Abstract

This paper examined the impact of current healthcare expenditure from 2000 to 2019 on the gross domestic product (GDP) per capita. Both a global effect and an effect on country income were considered. Data from the World Development Indicators Database and the World Health Organization's Global Health Expenditure Database were used. A panel regression comparing pooled OLS, random effects, and fixed effects were used to find the best fit for the model of interest. The overall result of this work is that current healthcare expenditure is negatively correlated with GDP per capita, as expected, but the sign of this correlation is not significant. The overall fit of our model of interest is a fixed effect model. This is true for both the global effect and the country income effect, except for some country income groups. However, the result of this paper has some limitations that should be considered in further research.

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1 Introduction

One can quickly agree that a good government health care system can be an important factor in overall life expectancy, along with other things like infant mortality rates. If so, then the purpose and outcome of health care is a good and positive thing for people's overall health. But all goods come at a cost, and that unfortunately includes the cost of health care, keeping people healthy, and preventing premature death and disease. Considering this, the cost of health care can increase and decrease.

However, the question is whether or not the health expenditure has any effect on the economic if decrease or increase overtime.

Because, according to data found by the World development indicators database and World Health Organization Global Health Expenditure database The world bank (2022b) , where the current health care expenditure has increased worldwide since the beginning of 2000.

So what do these health expenditure means in regards to the whole economic, or more specific what kind of effect do health expenditure have on the Gross Domestic Product (GDP) per capital.

This question will be examined and tested in this paper in regards to the data mention above. In addition to the global effect and perspective, the data are divided into income groups to see if a country's income plays a role in how health spending affects GDP per capital.

The structure and the map of this paper start with a review of previous literature that has similar, if not the same, interest as this paper. This is followed by a description of the data and the methodology behind this study, which uses panel data regression and compares pooled OLS, random effects, and fixed effects to find the best fit for our model of interest. The penultimate section of the paper discusses the results, including all regressions for each country income group and for the world. The paper ends with a conclusion that mentions a few shortcomings of this paper that should be considered in a further study of the results found in this paper.

2 Past litterateur

In this section, a number of earlier litterateur has been reviewed and included. Some of them deal with a country-level panel regression analysis examining the impact of health spending on economic growth.

The paper Piabuo and Tieguhong (2017) examines and analyses the impact of health spending in five African countries that are signatories to the Abuja Declaration and the countries of the CEMAC subregion. The data selected for the paper are from the World Development Indicators database, which is also used for this paper. The authors used panel regression with ordinary least squares, fully modified ordinary least squares, and dynamic ordinary least squares. They found that health expenditure has a significant positive correlation with GDP in both the five African countries that signed the Abuja Declaration and the countries in the CEMAC subregion. However, the paper does not consider reverse causality.

The positive relationship between health spending and GDP was also shown in Atilgan et al. (2017)'s study, which examined this issue at the Turkish economic level. However, their approach to this issue is different as they use an ARDL model to study the short and long term impact of health spending on economic growth.

Another country level study Mehrara and Musai (2011) examines the relationship between Health expenditure and GDP for Iran. Nearly 40 years of annual data were used along with The Gregory-Hansen (1996) cointegration technique, to examine the long-term effects of health spending and GDP. The Granger Causality test of their study showed that health spending does not promote long-term economic growth. This result differs from that of the first two studies, which found a positive relationship between health spending and economic growth. Thus, this is either a strong indication that there is reverse causality that needs to be considered, or/and these results depend on what country-level data are examined.

This is again the case with health expednitutre and economic growth in Nigeria when it comes to the paper of Bakare and Olubokun (2011). Here, OLS multiple regression was used to analyse this relationship and the result, like most of these papers, showed that there is a positive relationship between health care expenditure and economic growth. The study even suggests that the Nigerian government should increase its annual budget for the health sector.

