaningful, but number of physicians has great impact on health outcomes. Statistical insignificance and extremely low coefficients of health spending variables signal over-spending and cost inflation issues of healthcare. This may be especially true for the U.S. and might explain lackluster health outcome despite the highest healthcare spending in the world.

JEL Classification: I1
Keywords: Healthcare, Healthcare spending, Life Expectancy, Infant Mortality, OECD

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1.0 INTRODUCTION

Healthcare expenditure has been increasing for the past two decades worldwide. In the United States, it has become a major factor of the GDP (almost 18%), which is the highest among other OECD countries. There are two important categories of healthcare expenditure: private and public. This study aims to enhance understanding of how private and public spending on healthcare influences health outcomes, such as life expectancy and infant mortality.

Most industrialized countries have national healthcare system or market regulation that is able to provide service to almost all citizens. In fact, comparable countries such as Switzerland and United Kingdom have 100% of their citizens insured. However, the United States falls significantly below at 91.2% (Peterson-Kaiser, 2018). Ironically, the United States spends the most on healthcare among other OECD countries. Hence, a key difference in healthcare systems between the United States and other wealthy nations is that the United States does not provide insurance programs for all citizens. With this difference, there arises the question of whether the healthcare structure is efficient. Indeed, it is not difficult to find evidence that the United States is at the bottom of the list when it comes to healthcare efficiency (Miller & Lu, 2018).

The discussion about healthcare structure of the United States has been a constant debate. Most notably, the Affordable Care Act was introduced in 2010 to increase public provision of healthcare, but the current (2019) government favors more market driven healthcare sector. The common argument for supporting capitalist structure of healthcare system is that market can provide services efficiently to insureds and regulation will disincentivize private companies from offering good quality healthcare to insureds. Nevertheless, the apparent results have shown that the healthcare expenditure has soared in the United States without being able to provide the service to almost 10% of its population while citizens do not live longer than other OECD countries. At a glimpse, market failure exists because the supply of healthcare does not meet the demand of the population, which calls for government intervention. Moreover, healthcare being a necessity asks for public provision as well.

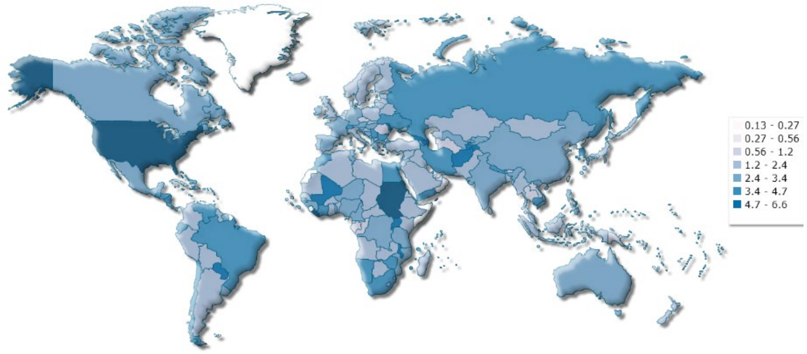
Because the United States constantly undergoes healthcare reforms and struggles to create a wholesome healthcare system that can cover more than 99% of the population, it is critical to understand how healthcare spending can affect population health. More specifically, it is necessary to realize the different impacts public and private health expenditure have on health outcomes in order to create a policy that reflects more efficient resource spending. Furthermore, it is crucial to investigate the limit of healthcare spending where decreasing returns to scales begins.

Therefore, the research objectives are (1) reiterate the effects of private and public healthcare spending on life expectancy, infant mortality, and mortality under age 5 with recent data, and (2) investigate the implication of healthcare spending in the U.S.

The rest of the paper is organized as follows: Section 2 shows trends and section 3 gives a brief literature review. Section 4 outlines the data and empirical analysis. This is followed by empirical results in section 5 and conclusion in section 6.

