Panel Modelling of Health Expenditure per Capita and percentage of GDP on Infant Mortality Rate

Uyoyou-Oghene Emamusi Ogbonda & Isaac Didi Essi
Department of Mathematics,
Faculty of Science,
Rivers State University,
Nkpolu Orowokuoro, Rivers State,
Nigeria.

Abstract
This study evaluated the effect of health expenditure per capita and the percentage of health expenditure from Gross Domestic Product (GDP) on Infant Mortality Rate (IMR). The dataset analysis was taken from the year 2005 to 2014. The three European countries chosen were namely; Luxembourg, Latvia and Estonia which have low IMR. While the two African countries were namely; Nigeria and Ghana have high IMR. The panel data sets of these five countries were modelled in three model methods. The model methods used are Pooled Ordinary Least Squares (POLS); Fixed Effect Model (FEM) and Random Effect Model (REM). These models were analyzed on a statistical software Stata version 14. The three specification model test chosen were; Hausman test, Breusch and Pagan Langrangian Multiplier test and F-test in order to aid in model selection. The result from the Hausman test showed REM is better than FEM. The F-test indicated that POLS is better than FEM. While the Breusch and Pagan Lagrangian Multiplier test result rejected its null hypothesis; indicating REM is better than POLS. After the test results of three model specification test; REM was chosen as the best model. Firstly, the REM analysis showed in general that health expenditure is significant but not the percentage of GDP on health expenditure. The correlation of the independent variable to error term was zero. Implying that IMR effect is not correlated with explanatory variables. Secondly, each country with its explanatory variables were specified to get in-depth analysis. From the REM analysis theta (θ=0) was zero. This meant that the REM is no different from POLS in the detailed analysis of each country. The three European countries showed that health expenditure and the percentage of GDP on health expenditure has no significant effect on IMR. But for Ghana and Nigeria, these factors were highly significant and had a negative correlation with their IMR. As the health expenditure and GDP percentage increases, IMR reduces and vice versa. In conclusion, REM is chosen as the best model. In the detailed analysis of the five countries, REM and POLS were not different from each other. And for the IMR of the African nations to reduce; health expenditure and the percentage of health expenditure from GDP should be increased.

1.0 Introduction

This researcher investigates causal relationship of health expenditure per capita (Current US$) and the health expenditure total, percentage of Gross Domestic Product (GDP) on Infant Mortality rate (IMR) per 1,000 live births. IMR is the number of deaths of infant under one year of age per 1,000 live births.

Innumerable health complications lead to high infant mortality rate, low life expectancy, low fertility rate, maternal mortality rate etc. This is a result of scarce health resources. The unavailability of these resources is among of the reasons why death rates increase. The lack of investment in the health sector and not acting promptly to address environmental and social determinants of health is a serious restraint. The main objective should be upgrading health expenditure globally but most importantly in Africa; as Africa registers massive global maternal and infant mortality (Nwakuya and Ijomah, 2017).

Health expenditure per capita (current US$) is the sum of the private and public health expenditure as a ratio of total population of a nation. These expenses cover health services (both preventive and curative), family planning with nutritional activities and emergency aid designated for health. According to World Health Organization (WHO) desideratum; "health for all" is the global entitlement to health that should be guaranteed for everyone.
Five countries are picked to view the causal relationship. In Europe, Luxembourg, Estonia and Latvia were picked with average fertility rate of 1.58, 1.59 and 1.47 and IMR of 2.41, 3.95 and 6.74. Comparing the two nations picked in Africa; namely Ghana and Nigeria. Nigeria and Ghana have an average fertility rate of 5.83 and 4.29 with IMR of 83.0 and 50.75 respectively. The data analysis from 2005 to 2014 (World Bank Statistics) of these countries in Europe to African nations could be positively or negatively significant.
The commitment and political will of leaders in every country is the ability to translate the health care expenses to a sound system for financing every area of the health sector. Can the statistics of the mentioned countries show proper appropriated expenses of health on IMR? In the review of the literature and an analysis between Economic Community for Central African Countries (CEMAC) and selected African nations; it pointed out a declaration made in Abuja, 2010 (Bakare and Olubokun, 2011).

The Abuja declaration introduced investment of 15% of government budget on health and to have less than 20% of the total health expenditure coming from out-of-pocket spending. But as at 2013, only Botswana met the target. Nigeria is among the countries yet to comply with this declaration.
Other researchers have also shown how health expenditure can improve the economic growth. An example of this is from research done by Erdogan*et al* (2013). He proved this positive relationship between health expenditure and economic growth using samples of member countries in Organization for Economic Cooperation and Development (OECD) from 1970 to 1992.