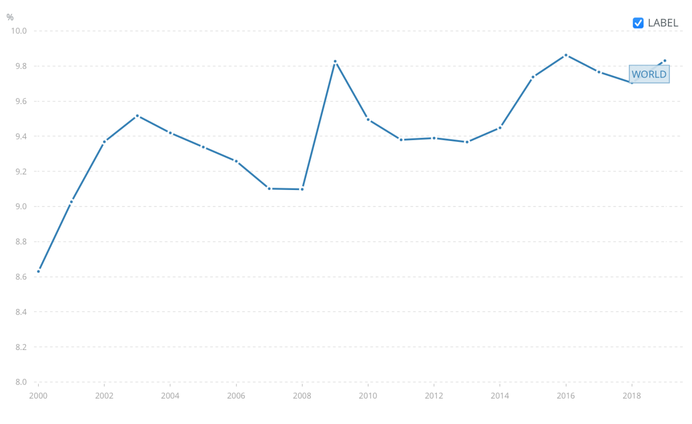
Another Granger causality method was used in a study with southern Indian state-level data for the period 1960-2009,Balaji (2011). The result of this paper was that there is no relationship between health spending and economic growth in these states. The paper does mention unidirectional causality for one state, but does not specify why only that one state suffers.

The reviews shown in this section do not use the same exact approach as each other, but most of them conclude that there is a positive relationship between health spending and economic growth. These reviews are only at the country level, and focusing on reverse causality is not sufficient.

3 Method and data description

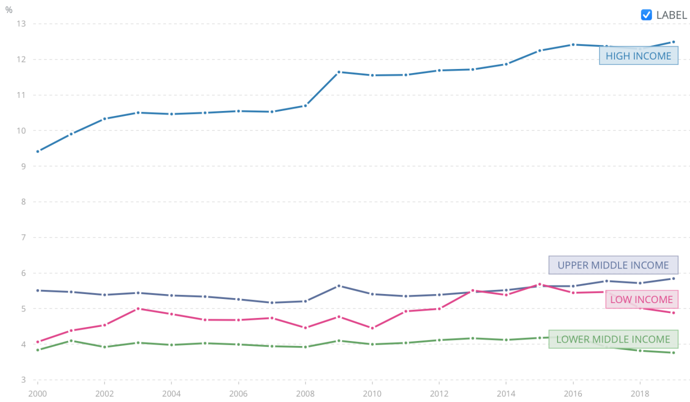
3.1 Data description

The current Health expenditure has since the year of 2000 been increasing world wide. The current Health expenditure has increased from 8.6 percent of GDP in 2000 to 9.13 percent of GDP in 2019. there has been some decline in the expenditure after the finance crises in 2008, however increased again after 2014. This increased trend of the current Health expenditure can be seen in the below table



Figur. 1: Current Health expenditure % of GDP world wide for year 2000 to 2019, The world bank (2022b).

However, when differentiating countries by income level, we can observe that the Health expenditure has increased the most in high-income countries, while the other



Figur. 2: Current Health expenditure % of GDP income groups for year 2000 to 2019, The world bank (2022c).

income groups are more similar and health spending has increased less compared to high-income countries, see table and figure 2.

Even though we can see these health expenditures from 2000 to 2019 in the charts above, they do not tell us anything about how health expenditure prices affect GDP per person. Therefore, further analysis needs to be done, such as a panel data regression in the next section of this paper.

The data set for this paper is a balanced panel data set for the period 2000-2019, covering 172 countries worldwide [1]. The data come from the World Development Indicators database and the World Health Organization's Global

World Health Organization health expenditure database The world bank (2022b). The selected dependent variable is GDP per capital, and the selected independent variable is current health expenditure as a percentage of GDP. In this case, both variables have been log transformed. For more information, see the following table

Variable	Number of observation	Long description
Year	3440	From Year 2000 to 2019
Country	3440	Se appendix for country list
LOGCEP	3440	Logarithmic transformation of Current health expenditure (% of GDP)
LOGGDP	3440	Logarithmic transformation of GDP per capita, PPP (constant 2017 international $)

[1] See the full list of countries on page 21

3.2 Method

To measure the effect Health expenditure on GDP capital, the following simple model equation was constructed. Here, all variables are converted to logarithmic form.

$$LOGGDP_{it} = \alpha + \beta * LOGCEP_{it} + u_{it} \tag{1}$$

where t = 1, 2, ..., T is the time period and i = 1, 2, ..., N is the cross-section data, and u_{it} is the error term.

