NEC TAMEN CONSUMEBATUR

Estd.: 1830

Scottish Church College

DEPARTMENT OF ECONOMICS

ACTIVITIES : 2022-23


TYPES OF RETURN
REVENUE RETURN
Periodic cash flow such as dividend ,interest etc.
CAPITAL RETURN
Return due to price appreciation
VALUE
Total return=revenue return +capital return
PeopleLink


Scottish Church College
1 & 3, URQUHART SQUARE, KOLKATA - 700006
NAAC Re-accredited Grade 'A' Institution (3rd Cycle)
DEPARTMENT OF ECONOMICS
Presents a Seminar
on
RISK MANAGEMENT IN FINANCIAL MARKET
Theoretical Overview and Real Market Experience
SPEAKERS
PRIYA DEV
Faculty, Department of Business Administration, SCC
DEBOJYOTI BISWAS
Former Student of the Department of Economics, SCC & Risk Management Professional
21st March | 10-30 am – 1-30 pm | Seminar Hall


Scottish Church College

Estd.: 1830

Scottish Church College

DEPARTMENT OF ECONOMICS

Activities

2022-23

Contents

Editorial Note

We are pleased to bring out the current volume of documentation of the University results, seminars, extension lectures, students' presentations, and other co-curricular activities which were organized by the Department of Economics, Scottish Church College, Kolkata in the academic session 2022-23. During this period two students' seminars were held. The first one was held in September, 2022. The abstracts of the papers presented by the resource persons and the full papers presented by the students are included in this volume. Moreover, a summary of the results of the research studies done by the students is also presented here. The second one was held in March, 2023. Summaries of the papers presented by the resource persons are incorporated here. The third Econverge, a departmental programme of inter-college students' competition on various events, was organized in September, 2022. After a two-year gap, in this session, all activities could be organized in offline mode. However, realizing the advantage of some flexibility in online mode, a few of the events of Econverge'22 were held online.

We thank the College authority for always encouraging us to endeavor in activities beyond the regular curriculum. We take this opportunity to acknowledge the support received from all staff of the College whenever necessary. We highly appreciate the contribution of Sri Protick Chakraborty of the present Semester IV class who did the photography for all events. Last, but not the least, we thank Sri Samrat Paul to co-operate with us to publish this volume.

Dr. Smita Nath
Dr. Sudeshna Ghosh
Dr. Mausumi Manna
Dr. Smritikana Ghosh

May 2023

B.Sc. Economics (Honours) Examination, 2022
Summary of Result

Year of Admission: 2019	
	No. of Students
Enrolled for Sem I Exam in 2019	39
Passed out the Final Sem exam in 2022	38 (97.4%)
CGPA < 7	1
7 ≤ CGPA < 8	5
8 ≤ CGPA < 9	32
Highest CGPA	8.966
Name of the Topper	Khirabdhi Tanaya

Proceedings of the Students' Seminar on

Issues in Development Economics: Econometric Applications

held on 26th September, 2022

Abstracts of Papers presented by the Resource Persons

Women Empowerment and Future Human Capital Formation

(A Case Study from Urban Slum Area in India)

Simontini Das[1] and Bidisha Chakraborty[2]

The present paper intends to investigate the impact of women empowerment on future human capital formation in urban slum area of Kolkata, India. The urban areas are considered as the main source of future productive workforce; hence it is crucial to understand the process of human capital formation in these pockets for an emerging economy, like India. This primary survey based research considers different dimensions of women life, economic dimension, socio-cultural dimension, interpersonal dimension and legal and political dimension. Base on the autonomy in different dimensions, a multi-facet comprehensive women empowerment index is constructed. Empirical estimation explains that empowering mother in the urban slum area improves the school going habits and monthly educational expenditure on their off-springs. In fact empowered mother can induce school going habit more to their girl child than boy child. However, regarding educational expenditure, empowered mothers do not discriminate their children according to their gender. Survey data elucidate that incidence of mal-nutrition is reasonably low in urban slum area of Kolkata. The probability of having a well-nourished child increases with the rise in the status of mothers' empowerment, but there is no sign of discrimination between male child and female child. Empowered mother are equally concerned about the nutrition level of their male child and female child. This infers that women empowerment is important in determining overall mental and physical development of their children irrespective of child's gender and in turn fosters the formation of future human capital. The paper proposes that women empowerment is an important policy variable that can help to produce healthy, productive and skillful workforce in future from the urban slum pockets.

[1] Assistant Professor, Department of Economics, Jadavpur University

[2] Professor, Department of Economics, Jadavpur University

Devaluation and Export Price Pass Through

Darpajit Sengupta[3] and Saikat Sinha Roy[4]

In the event of sticky prices, any exchange rate fluctuation can have significant consequences in the real sector of the economy. The response to such external shocks can be heterogeneous across industries depending upon the market characteristics, demand conditions and other factors including trade invoicing and exchange rate regimes. This paper aims to capture the effect of nominal exchange rate fluctuations on the price of India's export products. For that reason, we consider four categories of industry which differ based on technological intensities. The unit level data of export prices are based on 8-digit HS classification provided by Directorate General of Commercial Intelligence & Statistics, Government of India. The data on exchange date are obtained from the Reserve Bank of India database. Using profit maximising approach of firms, in lines of Bailliu and Fujii (2004) theoretical specification, this paper estimates the ERPT elasticities under the ambit of static panel data technique. Using a host of controls like marginal costs, world demand, the estimation results show that the pass through to export prices is incomplete in the short run across all the selected industries. This is indicative of high degree of absorption in foreign currency term and low pass-through in domestic currency terms, following exchange rate changes. Unlike in the short run, the pass-through is relatively high in the long run. This result is in conformity with the findings of incomplete pass- through literature. The results of the aggregate level analysis show that marginal cost, trade openness and foreign demand are statistically significant variables in explaining the volatility of export prices and thereby value of the exports. The study also accounts for the asymmetrical impact of exchange rates fluctuations on the unit price of exports. Further, the pass-through elasticities as revealed by the estimated coefficients depend on depreciation or appreciation of domestic currencies of respective counties. The results bring about an empirical verification of the traditional theoretical wisdom that depreciation of currency leads to a decrease in export prices thereby making these products more competitive in the world market. The findings on exchange rate pass through have implications for exchange rate being used as a price based policy instrument for export promotion, thereby reducing current account deficit.

[3] Senior Research Fellow, Department of Economics, Jadavpur University.
[4] Professor, Department of Economics, Jadavpur University.

Papers presented by the Students (Semester V, Batch 2020-23)

A Study of the Impact of Government Health Expenditure on Adult Mortality Rate for High-income Countries

Sayantika Bhowmik, Ankita Deb, Sutapa Dutta, Srijaa Mukherjee, Satakshi Nandy

Abstract

In this paper, we have studied the impact of Government Health Expenditure as a percentage of GDP on the adult mortality rate (male and female) for high-income countries. We started our study with the expectation that the adult mortality rate is dependent on government health expenditure. Then upon studying the data, we found that the mean of adult mortality rates for males is greater than that of the mean of adult mortality rates for females. This indicates that the life expectancy of females is more than the life expectancy of males. We also observed that the standard deviation of the male mortality rate is higher than the female mortality rate indicating the presence of more variation in the male mortality rate than the female mortality rate.

Descriptive statistical techniques have been used in our study of the four models and after analysing the models using econometric tools, we found that the null hypothesis of all four models does not get rejected which dismissed our expectation that "Government Health Expenditure as a percentage of GDP will have an impact on Adult Mortality Rate".

I Introduction

Adult mortality rate refers to the probability that those who have reached age 15 will die before reaching age 60 (shown per 1,000 persons) and the government expenditure shows how much of the entire cost of public sector operations is spent on health care. This indicator takes into account not just the funds allocated through government budgets but also the costs of parastatals, extra-budgetary organisations, and, most significantly, the requirement for health insurance. It also covers all costs associated with providing health services, family planning, nutrition, and health-related emergency help and hence these two terms are very closely related while measuring the mortality and life expectancy of different Nations around the world.

It was observed in India as per a recent article published that at the beginning of 2004-05 the government expenditure on health has seen a steady rise till 2017-18 and thereafter as a percentage of GDP has fallen for the first time in this period to just under 1.3% in 2018-19 released from the National Health Accounts.

People's out-of-pocket healthcare expenditure decreased from nearly 70% of overall healthcare costs in 2004–05 to 48% by 2018–19, while governmental healthcare expenditure rose from 22.5% to 40.6% during the same time period. Out-of-pocket expenditures are the expenditures directly made by households at the point of receiving healthcare. As health is generally a state issue, state spending accounts for the majority of this.

Government health spending per person was Rs. 1,815, whereas out-of-pocket expenditure per capita was Rs. 2,155. Government health expenditures as a percentage of GDP were at 1.2% in

2018–19, down from 1.3% in 2017–18, despite the fact that overall government spending has increased while the share of out-of-pocket spending has decreased. The cost of private health insurance as a share of overall health spending increased significantly from 1.6% in 2004–05 to 6.6% in 2018–19.

Currently, private hospitals accounted for 28.7% of current healthcare spending, while government hospitals accounted for 17.3% of that spending (excluding all capital expenditures). 4.2% of current health expenditures were spent on conventional, complementary, and alternative medicine. Preventive care made up only 9.4% of the total, whereas inpatient curative care accounted for 34.6% and outpatient curative care for 18.9%.

Therefore, the government should invest more in the purchase of cutting-edge medical devices like X-Ray and CT scan machines in order to lower the adult mortality rate. It should also ensure that the right devices are present in almost all healthcare facilities and maintain the ones that already exist along with the proper access to competent medical care facilities and medication availability. Additional funds should be allocated towards developing new hospitals and community health centres close to residential areas that offer 24-hour care services and have access to qualified medical personnel.

More professional healthcare practitioners should be trained, and the government should invest in the costs involved. It should also take steps in order to provide better nutrition and micronutrients to the citizens. Steps such as educating people on Health and Nutrition to promote dietary diversification and establishment of nutritional rehabilitation centres to manage acute and severe malnutrition.

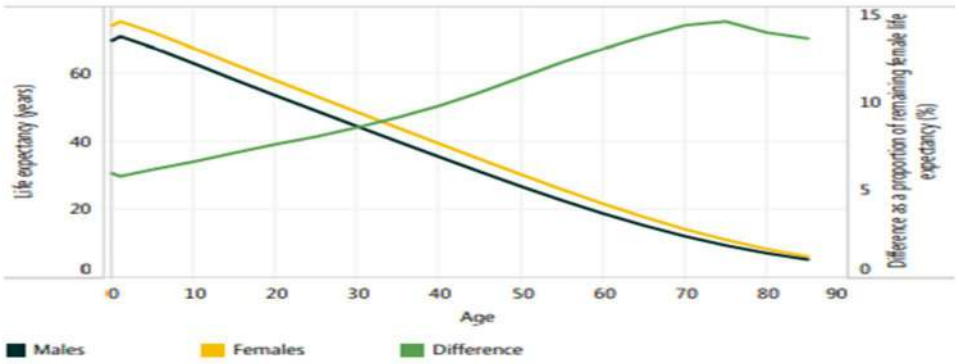
Frequent medical camps should be held as an outreach activity and also organizing awareness programmes to identify and prevent different diseases as well as educate people on proper hygiene and sanitation which can help to lower a nation's mortality rate.

The objective of the present study is to examine the effects of government expenditure as a percentage of GDP on male and female mortality rates by using cross-sectional data from 2019 as it is the latest year for which World Bank provided the data. We used data from high-income nations for two main reasons: first, because all the data were easily accessible; second, because high-income nations can serve as a basic model for research because they invest a sufficient portion of their GDP in healthcare. Additionally, by using data from high-income nations, we can fix other variables like calorie intake, access to healthcare, and other factors that may have an impact on citizens' mortality rates. Since women have been found to have greater life expectancies than males at all ages, we have divided the death rate data by gender in our model. Now, the differences in life expectancy between men and women are smaller in low-income countries than in high-income countries as developed countries have high standards of living, more effective health systems, and more resources invested in determinants of health.

In our study, we have investigated the relationships separately for males and females. There are several reasons for us to do so as explained by World Bank Health statistics. Women have a longer life expectancy than men at all ages. Although the absolute difference in life expectancy decreases with age, the proportional difference increases from age 1 year up to age 80 years before it declines.

Thus, women can expect to live 7.6% longer than men at age 20 years, and 14% longer at age 80 years. Men's reduced life expectancy compared with women is not due to a single or a small number of causes. Of the 40 leading causes of death, 33 causes contribute more to reduced life expectancy in men than in women.

Fig. 1.1
Global life expectancy at different ages for men and women, 2016



Source: WHO (2018) (2).

Figure 1.1 represents the difference in life expectancy of men and women of different age groups for the year 2016

Our discussion is divided into five sections including Introduction. In Section II we discuss the survey of the literature where a brief idea has been provided of all four papers that the authors have considered prior to helming the paper. In Section III we discuss the Data and Methodology. Section IV contains the results and analysis. In Section V the concluding remarks are made.

II Literature Survey

Farhani, Subhramanian and Canning (2010) looked at the second National Family Health Survey of India to estimate on mortality controlling for individual, household and state level covariates. The author utilized across country studies of 519502 individuals from 91573 households in Indian states. In this research a multilevel probity model is used for estimating the effects of health spending at state level or the mortality rate at individual level. This research found a significant impact of public spending on health at state level given individual household, other state levels.

Budhdeo et al. (2015) used multivariate regression model where the effect of changes in healthcare spending as a proportion of total government expenditure, GDP and purchasing power parity per capita, on mortality indicates. Additional variables were controlled to avoid any error and a lag of 1-5 years was present during the analyses. 1% change (decrease) in government healthcare spending was associated with significant increase in adult mortality rate of both male and female – both in short period and long period (5years) – in the mortality metrics (Government healthcare expenditure- measured in terms of GDP). Model together with the implemented robustness checks, accounts for many criticisms levelled at other studies - this study looks at health economic relationships controlling for time irrelevant heterogeneity between countries something that

aggregate time-series analysis fails to do. 4. One limitation of this study is that it measures government health spending and mortality for the entire population- where population have not been segmented by socio-economic status or geographic group might have been most affected due to change in government health spending.

Pritchard et al. (2021) highlights all adult mortality rates drawn from the annual mortality data updated to December 2018. It also used the SPSS statistical package from which confidence intervals (to 95% significance) were calculated to compare the changes in the Age Specific Death Rate (ASDR) over the period in the US. The total %GDP is given for the years 1980, 2000,2010 and 2016 to show the changes between the mortality rate and the expenditure on health over the years. It was noted that the US always had the highest current and average % GDPEH (17.07% and 13.53% respectively) but the changes in total mortality between 1989-1991 and 2013- 2015 showed that the US had the smallest reduction in the adult mortality at just 23% over the period. It was concluded that there were various causes that influence the national mortality rate and lifestyle as well as the local geography of American states are some of the factors.

Bokhari, Gai and Gottret (2007) provide econometric evidence linking a country's per capita government health expenditure and per capita income to maternal mortality rate. In this empirical model we consider that, the current investment on government health expenditure depends upon the previous mortality rates- which shows the proportion of maternal mortality caused due to lack of government expenditure. So, government expenditure acts as an endogenous variable and not reverse causality because- the prior year's spending on health helps to determine the current year's spending. It was observed that the maternal mortality rate was far lower than the estimated mortality rates. Several policies are taken up to reach the millennial goal of reducing maternal mortality by 65% but only few policies are justifiably implemented because the government have various other sectors to invest.

III Data and Methodology

The variables used for the study and their notations are given below:

1. GDP_PCI - GDP per capita of the High-Income Countries for the year 2019.
2. AMR_MALE – Adult Mortality Rate of Males of High-Income Countries for the year 2019
3. AMR_FEMALE – Adult Mortality Rate of Females of High-Income Countries for the year 2019
4. LGDP_PCI – Log value of GDP_PCI
5. LAMR_MALE – Log value of AMR_MALE
6. LAMR_FEMALE – Log value of AMR_FEMALE

Data on these variables are collected from World Development Indicators published by the World Bank.

For the study we estimate the following regression equations:

Model 1: $AMR\_MALE = \alpha_1 + \beta_1 GDP\_PCI + error$

Here, The Explanatory Variable is GDP_PCI

The Explained Variable is AMR_FEMALE

The Parameters are α_1 and β_1

β_1 is the regression coefficient which represents the impact of GDP_PCI on AMR_FEMALE

The Null Hypothesis Ho: $\beta_1 = 0$ (i.e. GDP_PCI has no impact on AMR_FEMALE)

Model 2: AMR_FEMALE= $\alpha_2 + \beta_2$GDP_PCI + error

Here, The Explanatory Variable is GDP_PCI

The Explained Variable is AMR_MALE

The Null Hypothesis Ho: $\beta_2 = 0$ (i.e. GDP_PCI has no impact on AMR_MALE)

MODEL 3: ℓ AMR_MALE= $\alpha_3 + \beta_3$ ℓGDP_PCI+ error

Here, The Explanatory Variable is LGDP_PCI

The Explained Variable is LAMR_MALE

The Null Hypothesis Ho: $\beta_3 = 0$ (i.e. LGDP_PCI has no impact on LAMR_MALE)

MODEL 4: ℓAMR_FEMALE= $\alpha_4 + \beta_4$ ℓGDP_PCI+ error

Here, The Explanatory Variable is LGDP_PCI

The Explanatory Variable is LAMR_MALE

The Null Hypothesis Ho: $\beta_4 = 0$ (i.e. LGDP_PCI has no impact on AMR_FEMALE)

IV Results and Analysis

The descriptive statistics of the variables are presented in Table 1.

Table 1: Descriptive Statistics of the Variables

	AMR_MALE	AMR_FEMALE	GDP_PCI
Mean	108.11	57.75826	7.542037
Median	92.108	49.321	7.009032
Skewness	.6675393	.8075126	.6468741
Kurtosis	2.293331	2.684411	4.168139
Standard deviation	46.9172	22.61169	2.779919

Source: The Authors

Model 1: AMR_MALE= $\alpha_1 + \beta_1$GDP_PCI + error

Estimated model: $\widehat{AMR\_MALE} = 132.1767 - 3.191003$ GDP_PCI

$H_0 : \beta_1 = 0$ [There exists no relationship between GDP_PCI & AMR_MALE]

1. From Figure 4.1 we find a non-linear relationship between GDP_PCI& AMR_MALE
2. Here the regression coefficient is negative i.e. if GDP_PCI increases by 1 unit then AMR_MALE is expected to decrease by 3.191003 units.
3. Rejection /Non-rejection: Null hypothesis is not rejected at 5% level of significance as the p = 0.225 > 0.05
4. Here $r^2 = 0.0357$ i.e. only 3.57% variation is being explained by the regression model.