2.0 Trend

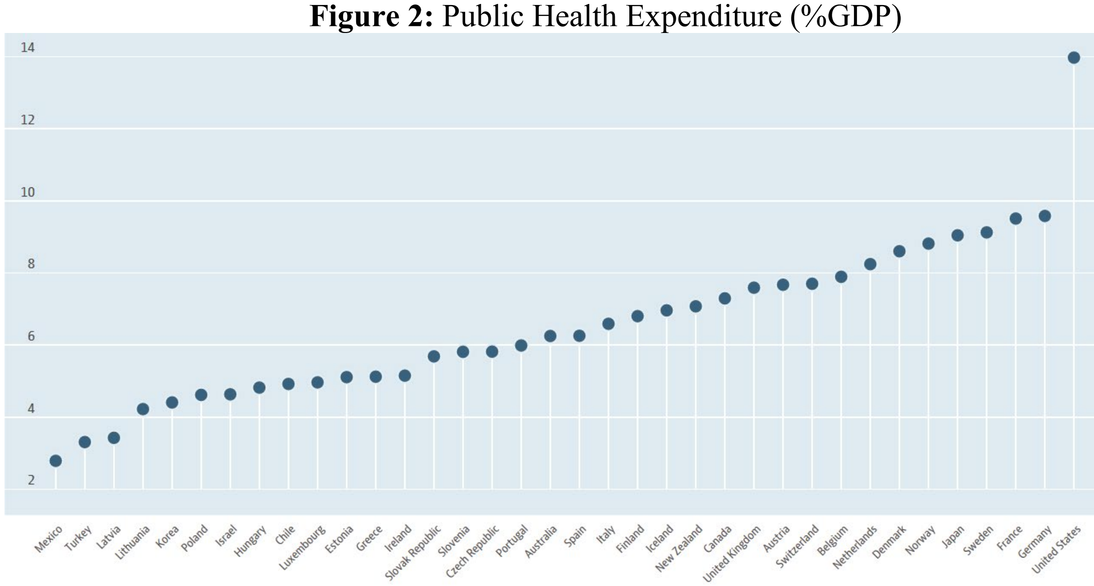
Figure 1: Private Health Expenditure (%GDP)



Source: Index Mundi https://www.indexmundi.com/facts/indicators/SH.XPD.PRIV.ZS

Figure 1 shows that the United States is one of the countries with the highest private healthcare spending. Similarly, in Figure 2, public expenditure as a share of GDP of the United States (14%) is the highest among the OECD countries.

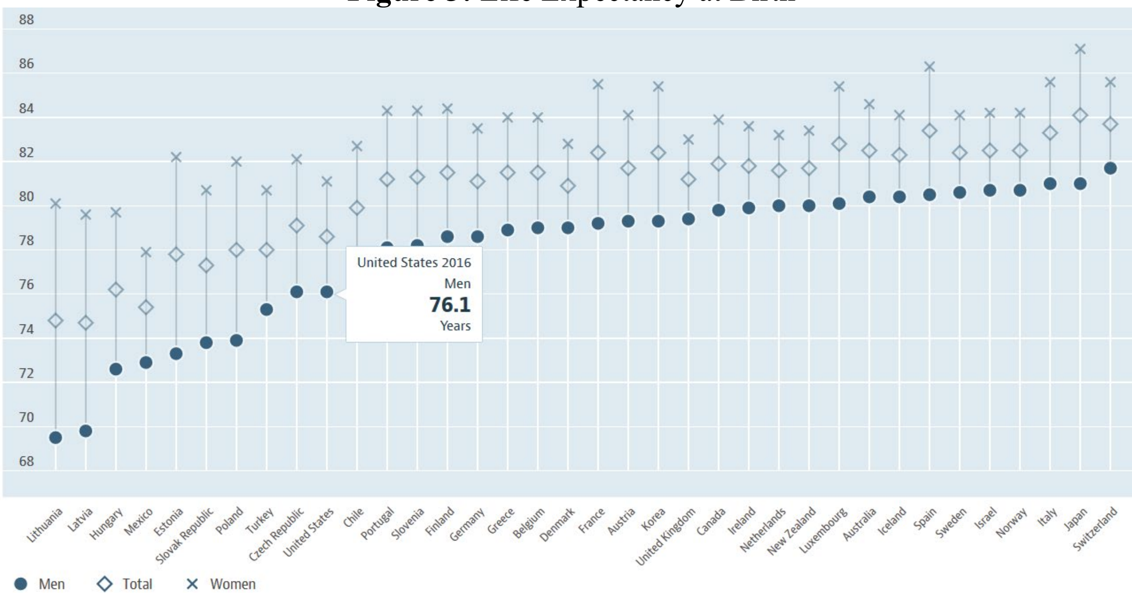
Figure 2: Public Health Expenditure (%GDP)



