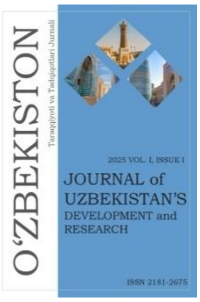


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# MACROECONOMIC DETERMINANTS OF CHILD MORTALITY: AN INVESTIGATION USING A CROSS-SECTIONAL ANALYSIS OF 102 COUNTRIES

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KEYWORDS

Child mortality, GDP, well-being, Pérez-Moreno, Blanco-Arana, Bárcena-Martín.

ABSTRACT

Child mortality remains a critical global challenge, particularly in developing regions such as Africa and South Asia. Despite significant global progress, with child mortality rates dropping from 61% to 37% since 1990, approximately 5 million children under the age of five died in 2020 alone. This research investigates the key determinants of under-five child mortality using cross-sectional data from 102 countries across all income levels for the year 2019. Drawing on existing literature, the study examines the impact of health expenditure, food inflation, gender parity in literacy, aggregate income, and carbon emissions on child mortality. A multiple linear regression model was employed, and assumptions of the classical linear regression were tested and satisfied. The results indicate that increased female literacy and public health expenditure are significantly associated with reductions in child mortality, while food inflation is positively associated with higher mortality rates. In contrast, GDP per capita and $CO_2$ emissions were found to be statistically insignificant in the global context. These findings suggest that governments should prioritize female education and invest more in public health to reduce under-five mortality. Future studies are encouraged to incorporate more variables and broader datasets to further explore regional differences and causal mechanisms.

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## Introduction

Child mortality is one of the most controversial topics in development economics. The severity of the issue can be seen in developing countries, especially African and South Asian

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countries. Although there has been a significant reduction (from 61% to 37%) in child mortality since 1990, the issue is still one of the urgent concerns of the globe. In 2020, the number of children who are under 5 years of age was 5 million. In other words, 13800 children died per day in 2020 (UNICEF, 2021). According to the World Health Organization (2018), improvement in the well-being of children is one of the purposes of the Sustainable Development Goals (SDGs). The SDG Goal 3.2.1 is to eliminate under-5 child mortality by 2030. In this regard, this research is conducted to find out the main determinants of child mortality around the globe. Thus, the aim of the research is to recommend policies to reduce child mortality.

Literature review

In the literature, some of the existing knowledge, which is about the impact of health expenditure, inflation, and literacy on child mortality, is mentioned.

Having used a dynamic panel data approach with world data, Ray and Linden (2019) concluded that public expenditure on health is a significant factor for child mortality and investigated that 10% increase in public expenditure on health will lead to the reduction of infant mortality by 2.31%, on average. Furthermore, it is revealed that there is a significant negative relationship between health expenditure and child mortality rates in low-, lower-middle- and upper-middle-income countries. However, the relation is insignificant in high-income countries (Dhrifi, 2019).

Volatility in food prices might cause to lessen the purchasing power parity of poor families and can lead to undernourishment and high child mortality. In the study of Lee et al. (2013), it is summarized that high and volatile food prices have a significant and negative effect on child mortality, especially in the least developed countries. Similarly, in the research of Lee et al. (2015), it is concluded that rising food prices have a significant effect on infant and child mortality in the least developing countries. The results of the study showed that 10% increase in food price inflation results 2.3% increase in infant mortality rate, on average.

The study of Pradhan et al. (2017) revealed that female literacy is more significant than male literacy in achieving a reduction in child mortality. Similarly, Latif, Ashraf, and Zeeshan's (2019) study in Pakistan presented that male literacy is an insignificant factor for child mortality, while female education is considered a significant factor.

After analyzing the crises of 1982-85 and 1995-96 in Mexico, Cutler et al. (2002) found that economic crises led to an increase in the mortality rate of children and elderly up to 9%. Having used the cross-sectional data of the least developed countries, GDP per capita is revealed to be a significant determinant for child mortality during downturns, while it is not significant during expansions (Pérez-Moreno, Blanco-Arana, and Bárcena-Martín, 2016).

In the research of Zakaria, Tariq, and Husnain (2019), carbon emission is found to be a significant factor in determining child death in South Asia and it is stated that 1% increase in carbon emission will increase child mortality by 1.254%. The study about energy use in Africa revealed that 1% increase in carbon emission will lead to 4% increase in child mortality, on average (Shobande, 2019).

To summarize, investigations of previous studies revealed that health expenditure, inflation, and carbon emission are significant factors for child mortality. However, it is ambiguous whether mother education is a more significant factor in the reduction in child mortality than father education. Finally, the effect of the aggregate income is subtle according to the business cycle.

## Materials and Methods

### Data overview

According to the empirical literature review, public health expenditure, food inflation, female and male literacy, aggregate income and carbon emission are found to be the essential determinants of child mortality and, thus, variables are chosen accordingly. All figures, which are used in this report, are obtained from the database of World Bank. Furthermore, cross-sectional data of 108 countries from all income divisions have been analyzed to determine the factors of child mortality in 2019[2]. The detailed information about the variables is given in the table below. In addition, the raw data of all variables is available in Appendix 1.