5. The correlation coefficient is found -0.189072022 which becomes another witness to the negative relationship between GDP_PCI & AMR_MALE.
6. For the B-P test the p-value (=0.2505) > 0.05. This means that the null hypothesis of constant error variance is not rejected and heteroscedasticity is not detected.

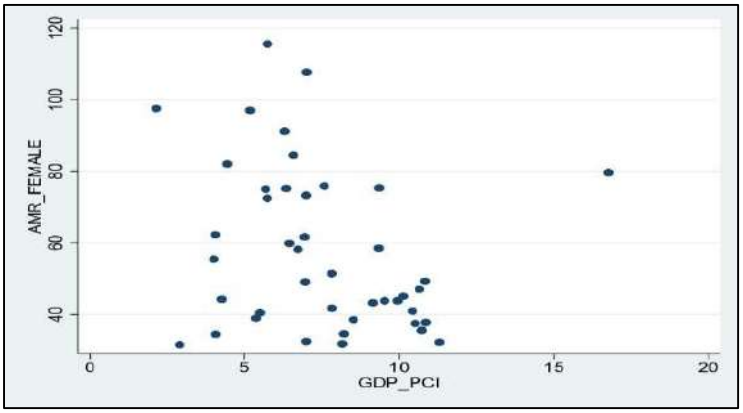


Figure 4.1: Scatter Diagram showing the relationship between GDP_PCI & AMR_MALE

Model 2: AMR_FEMALE $= \alpha_2 + \beta_2 GDP\_PCI + error$

Estimated model: $\widehat{AMR\_FEMALE} = 73.57394 - 2.097004\ GDP\_PCI$

Following observations can be made:

1. Here the regression coefficient is negative i.e. if GDP_PCI increases by 1 unit then AMR_FEMALE is expected to decrease by 2.097004 units
2. $H_0 : \beta_2 = 0$ is not rejected at 5% level of significance as p = 0.095 > .05).
3. Here $r^2 = 0.0665$ i.e. only 6.65% variation is being explained by the regression model.
4. The correlation coefficient is found to be - 0.2578091803 which becomes another witness to the negative relationship between GDP_PCI & AMR_FEMALE.

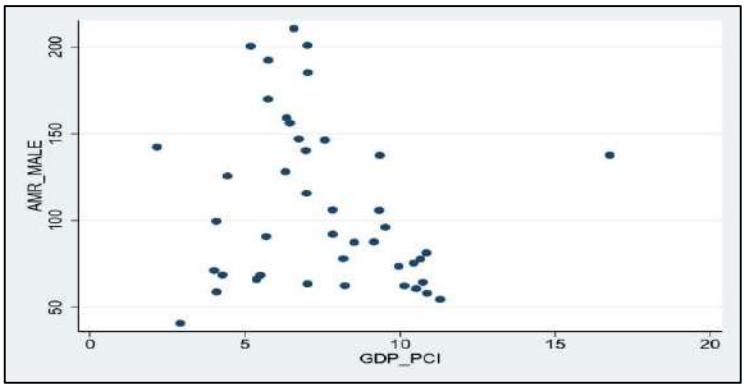


Figure 4.2: Scatter Diagram showing the relationship between AMR_FEMALE & GDP_PCI

Figure 4.2 indicates a non-linear relationship between AMR_FEMALE & GDP_PCI.

Model 3: ℓ AMR_MALE= $\alpha_3 + \beta_3$ ℓGDP_PCI+ error

ESTIMATED MODEL: $\widehat{\ell AMR\_MALE} = 4.810657 - .111455 \ell GDP\_PCI$

$H_0 : \beta_3 = 0$ [There exists no relationship between ℓGDP_PCI & ℓAMR_MALE]

Results:

1. Here we get the regression coefficient is negative i.e. if GDP_PCI increases by 1% then AMR_MALE is expected to decrease by 11.1455%.
2. Null hypothesis is not rejected at 5% level of significance as p = 0.509 >.05).
3. Here r^2 =0.0665 i.e. only 6.65% variation is being explained by the regression model.
4. If ℓGDP_PCI increases by 1 unit then ℓAMR_MALE is expected to decrease by .111455 units, which implies elasticity(e) =.111455 [inelastic].
5. From Figure 4.3 we observe a non-linear relationship between ℓGDP_PCI & ℓAMR_MALE.

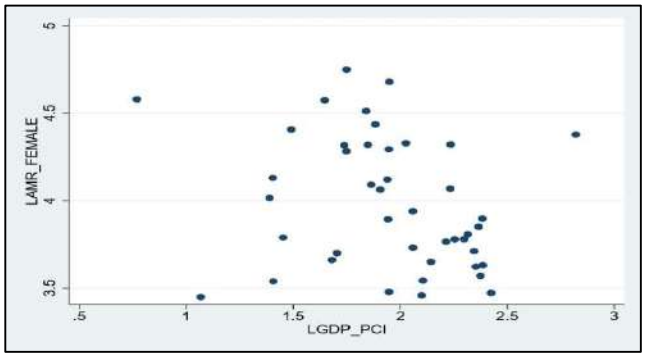


Figure 4.3: Scatter Diagram showing the relationship between ℓGDP_PCI and ℓAMR_MALE.

Model 4: ℓAMR_FEMALE= $\alpha_4 + \beta_4$ ℓGDP_PCI+ error

Estimated model: $\widehat{\ell AMR\_FEMALE} = 4.443152 - .2344205 \ell GDP\_PCI$

We note the followings:

1. Since the regression coefficient is negative if ℓGDP_PCI increases by 1% then ℓAMR_FEMALE is expected to decrease by 23.44205%.
2. $H_0 : \beta_4 = 0$ is not rejected at 5% level of significance.as p = 0.107 > .05).
3. Here r^2 = 0.0622 i.e. only 6.22% variation is being explained by the regression model.
4. If ℓGDP_PCI increases by 1 unit then ℓAMR_FEMALE is expected to decrease by .111455 units, which implies elasticity(e) =.2344205 [inelastic].
5. Figure 4.4 indicates a non-linear relationship between ℓGDP_PCI & ℓAMR_FEMALE.

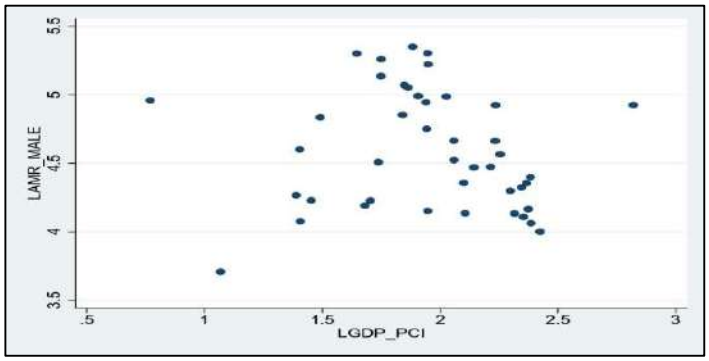


Figure 4.4: Scatter Diagram showing the relationship between ℓGDP_PCI and ℓAMR_MALE
Figure 4.4 indicates existence of no relationship between ℓGDP_PCI & ℓAMR_MALE

V Conclusion

In our study, in each of the four models we have observed that the null hypothesis is not rejected which implies that there may not exist no relationship between the variables that we had taken for our study.

There are certain limitations in our study due to omission of relevant variables, use of SLRM instead of MLRM and for using smaller sample size.

There are various other relevant variables which can impact the adult mortality rate of a nation, like education, occupation, age, standard of living, area of residence, literacy composition, alcohol consumption, smoking, mental heath of adult etc. which are not incorporated in our model. These have considerable impact on Adult mortality rate other than Government expenditure in the health sector, so presence of these factors might bring about change in our observation as well as the diagrammatic representation.

SLRM is used for ideal condition of Ceteris Paribus and MLRM is used for real market condition. Presence of more than one explanatory variables cannot be accommodated so, we have to assume all other variables like occupation, age, etc are fixed so that we find the impact of only government health expenditure on mortality rate. If we had used MLRM then we could have used all the variables together representing the real market condition.

Sample size has a major effect on power of hypothesis testing. The greater the sample size greater the power of the test, as this is the best way to increase the power of the test. In our study we have used 43 nations around the world as sample size which relatively smaller to the total number of countries around the world, so this maybe a possible reason of non-rejection of Null hypothesis.

Though there were quite a few shortcomings in this study but it has helped us to learn and understand the government expenditure of various nations in the health sector which affect the mortality rate of both male and female.

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An Enquiry into the Infant Mortality Rates for the High-income Countries

Anway Chanda, Ratnadeep Ghosal, Laher Gupta, Shivani Sahu and Deepak Emmanuel Soren

Abstract

Through this survey, we have tried to find out the impact of government health expenditure on the infant mortality rate for males, females and overall. We have used regression models for that. The paper summarizes the central tendency values for the variables along with the estimated regression models. We have also used scatter diagrams to get a better understanding of the variables.

I Introduction

Infant mortality has always been an issue of serious concern for all countries around the globe. The reason is, it is an important indicator of the effectiveness of the overall health system. However, in recent times, the infant mortality rate (IMR) has declined considerably. The infant mortality rate is the probability of a child born in a specific year and dying before reaching the age of one. It helps in measuring child survival and also reflects the social, economic and environmental conditions in which the child lives including their health care.

In the study, we are motivated to find whether there exists any relation between health expenditures made by the government and IMR in high-income countries. High-income countries include the countries that have a per capita income of more than 12000 American Dollars per year. Though the intervention of government in the market has always been a topic of debate, one cannot deny the role it plays in shaping an economy. Expenses incurred by the government on health institutions, sanitation, education, family planning activities, nutrition activities and emergency aid designated for health, etc. form a part of government expenditure as well. These expenses are very much required for ensuring a healthy community. An increase in expenditure on the health of the population will help the government to keep track of the health of the people in rural areas who are more prone to diseases due to a lack of awareness. Improvement in the health of males and females can reduce the present as well as future infant mortality rates. So, health expenditure can affect the infant mortality rate.

Let us trace whether this expenditure gets any credit or not for a decline in the IMR rates.

The basic objective is to study the relationship between infant mortality rate and health expenditure (as a percentage of GDP) on males and females of high-income countries – to examine whether the health expenditure on the population has a significant impact on the infant mortality rate. The study includes data on both males and females and overall mortality rates. Data for the countries have been taken from 2019 as data for most major countries were not available in the period 2020-21 due to the pandemic situation. Therefore, the latest data that was available for most of the high-income countries depicting the rate of IMR was for the year 2019.

The data source had data from around 80 countries but the number of observations taken by the study is 58 only. Since the data of the rest were missing.

The rest of the paper is organised as follows. Section II represents a brief of the literature surveys

conducted. Section III represents the data and methodology used in the study. Section IV reveals the results and analysis of the study. The concluding remarks are made in section V of the paper.

II Literature Survey

Sefiqdar, Zayeri, Kazemi and Salehi (2019) studied the data on preterm infant mortality rates of different countries based on their income levels through statistical methods to find any relation whether the preterm infant mortality rates depend on the income level of the country or not.

To study the said relationship, statistical methods have been used. The generalized linear models have been proposed to unify the regression approaches for a wide variety of discrete and continuous longitudinal data.

Sefiqdar, Zayeri, Kazemi, and Salehi have found that the preterm mortality rate has been declining over the years 1990 to 2017 and it was also observed that it has been declining faster in developed countries than in developing countries.

Goldstein, Palumbo, Bellamy, Purtle and Locke (2020) suggest that government expenditure on non-healthcare services can reduce infant mortality rate but it is still vague as to what types of spending have the greatest impact among groups at the highest risk.

We have assembled a longitudinal state-level data set of annual infant mortality and government expenditure for the time period 2000-2016. The dependent variable-IMR was obtained for each state from the US National Centre for Health statistics.

The independent variable expenditure was obtained from the US Census Bureau's annual survey of State and Local Government Finances. Using generalized linear regression models, we assess how changes in spending impact infant mortality over time.

The US has been facing a high infant mortality rate among all developed countries of the world. Indeed, we observed that overall and most of the specific expenditures were associated with directionality for reduced infant mortality at the state level, although there was considerable variability. Results from adjusted regression models show that a continuous increase in government expenditure both in health and non-healthcare services like education, transportation, and many more social services may reduce IMRs over time.

IMR is reflective of and amenable to, broad social, economic, and healthcare delivery contexts within a society. State and local governments, via increased social and environmental expenditures, have the potential to reduce, albeit not eliminate, IMR disparities.

Owusu, Sarkodie and Pedersen (2021) the study seeks to examine the overarching effect of healthcare expenditure on infant mortality. Infant mortality is majorly considered because infants are vulnerable in society, and governments spending on health are mostly not categorized based on the type of care (primary, secondary, and tertiary) provided.

The data series examined in this analysis are annual data series of Infant Mortality rate (IMR, per 1,000 live births). Because countries are diversified and are not equal in terms of demographic characteristics, medical technology, the burden of disease, and health infrastructure, among others, econometric methods that account for such heterogeneities, country-specifics, and unobserved common factors, have been utilized.

The countries with lower IMR can be spotted in Southern America, North America, Europe, Antarctica, Asia (except Pakistan and Afghanistan), and Australia. Sub-Saharan Africa records the highest IMR with the Democratic Republic of Congo (90.6 deaths per 1000 live births), Central African Republic (104 deaths per 1000 live births), and Sierra Leone (117 deaths per 1000 live births) as the top three records for the study period.

Zylbersztejn, Gilbert, Hjern, Wijlaars and Hardelid (2018) note that child mortality is almost twice as high in England compared with Sweden. We aimed to establish the extent to which adverse birth characteristics and socioeconomic factors explain this difference.

We developed nationally representative cohorts of singleton livebirths between Jan 1, 2003, and Dec 31, 2012, using the Hospital Episode Statistics in England, and the Swedish Medical Birth Register in Sweden, with longitudinal follow-up from linked hospital admissions and mortality records. We analysed mortality as the outcome, based on deaths from any cause at age 2–27 days, 28–364 days, and 1–4 years. We fitted Cox proportional hazard regression models to estimate the hazard ratios (HRs) for England compared with Sweden in all three age groups. The models were adjusted for birth characteristics (gestational age, birth weight, sex, and congenital anomalies), and for socioeconomic factors (maternal age and socioeconomic status).

Excess child mortality in England compared with Sweden was largely explained by the unfavourable distribution of birth characteristics in England. Socioeconomic factors contributed to these differences through associations with adverse birth characteristics and increased mortality after 1 month of age. Policies to reduce child mortality in England could have the most impact by reducing adverse birth characteristics improving the health of women before and during pregnancy and reducing socioeconomic disadvantage.

III Data and Methodology

We have conducted an econometric analysis to understand the relationship between government expenditure (HE) & IMR in males (IMR_M), females (IMR_F) and overall (IMR_T) separately. The study involves a linear regression model where IMR has been taken as the explained variable & government expenditure as the explanatory variable. We have found out the correlation coefficient between the variables(r), coefficient of variation(R^2), adjusted R^2, skewness and kurtosis.

IV Analysis of Results

Table 1: Descriptive Statistics of the Variables

	Mean	Median	Standard Deviation	Correlation Coefficient
IMR_M	5.586207	1.86907626	4.691629	-0.1821
IMR_F	4.681034	1.758466657	3.867791	-0.1946
IMR_T	5.005263	1.485348342	4.204565	-0.1665
Health Expenditure	7.711261	7.468174193	2.725441	

Source: The authors

Table 1 reveals that the mean of the male IMR is greater than the mean of the female IMR. The median of the male IMR is higher than that of the female. However, the mean and median are highest for that of the health expenditure. The SD of male IMR is higher which implies that they

are more scattered among the class intervals. The IMRs of male, female as well as overall are negatively correlated with the health expenditure made by the government. This implies that increased health expenditure aided in reducing IMR. However, the highest absolute value of the correlation coefficient holds for female infant mortality.

For the regression analysis let us now consider the following models:

Model 1: $IMR_M = \alpha_1 + \beta_1 HE + e_1$

Model 2: $IMR_F = \alpha_2 + \beta_2 HE + e_2$

Model 3: $IMR_T = \alpha_3 + \beta_3 HE + e_3$

where e_1, e_2, e_3 are the error terms of their respective models that follow normal distribution by the virtue of assumption of CLRM.

The null hypotheses of the respective models are: $H_0: \beta_1 = 0$ against $H_A: \beta_1 \neq 0$;

$H_0: \beta_2 = 0$ against $H_B: \beta_2 \neq 0$; $H_0: \beta_3 = 0$ against $H_C: \beta_3 \neq 0$

Model 1:

Estimated regression equation: $\widehat{IMR_M} = 8.003775 - 0.3135114HE$

p-value (0.00) (0.171)

Therefore, we cannot reject the null hypothesis, H_0. We come to conclude that β_1 is insignificant in model 1.

Model 2:

Estimated regression equation: $\widehat{IMR_F} = 6.99128 - 0.2761754HE$

p-value (0.00) (0.143)

Therefore, the null hypothesis H_0 is not rejected. We find that the explanatory variable seems to have no significant impact on the explained variable.

Model 3:

Estimated regression equation: $\widehat{IMR_T} = 6.99128 - 0.2561983HE$

p-value (0.00) (0.216)

Since the p-value is greater than 0.01, the null hypothesis, H_0 is not rejected. We can comment that β_3 is insignificant in the model specified above. We note that

(a) The infant mortality rate in males was negatively correlated to health expenditure. For a 1 unit increase in expenditure on the health sector, the IMR is expected to fall by 0.314 units.

(b) The infant mortality rate in females was also negatively correlated to health expenditures made by the government. For a 1 unit increase in expenditure, the IMR is expected to fall by 0.276 units.