Source: OECD Data https://data.oecd.org/healthres/health-spending.htm

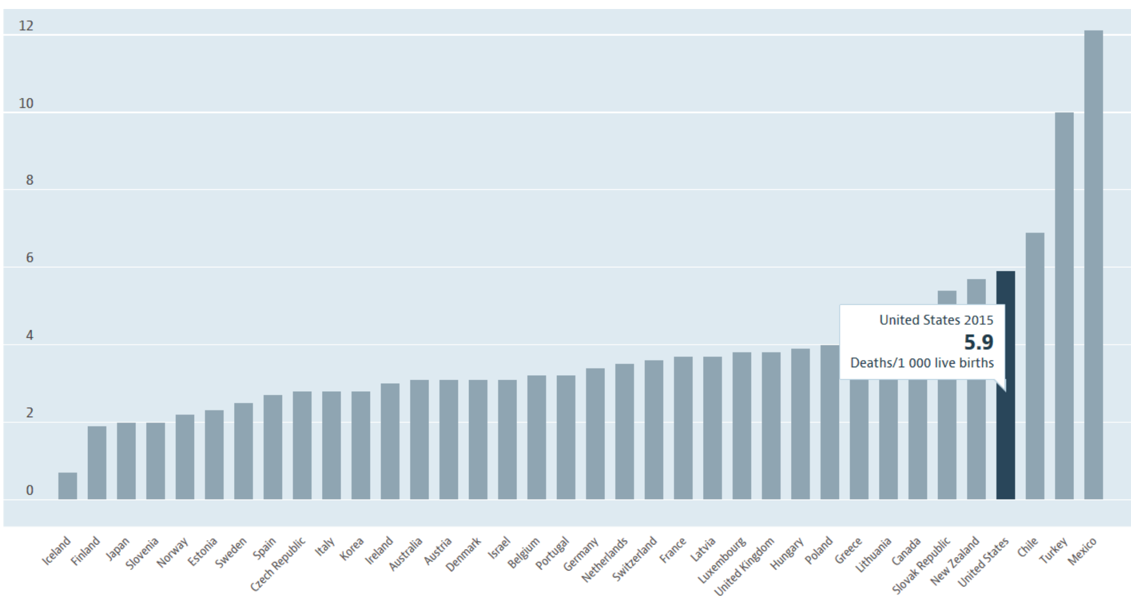
While one might think high spending on health care from both private and public sectors has increased average American's quality of life, the health outcomes tell a different story.

Figure 3: Life Expectancy at Birth



Source: OECD Data https://data.oecd.org/healthstat/life-expectancy-at-birth.htm

Figure 4: Infant Mortality



Source: OECD Data https://data.oecd.org/healthstat/infant-mortality-rates.htm

Both Figure 3 and Figure 4 exhibits that health outcome measured in life expectancy and infant mortality are among the worse in the United States. The discrepancy between high health spending and low health outcomes raise the questions of whether private health expenditure or public health expenditure results in superior health outcome than one another, and the possibility of low return on outcome beyond certain level of healthcare expenditure.