Jones (2007) also applied the panel data methods (Hsiao; 1992, 2003, 2007) in health economics but is on linear models. Using these methods to see if it can determine the influence of policies from the chosen data sets (Gujarati, 2004). The working paper cited numerous health economists and how they applied same methods to highlight challenges in the health sector. An example of this is from Dranove *et al* (2003). They used same methods to know the impact of health expenses on patients with coronary health disease (CHD) who are receiving coronary artery bypass graft (CABG).

Another publication by Barenberg *et al* (2012) on "The Effect of Public Health Expenditure on Infant Mortality: Evidence from a panel of Indian States, 1983-84 to 2011-2012. The paper studied the impact of public health expenditure on IMR after controlling covariates like capita income, female literacy and urbanization. An unbalanced panel (Woolridge; 2002, 2006) of 31 Indian states were used. They used instrumental variable strategy. The results showed that public expenditure on health care as a share of state-level GDP was negatively associated with state-level infant mortality rates. They also found an increase in female literacy and urbanization to be associated with lower IMR.

In the *Asian Journal of Epidermiology*, Uddin and Hossain (2008) did a research on what are the predictors of Infant mortality in developing countries. The IMR varied consequentially by several factors. They pointed out that the likelihood of an infant dying is also closely related to the surroundings and lifestyle. The education of the mothers was negatively correlated with IMR. From the research, they found out those women who were far more educated had less chances of losing their children at an early age.

Osawe (2014) published his research on “Determinant of Infant mortality rate: A panel Data Analysis of African countries” examined factors that affect infant mortality. He looked at 53 African countries using panel data and concluded after his empirical research that, fertility rate significantly affected infant mortality rate in a positive way.

Public health expenditure and health outcomes in Nigeria by Edeme*et al* (2017). They investigated the effect of public health expenditure and its health outcomes in Nigeria where it indicated a long-run equilibrium relationship. Furthermore, it showed that if there was an increment in health expenses, it would enhance life expectancy and thus, bring a declined IMR.

Vaidean and Ferent-Pipas (2015) examined the effect of healthcare expenditure and how best to improve the health sector by looking at the determinants and implications of some factors. Thirty-four countries were examined. They suggested from their result that though, the mortality rate of infants maintained a steady downward trend, it was not an indication that citizens of a nation have healthier lives.
Comparing the publications of these outstanding researchers; many countries have not met their sustainable goals in the health sector. The modern concept of Sustainable development (SD) was derived mostly from 1987 Brundtland Report. From sustainable forest management to the twentieth century, other concerns including the environment, social and economic development arose.
Sustainability is the practice of maintaining processes which could aid in replacing resources used. The resources replacements are items/things which are equal or greater value without endangering natural biotic systems. Among these concerns, health of an individual is also addressed.

It is addressed by the Sustainable Development Goal three (SDG3s). SDG3s is “good health and well-being”. Each of the SDGs has specific targets to be achieved in 2030. And reaching these goals requires the action of all. The government, businesses, civil society and people everywhere all have a role to play (Ogbuabor*et al,* 2013).
In SDG3s, Target 3.1 aims to reduce global maternal mortality ratio to less than seventy per 100,000 deaths and Target 3.2 aims at “ending preventable deaths of newborns and children under five years of age. The question arises as to how to meet the aims of each target. But this paper arose from looking at target 3.2 at the IMR.

Can the health expenditure of Luxembourg be a key factor to their economic growth and reduction in IMR as well? Is Nigeria’s economy suffering due to the low health expenditure? These questions brought about these investigations. Investigating Luxembourg, Latvia, Estonia, Ghana and Nigeria to know the differences and impact using panel datasets.
These are the issues that need to be addressed by this paper. The following are the questions which this research need to investigate:

- Which specification test to use in selection?
- Would Stata give a good analysis?
- If health expenditure and its percentage in GDP affect IMR?

- Is there any effect of these factors on the five chosen countries?
- Is there any effect of these factors on each country?
- Can knowing the relationship of these factors, show a way to reduce IMR?

The basic aim of this dissertation is to select a panel model that best interprets the causal effect of health expenditure per capita and health expenditure total (percentage of GDP) on IMR.
The objectives of this dissertation are as follows:

- This paper investigates causal relationship of health expenses with the percent of GDP on IMR per 1,000 live births.
- This paper determines best model by performing tests (Hausman 1978) on Fixed Effects (FE), Random Effects (RE) and Pooled Ordinary Least Squares (POLS).
- This also is a proper review and reporting of Target 3.2 of SDG3s in Nigeria.