(c) Overall, the IMR can be reduced to a certain extent with the help of government expenditure on the health sector but it is not the only solution in high-income countries.

(d) On plotting the observations, we find that there are outliers present in the data set and the data values cluster around a central mean.

(e) All the variables (IMR for males, females, and total, and health expenditure) are positively skewed.

V Conclusion

We have tried to find out whether there exists any relationship between the expenditure of the government on health and the infant mortality rate. Hence, we conclude that there exist many aspects to address the issue of infant mortality rate in high-income countries along with government expenditure on health, which remain uncovered in our study.

We have some shortcomings in our analysis which are as follows:

First, although, we see that the variables assume a linear relationship but through the scatter diagram we can clearly see that there exists no linear relationship between the variables.

Second, as the models are two-variable models there may be a possibility of excluding some relevant explanatory variables like education, pre-pregnancy etc., which can give misleading, results.

Third, the data used in the study is cross-section data so there may be a possibility of heteroscedasticity and if heteroscedasticity exists, then the OLS method will not be applicable.

The error term (e_i for i= 1,2,3) may not follow normal distribution since it is a two-variable model and it may exclude some relevant explanatory variables.

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Relationship between Adult Mortality Rate and GDP per capita in Low-income Countries

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Abstract

This paper investigates the effect of GDP per capita on the adult mortality rate in low-income countries. The cross-section data for 24 countries for the year 2019 have been studied. The model uses regression analysis to observe the effect of change in the independent variable, i.e., GDP per capita on the dependent variable, i.e., adult mortality rate. It is expected that with increasing GDP per capita, the adult mortality rates should fall. The results obtained are in line with the expectations and it was found that AMR indeed falls with increasing GDP per capita. The effect of increasing GDP per capita on AMR is almost similar for both males and females. So, the model is consistent with the conventional idea that increasing GDP per capita leads to better healthcare and consequently falling AMR.

I Introduction

Since the end of World War II mortality rates have been decreasing and life expectancy has been increasing all over the world. This observation intrigues the question how GDP per capita of countries affect the mortality rate

The present study aims to examine the effect of GDP per capita on adult mortality rate separately for male and female in the low-income countries. Data used in this paper is that of 2019 for twenty four low-income countries. The countries examined are Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, Congo, Ethiopia, Gambia, Guinea, Guinea-Bissau, Rep., Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, Sudan, Togo, Uganda, Yemen, and Zambia.

The primary objective of this study was to analyze the relationship between adult mortality rate (AMR) and income per capita (GDP) in low-income countries. This study examines if there is any significant relationship between AMR and GDP and the nature of the relationship if there exists any.

The present study has been undertaken with the following specific objectives: -

1. To describe the fluctuations in gdp per capita in low-income countries.
2. To retrieve out relationship between adult mortality rate (male and female) (dependent variable) and gdp per capita (independent variable) in low-income countries.

This paper contains literature survey in section II, followed by data and methodology in section III, analysis and results in section IV and conclusion remarks in section V.

II Literature Survey

The summary below is the review of the paper:

Bolyky et al. (2019) conducted an econometric analysis to study the effect of democratic growth in terms of gdp on adult mortality rate. They have used a panel of data spanning 170 countries to assess the association between democracy and cause-specific mortality and explore the pathways connecting democratic rule to health gains. When enforced by free and fair elections, democracies are more likely than autocracies to lead to health gains for causes of mortality.

The results in the paper are consistent with the conclusion that countries with high GDP have lower adult mortality rates. The hypothesis underlying this conclusion is that countries with higher GDP can spend more and are more open to feedback from interest groups sharing healthcare information. The indirect effects of higher GDP are expected to be measurable in terms of decreasing mortality rates in adults.

Ozcan et al. (2002) investigated the effects of declining mortality on economic growth in an endogenous fertility and human capital investment framework. The author had found out that the developed economy steady state is characterized by higher levels of income per capita, human capital investment and a lower level of fertility compared to the Malthusian steady state.

Through the research on the determinants of economic growth, it was found out that there was positive relationship of human capital investment, negative relation of fertility and positive relation of life expectancy with the economic growth.

Endogenizing mortality there exists multiple equilibria – the Malthusian steady state (population growth increases as income per capita increases) and the developed economy steady state (population growth decreases as income per capita increases).

The model of this paper includes both the equilibria which results in a hump shaped population growth function of income per capita.

Rocco et al. (2021) found that reducing mortality and disability adjusted life years (DALYs), a measure which combines morbidity and mortality, promotes per capita GDP growth. The magnitude of the effect is moderate, but non negligible, and it is similar for mortality and DALYs. We find that reducing mortality and morbidity is beneficial to long run economic growth.

Specifically, reducing mortality by 10 per cent increases the growth in GDP per capita over a quarter century by at least 9.6 percentage points on average.

Effects are heterogeneous and are driven by low income and high-income countries, among which the effect is higher in absolute value than that in middle income countries, for both mortality and DALYs. We find non-linear patterns across countries depending on the stage of the demographic transition they are in at the beginning of the study period. Generally, the effects are smaller in absolute terms in countries where the share of the senior population exceeds 10 per cent.

Countries that step up their health policy efforts achieve an additional reduction in mortality and DALYs by 1 percentage point, compared to the status quo.

Ochalek et al. (2019) studied the relationship between mortality and variations in health care expenditure employed alongside country-specific data on demography, epidemiological profile to inform estimates of health opportunity cost.

This economic evaluation of healthcare interventions required an assessment of whether the improvement in health outcomes they offer exceeds the improvement in health that would have

been possible if the additional resources required had been made available for other healthcare activities. This study required high quality data on health outcomes and government expenditures with econometric techniques. This paper also demonstrates that it is possible to generate country specific estimates by applying elasticities estimated from cross-country data which influence how supranational bodies make recommendations and set priorities.

III Data and Methodology

Data used in this paper is that of 2019 for 24 low-income countries. The choice of the period is recent and the countries examined are Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, Congo, Ethiopia, Gambia, Guinea, Guinea-Bissau, Rep., Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, Sudan, Togo, Uganda, Yemen, and Zambia.

We have used econometric analysis to get the results of the study. Stata software is used to get the results.

Dependent variable: 1. Adult mortality rate of female

2. Adult mortality rate of male

Independent variable: GDP per capita in low-income countries.

Economic Model: -

AMR= f(GDP)

Econometric Models:-

Model 1: $\mathrm{AMR_F} = \alpha + \beta\mathrm{GDP} + \mathrm{ERROR}$

Model 2: $\mathrm{log\_AMR_F} = \alpha_0 + \beta_0\mathrm{log\_GDP} + \mathrm{ERROR}$

Model 3: $\mathrm{AMR_M} = \gamma + \delta\mathrm{GDP} + \mathrm{ERROR}$

Model 4: $\mathrm{log\_AMR_M} = \gamma_0 + \delta_0\mathrm{log\_GDP} + \mathrm{ERROR}$

SOURCE OF THE DATA: WORLD BANK DATABASE

IV Analysis of Results

Table 1 presents some descriptive statistics on adult mortality rates of males and females and GDP per capita in low-income countries.

Table 1: Descriptive Statistics on Adult Mortality Rates of Males and Females and GDP

	AMR_F	AMR_M	GDP
Observation	24	24	24
Mean	235.1406	291.1364	744.0117
Standard deviation	54.96921	63.03565	363.3024
Skewness	0.9974053	0.8746951	1.8915
Median	222.721	272.573	650.2414

Source: The Authors

It is evident from Table 1 that the adult mortality rate for males has a greater mean and median value compared to the adult mortality rate for females. Thus, the mortality rate might be higher in males. It is also evident that GDP per capita, i.e., income distribution is positively skewed which implies that the mean value of the data is found to be greater than the median value.

The regression results for different models are presented below:

Model 1: $\mathrm{AMR_F} = \alpha + \beta\mathrm{GDP} + \mathrm{ERROR}$

Estimated regression equation:- $\widehat{\mathrm{AMR_F}} = 275.6405 - 0.0544346\mathrm{GDP}$

Hypothesis Testing:

$H_0: \beta = 0$ [GDP does not affect AMR] ag. $H_1: \beta \neq 0$

Table 2 presents the regression results.

Table 2: The Summary of Regression Results for Model 1

Variable	Coefficient	Standard error	t-statistic	p-value
α	275.6405	24.7875	11.12	0
β	-0.0544346	0.0300507	-1.81	0.084

Source: The Authors

$R^2 = 0.1298$ Adjusted R^2= 0.0902

Model 2: $\log\_\mathrm{AMR_F} = \alpha_0 + \beta_0 \log\_\mathrm{GDP} + \mathrm{ERROR}$

Estimated regression equation: $\widehat{\log\_\mathrm{AMR_F}} = 6.69 - 0.1923 \log\_\mathrm{GDP}$

Hypothesis Testing:

$H_0: \beta_0 = 0$ [GDP does not affect AMR] ag. $H_1: \beta_0 \neq 0$

The summary of regression results for model 2 is given in Table 3.

Table 3: Regression Results for Model 2

Variable	Coefficient	Standard error	t-statistic	p-value
α_0	6.690224	0.6698895	9.99	0
β_0	-0.1923296	0.102533	-1.88	0.074

Source: The Authors

R^2 =0.1379 Adjusted R^2= 0.0987

Model 3: $\mathrm{AMR_M} = \gamma + \delta\mathrm{GDP} + \mathrm{ERROR}$

Estimated regression equation: $\widehat{\mathrm{AMR_M}} = 332.9199 - 0.0561597\mathrm{GDP}$

Hypothesis Testing:

$H_0: \delta = 0$ [GDP does not affect AMR] ag. $H_1: \delta \neq 0$

The summary of regression results for model 3 is shown in Table 4.

Table 4: Summary Regression Results for Model 3

Variable	Coefficient	Standard error	t-statistic	p-value
γ	332.9199	28.8269	11.55	0
δ	-0.0561597	-0.0349468	-1.61	0.122

Source: The Authors

$R^2 = 0.1051$ Adjusted R^2= 0.0644

Model 4: $\log\_AMR_M = \gamma_0 + \delta_0 \log\_GDP + ERROR$

Estimated regression equation:

$$\widehat{\log\_AMR}_M = 6.783 - 0.1733072 \log\_GDP$$

Hypothesis Testing:

$H_0: \delta_0 = 0$ [GDP does not affect AMR] ag. $H_1: \delta_0 \neq 0$

The summary of regression results for model 4 is presented in Table 5.

Table 5: Summary Regression Results for Model 4

Variable	Coefficient	Standard error	t-statistic	p-value
γ_0	6.783	0.628353	10.79	0
δ_0	-0.1733072	0.0961754	-1.81	0.085

Source: The Authors

R^2 =0.1286 Adjusted R^2= 0.089

Interpretation of Regression Results:

Dependent variable: adult mortality rate female (amrf)

Independent variable: GDP per capita in low-income countries. (gdp)

Model 1: $amrf = \alpha + \beta gdp + error$

Model 2: $\log\_amrf = \alpha + \beta \log\_gdp + error$

We find that the estimated regression coefficient (β) is -0.0544346 (negative), that is, it has an anticipated sign and it is statistically significant only if the level of significance chosen is 10% or more otherwise it is found to be insignificant at our usual 5% level of significance since the p-value is less than 10% level of significance. So, we may conclude that the gdp per capita negatively affects the adult mortality rate (female) in low-income countries.

The estimated elasticity of the adult mortality rate (female) with respect to gdp per capita (given by the value of the estimated coefficient) is 19.23 per cent. For one per cent increase in gdp per capita, amr female is expected to fall by 19.23 per cent. However, gdp per capita can explain only 13 per cent of variation inamr(female). The measure of goodness of fit shows that it is a poor fit.

Dependent variable: adult mortality rate male (amrm)

Independent variable: GDP per capita in local income countries. (gdp)

Model 3: $amrm = \alpha + \beta gdp + error$

Model 4: $\log\_amrm = \alpha + \beta \log\_gdp + error$

We find that the estimated regression coefficient (β) is -0.1923296 (negative), that is, it has an anticipated sign and it is statistically significant only if the level of significance chosen is 10% or more otherwise it is found to be insignificant at our usual 5% level of significance since the p-value is less than 10% level of significance. So, we may conclude that the gdp per capita negatively affects the adult mortality rate (male) in low-income countries.

The estimated elasticity of the adult mortality rate (male) with respect to gdp per capita (given by the value of the estimated coefficient) is 17.33 per cent. For one per cent increase in gdp per capita, amr male is expected to fall by 17.33 per cent. However, gdp per capita can explain only 12 per cent of the variation in amr (male). The measure of goodness of fit shows that it is a poor fit. Most of the results seem to be significant at a 10% level of significance which makes the results less robust according to statistical standards. A better analysis in this context would be to do a correlational study. Being a cross-sectional study, heteroskedastic biases should be controlled for more efficient results.

V Conclusion

The focus of this paper was to observe the impact of gdp per capita on the adult mortality rate for males and females in low-income countries.

We obtain a negative relationship between gdp per capita and adult mortality rate in low-income countries. Our findings are consistent with the results of the literature survey.

The estimated elasticity of the adult mortality rate with respect to gdp per capita is 17.33 per cent for males and 19.23 per cent for females. However, gdp per capita can explain only 12 per cent of the variation in the adult mortality rate for males and only 13 per cent for female. The measure of goodness of fit shows that it is a poor fit.

We face challenges in determination as well, the presence of heteroschedasticity for cross section data being the first challenge. The sample size is small. Apart from this, missing observations have been dropped. Also, error terms may not follow the normal distribution. We need to consider that we chose a two-variable model for our study so some relevant variables might be omitted like education, climate, healthcare facilities etc.

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Adult Mortality Rate and Government Expenditure on Health for Low-income Countries

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Abstract

Health is an important indicator of the development of a country. For low-income countries, health expenditure indicates the quality of health care that the population receives which in turn affects the adult mortality rate (AMR) in that country. In this context, our study examined the effect of government health expenditure on adult mortality rates separately of males and females. It can be seen from the descriptive statistics that the adult mortality rate among males is greater than the adult mortality rate among females. We had expected that there would be a negative relation between government health expenditure and adult mortality rate among males and females and this notion is supported by our study. That is as health expenditure increases (decreases), AMR among males and females decreases (increases). However, the estimated regression coefficients are not statistically significant in these models. Our study concludes that there are several other factors like the living conditions of the masses and social awareness etc. that affect the adult mortality rate among males and females and not just government health expenditure.

I Introduction

We got motivated to make a paper presentation on this topic by an article published by The Economic Times on the direct correlation between health expenditure and covid outcomes. We wanted to examine the effects of health expenditure on the adult mortality rates of males and females,especially in low-income countries. Covid had adversely affected low-income countries and we believe the health expenditure in these respective countries had a role to play. We have considered the data for 2019 as the maximum amount of data available for most of the low-income countries for the year 2019. When health expenditure is improved, an increased number of health benefits will be available to the people of the nation.

The objective of the present study is to examine the relationship between the adult mortality rate and government expenditure on health in low-income countries. In assessing the health status of any given country, the adult mortality rate plays a vital role in assessing population health, quality of care, poverty, and socioeconomic status, among others. Health status in general, as well as, the mortality rate at various stages of life in developed, developing, and least developed countries vary based on several factors. But here we will study theeffect of health expenditure over adult mortality rate. When we form a regression equation, healthexpenditure is the independent variable and adult mortality rate is the dependent variable. The study of this relationship will help us to understand that when health expenditure is increased or decreased by the government, what will be its impact on the adult mortality rate.

There might be a negative effect of health expenditure on adult mortality rate. That is, health expenditure and mortality rate may be negatively related. There are a lot of factors that affect adult mortality rate among males and females but for this particular paper we have takenthe effect of health expenditure on adult mortality. When we regress adult mortality rate on health expenditure, the value of the estimated regression coefficient comes out to be negative. From this it may be

inferred that the relationship between health expenditure and adult mortality may not be positive. This leads us to believe that if the government increases its health expenditure, more will be spent on the health sector that is more hospitals are built, more health care centers in the villages are set up and more health benefits will be available to the masses. So by this we can say thatthe adult mortality rate will go down. The exact opposite will happen to adult mortality rate when the government decreases its health expenditure.

II Literature Survey

Odhiambo et al. () have estimated the econometric models using panel data to estimate the impact of health expenditure and corruption on adult mortality rate as well as how level of corruption has influenced effectiveness of health expenditure. The baseline model measuresthe effect of health expenditure on adult mortality and is specified with control variables. This study examined the link between health expenditure and adult health in Sub-Saharan Africa and how level of corruption influences that relationship. Despite the intergovernmental and development partner's efforts to improve adult health, adult mortality rates in SSA are still higher than the rest of the world. More interventions are needed to reduce premature mortality among the economically active population in SSA.

Karaman et al.aimed to reveal the impacts of the selected healthcare spending indicators on the selected health outcomes for OECD countries. Healthcare spending as a share of GDP, public and private health-care spending per capita and pharmaceutical spending per capita were considered as independent variables in this study. In this study, a multiple linear regression analysis is conducted to evaluate the impacts of the healthcare spending indicators on the selected health outcomes. Due to the small sample size (n=30), a stepwise multiple regression analysis is used (14). All statistical analyses are carried out in SPSS (Statistical Package fort the Social Sciences) v21.0.The Durbin-Watson statistic and Variation Inflation Factor (VIF) were calculated and the level of significance was taken 0.05 to determine if there was multiple correlation and autocorrelation in theestablished regression models. According to the results, it was found out that public healthcare spending per capita has a significant impact on maternal mortality, male and female life expectancy at birth and in 80 years. Also, private healthcare spending per capita was found as an important determinant of self-reported health.

Oluwaseyi et al. have estimated the econometric models using the annual time series data to estimate effect of public health expenditure has on health outcomes in Nigeria and Ghana whilst re-conceptualizing health outcome by capturing adult Malaria and HIV/AIDS mortality. It focuses on public health expenditure, health outcomes and control variables such as GDP and urban population. This study captures two areas in Sub-Saharan Africa, Nigeria and Ghanadue to the prevalence of adverse outcomes of HIV/AIDS and Malaria.