Summary of variables

| Variables (Abbreviations) | Variable definitions | Measurement units |
|---|---|---|
| **Under-five mortality rate (U5MR)** | Probability (per 1000) of dying a child before the age of 5 | Percentage |
| **Domestic general government health expenditure per capita, PPP (HE)** | Public expenditure on health per capita at purchasing power parity | USD |
| **Inflation (Consumer Price Index) (INF)** | Annual percentage change in the cost of acquiring a basket of goods | Percentage |
| **Gender parity index in literacy rate (GPILR)** | The ratio of literate female to literate male | Percentage |
| **GDP per capita (GDPpercapita)** | GDP divided by mid-year population. | USD |
| **CO2 emissions (CO2)** | Carbon dioxide emission | Metric tons per capita |

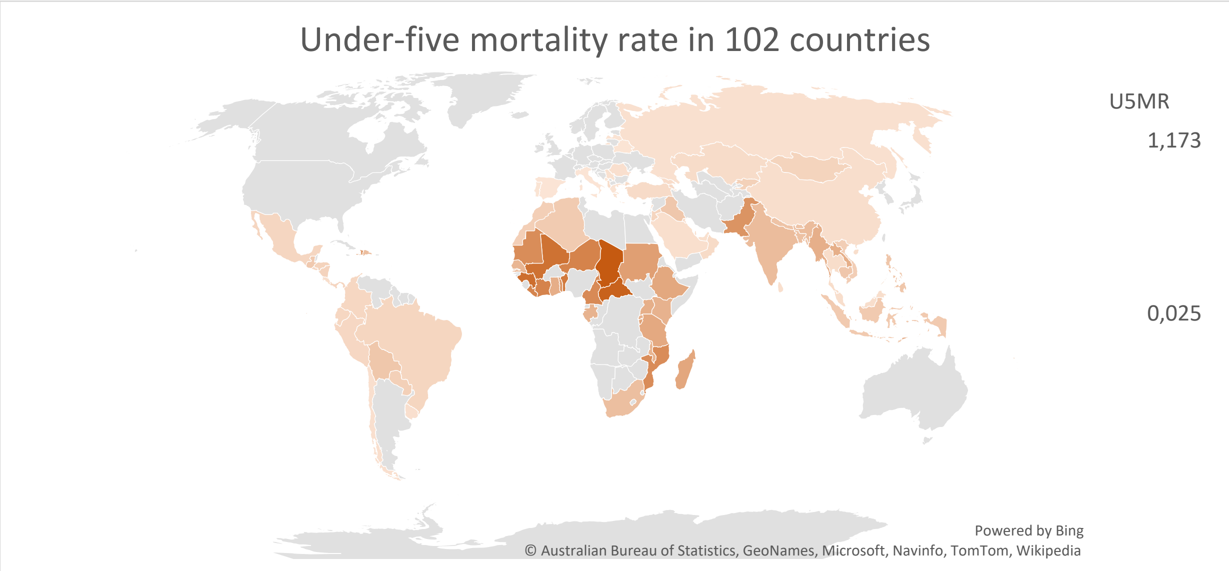
Table 2. Descriptive statistics of the variables

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| **U5MR** | 30.21373 | 27.19534 | 2.5 | 117.3 |
| **INF** | 4.431791 | 7.130132 | -2.814698 | 63.29251 |

[2] Exemption: The values of the gender parity index in literacy rate (GPILR) are taken as a 5-year average due to the limitation in the data availability.

| | | | | |
|---|---|---|---|---|
| **GPILR** | 96.53506 | 9.713281 | 52.5805 | 104.718 |
| **lnHE** | 5.328456 | 1.611706 | 1.908986 | 7.953927 |
| **CO2** | 3.664968 | 5.247188 | .0527946 | 32.41564 |
| **lnGDPpercapita** | 11.81064 | 2.556589 | 6.232973 | 18.22755 |

As shown in Table 1, the under-five mortality rate (U5MR) has the highest standard deviation. Furthermore, the average U5MR is 30.21 per 1000 children and the maximum and minimum probability is 117.3 (Chad) and 2.5 (Singapore), respectively (see the map below). The same interpretation can be proposed for all other variables.




As HE and GDP per capita have high values in USD, it might cause heteroscedasticity and non-normal distribution of error term. Therefore, it is decided to use ln of both variables.

Estimation

The model of the analysis is as follows: U5MR = F(HE,INF,GPILR,GDPpercapita,CO2)

Thus, the population regression function is generalized:

$$U5MR_i = \beta_0 + \beta_1 \cdot INF_i + \beta_2 \cdot GPILR_i + \beta_3 \cdot lnHE_i + \beta_4 \cdot CO2_i + \beta_5 \cdot lnGDPpercapita_i + \varepsilon_i$$

In this equation, $\beta_0$ (constant) is an average child mortality excluding all the variables in the model; $\varepsilon_i$ is an error term; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are partial regression coefficients.