3.0 LITERATURE REVIEW

Assessment of the relationship between healthcare spending and health outcome is measuring the efficiency. This enables us to measure how well the resources, private and public health expenditure, are spent by evaluating the output, mortality and life expectancy. In many existing literatures, healthcare efficiency has been evaluated using Data Envelopment Analysis (DEA), which is a non-parametric benchmarking tool. These literatures (World Health Organization, 2018; de Cos & Moral-Benito, 2011) usually use total healthcare expenditure, rather than separating them in private and public spending. On the other hand, studies that do separate healthcare expenditure in private and public, such as Rahman, Khanam, & Rahman (2018), Raeesi et al. (2018), and Tacke & Waldmann (2011), generally use parametric models.

Measuring the difference between the effect of private and public healthcare expenditure needs to be treated in another way than the common efficiency gauging methods. Previously mentioned efficiency calculating technique, DEA, uses an entity with the best combination of input and output as a benchmark. Using linear programming, other entries that deviate from the benchmark are considered inefficient. Efficiency scores are calculated for each input-output combination based on the deviation from the benchmark. This technique could have been useful if the focus of this study was to rank countries based on how efficiency they spend private and public healthcare. However, the scope of the efficiency in this study's objective is a different matter. The interest of this study is observing how health outcome reacts to changes in private and public health spending, which is not possible by simply scoring efficiency ratings.

The structure of healthcare system creates differences in how healthcare spending impacts health outcomes (Raeesi et al., 2018). Raessi et al. (2018), categorizes healthcare system into four types: National Health Insurance System offering health insurance at national level, Traditional Sickness Insurance where state subsidy is present in private insurance market, National Health Services which health care is provided by the country, and Mixed Systems that has both traditional sickness insurance and national health coverage. Depending on the structure of healthcare system, the impact of public and private health expenditure on health outcomes change. Intuitively, in systems where government regulation is less strict, private healthcare spending has greater impact on health outcomes. In addition, Raessi et al. (2018) implies that more tightly controlled healthcare system is more efficient than a system that is less tightly controlled. Raessi et al. (2018) provides important information about how the effects of private and public healthcare spending can differ based on the structure of the healthcare system.

On the other hand, an important issue arises when countries are categorized based on their healthcare systems. It only allows you to analyze effectiveness of healthcare spending structure among the countries in the same cohort. If the goal of a research is to find which system performs better under public or private healthcare spending, classifying the systems works well. However, if the goal is to compare the effectiveness of healthcare spending regardless of the healthcare system, categorical data would not provide the information the research is looking for. This is especially true when the research focus is rather small group of developed countries. Sorting the countries result in small number of observations, which is not desirable.

Therefore, to compare the United States with other developed countries, this study uses fixed effects model to control for healthcare system differences in countries without separating the countries.

Lastly, in comparing the healthcare system of Switzerland and the United States, Cosgrove (2018) asserts that over-spending on healthcare insurance results in cost inflation, which is the reason why Switzerland’s goal is to prevent its citizens from spending more than 10% of their income on healthcare. Considering the high amount of health expenditure of the United States, this imposes the possibility of healthcare cost inflation.

4.0 EMPIRICAL METHODOLOGY

4.1 Data

Panel data from 2000 to 2016 is used for data analysis. There are 11 countries in total. These countries are Australia, Canada, Switzerland, Germany, Denmark, France, the United Kingdom, Japan, Netherlands, Sweden, and the United States. Data are collected from the OECD and the World Development Indicator (WDI) websites. Variables used are life expectancy at birth; infant mortality under age 1; infant mortality under age 5; public health expenditure; private health expenditure, which is measured by adding voluntary and out of pocket expenses; per capita income; and per capita physician per 1000 population.

Following Raessi et al. (2018), this study adapted their analytical framework, without categorizing countries. First, Ordinary Least Squares method is used to perform Hausman test and investigate whether fixed effects is appropriate for the model. Second, Generalized Least Square method is performed for fixed effects model. Additionally, Generalized Method of Moments is used to compare the results with GLS. Below is the summary statistics.