Despite the government expenditure spent on healthcare in both countries is deficient in combatingadult Malaria and HIV/AIDS mortalities. This study has revealed that increasing public health expenditure by 1% annually up to at least 15% can significantly reduce health outcomes. This study has shown that fulfilling the UN General Assembly (MDG/SDG) and the Abuja

Declaration commitment is critical to resolving these over dragging issues.
Rahman et al. investigated the relationship between different types of healthcare expenditures (public, private andtotal) and three main health status outcomes - life expectancy at birth, crude death rate and infant mortality rate - in the region.
Using the World Bank data set for 15 countries over a 20-year period (1995–2014), a panel data analysis was conducted where theoretical models were estimated to determine the effects of healthcare expenditure on health outcomes.
Private health expenditure also had a significant role in reducing the crude death rate. Per capita income growth and improved sanitation facilities also had significant positive roles in improving population health in the region.
Health expenditure in the SAARC-ASEAN region should be increased as these results indicated that itimproved the health status of the population in the region. Public sector health funds must be appropriately and efficiently used, and accountability and transparency regarding spending of public health funds should be ensured. Finally, government and private institutes should implement appropriate strategies to improve sanitation facilities.

III Data and Methodology

In this survey, we have considered the impact of health expenditure on the mortality rates of male and female of the low income countries. For this we have taken the data on the health expenditure and the mortality rates.
We have run the regression of mortality rates on the health expenditure taking health expenditure as the independent variable and adult male /female mortality rates as the dependent variable. We have denoted the Government health expenditure by "health-exp", the male mortality rate by "amr male" and female mortality rate by "amr female". We have also computed the mean, median, standard deviation, measure of kurtosis, coefficient of variation and the correlation coefficient separately for each of the variables. The scatter diagram for each regression has also been studied here.

IV Results and Analysis

Table 1: Descriptive Statistics of the Variables

Variable Names	Mean	Median	Standard Deviation	Skewness	Coefficient of Variation
health-exp	5.990817	5.566787	2.370364	1.189352	0.3956662
Amr male	286.1655	265.5425	69.77704	0.567821	0.2438346
Amr female	226.7581	221.124	71.05181	-0.0258005	0.3092462

Source: The Authors

Model 1: amr male= $\alpha+\beta$ health-exp+error
The correlation coefficient of -0.0728 signifies that there is negative correlation between the variables.

The scatter diagram shows that there is no linear relationship between amr male and health expenditure.

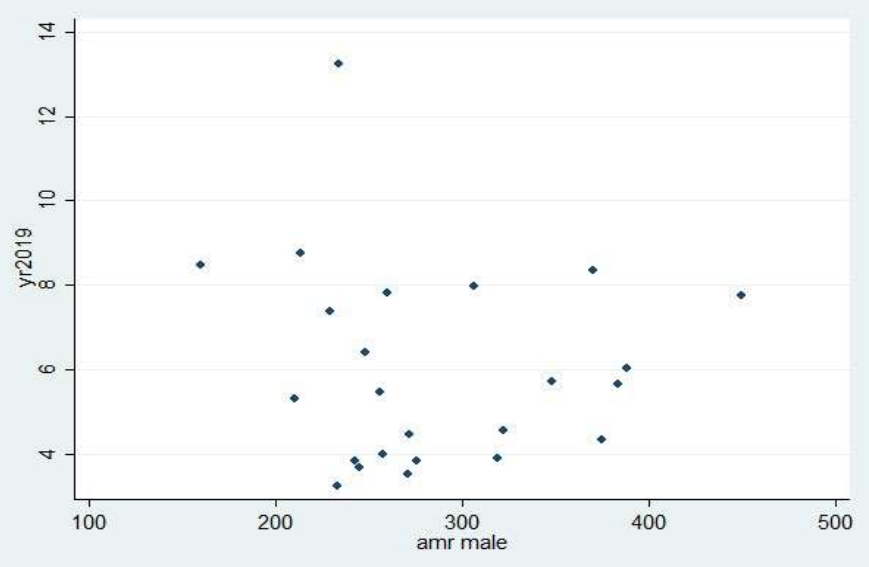

Figure 1: Scatter Diagram of health-exp and amr male

Estimated regression equation:

$$\widehat{\text{amr male}} = 299.0024 + (-2.142773)\text{health-exp}$$

(0.0) (0.735)

The value of the estimated regression coefficient comes out to be 2.142773 with a negative sign. This implies that with 1 unit increase (decrease) in government health expenditure, adult mortality rate among males is expected to decrease (increase) by 2.142773 units. Such a result validates our expectations that adult mortality rates among males will increase with a decrease in heath expenditure by the government and vice versa.

The value of the estimated intercept coefficient comes out to be 299.0024 which implies that with no government health expenditure, the adult mortality rate among males become 299.0024 units.

H_0:β=0 ag alt H_0:β≠0

The p-value of the estimated regression equation is 0.735 which is greater than both 5% and 1% level therefore we have no reason to reject the null hypothesis.

The R^2 value is 0.0053. This implies that there are other factors other than government health expenditure that affect adult mortality rates among males. Due to the low value of R^2 , it is difficult to compute a best fitted line, which is also depicted in our scatter diagram.

Model 2: amr female= α+βhealth-exp+error

The correlation coefficient of -0.0387 signifies that there is negative correlation between the variables.

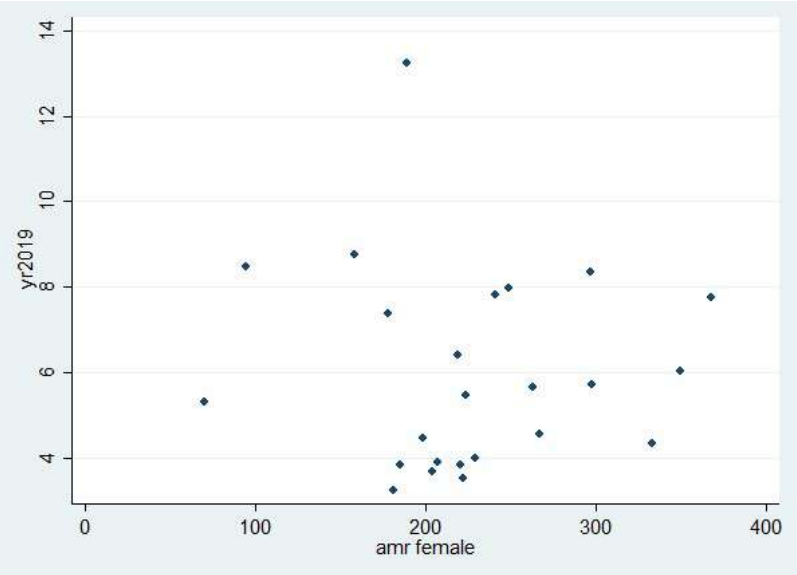

Figure 2: Scatter Diagram of health-exp and amr female

The scatter diagram shows that there is no linear relationship between amr female and health expenditure.

Estimated regression equation:

$$\widehat{\text{amr female}} = 233.7105 + (-1.160506)\text{health-exp}$$

(0.0) (0.857)

The value of the estimated regression coefficient comes out to be 1.160506 with a negative sign. This implies that with 1 unit increase (decrease) in government health expenditure, adult mortality rates among females is expected to decrease (increase) by 1.60506 units. Such a result validates our expectations that adult mortality rates among females will decrease with an increase in heath expenditure by the government and vice versa.

The value of the estimated intercept coefficient comes out to be 233.7105 which implies that with no government health expenditure, the adult mortality rate among females become 233.7105 units.

H_0:β=0 ag alt H_0:β≠0

The p-value of the estimated regression equation is 0.857 which is greater than both 5% and 1% level therefore we have no reason to reject the null hypothesis.

The R^2 value is 0.0015 . This implies that the presence other factors other than government health expenditure that affect adult mortality rates among females.

V Conclusion

As mentioned earlier that there might be a negative relation between government health expenditure and adult mortality rates of males and females. We had regressed adult mortality rate

of males and females on health expenditure and found out that as health expenditure increases (decreases), adult mortality rates decreases(increases). It could also be concluded from these two models that there is no statistical significance of these models.

We have also found out that the R^2's of both the models are very low, which brings us to conclude that there are other factors which influence adult mortality rates, not just government health expenditure. This is the primary shortcoming of this study as we have considered a simple linear regression model and not a multiple linear regression model which includes multiple variables. If amultiple linear regression model would have been considered then the effect of other factors such as living conditions of the masses, social awareness etc on the adult mortality rate could also have been found out.

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Relationship between Life Expectancy and GDP per capita for Low-income Countries

Trishita Ballav, Abhishek Dubey, Farhin Imran, Souvik Mahato and Sayan Pal[5]

Abstract

This paper administers the collection of data on life expectancy for males, females and total population together with the GDP per capita of 24 low-income countries from the World Bank database (2019). Descriptive statistics and econometric analysis (using OLS estimation) have been performed (separately for males, females and total) to estimate and analyze the relationship between life expectancy and GDP per capita. The unexpected results of the analysis prove our understanding of the strong positive correlation between life expectancy and GDP per capita incorrect. We discover the correlation coefficient to be significantly low. The scatter diagram too doesn't reveal any particular trend as the points are unevenly distributed across the plane. Additionally, performing regression analysis we get similar results for males and females where the relationship is neither valid at 1% nor 5% but becomes valid for a 10% level of significance. Doing a further analysis of the log-log model we discover differing results for males and females in that relationship emerges invalid even at a 10% level of significance for the female scenario. Such inconsistency in the results may be due to the omission of relevant variables eg, genetics, diet and nutrition, and lifestyle choices.

I Introduction

This research is driven by a newspaper article highlighting the factors affecting the life expectancy of people. In the article, it was mentioned that people who tend to work hard or work more hours usually end up deteriorating their health resulting in declined life expectancy. We are also aware that there is a significant correlation between a country's GDP per capita and number of labour hours, so this fact indicates that life expectancy of people living in countries with higher GDP per capita is lesser. This is an interesting study to carry out as we can analyze the same problem from different angles. As mentioned earlier higher GDP also indicates higher expenditure in healthcare sectors, hence higher expected level of life expectancy. Therefore, this research's main objective is to solve this paradoxical scenario with empirical research and to gather enough data based evidence that clarifies the real trend of relationship between the variables.

Hence, the objective of this research is to study the relationship between GDP per capita and the Life Expectancy of Male and Female citizens separately and then do the study again for GDP per capita and Total Life Expectancy on an average for every citizen in the low income nations-to examine whether GDP per capita has a significant impact on the Life Expectancy of the residents of low income nations.

[5] We are deeply grateful to Dr. Smita Nath, Prof. Simontini Das (Jadavpur University) and Sri Darpajit Sengupta (SRF, Jadavpur University) for their benevolent guidance in making this paper possible.

Life expectancy is a measure of the number of years an average person is expected to live, based on the year of its birth, its current age and various other demographic factors. GDP per capita is a measure that calculates the country's economic output that accounts for the country's population. It is calculated by dividing a country's GDP by the country's total population. Per capita income is a measure of the amount of money earned per person in a nation or geographic region. It is used to estimate the standard of living and quality of life of the population. GDP per capita is used as an indicator of per capita income since it is a basic measure of the value of output per person and thus proves to become an indirect indicator of per capita income.

Gross Domestic Product is a monetary measure of the market value of all the final goods and services produced in a specific time period by countries. If a state has a higher GDP per capita, then it can have a higher health budget-it can open new medical colleges and research centers, it can buy state-of-the-art technologies, can run awareness campaigns, and build better hospitals. All the mentioned factors can contribute to saving the lives of people residing in the country and thus increase their life expectancy. By this cause-and-effect relationship, GDP per capita is used as the independent variable(gdp_pc) and life expectancy is used as the dependent variable (lemale for Male Life Expectancy, lefemale for Female Life Expectancy and letotal for Total Life Expectancy).

We have organised the paper as follows. In Section II we present a literature survey that mentions the various discussion papers and articles that were studied for the purpose of understanding the work done on the same topic, in the past, by learned authors. Section III states the methodology used and then specifies the different models that were built for the study. The database for the data used for the study is then cited. Section IV consists of a summary describing the basic features of the dataset using descriptive statistics and the regression analysis that examines the relationship between the predictor variables and a response variable. Finally, we conclude our findings and also put forth the shortcomings of our study in Section V.

II Literature Survey

Ngangue and Manfred (2015) did a descriptive analysis and econometric analysis on panel data of 141 Developing countries for the time period 2000-2013 and found a positive relationship between Life Expectancy and Economic Growth measured by the growth of Gross National Income (GNI) per capita in the developing countries.

Adeline and Delattre (2017) used descriptive statistics and examined the relationship between income and health inequalities in Europe for 15 countries (cross-section data) and discovered a positive relationship between income and self-perceived health status. Self-perceived health status is the health outcome being reported by the individuals themselves under study, aged 50 and older by gender for all countries and labeled from 'poor' to 'excellent'.

Herzer and Nunnenkamp (2015) assessed the effect of income inequality on life expectancy by performing panel cointegration techniques as well as econometric analysis separately for developed and developing countries. They discovered that people living in developing countries

with more income inequality have a significantly lower life expectancy than people with a more equal distribution of income.

Hansen and Lonstrup (2013) did an empirical analysis to study the relationship between growth in life expectancy and per capita GDP for all countries for the time periods 1900-1940 and 1940-1980 and discovered a negative relationship between the two variables.

Mohamad, Houssain, Hossain, Islam and Rawal (2013) did a similar study in Bangladesh during 1995-2011 using multiple regression analysis and found out that increase in per capita real income has a positive impact on life expectancy and overall well-being of the country's population.

Another paper by Jetter, Laudage, Stadelmann (2019) employs quantitative regression methods and finds that there is a systemic relation between income level and life expectancy. They took a sample size of 197 over 213 countries. GDP itself explained 64% of variation in life expectancy.

III Data and Methodology

The following research is carried out by using the data of 24 countries that are taken from the World Development Indicators published by the World Bank. For our research, we have not included other low-income countries as the required data was either not available or incomplete.

In this research our objective is to understand the pattern of the relationship between life expectancy and GDP per capita of low-income countries, hence we find the metrics like mean, median, standard deviation, and coefficient of variation for the male population, female population and total population separately. Also, we will take the help of a scatter diagram and correlation coefficient to understand the pattern of the relationship between the two variables better. The method that we are using is econometric analysis, in this, we will carry out regression and find the p-value to check the statistical significance of the dependent variable. We will also derive the econometric model of the form 'Y = α + βX + error', and check the null hypothesis $\beta = 0$ to test the validity of the relationship between the variables.

In this paper, the variable 'lemale' represents life expectancy of male citizens in the low-income countries considered for study. Similarly, the variables 'lefemale' represents life expectancy of female citizens and 'letotal' represents life expectancy of all the citizens of the low-income countries. The unit of measurement for all three variables is the number of years. The variable 'gdp_pc' represents GDP Per Capita of the considered low-income countries in US Dollars. The software stata has been used for the study.

IV Analysis and Interpretation

a. Descriptive Statistics

The global life expectancies for males and females are 72 and 79 years respectively as of 2019. From Table 1 we find that the universally accepted statement that "women outlive men" stands true even in the case of low-income countries. However, the average life expectancy of males and females in low-income countries is almost 12 years less than the global rate.

It is also observed that the standard deviation is greater in females than males which implies that there is more variability in the life expectancy of females in low-income countries than the mean life expectancy.

Table 1: Descriptive statistics for the life expectancy of the male, the female and all the citizens of a country

	lemale	lefemale	letotal	gdp_pc
Mean	60.108	63.49975	61.81687	744.0117
Median	60.7935	63.551	61.826	650.2414
Standard Deviation	3.972529	4.296983	4.076783	363.8024
Coefficient of Variation	6.608985%	6.766929%	6.594879%	48.897403%
Skewness	-0.5641823	-0.3852731	-0.491502	1.81915

Source: Authors

The coefficient of variation is a little higher in females than in males. This means that there is greater level of dispersion for females around the mean life expectancy.
The standard deviation is quite high implying that there is great variation in the income distribution among different sectors in low-income nations. It has a positive skewness and as it is greater than 0, it has a long right-tail. This implies there exists inequality in the distribution of income between the rich and the poor in low-income nations. As income earned depends upon a number of factors ranging from job opportunities available to wages and wage structures, it also implies that resources and opportunities are unequally distributed as well.

b. Econometric and Graphical Analysis

The results of the regression analysis are presented below.

Model 1**:** lemale= α_0+ $\alpha_1$gdp_pc + error

Estimated model: $\widehat{lemale}$ = 57.19023 + 0.0039217gdp_pc

p-value: (0.000) (0.085)

R-Square: 0.1290

Correlation Coefficient: 0.3591

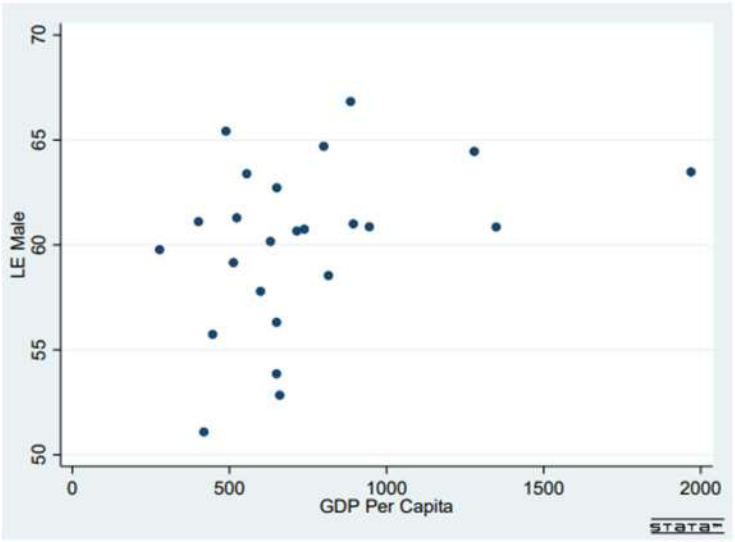
Hypothesis Testing:

H_0: $\alpha_1 = 0$ (i.e., no relationship exists between gdp_pc and lemale) against H_1: $\alpha_1 \neq 0$.