Table 1. Correlation matrix

| | U5MR | INF | GPILR | lnHE | CO2 | lnGDPpercapita |
|---|---|---|---|---|---|---|
| U5MR | 1.0000 | | | | | |
| INF | 0.1779 | 1.0000 | | | | |
| GPILR | -0.8199 | -0.0180 | 1.0000 | | | |
| lnHE | -0.8511 | -0.1962 | 0.5622 | 1.0000 | | |
| CO2 | -0.4410 | -0.1385 | 0.2568 | 0.5915 | 1.0000 | |
| lnGDPpercapita | 0.1030 | -0.1914 | -0.0722 | -0.1470 | -0.0616 | 1.0000 |

The table above shows correlations among variables. It should be mentioned that there is no perfect colinear relation between regressors. The highest one is 59.15%, which is between CO2 emissions and Health Expenditure. According to correlation, it is estimated that an increase in CO2 emissions, health expenditure, and female literacy can lead to a decrease in child mortality. On the other hand, an increase in inflation might lead to an increase in child mortality. Lastly, the effect of aggregate income is subtle. All these results are theoretically consistent with the findings in the literature review.

Estimated results[3]

Starting with the overall significance of the model, the following hypothesis is set:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$

$$H_a: \text{Not all slope coefficients are equal to zero}$$

Decision making: Reject $H_0$, if $F > F_\alpha$ or $Prob(F) < \alpha$

As Prob(F) is equal to 0.0000, it can be concluded that at least one of the predictors is significant in the model.

Table 2. Overall significance of the model

| SOURCE | SS | DF | MS |
|---|---|---|---|
| **MODEL** | 67172.9635 | 5 | 13434.5927 |
| **RESIDUAL** | 7525.29731 | 96 | 78.3885136 |
| **TOTAL** | 74698.2608 | 101 | 739.58674 |

| **Number of obs** | **102** |
|---|---|
| **F(5, 96)** | 171.38 |
| **Prob > F** | 0.0000 |
| **R-squared** | 0.8993 |
| **Adj R-squared** | 0.8940 |
| **Root MSE** | 8.8537 |

The R-squared is 89.98%, which represents that 89.98% of the variation in the child mortality can be expressed with the regressors: domestic general government health expenditure, inflation, literacy rate (GPI), aggregate income and CO2 emissions. Furthermore, the difference between Adjusted R-squared and R-squared is low (0.53%), which can represent that the predictors are selected correctly. To sum up, it can be concluded that the chosen model fits the sample data.

Table 3. Overall significance of the model

| SOURCE | SS | DF | MS |
|---|---|---|---|
| **MODEL** | 67172.9635 | 5 | 13434.5927 |
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| **TOTAL** | 74698.2608 | 101 | 739.58674 |

[3] Ordinary least squares (OLS) regression is used to find out the main factors of child mortality.

| | |
|---|---|
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Regarding the significance of the individual regression coefficients, the following hypothesis is set:

$$H_o: \beta_n = 0$$
$$H_a: \beta_n \neq 0$$

In the equation above, n identifies the regression coefficients. $n \in [1; 5]$

Decision making: Reject $H_0$, if $|t| > t_{\frac{\alpha}{2}}$ or $Prob(F) < \alpha$

Table 4. Estimated results

| U5MR | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| INF* | 0.226514 | 0.130332 | 1.74 | 0.085 | -0.03219 | 0.48522 |
| GPILR*** | -1.40778 | 0.111181 | -12.66 | 0.000 | -1.62847 | -1.18709 |
| lnHE*** | -9.80232 | 0.822335 | -11.92 | 0.000 | -11.4347 | -8.17 |
| CO2 | 0.205641 | 0.209717 | 0.98 | 0.329 | -0.21064 | 0.621926 |
| lnGDPpercapita | -0.05141 | 0.358175 | -0.14 | 0.886 | -0.76238 | 0.659565 |
| _cons | 217.1948 | 10.23685 | 21.22 | 0.000 | 196.8748 | 237.5148 |

***(*) show that value is statistically significant at 1% (10%) level

From the Table, it is revealed that inflation in a basket of foods is significant in 10% significance level, which is consistent with the research of Lee et al. (2013). The estimated result implies that 1% point increase in inflation, ceteris paribus, tends to increase the under-five mortality rate by 0.22% point, on average. In fact, the estimated result of Lee et al. (2015) is approximately the same as the result above. In other words, an increase in the prices of commodities drops purchasing power of people and some people cannot afford to buy necessities. Consequently, undernourishment and child mortality will rise.

The gender parity index of literacy rate is found to be significant at 1% significance level (see Table 4. The interpretation of the result is that 1% point increase in the ratio of literate female to literate male, holding all other variables constant, tends to decrease child mortality by 1.4% points. This result represents that the increase in female literacy has a more significant effect on child mortality than male literacy, which is in line with the conclusions of Pradhan et al. (2017) and Latif, Ashraf, and Zeeshan(2019). Generally, women are engaged to take care of a child in most countries. Literate mothers are efficacious to control the nutrition and health of a child.