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Max
PerCapitaIncome	164	39,700.150	8,376.361	26,358.120	65,454.680
InfantMortality	164	4.225	1.094	2.100	7.000
LifeExpectancy	164	80.329	1.614	76.700	83.700
Mortality_Under_5	164	5.013	1.227	2.800	8.400
Physician	164	3.046	0.624	1.930	4.270
PublicHealthExpenditure	164	2,908.264	985.013	1,242.478	7,778.120
PrivateHealthExpenditure	164	1,768.153	1,211.266	506.669	5,440.932

4.2 Empirical Models

There are three models to consider. These models are used for Ordinary Least Squares (OLS) and Generalized Least Squares estimation (GLS).

$$LE = a + B_1 PHE + B_2 PrHE + B_3 Y + B_4 PHY + e \quad (1)$$

$$IM = a + B_1 PHE + B_2 PrHE + B_3 Y + B_4 PHY + e \quad (2)$$

$$IM5 = a + B_1 PHE + B_2 PrHE + B_3 Y + B_4 PHY + e \quad (3)$$

Dependent variables are Life expectancy at birth (LE), Infant Mortality (IM), Mortality under age 5 (IM5). Independent variables are Public Health Expenditure %GDP (PHE), Private Health Expenditure %GDP (PrHE), Per Capita Income (Y), Per Capita Physician per 1000 population (PHY).

Next, there are three models for Generalized Method of Moments (GMM) estimation.

$$LE = LE_{i(t-1)} + B_1 PHE + B_2 PrHE + X_{it} + e \quad (4)$$

$$IM = IM_{i(t-1)} + B_1 PHE + B_2 PrHE + X_{it} + e \quad (5)$$

$$IM5 = IM5_{i(t-1)} + B_1 PHE + B_2 PrHE + X_{it} + e \quad (6)$$

Variables are the same as OLS and GLS regressions. Here, lag of the dependent variables and health expenditures are included as GMM instruments. X is a vector that includes per capita income and number of physicians.

OLS and Hausman test are used to observe and confirm the fixed effects model. GLS and GMM are performed to estimate and compare the effects of healthcare spending on health outcomes between the two regression models.

5.0 Empirical Results

5.1 OLS

In Table 2, models 1, 3, and 5 are fixed effects models and models 2, 4, and 6 are random effects models. Two models do not show any meaningful difference. Hausman test results for the equations (1), (2), and (3) are 0, 0, and 0, respectively. This rejects the null hypothesis that the unique errors are not correlated with the regressors and confirms the usage of fixed effects models. In general, fixed effects model has more significant variables than random effects models. R-squared is higher for fixed effects when the dependent variables are mortality measures, but it is lower when the dependent variable is life expectancy. Significant variables differ depending on the model. However, the number of physicians is consistently significant for all models and may be the most important factor.

Both kind of the health expenditure are simultaneously significant only when the dependent variable is mortality under age 5. Furthermore, public health expenditure is more statistically significant than private health expenditure under this model. Nevertheless, it would be premature to conclude that the public health expenditure has stronger impact on reducing the mortality, since our OLS results are not consistent.

In addition, Tables 3, 4, and 5 shows fixed effects coefficients for each country. All countries' coefficients are statistically significant. The United States' coefficient for the life expectancy is the smallest and highest for the mortality measures, which reiterates