The method that has been used is simple panel regression analysis with Pooled OLS, Random and Fixed-effects regression models. The dummy variables for year and country are included in the Random effects model, but only the dummy variable for year is included for the Fixed effect, as the dummy variables for country are omitted for the fixed effect. Three test is carried out to determine which model fits best. One test is the Hausman test, which compares the random effect to the fixed effect. The second test performed is the Breusch and Pagan Lagrange multiplier test, which compares the random effect to the pooled OLS. Finally, an F-test comparing the fixed effect with the pooled OLS, with the null hypothesis $u_i = 0$.

This method is applied to equation 1, which is the base model of this study. However, to capture the impact of Health expenditure on GDP capital based on country income level, the data is will be divided based on each countries income level classifies by the World Development Indicators. The world bank (2022a) After the income division the same method and model used for the baseline and global regression are applied to each income group to see if there are any differences in health expenditures. The full country income list can be found on page 21: income level 1 corresponds to low income groups, income level 2 corresponds to lower middle income groups, income level 3 corresponds to upper middle income groups, and finally income level 4 corresponds to high income groups.

	OLS	Fixed	Random
LOGCHE	-0.157***	-0.0364	-0.0364
	(0.0357)	(0.0258)	(0.0264)
Constant	8.811***	7.989***	6.463***
	(0.250)	(0.208)	(0.216)
Year Dummy	NO	YES	YES
Country Dummy	NO	Omitted	YES
Observations	3440	3440	3440
r2	0.0239	0.00453	
Number of Groups	172	172	172

Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Panel regression result for Pooled ols, Fixed effect and Random effect for baseline model and global group

4 Result

4.1 Global

4.1.1 Pooled ols

The regression for the Pooled OLS has a significant result for the effect of the log Health expenditure coefficient on log GDP per capita. This is due to the p-value being below 0.05. The coefficient for Health expenditure has a value of -0.152 meaning that for each time Health expenditure goes up by 1 the log GDP per capita will decrease by -0.152. The r^2 is 0,0239 this means that the independent variable can explain 2,39 percent of the variance for the dependent variable, which is on the lower site. The result of the pooled OLS can be seen in table 1.

In addition to the pooled OLS estimation, three diagnostically test has been made. Firstly, one test that tests the normality of the data by Jarque-Bera normality test. Here the null hypothesis is that we test for normality. The result of Chi(2)=0 means that our data is not normally distributed, since it is below 0.05.

Secondly, one test tests whether the data suffer from multicollinearity. The result has been here that the data do not suffer from multicollinearity. This is due to VIF results below 10.

Thirdly and lastly, one test that tests if the data suffers from Heteroscedasticity. Here it has been found that the data do suffer also from Heteroscedasticity since the p-value is below 0.05.

To cover all these above, the robust standard error for OLS in table 1 has been taken and clustered around the country.

4.1.2 Fixed Effects and Random effects

For our fixed effect result, we have that the coefficient of LOGCHE is not significant. However, for the log health expenditure, we have the coefficient value being -0.0362 which means that health expenditure is negatively correlated with GDP growth even though is not significant. These result can be seen in table 1 and is identical to the random effect. However, there is a slight difference in the robust standard error in parentheses when comparing the Fixed and random models. Additionally, the estimation has been clustered around 172.

4.1.3 Comparison of all regression models for the baseline model

In this section two test results will be interpreted, to find out which of the three models is the best-fitted model for our interest.

The first test that has been made is the Hausman test, which compares the fixed effects with the random effects. The result of this test has been that the fixed effect is the better fit for our model. This is because the p-value is below 0.05 and that means that we can reject the null hypothesis in which there is no difference in the coefficient therefore we need to use the fixed effect model for our analysis.

The second test that has been made is the Breusch and Pagan Lagrangian multiplier test, that test the presence of the random effect. The result of the test has been insignificant since we have a p-value above 0,05 which means that pooled OLS is preferred over Random effect.