We find that the estimated regression coefficient is positive, that is, it has an anticipated sign. It can be clearly understood that if GDP per capita increases by 1 unit, Male Life Expectancy is predicted to increase by 0.0039217 units which is quite small. However, such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind

Male Life Expectancy. Also, if gdp_pc= 0, lemale is predicted to be 57.19023 units. The value of R-square is only 0.1290 which means gdp_pc can only explain 12.90% variation in the dependent variable lemale (Life Expectancy of Male). Statistically, for the given dataset gdp_pc is an insignificant factor behind lemale since its p value(0.085) is greater than 0.05 which indicates that the positive relationship between gdp_pc and lemale may not be valid for 1% and 5% levels of significance. The relationship may be valid at 10% level of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1% and 5% level of significance, lemale and gdp_pc may not be proportionally related.

We can also confer to similar conclusion by looking at the correlation coefficient between variables "lemale" and "gdp_pc" which is 0.3591. This value is very less indicating the possibility of very little correlation between the life expectancy of male population and the county's gdp per capita.



Graph 1: Scatter Diagram of GDP per capita and male life expectancy

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to a similar conclusion that no relationship is expected between Life Expectancy of male citizens and GDP per capita for low-income countries. We also find the presence of outliers.

All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the male life expectancy but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1% and 5% level of significance. Although it becomes significant at 10% level of significance.

Model 2**:** lefemale= $\alpha_2 + \alpha_3$gdp_pc + error

Estimated model: $\widehat{\text{lefemale}} = 60.38381 + 0.004188\text{gdp\_pc}$

p-value: (0.000) (0.089)

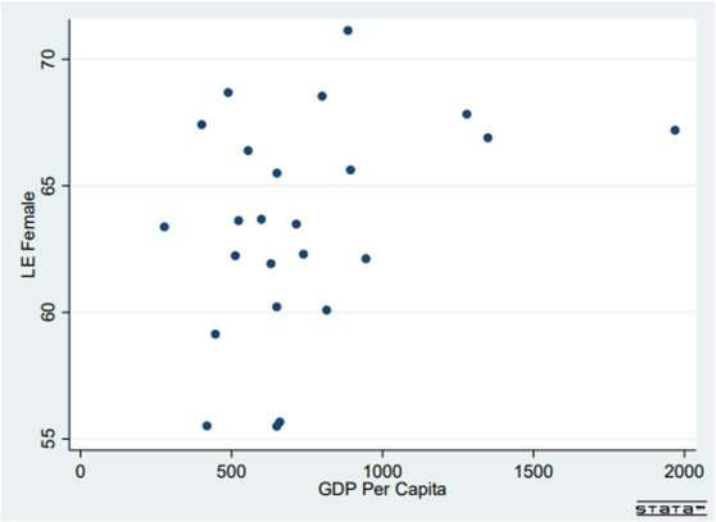
R-Square: 0.1257

Correlation Coefficient: 0.3546

Hypothesis Testing: $H_0: \alpha_3 = 0$ against $H_1: \alpha_3 \neq 0$

We find that the estimated regression coefficient is positive, that is, it has anticipated sign. It can be clearly understood that if GDP per capita increases by 1 unit, Female Life Expectancy is predicted to increase by 0.004188 units which is quite small. However such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind Female Life Expectancy. Also if gdp_pc= 0, lefemale is predicted to be 60.3881 units. The value of R-square is only 0.1257 which means gdp_pc can only explain 12.57% variation in lefemale. Statistically, for the given dataset gdp_pc is an insignificant factor behind lefemale since its p value (0.089) is greater than 0.05 which indicates that the positive relationship between gdp_pc and lefemale may not be valid for 1% and 5% levels of significance. For this dataset, the relationship may be valid at 10% level of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1% and 5% level of significance, lefemale and gdp_pc may not be proportionally related.

We can also confer to similar conclusion by looking at the correlation coefficient between variables "lefemale" and "gdp_pc" which is 0.3546. This value is very less indicating the possibility of very little correlation between the life expectancy of female population and the county's gdp per capita.



Graph 2: Scatter Diagram GDP per capita and life expectancy of male Citizens

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to a similar conclusion that no relationship is expected between Life Expectancy of female citizens and GDP per capita for low income countries. We also find the presence of outliers. All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the Female Life Expectancy but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1% and 5% level of significance. Although it becomes significant at 10% level of significance.

Model 3: letotal= $\alpha_4 + \alpha_5$gdp_pc + error

Estimated model: $\widehat{letotal}$= 58.79422+0.0040626gdp_pc

p-value: (0.000) (0.082)

R-Square: 0.1314

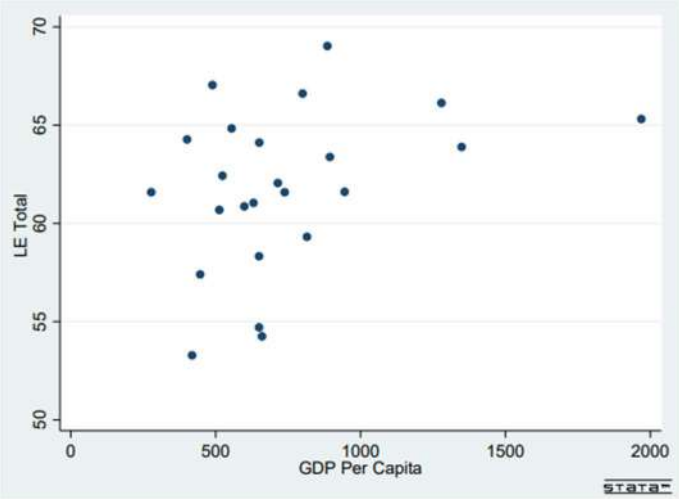
Correlation Coefficient: 0.3625

Hypothesis Testing: H_0: $\beta_1=0$ against H_1: $\beta_1\neq0$

We find that the estimated regression coefficient is positive, that is, it has anticipated sign. It can be clearly understood that if GDP per capita increases by 1 unit, Total Life Expectancy is predicted to increase by 0.0040626 units which is quite small. However, such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind Total Life Expectancy. Also if gdp_pc= 0, letotal is predicted to be 58.79422 units.

The value of R-square is only 0.1314 which means gdp_pc can only explain 13.14% variation in total life expectancy. Statistically, for the given dataset gdp_pc is an insignificant factor behind letotal since its p value (0.082) is greater than 0.05 which indicates that the positive relationship between gdp_pc and letotal may not be valid for 1% and 5% levels of significance. The relationship may be valid at 10% level of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1% and 5% level of significance, letotal and gdp_pc may not be proportionally related.

We can also confer a similar conclusion by looking at the Correlation Coefficient between variables "letotal" and “gdp_pc" which is 0.3625. This value is very less indicating the possibility of very little correlation between total life expectancy and the country's gdp per capita.



Graph 3: Scatter Diagram of GDP per capita and Life Expectancy of Female

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to similar conclusion that no relationship is expected between Total Life Expectancy and GDP per capita for low income countries. We also find the presence of outliers.

All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the Life Expectancy of all citizens of a country but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1% and 5% level of significance. Although it becomes significant at 10% level of significance.

Model 4: Loglemale = $\beta_0 + \beta_1$LogGDP + error

Estimated model: $\widehat{\text{Loglemale}}$= 3.719603+0.0574189LogGDP

p-value: (0.000) (0.084)

R-Square: 0.1296

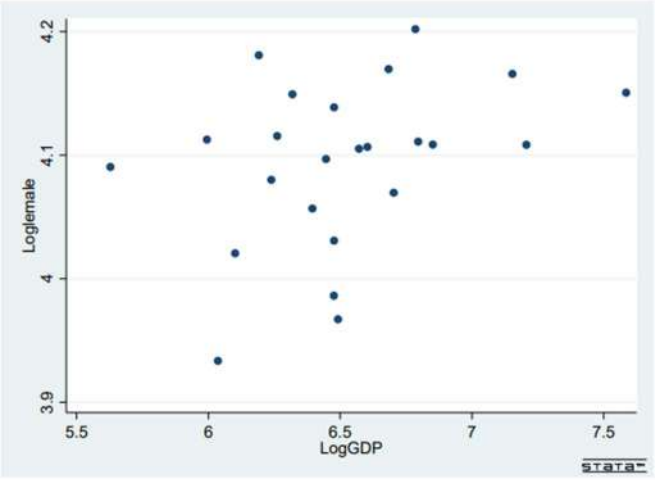
Correlation Coefficient: 0.3600

Hypothesis Testing: $H_0: \beta_1=0$ against $H_1: \beta_1 \neq 0$.

We find that the estimated regression coefficient is positive, that is, it has anticipated sign. It can be clearly understood that if GDP per capita increases by 1 percent, Male life expectancy is predicted to increase by 0.0574189 percent which is quite small. However such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind Male Life Expectancy. Also if LogGDP= 0, Loglemale is predicted to be 3.719603 units. The value of R-square is only 0.1296 which means LogGDP(Log of GDP per capita) can only explain 12.96% variation in the dependent variable Loglemale (Log of Life Expectancy of Male).

Statistically, for the given dataset LogGDP is an insignificant factor behind Loglemale since its p value(0.084) is greater than 0.05 which indicates that the positive relationship between LogGDP and Loglemale may not be valid for 1% and 5% levels of significance. The relationship may be valid at 10% level of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1% and 5% level of significance, Loglemale and LogGDP may not be proportionally related.

We can also confer a similar conclusion by looking at the Correlation Coefficient between variables "Loglemale" and “LogGDP" which is 0.3600. This value is very less indicating the possibility of very little correlation between Loglemale and LogGDP.



Graph 4: Scatter Diagram of GDP per capita and Log of Life Expectancy of Male Citizens

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to a similar conclusion that no relationship is expected between Loglemale and LogGDP. We also find the presence of outliers. All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the

Life Expectancy of male citizens of a country but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1% and 5% level of significance. Although it becomes significant at 10% level of significance.

Model 5: Loglefemale = $\beta_2 + \beta_3$LogGDP + error

Estimated model: $\widehat{Loglefemale}$ = 3.805257 + 0.0526878LogGDP

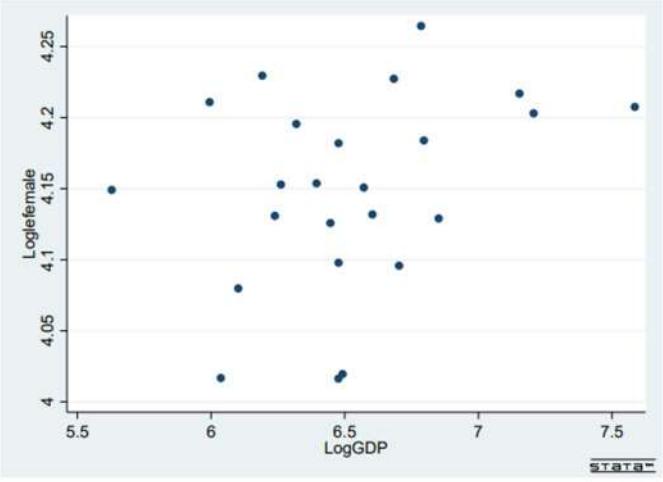
P-value: (0.000) (0.122)

R-Square: 0.1053

Correlation Coefficient: 0.3246

Hypothesis Testing: $H_0: \beta_3 = 0$ against $H_1: \beta_3 \neq 0$

We find that the estimated regression coefficient is positive, that is, it has anticipated sign. It can be clearly understood that if GDP per capita increases by 1 percent, Female life expectancy is predicted to increase by 0.0526878 percent which is quite small. However, such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind Female Life Expectancy. Also, if LogGDP= 0, Loglefemale is predicted to be 3.805257 units. The value of R-square is only 0.1053 which means LogGDP can only explain 10.53% variation in the dependent variable Loglefemale. Statistically, for the given dataset LogGDP is an insignificant factor behind Loglefemale since its p value(0.122) is very high as compared to 0.05 which indicates that the positive relationship between LogGDP and Loglefemale may not be valid for 1%, 5% and 10% levels of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1% and 5% level of significance, Loglefemale and LogGDP may not be proportionally related. We can also confer to similar conclusion by looking at the Correlation Coefficient between variables "Loglefemale" and "LogGDP" which is 0.3246. This value is very less indicating the possibility of very little correlation between Loglefemale and LogGDP.



Graph 5: Scatter Diagram of Log of GDP per capita and Log of Life Expectancy of Male Citizens

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to a similar conclusion that no relationship is expected between Loglefemale and LogGDP. We also find the presence of outliers.

All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the Life Expectancy of all citizens of a country but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1%, 5% and 10% level of significance.

Model 6: Logletotal = $\beta_4 + \beta_5$LogGDP + error

Estimated model: $\widehat{Logletotal}$= 3.761821+0.0552459LogGDP

p-value: (0.000) (0.096)

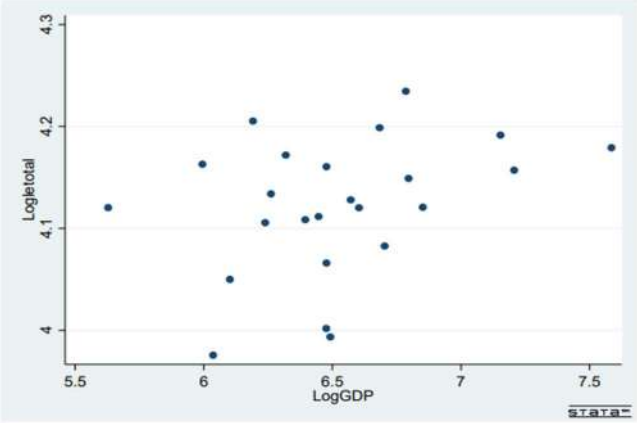
R-Square: 0.1211

Correlation Coefficient: 0.3481

Hypothesis Testing: H_0: $\beta_5=0$ against H_1: $\beta_5\neq0$

We find that the estimated regression coefficient is positive, that is, it has anticipated sign. It can be clearly understood that if GDP per capita increases by 1 percent, Total life expectancy is predicted to increase by 0.0552459 percent which is quite small. However, such a result is not expected since we studied that GDP per capita for a country becomes an essential factor behind Total Life Expectancy. Also, if LogGDP= 0, Logletotal is predicted to be 3.761821 units. The value of R-square is only 0.1211 which means LogGDP can only explain 12.11% variation in the dependent variable Logletotal. Statistically, for the given dataset LogGDP is an insignificant factor behind Logletotal since its p value(0.096) is greater than 0.05 which indicates that the positive relationship between LogGDP and Logletotal may not be valid for 1% and 5% levels of significance. The relationship may be valid at 10% level of significance. This is not true for the intercept term since its p value is close to zero which indicates that for 1%, 5% and 10% level of significance, Logletotal and LogGDP may not be proportionally related.

We can also confer a similar conclusion by looking at the Correlation Coefficient between variables "Logletotal" and “LogGDP" which is 0.3481. This value is very less indicating the possibility of very little correlation between Logletotal and LogGDP.



Graph 6: Scatter Diagram of Log of GDP per capita and Log of Life Expectancy of female Citizens

On observing the scatter diagram, it can be understood that dots are very scattered and hence we return to a similar conclusion that no relationship is expected between Logletotal and LogGDP. We also find the presence of outliers.
All these results also are contrary to our expectations since we considered GDP per capita for a country to be an economically significant factor behind the Life Expectancy of all citizens of a country but for this given dataset we find GDP per capita to be a statistically insignificant factor at 1% and 5% level of significance. Although it becomes significant at 10% level of significance.

V Conclusion

In our study we have attempted to analyze whether any relationship exists between Life Expectancy of the Male, Female and Total population in low income countries and their GDP per capita. It was presented on logical grounds and via intuition that Life Expectancy to be positively correlated with the GDP per capita of the respective nation. We believed this to be true since an increase in the health budget means the Government can spend more on building better hospitals and healthcare facilities which can contribute in saving the lives of people residing in the country and thus increasing the life expectancy.
The results that we obtain by using econometric analysis and descriptive statistics prove otherwise. This inconsistency in the results may be due to a number of reasons. First, we have omitted a number of important and relevant explanatory variables affecting the life expectancy. Such factors include nutrition, infant or child mortality rate, genetic makeup, number of vaccinations per year, lifestyle choices etc. Hence a multivariate regression model in this context would improve the results.
Second, our choice for the dependent variable may be inaccurate. GDP per capita represents the overall average income of an individual of a country. It does not reflect the income inequality faced by the residing citizens of a nation. Income inequality is a major factor hindering the boons of increased GDP to be benefitted by the citizens on the breadline thus reducing the overall life expectancy even when GDP per capita improves.
Third, we did not perform the Jarque Bera test which may infer that the residuals might not have followed Normality assumption for the OLS method of estimation.
Fourth, we have not performed the Breusch Pagan test to check for the presence of heteroskedasticity since our empirical analysis was based on cross sectional country data for 2019. Heteroskedasticity, if present, may infer our method of estimation to be inaccurate giving inconsistent results. Thus, we can conclude that our estimated model is not exempt of errors as has been highlighted above. However, we can get an outline about the relation between the Life Expectancy and GDP per capita if we push aside such flaws.
Fifth, model selection tests have not been performed to check whether the linear regression model or the log-log regression model is justified for carrying out the analysis. Since various other functional forms exist which can give us convincing results, model selection tests could come to the rescue.

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A Study of the Relationship between Infant Mortality Rate and GDP per capita in the High-income Countries

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Abstract

In this paper we studied the relationship between infant mortality rate and GDP per capita for high-income countries. We separately studied the relationship between total IMR and GDP per capita, male IMR and GDP per capita and female IMR and GDP per capita. The effect of GDP per capita on IMR was found to be statistically significant and they had a negative relationship between them i.e. increase in GDP per capita led to a decrease in IMR. The estimated coefficient of GDP per capita in the case of male IMR is the highest and is 0.00587, the estimated coefficient of GDP per capita in case of Total IMR is 0.00539 and the estimated coefficient of GDP per capita in case of female IMR is the least and is 0.0000488.

I Introduction

We know that an increase in GDP is an indicator of the economic growth of a country. When the GDP of a country increases, then the GDP per capita also increases. The more GDP per capita, the more each citizen of a country produces and thus the more he earns and thus he spends more on his and his family's health. So we thought that GDP per capita can be significantly related to the infant mortality rate of a country. Hence in this paper we have tried to provide insight into the relationship between GDP per capita and Infant mortality rates of high-income countries by using secondary data from World Bank (2019).