Table 2: OLS Comparison

	Dependent variable:					
	LifeExpectancy		InfantMortality		Mortality_Under_5	
	(1)	(2)	(3)	(4)	(5)	(6)
PublicHealthExpenditure	0.0001	0.00003	-0.0001^{*}	-0.0001	-0.0002^{***}	-0.0002^{***}
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
PrivateHealthExpenditure	0.0002^{**}	0.0001	-0.0001	0.00003	-0.0002^{**}	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
PerCapitaIncome	0.0001^{***}	0.0001^{***}	-0.00001	-0.00002	-0.00001	-0.00002
	(0.00002)	(0.00002)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Physician	0.455^{*}	0.433^{*}	-0.894^{***}	-0.887^{***}	-0.881^{***}	-0.905^{***}
	(0.252)	(0.245)	(0.172)	(0.165)	(0.148)	(0.149)
Constant		73.933^{***}		7.816^{***}		9.094^{***}
		(0.601)		(0.395)		(0.372)
Observations	164	164	164	164	164	164
R^2	0.874	0.899	0.727	0.696	0.848	0.821
Adjusted R^2	0.862	0.896	0.701	0.689	0.834	0.817
F Statistic (df = 4; 149)	257.224^{***}	$1,395.247^{***}$	99.152^{***}	364.109^{***}	208.287^{***}	730.177^{***}

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 3: Life Expectancy: Fixed Effects Coefficients

	Estimate	Std. Error	t-value	Pr(>|t|)
AUS	74.996	0.510	147.036	0
CAN	74.638	0.367	203.212	0
CHE	73.269	0.618	118.651	0
DEU	73.291	0.632	115.989	0
DNK	72.265	0.577	125.189	0
FRA	75.153	0.580	129.572	0
GBR	74.397	0.435	171.100	0
JPN	77.270	0.376	205.676	0
NLD	73.456	0.472	155.722	0
SWE	74.442	0.648	114.799	0
USA	70.250	0.380	185.023	0

Table 4: Infant Mortality Under 1: Fixed Effects Coefficients

	Estimate	Std. Error	t-value	Pr(>|t|)
AUS	7.778	0.348	22.334	0
CAN	7.992	0.251	31.868	0
CHE	8.784	0.422	20.832	0
DEU	7.943	0.431	18.411	0
DNK	7.963	0.394	20.202	0
FRA	7.675	0.396	19.380	0
GBR	7.591	0.297	25.568	0
JPN	5.274	0.257	20.560	0
NLD	7.796	0.322	24.203	0
SWE	6.976	0.443	15.756	0
USA	9.934	0.259	38.317	0

Table 5: Infant Mortality Under 5: Fixed Effects Coefficients

	Estimate	Std. Error	t-value	Pr(>|t|)
AUS	9.039	0.300	30.108	0
CAN	9.146	0.216	42.306	0
CHE	10.229	0.363	28.143	0
DEU	9.089	0.372	24.440	0
DNK	8.941	0.340	26.315	0
FRA	8.664	0.341	25.380	0
GBR	8.753	0.256	34.202	0
JPN	6.535	0.221	29.552	0
NLD	8.911	0.278	32.097	0
SWE	7.974	0.382	20.892	0
USA	11.930	0.223	53.386	0

the poor health performance of the United States compared to other developed countries.

5.2 Generalized Least Square (GLS)

Table 6: Fixed Effects GLS Comparison

	Dependent variable:		
	LifeExpectancy	InfantMortality	Mortality_Under_5
	(1)	(2)	(3)
PublicHealthExpenditure	-0.001^{***}	0.0002^{**}	0.0002^{**}
	(0.0002)	(0.0001)	(0.0001)
PrivateHealthExpenditure	-0.001^{***}	0.001^{***}	0.001^{***}
	(0.0001)	(0.0001)	(0.0001)
PerCapitaIncome	0.0003^{***}	-0.0001^{***}	-0.0001^{***}
	(0.00003)	(0.00002)	(0.00002)
Physician	0.274	-0.820^{***}	-0.970^{***}
	(0.194)	(0.101)	(0.103)
Constant	73.637^{***}	8.030^{***}	9.616^{***}
	(0.673)	(0.351)	(0.357)
Observations	164	164	164
Log Likelihood	−296.093	−192.342	−195.028
Akaike Inf. Crit.	604.185	396.685	402.057
Bayesian Inf. Crit.	622.599	415.098	420.470
Note:			*p<0.1; **p<0.05; ***p<0.01

Both OLS and GLS results show that number of physicians have greater impact on all health outcomes in increasing life expectancy and decreasing mortality measures. Perhaps, this signals that better access to healthcare is more effective in enhancing the population health than spending more money for developed countries.