Lastly, we have that the Fixed effect is preferred over Pooled OLS this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$.

4.2 Low income groups

	OLS	Fixed	Random
LOGCHE	-0.0273	-0.0576	-0.0576
	(0.105)	(0.0839)	(0.0861)
Constant	7.464***	7.801***	7.891***
	(0.779)	(0.688)	(0.758)
Year Dummy	NO	YES	YES
Country Dummy	NO	Omitted	YES
Observations	400	400	400
r2	0.000368	0.0319	
Number of groups	20	20	20

Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Panel regression result for Pooled ols, Fixed effect and Random effect for low income country groups

4.2.1 Pooled OLS

For the low-income country groups, the regression for the Pooled OLS has an insignificant result for the effect of the log Health expenditure coefficient on log GDP per capita. This is due to the p-value being above 0.05. The coefficient for Health expenditure has a value of -0.0273 meaning that for each time Health expenditure goes up by 1 the log GDP per capita will decrease by -0.0273. The r^2 is equal to 0.000368, this means that the independent variable can explain the variance for the dependent variable at a very low percent. The result of the pooled OLS for the low-income country groups can be seen in table 2.

4.2.2 Fixed Effects and Random effects

For our fixed effect result, we have that the coefficient of LOGCHE is not significant. However, for the log health expenditure, we have the coefficient value being -0.0576

which means that health expenditure is negatively correlated with GDP growth even thought is not significant. These result can be seen in table 2 and is identical to the random effect. However, there is a slight difference in the robust standard error in parentheses when comparing the Fixed and random models. Additionally, the estimation has been clustered around 20 countries groups.

4.2.3 Comparison of all regression results for low-income groups

The result of the Hausman test has been that the fixed effect is the better fit for our model. This is because the p-value is above 0.05 and that means that we can not reject the null-hypothesis of which there is no difference in the coefficient, therefore, we need to use the fixed model for our analysis concerning low-income country groups. The result of the Breusch and Pagan Lagrangian multiplier test has shown insignificant results since we have a p-value above 0,05 which means that pooled OLS is preferred over Random effect.

Lastly, we have that the Fixed effect is preferred over Pooled OLS this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$.

4.3 Lower middle income groups

4.3.1 Pooled OLS

For the lower middle-income groups, the regression for the Pooled OLS has an insignificant result for the effect of the log Health expenditure coefficient on log GDP per capita. This is due to the p-value being above 0.05. The coefficient for Health expenditure has a value of -0.0934meaning that for each time Health expenditure goes up by 1 the log GDP per capita will decrease by -0.0934. The r^2 is equal to 0.00830, this means that the independent variable can explain the variance for the dependent variable at a very low percent. The result of the pooled OLS for the low-income country groups can be seen in table 3.

4.3.2 Fixed Effects and Random effects

For our fixed effect result, we have that the coefficient of LOGCHE is not significant. However, for the log health expenditure, we have the coefficient value being -0.0136

	OLS	Fixed	Random
LOGCHE	-0.0934	-0.0136	-0.0136
	(0.0660)	(0.0413)	(0.0423)
Constant	8.581***	8.074***	6.305***
	(0.420)	(0.289)	(0.306)
Year Dummy	NO	YES	YES
Country Dummy	NO	Omitted	YES
Observations	1000	1000	1000
r2	0.00830	0.0106	
Number of groups	50	50	50

Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Panel regression result for Pooled ols, Fixed effect and Random effect for the lower middle income groups

which means that health expenditure is negatively correlated with GDP growth even thought is not significant. These result can be seen in table 3 and is identical to the random effect. However, there is a slight difference in the robust standard error in parentheses when comparing the Fixed and random models. Additionally, the estimation has been clustered around 50 countries groups.