The objective of the study is to find relationship a between the infant mortality rate (IMR) and gross domestic product (GDP) per capita of high-income countries. The study has been separately done for male IMR, female IMR and total IMR.

We regress IMR (female), IMR (male) and IMR (Total) on GDP per capita of higher-income countries. The study will help us to find out the relationship between the variables and would also give us an approximate idea about the expenditure spread of families in high-income countries. Logically we can say that high GDP per capita implies low IMR but if we find in our study that the regression coefficient of GDP per capita is insignificant when IMR is regressed on GDP per capita, then we can say that the people in that country spend less on health and nutrition and more on other items. Or there might be some other socio-economic or demographic reasons for which IMR is higher. The study will help us to find whether or not the IMR and GDP per capita are related or not in the case of high-income countries and the results of this study would be of great significance for the policymakers.

Infant Mortality Rate (IMR) is the number of deaths of children of the age group (0-1) per 1000 live births. IMR male is the number of deaths of male children of the age group (0-1) per 1000 live births. IMR female is the number of deaths of female children of the age group (0-1) per 1000 live births.

GDP divided by the total population of a country gives us the GDP per capita of the country.

It is a measure of an economic output that accounts for its no. of people. It accounts for the Gross Domestic Product added by each citizen of a country. Thus, the higher GDP per capita, the more each citizen of that country produces and so the more wealth each individual of that country has. The more wealth each citizen of the country has, the more he spends on his and his family's health. Increased health spending implies lower chances of malnutrition and proper treatment of diseases for the newborn babies and pregnant woman of each family of the country and hence lower chances of death of newborn babies of the country. So, logically we can say that the higher the GDP per capita of a country, the lower the IMR of that country should be.

The paper is organised as follows. Section II presents a brief survey of the literature. Section III tells about the methodologies used in this study. Section IV tells about the specification of the econometric models. Section V describes how we collected our data. Section VI gives an insight into descriptive statistics. Section VII describes the scatter diagrams. Section VIII tells about regression, estimation, hypothesis testing and interpretation of results and Section IX Concludes our study.

II Literature Survey

Erdoğan, Ener and Arıca (2013) investigated the impact of the real per capita GDP on the infant mortality rate. They used the real gross domestic product per capita and the infant mortality rate as data in this study. Data were gathered on yearly basis from 1970 to 2007 from 25 high-income OECD countries. They applied the first-generation panel unit root tests. After stationarity tests had been carried out, it was investigated the relationship between the infant mortality rate and real per capita GDP. They concluded that real per capita GDP seemed to respond negatively to the infant mortality rate in 25 high-income OECD countries. Also, this empirical evidence obtained with the developed panel estimation method was consistent with other studies subjected to this issue. Consequently, they concluded that the countries, which give an answer to innovation, are more successful in diminishing infant mortality rates than others.

Infant Mortality Rate (IMR) is one of the most vital health indicators. One of the most important factors influencing IMR is public health spending. Shetty and Shetty conducted a study in 2014 on how IMR is affected by Health spending in Asian countries. Data on health spending of various Asian nations was obtained from the global health expenditure database of the World Health Organization (WHO). Current data on infant mortality rate for Asian Nations was obtained from the World Bank health indicators database. The study demonstrates that the benefits of a declining IMR accrue when the per capita health spending is robust, even low-income countries which allocate a reasonable proportion of state spending on health enjoy a relatively lower IMR. The countries which allocate and apportion more towards health have lower IMR than their peers. The proportion of GDP directed at health indicates that there is a scope among many countries for increased earmarking of funds for health. In this study, private spending on health did not have a significant benefit on IMR and this is probably due to factors such as affordability and affluence impacting private health care.

Sata, Khadije and Khalil (2015) conducted a study aimed to investigate the main determinant of infant mortality in OPEC (12 countries) over a ten-year period (2004 to 2013). In their study, they found that the total fertility rate, GDP per capita and public health expenditure as % of total health expenditure was identified as key explanatory variables that are significantly associated with infant mortality. Analysis of their data showed them that the infant mortality rate decreased as GDP per capita increased.

In order to effectively investigate the relationship between IMR and suspected responsible socioeconomic factors, Liu, Chen & Wang (2015) analysed data by using univariate and multivariate regression. They investigated the relationships of IMR with economic factor as GDP per capita and socioeconomic factors such as fertility rate, female education, and government health expenditure. To further explore the impact of per capita GDP on IMR, the data are stratified based on per capita GDP and analyzed using OLS models. The results obtained have suggested that IMR is positively associated with fertility, and negatively associated with government health expenditure and female education. In the case of countries with higher GDP per capita, fertility rate, government health expenditure and maternal education are significant determinants of IMR. Whereas in the case of countries with lower GDP per capita, only fertility rate and maternal education are significant indicators of IMR.

Loannis and Panagiotis . (2017) stated a relationship between IMR and GDPpc that is derived by the missing underlying convexity property, determines the IMR rates of change at GDPpc instants and provides a quantitative explanation to what economists have observed: that at high GDPpc, IMR increases after a bottoming out. Indeed, they assumed that the data come from a convex process, but convexity has been lost due to errors. They imposed the missing property as a constraint and derive the estimated IMR values by an optimization calculation. The results following from the analysis of real data in this article suggest that the assumption that Infant Mortality Rates and Gross Domestic Product per capita follow increasing returns not only adequately describes reality, but also it is able to capture imperceptible features of the underlying process.

III Methodology

Data on Infant Mortality rate (total, male and female) and GDP Per capita of high-income countries have been collected from World Bank Database. Descriptive statistics have been computed and econometric analysis has been used for our study.

IV Specification of the Econometric model

We will consider the following six econometric models for our study:

Dependent/Explained variable – IMR Total for model 1, log(IMR Total) for model 2, IMR Male for model 3, log(IMR Male) for model 4, IMR Female for model 6, log(IMR Female) for model 6.

Independent/ Explanatory variable – GDP per capita for model 1, 3&5 and log (GDP per capita) for model 2, 4& 6.

The following symbols will be used in our study
GDP Per Capita in High income countries → GDPPCi
IMR Total → IMRTi
IMR Male → IMRMi
IMR Female → IMRFi
ui→ error term in the model
Economic models
IMRT = f(GDPPC)
log(IMRT) = f{log(GDPPC)}
IMRM = f(GDPPC)
log(IMRM) = f{log(GDPPC)}
IMRF = f(GDPPC)
log(IMRF) = f{log(GDPPC)}

Econometric models:

Model 1 : $IMRT_i = \beta_0 + \beta_1 GDPPC_i + u_i$

Model 2 : $\log(IMRT_i) = \beta_2 + \beta_3 \log(GDPPC_i) + u_i$

Model 3 : $IMRM_i = \beta_4 + \beta_5 GDPPC_i + u_i$

Model 4 : $\log(IMRM_i) = \beta_6 + \beta_7 \log(GDPPC_i) + u_i$

Model 5 : $IMRF_i = \beta_8 + \beta_9 GDPPC_i + u_i$

Model 6 : $\log(IMRF_i) = \beta_{10} + \beta_{11} \log(GDPPC_i) + u_i$

V Data Collection

Cross-sectional data for 58 high-income countries for the year 2019 was taken. The most recent data for the year 2021 was not taken because it was not available for many countries.
Source of data: World Bank database

VI Descriptive Statistics

Some descriptive statistics of the variables are given in Table 1.

Table 1: Descriptive Statistics of the Variables

Variable	Mean	Median	Standard Deviation	Variance	Skewness
GDP per capita	37703.05	31143.16	28341.01	8.03×10^8	2.657634
IMR TOTAL	5.141379	3.5	4.29451	18.44282	2.329261
IMR MALE	5.586207	3.8	4.691629	22.01139	2.37687
IMR FEMALE	4.681034	3.25	3.867791	14.95981	2.26685

Source: The authors

Here we can see that the mean and median of GDP per capita are 37708.05 and 31143.16 respectively which gives a measure of GDP Per Capita across all the 58 high-income countries

under consideration, but the high standard deviation value of 28341.01 shows that it varies a lot from country to country. GDP per capita is positively skewed.

Now coming to IMR Total whose mean and median values come out to 5.141379 and 3.5 with a standard deviation of 4.29451, thus telling us on average the infant mortality rate irrespective of gender is 5.14 which varies in the range of 5.14 ± 4.29.

Next coming to IMR Male whose mean and median values come out to 5.586207 and 3.8 with a standard deviation of 4.691629, thus telling us on average the infant mortality rate of males is 5.58 which varies in the range of 5.58 ± 4.69.

Coming to IMR Female whose mean and median values come out to 4.681034 and 3.25 with a standard deviation of 3.867791, thus telling us on average the infant mortality rate of females is 4.68 which varies in the range of 4.68 ± 3.86.

So, we can very well see that the IMR Male average is higher than both IMR Total and IMR Female values hence proving that females have more life expectancy than males in the several high-income countries under consideration.

VII Scatter Diagrams

Figures (1) – (6) indicate the relationship between the variables for various models.

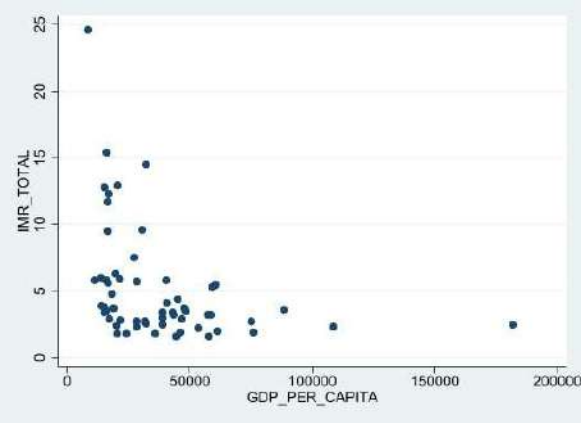

Figure 1: A scatter diagram of IMRT against GDPPC

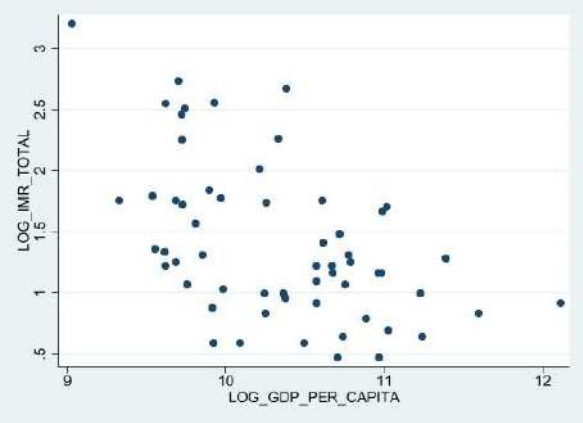

Figure 2: A scatter diagram of log (IMRT) against log (GDPPC)

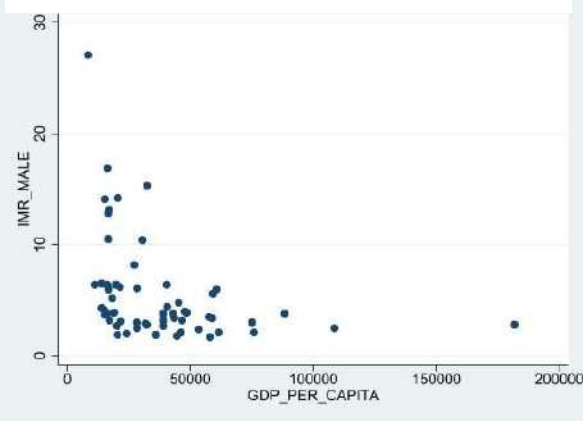

Figure 3: A scatter diagram of IMRM against GDPPC

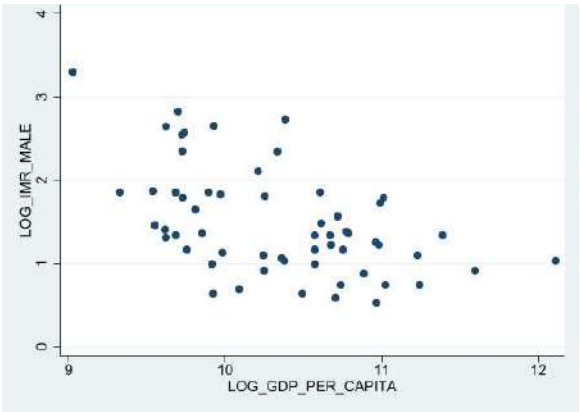

Figure 4: A scatter diagram of log (IMRM) against log (GDPPC)

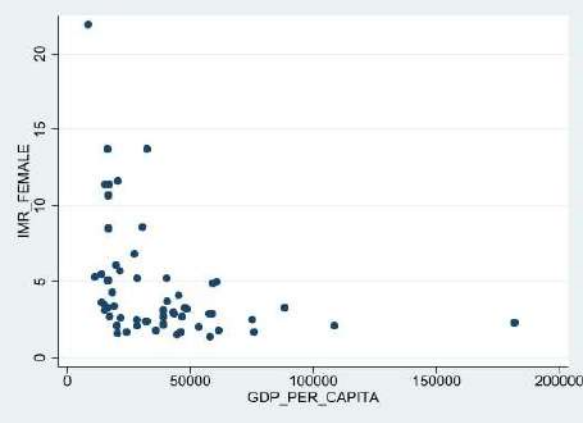

Figure 5: A scatter diagram of IMRF against GDPPC

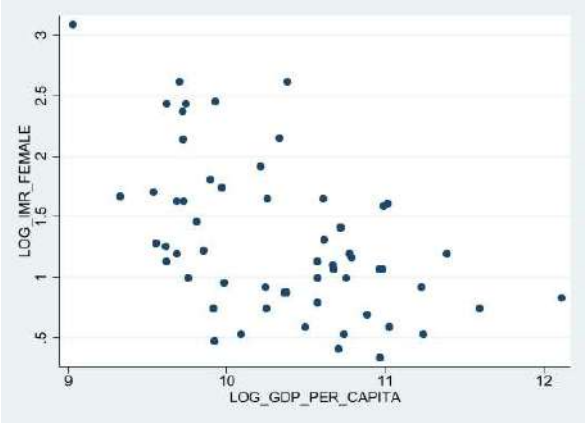

Figure 6: A scatter diagram of log (IMRF) against log (GDPPC)

Source: The authors

From the above graphical representation it is very clear that in Figures 1, 3 and 5 the variables are not that much linearly dependent whereas in Figures 2, 4 and 6 there ma ybe some linear relationship between the variables.

VIII Regression, Estimation, Hypothesis Testing and Interpretation of Results

Model 1 $IMRT_i = \beta_0 + \beta_1 GDPPC_i + u_i$

Estimated Model $\widehat{IMRT_i} = 7.174681 - 0.0000539GDPPC_i$

Standard Error	0.8897709	0 .0000189
t-statistic	8.06	-2.85
p-value	0.000	0.006

$R^2 = 0.1267$ Adjusted $R^2 = 0.1111$

Correlation coefficient= - 0.3559

Hypothesis testing:

$H_0: \beta_1 = 0$ [GDPPC does not affect IMRT]

Against $H_1: \beta_1 \neq 0$ [GDPPC affects IMRT]

In this model we regress IMR Total (IMRT) on GDP per capita in high-income countries (GDPPC). The absolute value for the observed t statistic from the given data and is 2.85 which is higher than the tabulated value or the critical value of t statistic which is 2.667 at 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is $H_0: \beta=0$ thus the variable β is statistically significant.

Interpretation:

In this model we regress IMR Total (IMRT) on GDP Per capita in high-income countries (GDPPC). The estimated value of β_0 is 7.174681 and it is statistically significant as well which can be understood from p value. Logically it means even with GDP per capita being 0 dollars, which

is impossible, the IMRT is 7.17 on average. This when interpreted logically, it has no significance as such.

Now coming to our main concern, the estimated value of β_1 came out to be - 0.0000539 and with low p value and t-test it also stands statistically significant. Thus, with one unit increase in GDPPC, IMRT decreases by0.0000539 (since the sign of β_1 is negative).

The R^2 value of 0.1267 shows that only 12.67% of the variation in IMRT is explained by GDPPC which seems to be a bad fit, but we also need to consider that we have ignored several other important variables in the regression. This problem can be solved by a multiple linear regression model.

Model 2	$\log(IMRT_i) = \beta_2 + \beta_3 \log(GDPPC_i) + u_i$	
Estimated Model	$\widehat{log\ (IMRT\iota)} =$	6.905549 - 0.5322391 $\log(GDPPC_i)$
Standard Error		1.219078 0.1177488
t-statistic		5.66 -4.52
p-value		0.00 0.00

$R^2 = 0.2673$ Adjusted $R^2 = 0.2542$

Correlation coefficient= -0.5170

Hypothesis testing:

$H_0 : \beta_3 = 0$ [log(GDPPC) does not affect log(IMRT)]

Against $H_1 : \beta_3 \neq 0$ [log(GDPPC) affects log(IMRT)]

The absolute value for the observed t statistic from the given data and is 4.52 which is higher than the tabulated value or the critical of t statistic which is 2.667 at 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is H_0: $\beta_3=0$ thus the variable β_3 is statistically significant.

Interpretation:

In this model we regress log(IMRT) on log(GDPPC). Directly moving to the $\beta_3$value as intercept doesn't seem to be much significant in these models. This being a log-log model $\beta_3$serves as elasticity. Thus 1% change in GDPPC leads to 0.5322% change in IMRT as the value of β_3- 0.5322391 suggests. The change will be in opposite direction as$\beta_3$is negative. Coming to the statistical significance $\beta_3$seems to be statistically significant due to its very low p value and also from t test result. The value of R^2 comes out to be 0.2673 which tells us that 26.73% variation in log(IMRT) is captured by log(GDPPC) which is not that high, but we also need to consider that due to lack of data and simplicity, we have dropped several relevant variables which leads to such low value of R^2. This problem can be solved by using MLRM.