5.3 Generalized Method of Moments (GMM)

Table 7: First Difference GMM

	Dependent variable:		
	LifeExpectancy	InfantMortality	Mortality_Under_5
	(4)	(5)	(6)
lag(LifeExpectancy, 1)	0.564^{***}		
	(0.079)		
lag(InfantMortality, 1)		0.430^{***}	
		(0.123)	
lag(Mortality_Under_5, 1)			0.995^{***}
			(0.037)
PublicHealthExpenditure	−0.00004	0.0002	0.0001
	(0.0001)	(0.0002)	(0.0001)
PrivateHealthExpenditure	0.0001	0.00001	−0.00002
	(0.0001)	(0.0001)	(0.00003)
PerCapitaIncome	0.00004^{**}	−0.00002	−0.00000
	(0.00002)	(0.00002)	(0.00001)
Physician	0.723^{**}	-0.976^{*}	−0.183
	(0.309)	(0.499)	(0.187)
Observations	136	136	136
Sargan test	1	1	1
AR (1) test	0.021	0.010	0.006
AR (2) test	0.074	0.725	0.546
Note:			*p<0.1; **p<0.05; ***p<0.01

6.0 Conclusion & Policy Discussion

The limitation exists in that there may be omitted variables. It will be necessary to further investigate the determinants of health outcomes for more robust analysis. Nevertheless, we conclude that the effect of public and private health expenditure on health outcomes should not be considered as meaningful. Statistical significance of health spending is inconsistent throughout OLS and GMM models. Moreover, even though health expenditures are statistically significant in GLS models, coefficients are extremely small and negatively impacts health outcomes by decreasing life expectancy and increasing infant mortalities.

On the other hand, the number of physicians per 1000 population has shown to be statistically significant throughout most models, except for GLS model with life expectancy as the dependent variable and GMM model with mortality under age 5 as the dependent variable. In addition, coefficients for physician variable are significantly higher for life expectancy and lower for mortality measures than all other variables.

The consistency of physician variable could be indicating that the increase in the number of physician impact health outcomes much better than healthcare spending and income per capita. This might be the case since the data consists of developed countries that already have high healthcare spending and income. Furthermore, this could imply that high healthcare spending already resulted in cost inflation, especially for the United States. This is in align with the extremely small coefficients of health expenditures. This possibly explains why spending almost 18% of GDP in healthcare does not result in better health outcome than other developed countries.

For future policy development, our results show that it will be more beneficial to focus on increasing the number of physicians. Having more physicians per 1000 populations would be the best way to enhance the population health. In addition, since the United States falls at the bottom in terms of health outcome, studying and implementing good practices of all the other countries included in this study will help to improve health outcome.

Appendix A: Variable Description and Data Source

Variable	Description	Data source
Life Expectancy	Life expectancy at birth.	OECD
Infant Mortality	Mortality under age 1.	OECD
Infant Mortality under 5	Mortality under age 5.	WDI
Public Health Expenditure	Health spending by Government/compulsory per capita.	OECD
Private Health Expenditure	Voluntary and out-of-pocket health spending per capita.	OECD
Income per Capita	Gross National Income per capita.	OECD
Physician	Number of medical doctors per 1,000 inhabitants.	OECD

Appendix B: Variables and Expected Signs

Acronym	Variable Description	Expected under Life Expectancy, Infant Mortality, and Infant Mortality under 5, respectively
LifeExpectancy	Life Expectancy	Dependent Vaiable
InfantMortality	Infant Mortality	Dependent Vaiable
Mortality_Under _5	Infant Mortality under 5	Dependent Vaiable
PublicHealthExpenditure	Public Health Expenditure	+/-/-
PrivateHealthExpenditure	Private Health Expenditure	+/-/-
PerCapitaIncome	Income per Capita	+/-/-
Physician	Physician per 1,000 in habitants	+/-/-

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