Similarly, domestic general government health expenditure per capita (HE) is significant at 1% significance level (see Table 4). The estimated result implies that 1% increase in HE, ceteris paribus, will lead to a decrease in the under-five mortality rate by 0.098% points. The finding is consistent with the studies of Ray and Linden (2019) and Dhrifi (2019). An increase in health expenditure improves health atmosphere in a country and reduces child mortality. Though the signs of coefficients are logically correct and corroborate the researches of Cutler et al. (2002) and Shobande (2019), the results showed that CO2 emissions and aggregate income are insignificant factors for child mortality. According to Pérez-Moreno, Blanco-Arana and Bárcena-Martín (2016), aggregate income becomes insignificant factor for child mortality during expansions. In cross-sectional data, it is ambiguous to determine the stage of the business cycle of a country. Thus, it might be the reason why GDP per capita becomes insignificant in the estimated results. Regarding CO2 emissions, Zakaria, Tariq and Husnain (2019) and Shobande, (2019) analyzed only the least developed countries. However, the sample data of this research consists of countries from all income divisions. Thus, the carbon dioxide emissions might be insignificant due to generalized data.

Assumption testing

The assumptions of classical linear regression model are examined to identify whether the regression output is valid or not.

1. Zero covariance between the error and regressors

From the covariance matrix, it can be concluded that there is roughly zero correlation between the error and regressors. This means that the regressors are independent from the error term.

2. Zero mean value of disturbance

The mean value of the disturbance term is approximately equal to zero ($\varepsilon_i = -1.61 \cdot 10^{-9}$). This means that there is no specification bias in the model or the model is correctly specified.

3. Homoscedasticity

The Breusch-Pagan test and Cameron & Trivedi's decomposition of IM-test is used to test homoscedasticity (see Table 6). The following hypothesis is set:

$$H_0: \text{Constant variance}$$
$$H_a: \text{Non} - \text{constant variance}$$

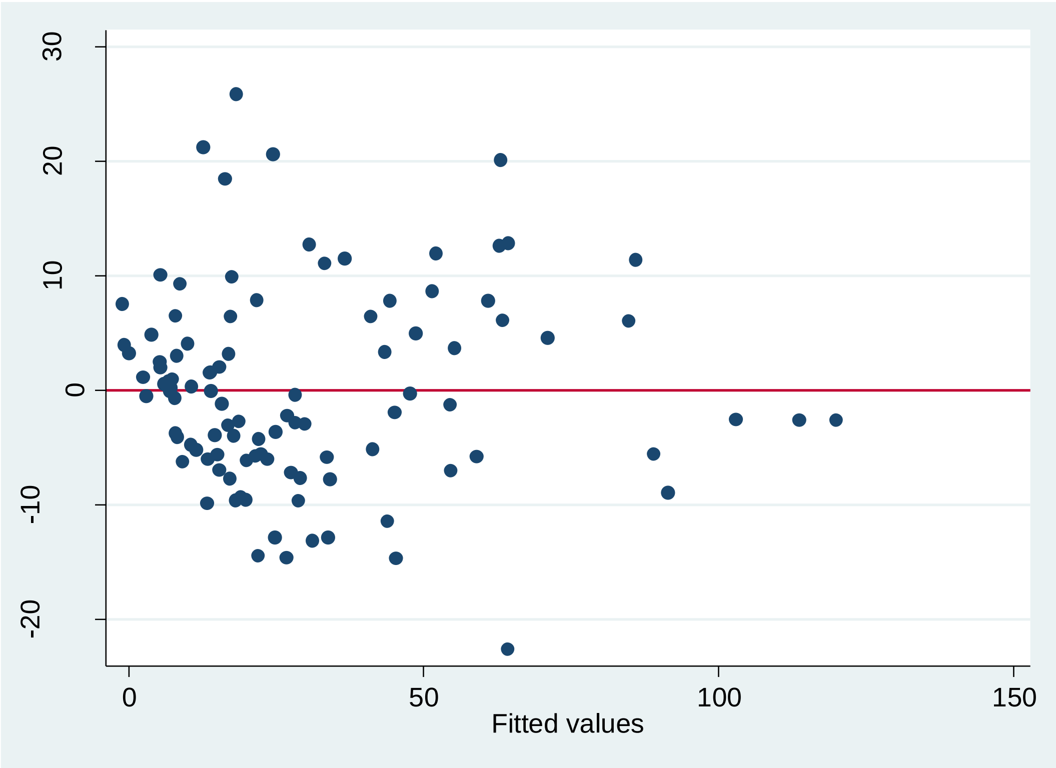
Table 5. Cameron & Trivedi's decomposition of IM-test

| Source | Chi2 | df | P |
|---|---|---|---|
| Heteroscedasticity | 16.32 | 20 | 0.6966 |
| Skewness | 4.42 | 5 | 0.4911 |
| Kurtosis | 1.06 | 1 | 0.3030 |
| Total | 21.80 | 26 | 0.6997 |

Decision making: Reject $H_0$ if Prob < α.

Prob(chi2) = 0.2715 (Breusch-Pagan) and P =0.696, so we fail to reject $H_0$. Thus, the error term has a constant variance. Furthermore, it is visible from the Figure 1 (Appendix 4) that squared residuals do not follow any residual.