Model 3	$IMRM_i = \beta_4 + \beta_5 GDPPC_i + u_i$	
Estimated Model	$\widehat{IMRM\iota} =$	7.80003 - 0.0000587 $GDPPC_i$
Standard Error		0.9725243 0.0000207
t-statistic		8.02 -2.84
p-value		0.000 0.006

R^2 = 0.1258 Adjusted R^2= 0.1102
Correlation coefficient= - 0.3547
Hypothesis testing:
H_0: β_5= 0 [GDPPC does not affect IMRM]
Against H_1: $\beta_5 \neq 0$ [GDPPC affects IMRM]
The absolute value for the observed t statistic from the given data is 2.84 which is higher than the tabulated value or the critical t statistic which is 2.667 at a 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is H_0: β_5=0 thus the variable β_5 is statistically significant.
Interpretation:
In this model, we regress IMR Male (IMRM) on GDP Per capita in high-income countries (GDPPC). The estimated value of β_4 is 7.80003 and it is statistically significant as well which can be understood from the p-value. Logically it means even with GDP per capita being 0 dollars, which is impossible, the IMRT is 7.80 on average. This when interpreted logically, it has no significance as such.
Now coming to our main concern, the estimated value of β_5 came out to be - 0.0000587 and with a low p-value and t-test it also stands statistically significant. Thus, with one unit increase in GDPPC, IMRM is expected to decrease by 0.0000587 (since the sign of β_5 is negative).
The R^2 value of 0.1258 shows that only 12.58% of the variation in IMRM is explained by GDPPC which seems to be a bad fit, but we also need to consider that we have ignored several other important variables in the regression. This problem can be solved by a multiple linear regression model.

Model 4	$\log(IMRM_i)$ =	β_6 +	$\beta_7 \log(GDPPC_i)$+	u_i
Estimated Model	$\log(\widehat{IMRM_1})$ =	6.988313	- 0.5322321	$\log(GDPPC_i)$
Standard Error		1.216636	0.117513	
t-statistic		5.74	-4.53	
p-value		0.00	0.00	

R^2 = 0.2681 Adjusted R^2= 0.2550
Correlation coefficient= -0.5178
Hypothesis testing:
H_0 :β_7= 0 [log(GDPPC) does not affect log(IMRM)]
Against H_1 :$\beta_7 \neq 0$ [log(GDPPC) effects log(IMRM)]
The absolute value for the observed t statistic from the given data and is 4.53 which is higher than the tabulated value or the critical t statistic which is 2.667 at 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is H_0: β_7=0 thus the variable β_7 is statistically significant.
Interpretation:
In this model, we regress log(IMRM) on log(GDPPC). Directly moving to the estimated β_7 value as intercept doesn't seem to be much significant in these models. This being a log-log model the

coefficient serves as estimated elasticity. Thus 1% change in GDPPC leads to a 0.5323% change in IMRT as the value of β_7- 0.5322321 suggests. The change will be in the opposite direction as the estimated β_7 is negative. Coming to the statistical significance β_7 seems to be statistically significant due to its very low p-value and also from t test result. The R^2 comes out to be 0.2681 which tells us that 26.81% variation in log(IMRM) is captured by log(GDPPC) which is not that high, but we also need to consider that due to lack of data and simplicity, we have dropped several relevant variables which leads to a such low value of R^2. This problem can be solved by using MLRM.

Model 5	$IMRF_i = \beta_8 + \beta_9 GDPPC_i + u_i$	
Estimated Model	$\widehat{IMRF\iota} =$	6.519134 - 0.0000488$GDPPC_i$
Standard Error		0.8009252 0.000017
t-statistic		8.14 -2.86
p-value		0.000 0.006

$R^2 =$ 0.1276 Adjusted $R^2 =$ 0.1120

Correlation coefficient= - 0.3572

Hypothesis testing:

$H_0 : \beta_9 = 0$ [GDPPC does not affect IMRF]

Against $H_1 : \beta_9 \neq 0$ [GDPPC affects IMRF]

The absolute value for the observed t statistic from the given data and is 2.86 which is higher than the tabulated value or the critical of t statistic which is 2.667 at 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is H_0: $\beta_9=0$ thus the estimated β_9 is statistically significant.

Interpretation:

In this model, we regress IMR Female (IMRF) on GDP Per capita in high-income countries (GDPPC). The estimated value of β_8 is 6.519134 and it is statistically significant as well which can be understood from the p-value. Logically it means even with GDP per capita being 0 dollars, which is impossible, the IMRT is 6.52 on average. This when interpreted logically, it has no significance as such.

Now coming to our main concern, the estimated value of β_9 came out to be - 0.0000488 and with a low p-value and t-test it also stands statistically significant. Thus, with one unit increase in GDPPC, IMRF decreases by 0.0000488 (since the sign of β_9 is negative).

The R^2 value of 0.1276 shows that only 12.76% of the variation in IMRF is explained by GDPPC which seems to be a bad fit, but we also need to consider that we have ignored several other important variables in the regression. This problem can be solved by a multiple linear regression model.

Model 6	$\log(IMRF_i) = \beta_{10} + \beta_{11} \log(GDPPC_i) + u_i$
Estimated Model	$\widehat{log\ (IMRF\iota)} =$ 6.821244 - 0.5329563 $\log(GDPPC_i)$

Standard Error	1.214643	0.1173204
t-statitic	5.62	-4.54
p-value	0.00	0.00

R^2 = 0.2693 Adjusted R^2= 0.2562

Correlation coefficient= -0.5189

Hypothesis testing:

H_0 :β_{11}= 0 [log(GDPPC) does not affect log(IMRF)]

Against H_1 :$\beta_{11} \neq 0$ [log(GDPPC) affects log(IMRF)]

The absolute value for the observed t statistic from the given data and is 4.54 which is higher than the tabulated value or the critical of t statistic which is 2.667 at 1% level of significance. So, from the given data we conclude that we should reject the null hypothesis which is H_0: β_{11}=0 thus the variable β_{11} is statistically significant.

Interpretation:

In this model, we regress log(IMRF) on log(GDPPC). Directly moving to the β_{11} value as intercept doesn't seem to be much significant in these models. This being a log-log model the coefficient serves as estimated elasticity. Thus 1% change in GDPPC leads to a 0.5329% change in IMRT as the estimated value of β_1 - 0.5329563 suggests. The change will be in the opposite direction as the estimated β_{11} is negative. Coming to the statistical significance β_{11} seems to be statistically significant due to its very low p-value and also from t test result. The R^2 comes out to be 0.2693 which tells us that 26.93% variation in log(IMRF) is captured by log(GDPPC) which is not that high, but we also need to consider that due to lack of data and simplicity, we have dropped several relevant variables which leads to a such low value of R^2. This problem can be solved by using MLRM.

IX Conclusion

In this paper, we attempted to study the relationship between IMR and GDP per capita and we found out that an increase in GDP per capita may lead to a decrease in all types of Infant Mortality Rates i.e. Total IMR, Male IMR, and Female IMR. This gives us a possible way to reduce IMR.

We see that a 1 dollar increase in GDP Per Capita leads to a 0.0000539 unit decrease in average Total IMR, 0.0000587 units decrease in IMR Male and 0.0000488 unit decreases in IMR Female. The IMR male decreases the most when GDP per capita increases, while the IMR female decreases but decreases less than that of the IMR male when GDP per capita increases. That means GDP per capita has a stronger effect on IMR Male than that of IMR Female.

So we can say that female children have a lesser probability of survival than that of male children even when GDP per capita increases in high-income countries. So much more significant and drastic steps must be taken to reduce the Female IMR.

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Infant Mortality Rate and Government Expenditure on Health for Low-Income Countries

Shruti Chatterjee, Anish Das, Souradeep Dhar and Shreyasee Sarkar

Abstract

Health is an outcome indicator of the economic growth and development of a country. Healthcare is a major factor in health status. In this regard healthcare expenditure is a vital input for the health production function. In this context, our study examined the effect of Government Healthcare Expenditure (as a % of GDP) on Infant Mortality Rates in low-income countries. We have taken data on Infant Mortality Rates separately for males, females and as well as in total. In this study, the descriptive statistics analysis gives us an idea that IMR among females is lower than that of males which are usually expected and found. Initially, we had expected that the relationship between the two variables would be negative i.e. IMR would fall as Government Health Expenditure increases. However, this notion did not hold true in this context as found out a positive relationship between IMR and Government Health Expenditure. Accordingly, the IMR and Government Health Expenditure data comes out to be statistically insignificant as proved by the p-values. The result obtained is indeed surprising but there are various possible causes that might have led to such a result. This study concludes that there are various other factors apart from Government Health Expenditure that may affect Infant Mortality Rates in low-income countries, this may include vaccination programs, income inequalities, social inequalities, GDP per capita etc.

I Introduction

Infant mortality is the death of young children under the age of 1. This death toll is measured by the infant mortality rate (IMR), which is the probability of deaths of children under one year of age per 1000 live births.

This study becomes more relevant in today's date as data suggests that almost 61 babies' dies for 1000 live births in developing countries compared with 8 deaths per 1000 in developed countries (Source: Guttmacher Institute). The role of government in the health sector is often overlooked. However, the expenditure on public health is deemed one of the most important arsenals of the government in improving life expectancy as well as the standard of living in the nation. It is the motive of every government to reduce IMR for which it needs to invest highly in infrastructure associated with public health. Thus it is anticipated that IMR would fall as government expenditure on health increases. In this study, we have taken Infant Mortality Rate (denoted by IMR_Male, IMR_Female, IMR_Total**)** as the dependent variable and Government Health Expenditure as a % of GDP (denoted by GDP_Health) as the independent variable, thus we examine how a change in government expenditure may have its impact on IMR.

The objective of this paper is to study the relationship between Government Heath Expenditure (as a % of GDP) and Infant Mortality Rate in low-income countries. This paper seeks to analyse whether government expenditure on health has a significant impact on the infant mortality rate, especially among low-income countries.

We have divided the paper into two sections. The first section comprises the Introduction, a Survey of Literature and the Data and Methodology. The analysis part is included in the second section

which comprises the Statistical, Graphical and Econometric analysis. Apart from this, we have the post-diagnostic tests and the conclusion included in this section as well.

II Survey of Literature

Kiross et al. (2020) used panel data from 2000 to 2015 for 46 countries in sub-Saharan Africa (SSA). This study determined the impact of health care expenditure on infant mortality rates in SSA countries. Infant mortality or neonatal mortality has been treated as the dependent variable while government health expenditure is the independent variable. The results from the analysis provide evidence that total healthcare expenditure per capita was associated with a reduction of infant and neonatal mortality rates. The result also highlighted the fact that both public and external sources of healthcare expenditures were significantly negatively associated with Infant Mortality Rates.

Rapidath and Attoley (2003) found that DALE (Disability Adjusted Life expectancy) and IMR (Infant Mortality Rate) has a strong linear association between them. Through the data of 180 countries of 1997, they observed that the countries having high DALE have low IMR. By this article, their main intention is to say that DALE and IMR both can be the proxy for each other and also either could stand as a proxy health expenditure. Due to the fact that IMR and DALE are highly correlated.

Theoretically, the principal agent theory helped to explain the importance of health and financing from agents to reduce deaths. Wager (1958) opined that increasing public financing of health activities. Wagner's public financing of 1958 explains the expanding state expenditure activities on health which have both short-run and long-run implications. Healthcare spending implies provisions of immunization and more access to healthcare services. In terms of empirical evidence, several studies on newborn health outcomes in developing countries have provided evidence to show different factors responsible for high infant deaths. Evidence from previous studies including Burchett and Mayghew (2009), Mesiko and Mojekwu (2012), Pillai (2013) etc, further reports disparities in infant healthcare service delivery to health financing, socio-economic conditions, environmental factors, parental income and proximate to a health facility in SSA countries.

David (2018) has used time-series data for the years 1980-2016 to empirically examine the nature of the relationship between infant mortality and government (public)health expenditure in Nigeria. Infant mortality has been treated as the dependent variable and government (public) health expenditure as the independent variable. The results indicate the presence of a long-run relationship between infant mortality and government health expenditure. In addition, the results also explain how government health expenditure, private health expenditure, immunization and external health expenditure are significantly negatively associated with infant mortality both in the short and long run.

III Data and Methodology

In the present study, cross-section data has been used for the year 2019. The choice of the year is based on the data availability as well as on the recentness of the data. The study sourced the data

from World Bank Open Data. The study has used data from 24 underdeveloped countries with their corresponding IMR and Government Health Expenditure (percentage of GDP).

The methodology used in the analysis of the paper is textual, graphical, tabular, and regression. We have used descriptive statistics measures like mean, median, standard deviation, coefficient of variation etc. to draw various relevant conclusions. As a part of our graphical analysis, we have taken the aid of scatter diagrams to check if there exists a linear relationship between the two variables and approximately guess about the direction of the trend. In our regression analysis we have used econometrics tools like the OLS estimation method, R^2, and the p-value to draw various conclusions about the data and the relationship between the two variables.

The research carried out in this paper is causal and the data is secondary in nature.

IV Analysis and Interpretations

A. Descriptive Statistics

In this sub-section, we have used various descriptive statistics measures to understand and interpret the reason for the discrepancy between the male and female Infant Mortality Rates.

Table 1: Descriptive Statistics for Infant Mortality Rate

	IMR_Male	IMR_Female	IMR_Total
Mean	54.667	45.1125	50.01667
Median	50.35	42.6	46.55
Standard Deviation	16.1385	14.33765	15.24532
Coefficient of Variation	29.5214%	31.7819%	30.4804%
Skewness	0.5022432	0.4754069	0.4902759

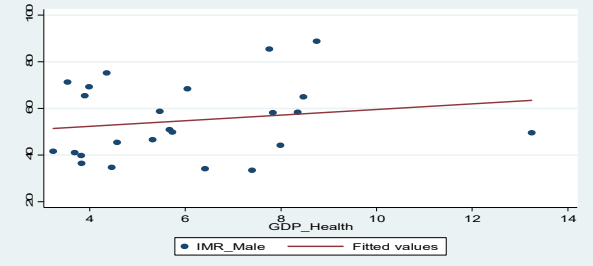
Source: The authors

Table 1 shows that the infant mortality rate on average is much more in males as compared to females. We have obtained a mean of 54.667 for males as compared to 45.1125 for females. This shows that the survival rate of the girl child is higher than boys in the low-income countries. It is also observed that standard deviation in higher in males as compared to females suggesting that there is greater variability in the infant mortality rates among males as compared to females. However, the coefficient of variation suggests that infant mortality rate among females more variable in relation to its mean value as compared to infant mortality rate among males. The skewness measure suggests that all the three variables are positively skewed.

B. Graphical Analysis

In this sub-section we have taken the help of scatter diagrams to interpret and judge the relationship between the two variable IMR (for male female and total) and Health Expenditure (as a % of GDP).

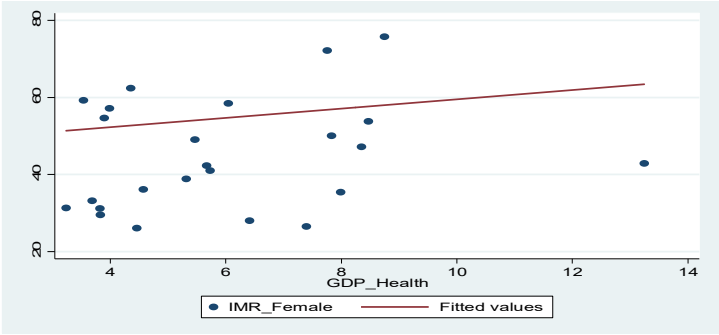
In Graph 1, Graph 2 and Graph 3 we have taken the variables in their general forms and in Graph 4, Graph 5 and Graph 6 we have constructed the scatter diagrams by taking the log values of the two relevant variables. However, we do not find any dramatic changes in the result in spite of that.



Graph 1: Scatter Diagram of GDP_Health and IMR_Male

Source: The authors

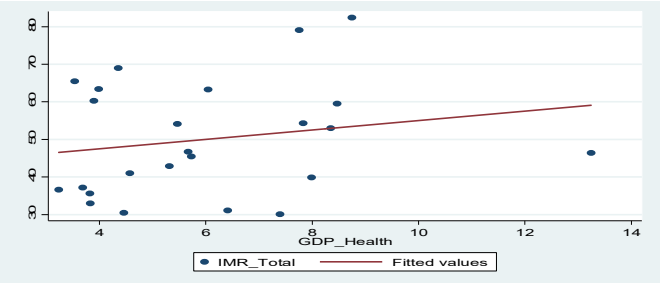
Graph 1 shows that the dots are very much dispersed. The scatter diagram indicates that there is no linear relation between the two variables. However, we can see that there exists a positive relation between IMR_Male and GDP_Health with the presence of few outliers.



Source: The authors

Graph 2: Scatter Diagram of GDP_Health and IMR_Female

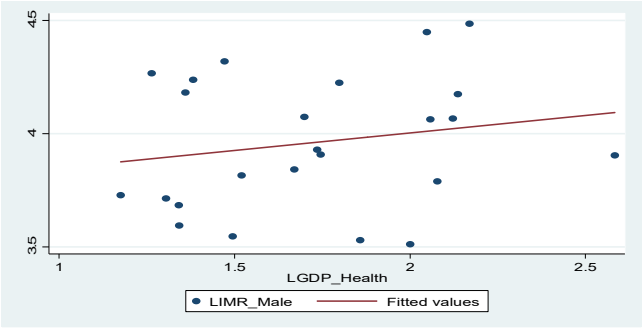
On observing the scatter diagram we find that the dots are very much dispersed. The scatter diagram shows that there is no linear relation between the two variables. However, we can see that there exists a positive relation between IMR_Female and GDP_Health with the presence of few outliers.



Source: The authors

Graph 3: GDP_Health and IMR_Total

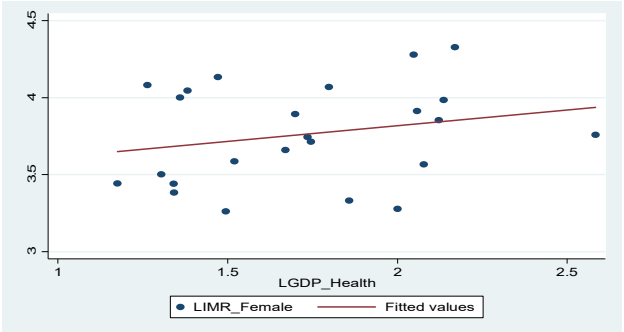
On observing the scatter diagram we find that the dots are very much dispersed. The scatter diagram shows that there is no linear relation between the two variable. However, we can guess that there exists a positive relation between IMR_Total and GDP_Health with the presence of few outliers.