The significance of the study is to Point to a few areas which can reduce IMR is of great importance. Knowing the causal relationship of health expenditure to IMR is key. If the relationship is a negative one, then increased health expenses would reduce IMRs.
Taking a look into the European countries could it point Nigeria and Ghana to the right direction. In the event of following the Abuja Declaration, could it aid in the reduction of IMR? Health is wealth and a nation with a good healthcare plan increases its economic growth.
The limitations encountered during the research were as follows:

- Analyzing the selection of model based on using the test results.
- The data input and not specifying the data which can give a wrong interpretation.
- Not understanding the commands in Stata can be a limitation.
- Not knowing how to handle a string variable.
- Some countries had unavailable data for 2016 and 2017, which limited data to 2015.

Finally, the challenge faced by researchers is which of these models is best? One of the ways to solve the challenge is by performing specification tests on the models.

2.0 Methodology

One fundamental goal of statistical modeling is to use the appropriate model that still explains the data. This is the reason for experimenting with FEM, REM and POLS in the study. A panel dataset that is used is from World Bank's World Development Indicator database.
The model variables are Y, X and W. The letter Y represents IMR. X represents the health expenditure per capita while W represents percentage of GDP put into health expenditure.

2.1 Stata presentation.

The total number of observation is 50 while the group is 5 (ie. the five countries), with each group having an observation of 10. STATA does not understand string variables and as such, Idcode represents the countries.
Idcode_1: Luxembourg as base country.
Idcode_2: Latvia
Idcode_3: Estonia
Idcode_4: Ghana
Idcode_5: Nigeria
The dependent variable- Y,and the two independent variables – X and W.

2.2 Model specification

The models use the following in their model:
$\alpha$is the common intercept model.
α_i is the individual effect.
μ_{it} ,$\mathcal{E}_{it}$ the idiosyncratic error term.
$\mathcal{E}_i$is the random error term with a mean value of zero and variance of $\boldsymbol{\sigma}^2_{\mathcal{E}}$.
iis the country (individual) in a cross section, i =1, 2,…,5.
t is the time period ; t = 1,2,……,10.
β's is the coefficient of the dependent variables.
And in each model, the following hypothesis testing is used:
H_0: the model is not significant
H_a: the model is significant
Decision rule: reject H_0 if P-value < 0.05 if Prob>F = 0.000 as seen in the models.

2.2.1 Specification of POLS

Using the individual-specific-effect:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 W_{it} + \mathcal{E}_{it} \quad (2.0)$$

From the equation (3.1), the POLS model becomes: α_1 &$\mathcal{E}_{it}$.

$$Y_{it} = \alpha + \beta_2 X_{it} + \beta_3 W_{it} + (\alpha_i - \alpha + \mathcal{E}_{it}) \quad , i =1, 2,\ldots,5 , t = 1,2,\ldots\ldots,10. \quad (2.1)$$

$(\alpha_i - \alpha + \mathcal{E}_{it})$ is the error term,

2.2.2. Specification of FEM.

From equation 2.0, FEM takes into variations; "within variation" and a "between variation". Where the variations over time is the health expenditure annually and across the countries.

$$Y_{it} = \alpha_i + \lambda_t + \beta_1 X_{it} + \beta_2 W_{it} + \mathcal{E}_{it} \quad (2.1)$$

Where λ_t is the time effect.
and the variation over time for each country mean; $X_i = (^1/_t) (\sum_t X_{it})$;
$W_i = (1/T)(\sum_t W_{it})$.
So; Within variation S^2_w for $X_{it} = (^1/_{(nt-1)}) \sum_i\sum_t(X_{it} - \dot{X}_i)^2$ and
S^2_w for $W_{it} = (^1/_{(nt-1)}) \sum_i\sum_t(W_{it} - \dot{W}_i)^2$
where$\dot{X}_i = (^1/_{ti}) \sum^t_1 X_{it;}$ $\dot{W}_i = (^1/_{ti}) \sum_t W_{it}$
Between variation S^2_B for $X_{it} = (^1/_{(n-1)}) \sum_i(X_i - \dot{X})^2$ and
S^2_B for $W_{it} = (^1/_{(N-1)}) \sum_i(W_i - \dot{W})^2$
The overall variance S^2_O for $X_{it} = (^1/_{(n-1)}) \sum_i\sum_t (X_i - \dot{X})^2$ and
S^2_B for $W_{it} = (^1/_{(N-1)}) \sum_i\sum_t (W_i - \dot{W})^2$
The within estimator of FE becomes:

$$(Y_{it} - \bar{Y}_i) = \beta_1(X_i - \dot{X}_i) + \beta_2(W_{it} - \dot{W}_i) + (\mathcal{E}_{it} - \acute{\varepsilon}) \quad (2.2)$$