Figure 1. Estimated squared residuals




4. No autocorrelation

As the sample data is cross-sectional, we cannot check for serial autocorrelation.

5. No perfect multicollinearity

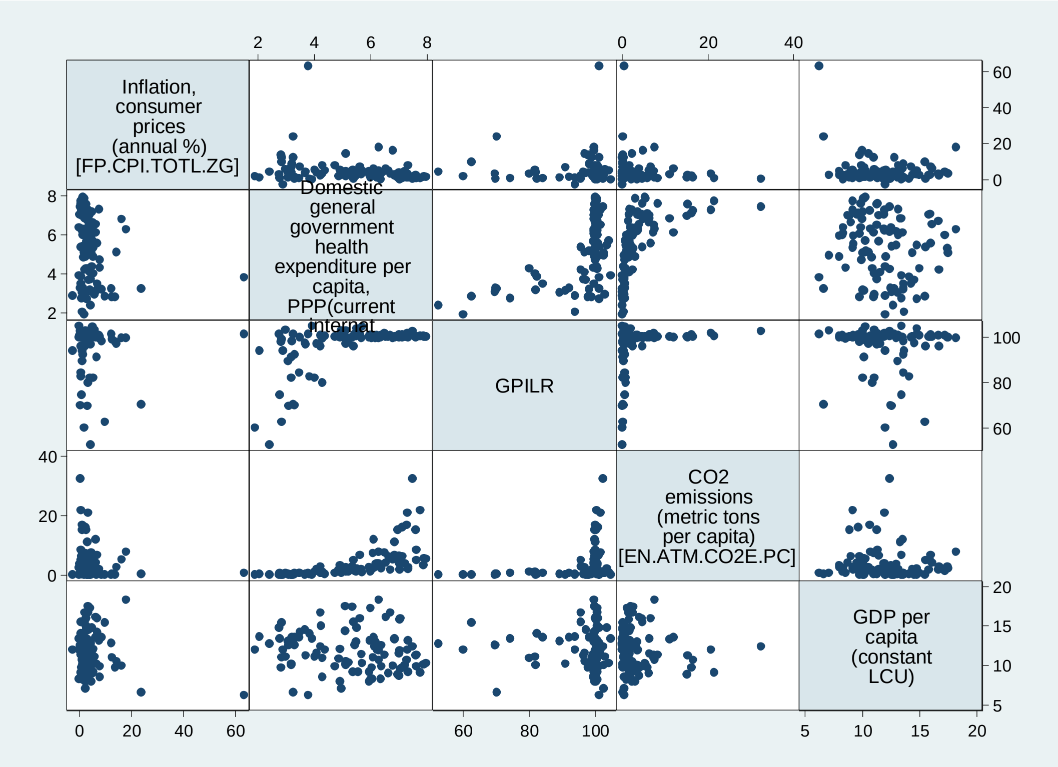
Correlation matrix showed that the highest correlation between variables are 0.5915, which is not perfect collinear (See Table 2, App. 2).

Table 6. Variance-inflating factor and Tolerance

| Variable | VIF | 1/VIF |
|---|---|---|
| **lnHE** | 2.26 | 0.441837 |
| **CO2** | 1.56 | 0.640930 |
| **GPILR** | 1.50 | 0.665488 |
| **INF** | 1.11 | 0.898745 |
| **lnGDPpercapita** | 1.08 | 0.925589 |
| **Mean VIF** | 1.50 | |

From Table 7, it is known that variance-inflation factor is less than 5 for all regressors, which indicates no perfect multicollinearity. Finally, it is obvious from the scatterplot (Figure 2, App. 3) that there is no perfect multicollinearity between regressors.

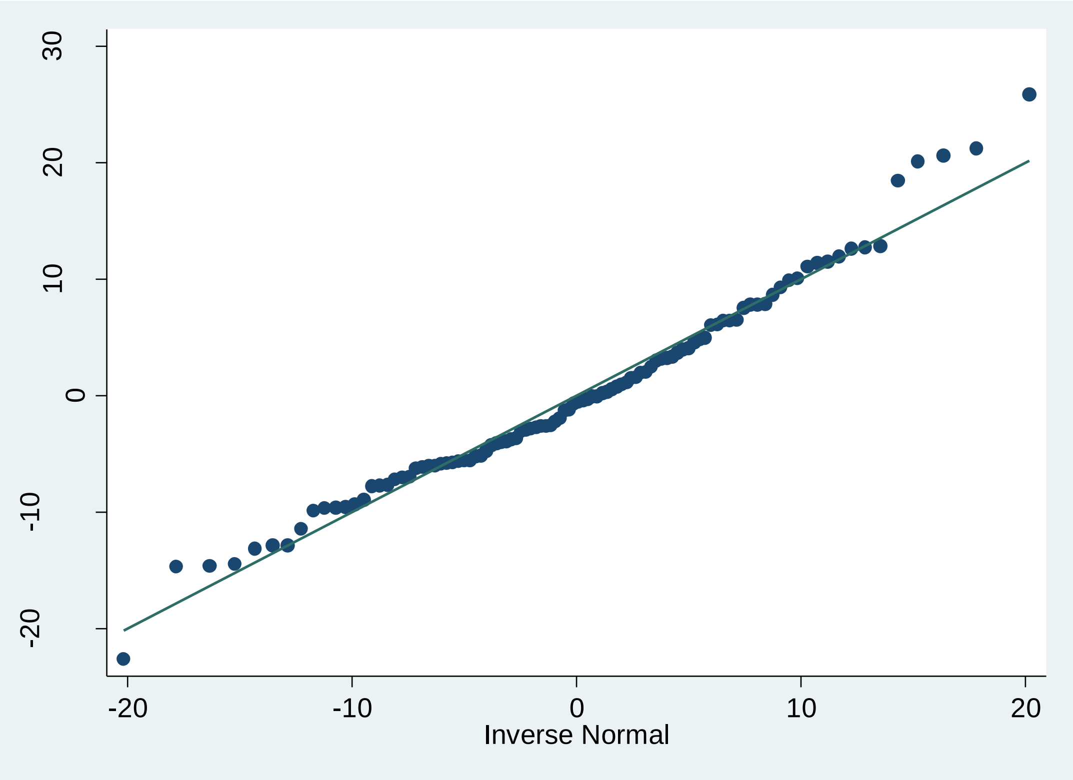
Figure 2. Scatterplot of independent variables