4.3.3 Comparison of all regression results for lower middle-income groups

The result of the Hausman test has been that the random effect is the better fit for our model. This is because the p-value is below 0.05 and that means that we can reject the null-hypothesis of which there is no difference in the coefficient, therefore, we need to use the Random effect model for our analysis regarding lower middle-income country groups. The result of the Breusch and Pagan Lagrangian multiplier test has shown insignificant results since we have a p-value above 0,05 which means that pooled OLS is preferred over Random effect. Lastly, we have that the Fixed effect is preferred over Pooled OLS this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$.

4.4 Upper middle income groups

	OLS	Fixed	Random
LOGCHE	-0.189*	-0.0785	-0.0785
	(0.0763)	(0.104)	(0.106)
Constant	8.576***	8.035***	0
	(0.560)	(0.761)	(.)
Year Dummy	NO	YES	YES
Country Dummy	NO	Omitted	YES
Observations	960	960	960
r2	0.0221	0.0265	
Number of groups	48	48	48

Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Panel regression result for Pooled ols, Fixed effect and Random effect for the upper middle income groups

4.4.1 Pooled OLS

For the upper middle-income groups, the regression for the Pooled OLS has a significant result for the effect of the log Health expenditure coefficient on log GDP per capita. This is due to the p-value being below 0.05. The coefficient for Health expenditure has a value of -0.189 meaning that for each time Health expenditure goes up by 1 the log GDP per capita will decrease by -0.189. The r^2 is equal to 0.0221, this means that the independent variable can explain the variance for the dependent variable around 2,21 percent. The result of the pooled OLS for the low-income country groups can be seen in table 4.

4.4.2 Fixed Effects and Random effects

For our fixed effect result, we have that the coefficient of LOGCHE is not significant. However, for the log health expenditure, we have the coefficient value being -0.0785

which means that health expenditure is negatively correlated with GDP growth even though is not significant. These result can be seen in table 4 and is identical to the random effect. However, there is a slight difference in the robust standard error in parentheses when comparing the Fixed and random models. Additionally, the estimation has been clustered around 48 countries groups.

4.4.3 Comparison of all regression results for Upper middle-income groups

The result of the Hausman test has been that the fixed effect is the better fit for our model. This is because the p-value is above 0.05 and that means that we can not reject the null hypothesis of which there is no difference in the coefficient, therefore, we need to use the fixed effect model for our analysis regarding upper middle-income country groups. The result of the Breusch and Pagan Lagrangian multiplier test has shown insignificant results since we have a p-value above 0,05 which means that pooled OLS is preferred over Random effect. Lastly, we have that the Fixed effect is preferred over Pooled OLS this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$.

4.5 High income groups

4.5.1 Pooled OLS

For the high-income groups, the regression for the Pooled OLS has a significant result for the effect of the log Health expenditure coefficient on log GDP per capita. The significance is at the 0,001 p-value level. The coefficient for Health expenditure has a value of -0.132 meaning that for each time Health expenditure goes up by 1 the log GDP per capita will decrease by -0.132. The r^2 is equal to 0.0808, this means that the independent variable can explain the variance for the dependent variable around 8,08 percent. The result of the pooled OLS for the low-income country groups can be seen in table 5.

4.5.2 Fixed Effects and Random effects

For our fixed effect result, we have that the coefficient of LOGCHE is not significant. However, for the log health expenditure, we have the coefficient value being 0.0124

	OLS	Fixed	Random
LOGCHE	-0.132***	0.0124	0.0124
	(0.0278)	(0.00773)	(0.00793)
Constant	9.001***	7.754***	0
	(0.171)	(0.137)	(.)
Year Dummy	NO	YES	YES
Country Dummy	NO	Omitted	YES
Observations	1080	1080	1080
r2	0.0808	0.167	
Number of groups	54	54	54

Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Panel regression result for Pooled ols, Fixed effect and Random effect high income country groups

which means that health expenditure is positively correlated with GDP growth even though is not significant. These result can be seen in table 5 and is identical to the random effect. However, there is a slight difference in the robust standard error in parentheses when comparing the Fixed and random models. Additionally, the estimation has been clustered around 54 countries groups.