2.2.3 Specification of REM

We assume the random variable with a mean value of α_1 from equation (2.0). The intercept value for an individual unit is expressed as

$$\alpha_{1i} = \alpha_1 + \mathcal{E}_i \quad (2.3)$$

Instead of treating α_{1i} as fixed, α_{1i} is assumed to be random variable with a mean value of α_1.
In the RE model, from equation (2.3) is substituted into equation (2.0), we have

$$Y_{it} = \alpha_1 + \beta_1 X_{it} + \beta_2 W_{it} + \mu_{it} + \mathcal{E}_i \quad , i =1,2,\ldots,5. \ t = 1,2,..,10 \quad (2.4)$$

$$Y_{it} = \alpha_1 + \beta_1 X_{it} + \beta_2 W_{it} + w_{it} \quad (2.5)$$

where $w_{it} = \mu_{it} + \mathcal{E}_i$
$\mu_{it}$is the idiosyncratic error term.

2.3. Data analysis

The data obtained from data.worldbank.org for this paper. The dataset is an annual panel dataset from 2004 to 2015.

2.4 POLS regression in STATA

Table 4.1*Stata analysis of POLS on the effect of X and W on Y*

```
. reg Y X W

      Source |       SS           df       MS      Number of obs   =        50
-------------+----------------------------------   F(2, 47)        =     69.35
       Model |  39637.8228         2  19818.9114   Prob > F        =    0.0000
    Residual |  13431.7222        47  285.781323   R-squared       =    0.7469
-------------+----------------------------------   Adj R-squared   =    0.7361
       Total |   53069.545        49  1083.05194   Root MSE        =    16.905

------------------------------------------------------------------------------
           Y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           X |   .0023606   .0011762     2.01   0.051    -5.48e-06    .0047268
           W |   -24.4374   2.577407    -9.48   0.000    -29.62248   -19.25233
       _cons |   163.2984   13.28227    12.29   0.000      136.578    190.0189
------------------------------------------------------------------------------

.
```

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

2.5 The FEM Stata analysis

Table 4.2*Stata analysis of FEM on the effect of X and W on Y*

```
. xtreg Y X W, fe

Fixed-effects (within) regression               Number of obs     =         50
Group variable: idcode                          Number of groups  =          5

R-sq:                                           Obs per group:
     within  = 0.0760                                         min =         10
     between = 0.0002                                         avg =       10.0
     overall = 0.0000                                         max =         10

                                                F(2,43)           =       1.77
corr(u_i, Xb)  = -0.1110                        Prob > F          =     0.1827

------------------------------------------------------------------------------
           Y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           X |   -.001724   .0021565    -0.80   0.428     -.006073    .0026251
           W |   2.279557   1.301277     1.75   0.087    -.3447181    4.903833
       _cons |   19.77075   8.241451     2.40   0.021     3.150282    36.39122
-------------+----------------------------------------------------------------
     sigma_u |  36.367281
     sigma_e |  4.3617599
         rho |  .98581925   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(4, 43) = 165.75                     Prob > F = 0.0000
```

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

2.6 The REM Stata analysis

Table 3: *Stata analysis of POLS on the effect of X and W on Y.*

```
. xtreg Y X W, re

Random-effects GLS regression                   Number of obs     =         50
Group variable: idcode                          Number of groups  =          5

R-sq:                                           Obs per group:
     within  = 0.0087                                         min =         10
     between = 0.2724                                         avg =       10.0
     overall = 0.2666                                         max =         10

                                                Wald chi2(2)      =       7.09
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0288
```

Y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
X	-.0044214	.0017318	-2.55	0.011	-.0078158	-.0010271
W	-.0738522	1.768317	-0.04	0.967	-3.53969	3.391986
_cons	38.29687	11.29301	3.39	0.001	16.16298	60.43076
sigma_u	9.1584017					
sigma_e	4.3617599					
rho	.81511453	(fraction of variance due to u_i)				

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

2.7 Hausman test.

This test is performed to choose between FEM and REM with the following hypothesis:

H_0: REM is the model

Ha: REM is not the model (FEM preferred)

Conditions: Reject H_0; if p-value is small (less than the significant level of 0.05).

But if the p-value is greater than the significant level of 0.05, it rejects H_a.