6. Normality

Figure 3 (App.3) shows that the residuals are normally distributed. Moreover, the result of D'Agostino test showed that p-value (0.0765) >0.05, which means we fail to reject null hypothesis of normality of residuals.

Figure 3. Q-Q probability plot




Conclusion and Limitations

This study examined child mortality in 102 countries from all income divisions. After checking for OLS assumptions, it can be concluded that the OLS estimators as the best linear unbiased estimators (BLUE), and the model fits the sample data. To sum up, female literacy and domestic health expenditure are found to be fundamental determinants of under-five mortality in any country. In other words, literate mothers and high health expenditures will increase the well-being of children. Furthermore, the main limitations of the research are time constraints and unavailability of data for literacy rate.

To decrease under-five mortality, governments should:

- Concentrate more on female literacy
- Rise government health expenditure

Future researches should consider more countries and add more control variables to increase the precision of the research and fill the research gap in the study of child mortality.

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Appendices

Appendix 1: Raw data

| CountryName | U5MR (%) | INF(%) | CO2(metric per tons) | lnGDPpercapita | lnHE | GPILR (%) |
|---|---|---|---|---|---|---|
| Senegal | 41.7 | 0.461 | 0.622 | 13.587 | 3.479 | 84.025 |
| Nepal | 30.6 | 4.061 | 0.428 | 11.265 | 3.698 | 96.649 |
| Armenia | 12.1 | 2.520 | 1.880 | 14.408 | 5.080 | 100.053 |
| Sri Lanka | 7.5 | 2.135 | 0.998 | 13.008 | 5.477 | 100.546 |
| Sao Tome and Principe | 18.1 | 7.857 | 0.663 | 9.899 | 4.732 | 100.145 |
| Egypt, Arab Rep. | 20.9 | 14.401 | 2.502 | 10.522 | 5.109 | 97.013 |
| Tonga | 11.9 | 5.032 | 1.841 | 9.199 | 5.349 | 100.192 |
| Bangladesh | 32.4 | 5.544 | 0.513 | 11.057 | 2.964 | 103.062 |
| Belarus | 3.4 | 4.872 | 6.284 | 9.044 | 6.629 | 100.053 |
| Kyrgyz Republic | 19.2 | 1.543 | 1.740 | 10.823 | 4.851 | 100.120 |
| China | 8.5 | 2.075 | 7.352 | 11.000 | 6.092 | 100.000 |
| Kazakhstan | 10.3 | 6.019 | 12.062 | 13.559 | 6.104 | 99.911 |
| Georgia | 9.7 | 2.615 | 2.539 | 9.240 | 5.944 | 99.842 |
| Liberia | 82.5 | 23.564 | 0.274 | 6.594 | 3.253 | 70.260 |
| Vanuatu | 26.3 | 2.331 | 0.615 | 12.361 | 4.228 | 100.642 |
| Albania | 9.5 | 2.028 | 1.940 | 13.175 | 5.973 | 100.582 |
| Azerbaijan | 21.5 | 2.269 | 3.221 | 8.001 | 4.906 | 99.952 |
| Morocco | 20.3 | 1.804 | 1.851 | 10.197 | 5.112 | 99.347 |
| Congo, Rep. | 47.6 | 1.153 | 0.614 | 13.617 | 3.301 | 92.267 |
| Malaysia | 8.4 | 0.885 | 7.600 | 10.675 | 6.297 | 100.381 |
| Montenegro | 2.9 | 2.611 | 4.050 | 8.736 | 6.998 | 99.738 |
| Iran, Islamic Rep. | 13.9 | 18.014 | 7.693 | 18.228 | 6.285 | 99.651 |
| Honduras | 17.4 | 4.347 | 1.019 | 10.018 | 5.103 | 102.576 |
| Lebanon | 7.4 | 6.077 | 4.040 | 16.057 | 6.540 | 100.177 |
| Cambodia | 27.7 | 2.459 | 0.687 | 14.995 | 4.254 | 100.766 |
| Gambia, The | 53.1 | 6.521 | 0.250 | 10.147 | 3.165 | 91.099 |
| Cabo Verde | 15.8 | 1.256 | 1.140 | 12.587 | 5.419 | 101.160 |
| Thailand | 9.4 | 1.064 | 3.714 | 11.945 | 6.212 | 100.605 |
| Mongolia | 16.8 | 6.812 | 6.725 | 15.937 | 5.598 | 100.898 |
| Niger | 83.5 | 2.968 | 0.102 | 12.624 | 3.076 | 69.630 |
| Russian Federation | 6.3 | 2.878 | 11.127 | 13.322 | 6.839 | 100.099 |