4.5.3 Comparison of all regression results for high-income groups

The result of the Hausman test has been that the fixed effect is the better fit for our model. This is because the p-value is above 0.05 and that means that we can not reject the null hypothesis in which there is no difference in the coefficient, therefore, we need to use the fixed effect model for our analysis concerning high-income country groups. The result of the Breusch and Pagan Lagrangian multiplier test has shown insignificant results since we have a p-value above 0,05 which means that pooled OLS is preferred over Random effect. Lastly, we have that the Fixed effect is preferred over Pooled OLS this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$.

4.6 Comparing of all models on for all groups

This section further discusses the results and compares the results of all the estimates for each group to better understand if there is a difference between the global estimate and the groups of all income countries.The pooled OLS estimation shows that the coefficient of LOGCHE is significantly and negatively correlated with LOGGDP at the global level. This is also true for all other income country groups, except that the coefficient of LOGCHE is not significant for the low- and lower-middle-income groups. For each income group, we found that the effect of LOGCHE on LOGGDP is higher for the high and upper-middle income groups and lower for the other income groups.The fixed effect estimation showed that the coefficient of LOGCHE is not significantly and negatively correlated with LOGGDP on a global basis. This is also true for all other income country groups, except for the coefficient The Random effect estimation has shown that the coefficient of LOGCHE is insignificant and negatively correlated with LOGGDP on a global basis. This is also the effect in regards to all the other income country groups, except the coefficient of LOGCHE being insignificant and positively correlated with LOGGDP for high-income groups. Additionally, we again have that the negative effect LOGCHE on LOGGDP is lowest for lower middle countries and high-income countries and highest for the low-income countries and upper middle countries.

One should also notice that in the different country groups, the low-income groups have an observation number of 400 while the rest of the groups have an observation number of around 1000. This may affect different estimation results for the low-income groups since there is less observation than the other groups. The r^2 is also very different when we compared the level of r^2 for the global basis and the different income group's levels. Here is r^2 much lower for the low and lower middle-income groups compared to upper-middle and high-income groups in addition to the global result. The Fixed effect is preferred over Pooled OLS in all of the regression cases made in this paper, this is due to the F-test resulting in an F-value below 0.05 and thereby rejecting the case that $u_i = 0$. For the global estimation, the fixed effect is preferred over the random effect when we performed the Hausman test. This is true for all the income country subgroups estimation except for lower middle-income countries that preferred random effect over fixed effect. This result does not make sense, since the Pagan Lagrangian multiplier test for lower middle-income countries showed that Pooled OLS is preferred over random effect and again the F test showed that the fixed effect is a better choice than the Pooled OLS. This might be due to some shortcomings and limitations of the paper.

5 Conclusion

The goal and purpose of this paper was to examine the impact of current health expenditure from 2000 to 2019 on the Gross Domestic Product (GDP) per capital. Here a global effect and an effect on country income were considered.The results of this paper have shown that for the global estimation, the fixed effect is the best fit and that LOGCHE is negatively correlated with LOGGDP but is not significant with respect to the best fit, the fixed effect estimation.The result with respect to income groups is almost similar to that of the global estimate. Here, the fixed effect was found to be preferable to the random effect and the pooled OLS estimation. This is true for all income groups except the lower middle income group, which did not produce results in the best-fit models. Another finding is that LOGCHE is negatively correlated with LOGGDP but is not significant with respect to the best-fit fixed effect estimate. This is true in all cases except for the high income groups, which show a positive correlation between LOGCHE and LOGGDP, but it is still not significant. Even though this result is not significant, the overall result could indicate that LOGCHE is negatively correlated with LOGGDP in most cases. Furthermore, because we found a positive correlation between LOGCHE and LOGGDP, this could indicate that these results may vary from country to country. However, this may be difficult to say because this study has some, if not many, limitations. It should be noted how simple the model is in this paper and that more independent variables could have improved the result. This is because current health care expenditure depends on a variety of factors, including demographic, social, economic, financing, and policy decisions about the health care system. It should also be noted that the result may suffer from reverse causality. This means that additional steps must be taken in the analysis to account for this. The paper needs to find a IV instrument or perform a GMM estimation to account for reverse causality. This could also lead to a different estimation result than in this paper.

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