Table 4: *Hausman test between FEM and REM*

```
. hausman fe re
```

	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
X	-.001724	-.0044214	.0026975	.0012851
W	2.279557	-.0738522	2.35341	.

```
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        3.39
                Prob>chi2 =      0.1835
                (V_b-V_B is not positive definite)
```

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

2.8 F-test.

This test is performed to determine the preferred model between POLS and FEM.

$F = [(R^2_{FE} - R^2_{POLS})/ J] /[(1- R^2_{FE})/(n-k)]$

R^2_{FE} is R^2 of the unrestricted regression (FE model)

R^2_{POLS} is R^2 of the unrestricted regression (POLS)

J = number of linear restrictions on the first model = 3.

k = number of parameters in the unrestricted regression = 3.

n = NT = number of observations = 50.

F = -8.69956
The calculated value is definitely lower than the value in the F-table ie$F_{(3,47)}$.
The explanatory powers of the two models are not highly significant. The conclusion drawn is the FE Model is invalid.
Observation: The F-test shows POLS is preferred.

2.9 Breusch and Pagan (BP) Lagrangian multiplier test.

This test is performed to choose between POLS and REM with the following hypothesis:
H_0: $\sigma_\mu^2 = 0$.
H_a: $\sigma_\mu^2$is not equal to 0.

Table 5: *BP Lagrangian multiplier test between REM and POLS*

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        Y[idcode,t] = Xb + u[idcode] + e[idcode,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                       Y |   1083.052       32.90975
                       e |   19.02495        4.36176
                       u |   83.87632       9.158402

        Test:   Var(u) = 0
                             chibar2(01) =    16.22
                          Prob > chibar2 =   0.0000
```

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

3.0 Results

The model selection was performed by Hausman test, BP Lagrangian multiplier test and the F-test. The Hausman test preferred REM over FEM. BP test indicated REM is better than POLS and F-test showed POLS is chosen over FEM.

Table 6: *Interpretation of result from Hausman test, BP Langrangian test and F-test*

S/N	**Model**	**Interpretation of result from Stata**	**Hausman test**	**BP Langrangian test**	**F-test**
1	POLS	Model-significant. X - not significant. W – significant. Relationship with Y: X – positive W- negative	N/A	No POLS	POLS
2	FEM	Model-not significant. X - not significant. W – not significant. Relationship with Y: X – negative W- positive	No FEM	N/A	No FEM
3	REM	Model-significant. X - significant. W – not significant. Relationship with Y: X – negative W- negative	REM	REM	N/A

***Note*:** This is the summary of the specification tests performed in Stata version 14.2.

Table 7: *REM- a detailed analysis of each country and how the two factors affect each country*

```
. xtreg Y X W i.idcode i.idcode#C.X i.idcode#C.W, re theta

Random-effects GLS regression                   Number of obs     =         50
Group variable: idcode                          Number of groups  =          5

R-sq:                                           Obs per group:
     within  = 0.9032                                         min =         10
     between = 1.0000                                         avg =       10.0
     overall = 0.9984                                         max =         10

                                                Wald chi2(14)     =   21646.65
corr(u_i, X)    = 0 (assumed)                   Prob > chi2       =     0.0000
theta           = 0
```

Y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
X	-.0002928	.0008838	-0.33	0.740	-.002025	.0014394
W	.1837931	1.230964	0.15	0.881	-2.228852	2.596438
idcode						
2	-6.41792	15.03359	-0.43	0.669	-35.88322	23.04738
3	5.008396	13.85629	0.36	0.718	-22.14943	32.16622
4	38.3142	13.71101	2.79	0.005	11.44112	65.18728
5	82.78142	14.54613	5.69	0.000	54.27153	111.2913
idcode#c.X						
2	-.003514	.0033392	-1.05	0.293	-.0100588	.0030307
3	-.0032826	.0038798	-0.85	0.398	-.0108868	.0043216
4	-.2564061	.0342257	-7.49	0.000	-.3234872	-.189325
5	-.351911	.0278375	-12.64	0.000	-.4064715	-.2973504
idcode#c.W						
2	1.838485	1.67264	1.10	0.272	-1.439828	5.116799
3	-.3469982	1.810345	-0.19	0.848	-3.895209	3.201212
4	5.089222	1.609591	3.16	0.002	1.934481	8.243962
5	6.828017	1.958595	3.49	0.000	2.989242	10.66679
_cons	3.30852	12.74973	0.26	0.795	-21.68048	28.29753
sigma_u	0					
sigma_e	1.5645034					
rho	0	(fraction of variance due to u_i)				

.

***Note*:** The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

Table 8: *POLS detailed analysis of each country and how the two factors affect each country.*