| | | | | | | |
|---|---|---|---|---|---|---|
| India | 36.3 | 3.945 | 1.800 | 11.548 | 4.075 | 96.964 |
| Serbia | 5.8 | 1.960 | 6.522 | 13.432 | 6.829 | 100.005 |
| Samoa | 17.8 | 4.197 | 1.632 | 9.227 | 5.546 | 100.598 |
| Latvia | 4.2 | 2.534 | 3.959 | 9.548 | 7.034 | 100.080 |
| Peru | 13.8 | 1.509 | 1.697 | 9.724 | 6.051 | 99.648 |
| Turkey | 10.7 | 16.332 | 5.015 | 9.968 | 6.793 | 99.608 |
| Greece | 4.2 | 0.626 | 6.083 | 9.730 | 7.106 | 99.809 |
| Vietnam | 21.3 | 3.540 | 2.699 | 17.415 | 5.326 | 99.827 |
| El Salvador | 13.8 | 1.090 | 1.061 | 8.261 | 5.991 | 100.624 |
| Iraq | 27 | 0.367 | 4.895 | 15.516 | 5.374 | 95.795 |
| Guatemala | 25.4 | 3.752 | 1.114 | 10.318 | 5.198 | 98.413 |
| Jordan | 16 | 4.462 | 2.479 | 7.992 | 5.957 | 100.299 |
| Chad | 117.3 | 4.275 | 0.069 | 12.732 | 2.403 | 52.580 |
| Central African Republic | 111.1 | 1.612 | 0.071 | 11.975 | 1.910 | 60.050 |
| Guinea | 100.4 | 9.826 | 0.251 | 15.453 | 2.843 | 62.420 |
| Indonesia | 24.6 | 3.198 | 2.178 | 17.478 | 5.091 | 99.961 |
| Malawi | 43.1 | 12.420 | 0.087 | 12.837 | 3.244 | 101.218 |
| Ethiopia | 53.2 | 13.831 | 0.149 | 9.729 | 2.810 | 97.894 |
| Mexico | 14.6 | 4.899 | 3.741 | 11.897 | 6.294 | 100.139 |
| Chile | 7.2 | 2.435 | 4.625 | 15.917 | 7.049 | 100.090 |
| Singapore | 2.5 | 0.439 | 8.399 | 11.338 | 7.610 | 100.041 |
| Philippines | 27.9 | 5.212 | 1.334 | 12.051 | 4.898 | 100.686 |
| Uganda | 47.4 | 2.624 | 0.143 | 14.809 | 2.738 | 101.249 |
| Ecuador | 13.9 | -0.224 | 2.314 | 8.344 | 6.370 | 100.008 |
| United Arab Emirates | 7 | 3.069 | 20.797 | 11.930 | 7.291 | 101.612 |
| Romania | 7.4 | 4.625 | 3.845 | 10.038 | 7.195 | 100.020 |
| Oman | 11.1 | 0.881 | 15.192 | 8.894 | 6.960 | 100.228 |
| Qatar | 6.6 | 0.256 | 32.416 | 12.388 | 7.468 | 102.327 |
| Maldives | 7.6 | -0.133 | 3.704 | 11.848 | 7.015 | 100.704 |
| Costa Rica | 8.4 | 2.221 | 1.652 | 15.768 | 7.010 | 100.191 |
| Portugal | 3.6 | 0.994 | 4.841 | 9.851 | 7.606 | 100.075 |
| Brazil | 15.2 | 3.665 | 2.042 | 9.882 | 6.382 | 100.633 |
| Mauritius | 15.4 | 3.216 | 3.264 | 12.554 | 6.373 | 100.619 |
| Uruguay | 7.3 | 7.607 | 1.890 | 13.144 | 7.308 | 100.617 |
| Nicaragua | 17.3 | 4.947 | 0.806 | 10.234 | 5.704 | 104.230 |
| Saudi Arabia | 7.7 | 2.458 | 15.269 | 11.265 | 7.586 | 99.959 |
| Brunei | 11.2 | 1.025 | 16.645 | 10.666 | 7.258 | 100.155 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Darussalam | | | | | | |
| Paraguay | 20.2 | 3.976 | 1.210 | 17.219 | 5.985 | 100.732 |
| Spain | 3.3 | 1.675 | 5.520 | 10.126 | 7.887 | 100.033 |
| Myanmar | 46.8 | 6.872 | 0.605 | 14.257 | 3.496 | 99.733 |
| Burundi | 59 | -2.815 | 0.053 | 11.960 | 2.882 | 94.051 |
| Italy | 3.2 | 1.137 | 5.376 | 10.257 | 7.954 | 100.030 |
| Colombia | 14.1 | 3.240 | 1.601 | 16.660 | 6.699 | 100.648 |
| Mozambique | 75.6 | 3.911 | 0.225 | 10.016 | 3.175 | 82.011 |
| Kuwait | 8.7 | 0.543 | 21.623 | 9.158 | 7.752 | 100.476 |
| Madagascar | 53.7 | 8.594 | 0.128 | 13.590 | 3.206 | 98.266 |
| Benin | 90.9 | 0.645 | 0.689 | 13.434 | 2.766 | 74.459 |
| Pakistan | 69.5 | 5.078 | 0.982 | 11.033 | 4.017 | 81.841 |
| Lao PDR | 47.5 | 2.040 | 2.661 | 16.679 | 4.214 | 95.865 |
| Algeria | 23.8 | 4.270 | 3.592 | 13.015 | 6.182 | 99.650 |
| Seychelles | 14.5 | 3.703 | 6.407 | 11.440 | 6.990 | 101.044 |
| Malta | 6.5 | 1.158 | 3.198 | 10.103 | 7.869 | 100.506 |
| Tanzania | 52.1 | 3.494 | 0.206 | 14.546 | 3.678 | 97.274 |
| Togo | 68.8 | 0.928 | 0.286 | 13.115 | 3.068 | 89.313 |
| Bhutan | 29.6 | 2.723 | 1.829 | 11.410 | 5.680 | 99.594 |
| Sudan | 60.1 | 63.293 | 0.483 | 6.233 | 3.796 | 101.334 |
| Palau | 18 | 2.110 | 16.191 | 9.655 | 7.112 | 100.933 |
| Bolivia | 27.4 | 2.272 | 2.000 | 8.353 | 6.061 | 100.010 |
| Panama | 15.4 | 0.762 | 2.428 | 9.211 | 7.306 | 99.757 |
| Kenya | 44.3 | 4.690 | 0.358 | 11.996 | 4.381 | 100.556 |
| Mali | 97.4 | 0.300 | 0.295 | 12.511 | 3.293 | 69.910 |
| Ghana | 48.1 | 7.809 | 0.541 | 8.559 | 4.294 | 99.404 |
| Haiti | 64.1 | 12.481 | 0.299 | 10.988 | 2.839 | 99.138 |
| Mauritania | 75.5 | 3.049 | 0.908 | 10.892 | 4.284 | 80.016 |
| Rwanda | 43.4 | -0.311 | 0.088 | 13.429 | 3.915 | 104.718 |
| Cameroon | 77.3 | 1.074 | 0.342 | 13.659 | 2.050 | 93.947 |
| Dominican Republic | 34.8 | 3.564 | 2.364 | 12.369 | 6.133 | 100.438 |
| Cote d'Ivoire | 83.2 | 0.359 | 0.395 | 14.100 | 3.845 | 82.324 |
| Timor-Leste | 45.1 | 2.294 | 0.505 | 7.132 | 4.952 | 102.590 |
| South Africa | 33.9 | 4.505 | 7.497 | 11.278 | 6.487 | 101.541 |
| Gabon | 44.1 | 4.749 | 2.175 | 14.775 | 5.493 | 103.617 |