```
. reg Y X W i.idcode i.idcode#C.X i.idcode#C.W

      Source |       SS           df       MS      Number of obs   =        50
-------------+----------------------------------   F(14, 35)       =   1546.19
       Model |  52983.8765        14  3784.56261   Prob > F        =    0.0000
    Residual |  85.6684789        35  2.44767082   R-squared       =    0.9984
-------------+----------------------------------   Adj R-squared   =    0.9977
       Total |   53069.545        49  1083.05194   Root MSE        =    1.5645

------------------------------------------------------------------------------
           Y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           X |  -.0002928   .0008838    -0.33   0.742     -.002087    .0015014
           W |   .1837931   1.230964     0.15   0.882    -2.315196    2.682783
             |
      idcode |
          2  |   -6.41792   15.03359    -0.43   0.672    -36.93774     24.1019
          3  |   5.008396   13.85629     0.36   0.720    -23.12136    33.13815
          4  |    38.3142   13.71101     2.79   0.008     10.47938    66.14903
          5  |   82.78142   14.54613     5.69   0.000     53.25121    112.3116
             |
 idcode#c.X  |
          2  |   -.003514   .0033392    -1.05   0.300     -.010293    .0032649
          3  |  -.0032826   .0038798    -0.85   0.403    -.0111589    .0045937
          4  |  -.2564061   .0342257    -7.49   0.000    -.3258879   -.1869243
          5  |   -.351911   .0278375   -12.64   0.000    -.4084242   -.2953978
             |
 idcode#c.W  |
          2  |   1.838485    1.67264     1.10   0.279    -1.557154    5.234124
          3  |  -.3469982   1.810345    -0.19   0.849    -4.022193    3.328197
          4  |   5.089222   1.609591     3.16   0.003     1.821578    8.356865
          5  |   6.828017   1.958595     3.49   0.001     2.851859    10.80418
             |
       _cons |    3.30852   12.74973     0.26   0.797     -22.5748    29.19184
------------------------------------------------------------------------------
```

.

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

In Table 9, the observation of each country is summarized for easy understanding. Using the p-value ie P >|z|.

Table 9: *The Observation of the Effect of X and Won each country*

S/N	Countries (idcode)	X	W
1	Luxembourg	Not significant	Not significant
2	Latvia	Not significant	Not significant
3	Estonia	Not significant	Not significant
4	Ghana	Significant and negatively correlated to Y	Significant and negatively correlated to Y
5	Nigeria	Significant and negatively correlated to Y	Significant and negatively correlated to Y

Note: The analysis from World Bank data in Appendix which were imported into Stata version 14.2.

4.0 Discussion

The number of groups in the analysis is five. These five units represent the five countries. Table 2, Table 3 and Table 6 show the number of groups but only Table 1 that does not show it. The observation per group is the annual time data of 10 years from 2005 to 2014,making the number of observation 50.

The POLS model is adequate since probability of F is less than the significant level of 0.05 (Table 1). The coefficient of X is not significant but the coefficient of W and the constant term are all significant. However, X is positively correlated with Y while W is negatively

correlated with Y. The total sum of squares in the POLS is 53069.545; of which our model explains 39637.8228 while the residual accounts for 13431.7222. In simple terms, 74.69% of the effect on IMR is from the health expenditure and the health expenditure, total (% of GDP). 25.31% is accounted for by unobserved factors that also affect the IMR.
The FEM is not adequate since probability of F is greater than the significant level of 0.05 (Table 2.) The coefficient of X and W are not significant but the constant term are significant. While X has a negative correlation with Y; W has a positive correlation with Y. In Table 3, REM is adequate since probability of F is less than the significant level of 0.05. The coefficient of X and the constant term; are significant but the coefficient of W is not significant. There is a negative correlation of X and W with Y.

The Hausman test result in Table 4; the p-value (prob> chi (2)) is 0.1835. This value is greater than the significant level of 0.05. Clearly the null hypothesis that REM is the model is accepted. Let us not forget that FEM deals with regressors that are correlated with residuals compared to REM which takes residuals to be uncorrelated random variables.
FEM is seen in Table 4 to be consistent in both hypotheses irrespective of the correlation of the regressors to the residuals. REM on the other hand, is inconsistent in the alternative hypothesis. REM is efficient and hereby consistent meaning there is no correlation with the regressors and the residuals. Hausman test therefore has selected REM to be the preferred model over FEM.

BP Lagrangian multiplier test result between REM and POLS in Table 5 shows that the null ofσ_μ^2 = 0 is rejected and RE Model is selected. The estimated results showed the variance of error term to be 83.87632. The p-value is 0.00 of which is less than the significant value of 0.05. The F-test concluded that POLS was chosen as the calculated value -8.69956 is less than the critical value of $F_{(2, 47)} = 3.20$.

Table 6 gives the summary of the results of the specification tests. FEM on Hausman test and F-test were not considered. And from the Stata analysis of FEM in Table 2, the model was not significant from the onset. Only REM had the effect of X and W to be negatively correlated with Y. Showing health expenditure per capita and the health expenditure total (% of GDP) has a negative relationship with Infant Mortality Rate. The observation from the two specification test, REM was preferred when compared with the other panel models.

In Table 7, REM has a detailed analysis of each country and how the two factors affect each country. The termθ; gives a measure of the relative sizes of the within and between component variances. Another assumption of RE-estimator follows:

- If $\theta = 1$, the RE-estimator is identical with the FE-within estimator; this is possible when $s^2e = 0$
- But if $\theta = 0$. It means that the RE-estimator is identical with the pooled OLS-estimator; this is because $s^2\mu = 0$.

It is also observed that the variance of the error term $\sigma_u^2 = 0$. And with $\theta = 0$, there is no difference between REM and POLS in Table 8. The REM detailed analysis of each country with their individual effect of X and W on IMR is the same with POLS.

Comparing Table 7 and Table 8 of POLS detailed analysis of each country, the $R^2 = 0.9984$ is the same with REM in Table 7. The slight difference with REM and POLS is in the column of P>|z| and P>|t| and the 95% confidence interval. The column of all the coefficients, standard error, z and t are the same. The comparism indeed proves that REM is not different from POLS.

Table 9 shows Ghana and Nigeria to have health expenditure with its % in GDP to be highly significant. With the negative correlation, it means as follows:

- As health expenditure with its % in GDP decrease, IMR increases
- As health expenditure with its % in GDP increases, IMR decreases.

The analysis though showed that health expenditure is not significant to Luxembourg, Latvia and Estonia. There are also other countries which can have same result with the European countries. Other countries that have middle-high IMR which makes health expenses to be significant.

The expenditure for a better health for every citizen is important. Providing the infrastructure is critical as well, but the study here only high-lights the health expenses per capita and the health expenditure total, percentage in GDP.

5.0 Conclusion and Recommendation.

5.1 Conclusion

The causes of IMR worldwide include diarrheal diseases, lower respiratory infections; various infections especially blood infections etc. And IMR is used as the indicator of the level of health in a country. Looking at the statistics of the five countries; the level of health of Ghana and Nigeria is at a very poor level.

The thought to not use IMR as this indicator of level of health of a population brought about a research by Reidpath and Allotey (2003). In the article proved IMR still remains an important indicator of health for a population. It reflected that the structural factors which affect health of entire population also have an impact on IMR.

By 2030, every nation should have met the targets of the 17 goals of SD. Among these goals and their targets; Target 3.2 of SDG3s aims to "end preventable deaths of newborns and children under 5years of age". This can be achieved if Ghana and Nigeria commence action on it. These targets and goals is universal hereby applying to all countries.

All countries aim to have a sustainable development which meets the need of the present generation. Without making a detriment to the ability for the future generation to meet their own needs and sustain themselves (from Brundtland Report). Since Luxembourg, Latvia and Estonia are among countries with low IMR; countries with high IMR can study the policies of nations with low IMR in order to achieve low-ranking rate.

Among the five countries, Nigeria has the highest population followed by Ghana. If Nigeria could take a step in implementation of introducing 15% of government budget, it can go a long way in the reduction of mortality rates including IMR. Making the out-of-pocket reduce as stated, "less than 20%". From the records, Botswana has implemented the introduction increased percentage of their budget.