Table 7. Estimated results

| U5MR | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. Interval] |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| INF* | 0.226514 | 0.130332 | 1.74 | 0.085 | -0.03219 | 0.48522 |
| GPILR*** | -1.40778 | 0.111181 | -12.66 | 0.000 | -1.62847 | -1.18709 |
| lnHE*** | -9.80232 | 0.822335 | -11.92 | 0.000 | -11.4347 | -8.17 |
| CO2 | 0.205641 | 0.209717 | 0.98 | 0.329 | -0.21064 | 0.621926 |
| lnGDPpercapita | -0.05141 | 0.358175 | -0.14 | 0.886 | -0.76238 | 0.659565 |
| _cons | 217.1948 | 10.23685 | 21.22 | 0.000 | 196.8748 | 237.5148 |

***(*) show that value is statistically significant at 1% (10%) level

Table 8. Covariance matrix

| | INF | lnHE | GPILR | CO2 | lnGDPpercapita | uhat |
|---|---|---|---|---|---|---|
| INF | 50.8388 | | | | | |
| lnHE | -2.25502 | 2.5976 | | | | |
| GPILR | -1.24832 | 8.80113 | 94.3478 | | | |
| CO2 | -5.18046 | 5.00254 | 13.0863 | 27.533 | | |
| lnGDPpercapita | -3.48949 | -.605547 | -1.79182 | -.826098 | 6.53615 | |
| uhat | 2.4e-08 | 4.0e-08 | -1.3e-08 | 1.7e-07 | 2.9e-08 | 74.5079 |