The out-of-pocket health expenditure (% private) for Luxembourg from 2005 to 2014 is 76.648 to 65.97. Latvia and Estonia from 93.675 to 95.413 and 88.823 to 97.844. Though Ghana and Nigeria are 64.96 to 66.848 and 95.337 to 95.744 respectively, the IMR has not decline to rates of the European countries.

5.2 Recommendations

In view of the analysis conducted in this research work with Stata and from the outcome of our findings, I hereby, offer these recommendations to Ghana and Nigeria:

1. To the Federal Government of Nigeria and Ghana to initiate the agreed percentage of the government budget on health (Abuja Declaration).
2. The citizens of these nations take their health more seriously to avoid an increase in

mortality rate. Education on health is key.

3. More efforts should be made by providing health infrastructures.
4. Reduce the out-of-pocket expenses from citizens which make them turn to cheap fake drugs due to hospital expenses.
5. The Government should increase their financial support to already existing public hospitals.

References

Bakare A.S. &Olubokun, S. (2011). Health care expenditure and economic growth in Nigeria: An empirical study. *Journal of Emerging Trends in Economic and Management Sciences*. Vol 2. Pp. 83-87.

Barenberg, A. J., Basu D. and Soylu C. (2015). The Effect of Public Health Expenditure on Infant Mortality: Evidence from a panel of Indian States, 1983-84 to 2011-2012. *Economics Department Working Paper Series*. 199. Retrieved from https://scholarworks.umass,edu/econ_workingpaper/199

Brundtland, G.H. (1987). Our common future. Report on the World Commission on Environment and Development. Oxford: *Oxford University Press.*

Dranove, D., Kessler, D., McClellan, M. and Satterthwaite, M. (2003). Is more information better? The effects of 'report cards' on health care providers. *Journal of Political Economy* vol. 111, pp. 555-88.

Edeme, R. K., Emecheta C. and Omeje M. O. (2017).Public health expenditure and health outcomes in Nigeria.*American Journal Of Biomedical and Life Sciences*. Vol. 5, No.5,2017, pp. 96-102. DOI: 10.11648/j.ajbls.20170505.13

Erdogan E., Ener M. and Arica, F. (2013): the strategic role of infant mortality in the process of economic growth: An application for high income OECD countries. 9th*International Strategic Management Conference.*

Gujarati, D.N. (2004). Basic Econometrics, fourth edition.Front Matter Preface.The McGraw-Hill.Companies, 2004. Chapter 16

Hausman, J. (1978). Specification tests in econometrics. *Econometrica Vol. 46, No. 6.46:1251–1271* pp. 1251-1271.

Hsiao, C. (1992). Random coefficient models. In: Matyas L. Sevestre P (eds). The econometrics of panel data, first edition.*Kluwer Academic*, Dordrecht, pp 223-241. Reprinted in second edition (1996), pp 410-428.

Hsiao, C. (2003). Analysis of panel data, second edition.*Econometric society monographs*, vol 34. Cambridge University Press, Cambridge.

Hsiao, C. (2007). Panel Data Analysis-Advantages and Challenges.*Sociedad de Estad´ıstica e Investigacio´nOperativa Test* (0000) Vol. 00, No. 0, pp. 1–63

Jones, A.M. (2007). Panel data methods and applications to health economics. HEDG Working Paper 07/18. *The Palgrave Handbook of Econometrics*, Volume II: Applied Econometrics

Nwakuya, M. T. and Ijomah M. A. (2017).Fixed Effect Versus Random Effects Modeling in a Panel Data Analysis; A Consideration of Economic and Political Indicators in Six African Countries, *International Journal of Statistics and Applications*, Vol. 7 No. 6, 2017, pp. 275-279.doi: 10.5923/j.statistics.20170706.01.

Ogbuabor, J. E., Malaolu V. A. and Mba, I. C. (2013). Informality and Bank Performance in Nigeria: A Panel Data Analysis. *Journal of Economics and Sustainable Development*, Vol.4, No.11.

Osawe, O. W. (2014). Determinant of Infant mortality rate: A panel Data Analysis of African countries.

Reidpath, D.D. and Allotey, P. (2003).Infant Mortality Rate as an indicator of population health *Journal of Epidemiology and community Health*, Volume 57, issue 5. DOI: 10.1136/jech.57.5.344.

Uddin, J. (Md) and Hossain, Z. (Md) (2008).Predictors of Infant Mortality in a Developing Country. Asian Journal of Epidemiology, 1:1-16. DOI: 10.3923/aje.2008.1.16. https://scialert.net/abstract/?doi=aje.2008.1.16

Vaidean, V. and Ferent-Pipas, M. (2015).The Infant Mortality Rate in OECD countries-Determinants and implications. DOI: 10.15835/buasvmcn-hort:11484.

Wooldridge J. M. (2002). Econometric Analysis of Cross-Section and Panel Data.Massachusetts Institue of Technology.*The MIT Press* Cambridge.ISBN 0-262-23219-7.

Wooldridge, J. M. (2006). Introductory Econometrics: A Modern Approach. International Student edition.Third edition.*Thomson South-Western* publication, ISBN-10: 0-324-32348-4, ISBN-13: 978-0-324-32348-1.