Source: The authors

Graph 4: $LIMR\_Male$ and $LGDP\_Health$

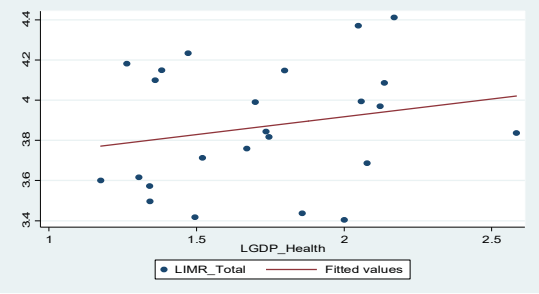
Graph 4 shows that there is no linear relation between the two variables. The dots are mostly scattered throughout.



Source: The authors

Graph 5: Scatter Diagram of LGDP_Health and LIMR_Female

Graph 5 shows that there is no linear relation between the two variables. The dots are mostly scattered throughout. However, we can guess that there exists a positive relation between $LIMR\_Female$ and $LGDP\_Health$.



Source: The authors

Graph 6: $LGDP\_Health$ and $LIMR\_Total$

The scatter diagram shows that there is no linear relation between the two variable. The dots are mostly scattered throughout. However we can guess that there exists a positive relation between $LIMR\_Total$ and $LGDP\_Health$.

C. Econometric Analysis

In this sub-section we have constructed six econometric models, the last three being log-log models. For each of the models, we have taken the aid of various econometric tools using which we have interpreted and drawn conclusions from the obtained results.

Model 1: IMR_Male = α + β GDP_Health + u

Estimated Regression Equation:

$\widehat{\text{IMR\_Male}} = 47.41609 + 1.210281\ \text{GDP\_Health}$

p-value (0.406) $R^2 = 0.0316$

The value of the estimated regression coefficient comes out to be 1.210281 with a positive sign. This implies that with a 1 unit increase (decrease) in the Govt. health expenditure, infant mortality among males is expected to increase (decrease) by 1.2102 units. However, such a result is contrary to our expectations as we had expected the infant mortality rate to decrease (increase) with an increase (decrease) in Govt. health expenditure.

The value of the estimated intercept coefficient comes out to be 47.41609, which implies that with no expenditure by the Government on health, the infant mortality rate among males becomes 47.41609 units.

We test the null hypothesis H_0: $\beta = 0$ ag alt. H_1: $\beta \neq 0$

The p-value of the estimated regression coefficient comes out to be 0.406 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there may not exist any relationship between IMR_Male and GDP_Health.

The R^2 value of 0.0316 implies that only 3% of the change in IMR among males is explained by Government health expenditure. This means that other than Government health expenditure there are other factors that affect IMR among males.

The correlation coefficient of 0.1778 signifies that there is very low degree of linear correlation between the two variables, i.e. IMR_Male and GDP_Health.

Model 2: IMR_Female $= \alpha + \beta$ GDP_Health $+ u$
Estimated Regression Equation:
$\widehat{\text{IMR\_Female}} = 37.32638 + 1.299675$ GDP_Health
(0.313) $R^2 = 0.0462$
The value of the estimated regression coefficient comes out to be 1.299675 with a positive sign. This implies that with a 1 unit increase (decrease) in the Govt. health expenditure, infant mortality among females is expected to increase (decrease) by 1.299675 units. However, such a result is contrary to our expectations.
The value of the estimated intercept coefficient comes out to be 37.32638, which implies that with no expenditure by the Government on Health, Infant Mortality Rate among Females becomes 37.32638 units.
For testing H_0: $\beta = 0$ ag alt. H_0: $\beta \neq 0$ the p-value of the estimated regression coefficient comes out to be 0.313 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there may not exist any relationship between IMR_Female and GDP_Health.
The R^2 value of 0.0462 implies that only 4.6% of the change in IMR among females is explained by Government Health Expenditure. This means that other than Government Health Expenditure there are other factors that affect IMR among females.
The correlation coefficient of 0.2149 signifies that there is a very low degree of linear correlation between the two variables, i.e. IMR_Female and GDP_Health.

Model 3: IMR_Total = $\alpha + \beta$ GDP_Health
Estimated Regression Equation:
$\text{IMR\_Total} = 42.50297 + 1.254203$ GDP_Health
(0.361) $R^2 = 0.038$
The value of the estimated regression coefficient comes out to be 1.254203 with a positive sign. This implies that with a 1 unit increase (decrease) in the Govt. health expenditure, infant mortality in total is expected to increase (decrease) by 1.254203 units. However, such a result is contrary to our expectations as we had expected Infant Mortality Rate to decrease (increase) with an increase (decrease) in Govt. health expenditure.
The value of the estimated intercept coefficient comes out to be 42.50297, which implies that with no expenditure by the Government on Health, Infant Mortality Rate in total becomes 42.50297 units.
For testing H_0: $\beta = 0$ ag alt. H_0: $\beta \neq 0$ the p-value comes out to be 0.361 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there may not exist any relationship between IMR_Total and GDP_Health.

The R^2 value of 0.0380 implies that only 3.8% of the change in IMR in total is explained by Government Health Expenditure. This means that other than Government Health Expenditure there are other factors that affect IMR in total.
The correlation coefficient of 0.1950 signifies that there is a very low degree of linear correlation between the two variables, i.e. IMR_Total and GDP_Health.

Model 4: LIMR_Male = α + β LGDP_Health + u
Estimated Regression Equation:

$$\text{LIMR\_Male} = 3.69272 + 0.1551854\ \text{LGDP\_Health}$$

(0.362) $R^2 = 0.0379$

The value of the estimated regression coefficient comes out to be 0.1551854 with a positive sign. This implies that with a 1% increase (decrease) in the Govt. health expenditure, infant mortality among males is expected to increase (decrease) by 0.1551854%. Thus, here 0.1551854 is the estimated elasticity of the model. However, such a result is contrary to our expectations as we had expected Infant Mortality Rate to decrease (increase) with an increase (decrease) in Govt. health expenditure.
The value of the estimated intercept coefficient comes out to be 3.69272, which implies that when LGDP_Health becomes 0, LIMR_Male is expected to become 3.69272 units.
For the test H_0: $\beta = 0$ ag alt. H_0: $\beta \neq 0$ the p-value comes out to be 0.362 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there does not exist any relationship between LIMR_Male and LGDP_Health.
The R^2 value of 0.0379 implies that only 3.7% of the change in log IMR male is explained by log Government Health Expenditure. This means that other than Government Health Expenditure there are other factors that affect IMR in total.
The correlation coefficient of 0.1947 signifies that there is a very low degree of linear correlation between the two variables, i.e. LIMR_Male and LGDP_Health.
Model 5: $\text{LIMR\_Female} = \alpha + \beta\ \text{LGDP\_Health} + u$
Estimated Regression Equation:

$$\text{LIMR\_Female} = 3.408407 + 0.2045816\ \text{LGDP\_Health}$$

(0.266) $R^2 = 0.0558$

The value of the estimated regression coefficient comes out to be 0.2045816 with a positive sign. This implies that with a 1% increase (decrease) in the Govt. health expenditure, infant mortality among females is expected to increase (decrease) by 0.2045816%. Thus, here 0.2045816 is the estimated elasticity of IMR of females with respect to govt. health expenditure. However, such a result is contrary to our expectations.
The value of the estimated intercept coefficient comes out to be 3.408407, which implies that when LGDP_Health becomes 0, LIMR_Female is expected to become 3.408407 units.
For testing H_0: $\beta = 0$ ag. alt. H_1: $\beta \neq 0$ the p-value comes out to be 0.266 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there does not exist any relationship between LIMR_Female and LGDP_Health.

The R^2 value of 0.0558 implies that only 5.5% of the change in log IMR female is explained by log Government Health Expenditure. This means that other than Government Health Expenditure there are other factors that affect IMR in total.
The correlation coefficient of 0.2362 signifies that there is a very low degree of linear correlation between the two variables, i.e. LIMR_Female and LGDP_Health.

Model 6: $\text{LIMR\_Total} = \alpha + \beta\ \text{LGDP\_Health} + u$
Estimated Regression Equation:
$\text{LIMR\_Total} = 3.563802 + 0.1767089\ \text{LGDP\_Health}$
(0.316) $R^2 = 0.0457$
The value of the estimated regression coefficient comes out to be 0.1767089 with a positive sign. This implies that with a 1% increase (decrease) in the Govt. health expenditure, infant mortality in total is expected to increase (decrease) by 0.1767089%. However, such a result is contrary to our expectations. Here 0.1767089 is the estimated elasticity of IMR with respect to govt. health expenditure.
The value of the estimated intercept coefficient comes out to be 3.563802, which implies that when LGDP_Health becomes 0, LIMR_Total is expected to become 3.563802 units.
We test H_0: $\beta = 0$ ag. alt. H_1: $\beta \neq 0$. The p-value comes out to be 0.316 which is greater than 5%; this implies that we have no reason to reject the null hypothesis. Thus, we have evidence that there does not exist any relationship between LIMR_Total and LGDP_Health.
The R^2 value of 0.0457 implies that only 4.5% of the change in log IMR total is explained by log Government Health Expenditure.
The correlation coefficient of 0.2139 signifies that there is very low degree of linear correlation between the two variables, i.e. LIMR_Total and LGDP_Health.

V Post-Diagnostic Tests

A. Test for Heteroscedasticity-

On conducting the Breusch-Pagan Test for heteroscedasticity we have obtained the following p-values for the various models which are presented in Table 2.

Table 2: Results of Breusch-Pagan Test

Model	p-value
$\mathbf{IMR\_Male = \alpha + \beta\ GDP\_Health + u}$	0.5896
$\mathbf{IMR\_Female = \alpha + \beta\ GDP\_Health + u}$	0.6304
$\mathbf{IMR\_Total = \alpha + \beta\ GDP\_Health + u}$	0.6127
$\mathbf{LIMR\_Male = \alpha + \beta\ LGDP\_Health + u}$	0.8867
$\mathbf{LIMR\_Female = \alpha + \beta\ LGDP\_Health + u}$	0.9962
$\mathbf{LIMR\_Total = \alpha + \beta\ LGDP\_Health + u}$	0.9432

Source: The authors

To test $H_0 : Var(u_i) = \sigma^2$

Table 2 shows that the p-value for each of these models is such that they are greater than 5% levels of significance. Thus, we find no reason to reject the null hypothesis and we can claim that the models are homoscedastic.

B. Test for Normality Assumption of the error term

On computing the residuals and finding out the skewness of the residuals we obtain the data as follows:

Table 3: Results for Test of Normality of Residuals

Model	Skewness of Residuals
$\mathbf{IMR\_Male = \alpha + \beta\ GDP\_Health + u}$	0.4584009
$\mathbf{IMR\_Female = \alpha + \beta\ GDP\_Health + u}$	0.4393846
$\mathbf{IMR\_Total = \alpha + \beta\ GDP\_Health + u}$	0.4503618
$\mathbf{LIMR\_Male = \alpha + \beta\ LGDP\_Health + u}$	0.0788711
$\mathbf{LIMR\_Female = \alpha + \beta\ LGDP\_Health + u}$	0.0416795
$\mathbf{LIMR\_Total = \alpha + \beta\ LGDP\_Health + u}$	0.0621789

Source: The authors

Table 3 shows that for each of the models, the skewness of the residual is greater than 0. This implies that the residuals in neither of the model are symmetric. Thus, we can conclude that the normality assumption of the error term is violated in each of the models.

6. Conclusion

In our study, we have tried to analyse the relationship between Infant Mortality Rate and Government health expenditure (as a percentage of GDP) for low-income countries. It was anticipated that the value of the slope coefficient would be negative i.e. IMR would fall as Government health expenditure increases. However, our analysis does not support such a notion.

This inconsistency in the results might have arisen for various reasons. Firstly, the major shortcoming of this paper is that we have used a linear model for our regression analysis. However, when we plotted the data on the scatter diagram, we didn't find any linear relationship between the two variables. Thus, misspecification of the functional form remains one of the fallacies which might have led to such a result.

Secondly, we might expect that there are some other variables apart from government health expenditure that might have a stronger impact on IMR. In order to keep the model simple, we used only one explanatory variable. But we surely feel that one explanatory variable is not sufficient enough to explain changes in IMR. Thus, we can say that the model excluded some of the relevant explanatory variables.

Apart from this, the residual does not follow a normal distribution as we have found it to be a positively skewed graph. Thus, the normality assumption is violated and the traditional t- test as we know would become invalid under such a circumstance. However, this limitation does not have an impact on the estimated values of the slope and intercept terms.

A possible source of the problem would have been heteroscedasticity, as we were working on cross-section data. However, the problem of heteroscedasticity does not exist as suggested by the Brusch-Pagan test.

Thus, we can conclude that the models are not free of vices as it has been highlighted above. However, we can at least get a rough idea of the relationship between the two variables and mull over the plausible causes.

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A Study of the Relationship between Life Expectancy and Healthcare Expenditure in High-income Countries

Ankita Dey, Trishita Ghosh, Ankita Halder, Ankush Roy and Debargha Som

Abstract

This research work studies the relationship between life expectancy and healthcare expenditure in high-income countries using cross-sectional data. We have used a simple linear regression model, where our dependent variable is life expectancy and the explanatory variable is health expenditure (as a percentage of GDP). We expected a positive correlation among our variables, our results show the same. Also, we have come across some distinctions in results on the basis of gender. The first model shows that health expenditure is able to explain life expectancy by 26.81% while 18% is male expectancy and 30% is female. Here we observed that female life expectancy is affected more, a reason for which could be health aid programmes are for females mostly in these countries. The second model shows 26.83% while 18.59% shows male life expectancy and 30.4% is female life expectancy. Using a simple scatter plot of life expectancy against healthcare expenditure for all high-income countries in our model, we tried to analyze the relationship between life expectancy and healthcare expenditure. We have also used a histogram to see the distribution of our data and ran different tests to check for the different CLRM assumptions. The results of the test mainly pointed out no presence of heteroscedasticity, the residual is not following normal distribution, and also there may be relevant omitted variables.

I Introduction

Life expectancy is a statistical measure of the average time an organism is expected to live, based on the year of its birth, its current age, and other demographic factors like sex. The most commonly used measure is life expectancy at birth (LEB), which can be defined in two ways. Cohort LEB is the mean length of life of a birth cohort (all individuals born in a given year) and can be computed only for cohorts born so long ago that all their members have died. Period LEB is the mean length of life of a hypothetical cohort assumed to be exposed, from birth through death, to the mortality rates observed at a given year.

Public expenditure on health refers to expenditure on health care incurred by public funds. Public funds are state, regional and local Government bodies and social security schemes.

We aim to study the relationship between life expectancy and government health expenditure for high-income countries in this paper. Life expectancy is the dependent variable and government health expenditure is the explanatory variable. Life expectancy is a measure that combines average levels of self-rated health with period life expectancy. We have collected data from 81 Countries.

In section I we have defined the objective of the paper, along with a brief explanation of our variables. In section II we have reviewed the existing literature on our research. In Section III, we have used econometric tools to analyse the data and finally, in Section IV, we have made our concluding remarks.

II Literature Review

The healthcare systems in different countries are explicitly portrayed by public health expenditure. An empirical analysis was made for the relationship between public health expenditure and national health outcomes among high-income countries. For analysing cross-country panel data, they have taken the help of a mixed effect model. A statistically significant association was found between government health expenditure and public health outcomes. Interestingly a negative relationship between government health expenditure and public health outcomes and a positive relation between government health expenditure and life expectancy at birth was found. (Lane, S. R. 2013)

Whilst the US spends a lot more than any other country on health care, Americans have lower life expectancy than most other high-income countries. This study highlights that lower expenditure on social policies, in the U.S., might stimulate less commending trends in Life expectancy. This study tests the hypothesis that greater social spending will be positively associated with Life expectancy across the countries of OCED. (Reynolds, M. M., Avendano, M., 2018)

The study found that in the last years, there has been quite evidently an increase in Life Expectancy in countries with improved health care, and to improve their healthcare they have also increased their Health Expenditure. This survey aimed to analyse the relationship between that Life Expectancy and the existing expenditure on the healthcare system. The results indicate the variation of health care expenditure per capita is also important among high-income countries (in specific), and this difference is growing over time. Their current study has only examined the effect of one determinant factor, namely health expenditure, on the health status of a population. The choice of one factor was done due to the reduced availability of data for a big sample of countries. (Jaba, Balan and Robu, 2014.)

The study finds that Life expectancy in England has been thwarted. Although such trends have been recorded in many high-income countries since 2011, the situation in England is among the worst. A growing number of studies have associated stalling life expectancy with reduced funding for public services following the introduction of austerity measures in England in 2010. A longitudinal ecological study was conducted by linking annual data from the Ministry of Housing, Communities, and Local Government on local government revenue expenditure. This study suggested that, during a period of large reductions in central government funds for local government in England, areas that had the greatest loss of revenue showed a decline in life expectancy and premature mortality trends. As funding for the most deprived local authorities decreased to a greater extent than for other local authorities, they showed the most adverse effects, widening health inequalities. (Alexiou, Fahy, Mason, Bennett, Brown, Bambra, Taylor- Robinson and Barr, 2021)

III Data and Methodology

The source of the data is the World Bank database, and the data collected is for the year 2019. We opted for the year 2019 because the data was readily available. We have used OLS (Ordinary Least Square) method to find the relationship between life expectancy and healthcare expenditure.

Descriptive Statistics

Table 1 shows the descriptive statistics of 53 high-income countries. From our computation, we find the average life expectancy is about 79.9671 years with a standard deviation (SD) of about 3.066 years. The average life expectancy for females is found to be 82.4714 years (SD 2.958912 years) and for males, we have 77.610 years (SD 3.410049 years). On average, the public health expenditure of these high-income countries, as a percentage share of GDP was about 7.876% (SD 2.672%). We also observe that the life expectancy of males, females, and both are negatively skewed, we have presented the same in Figure 3.

Table 1: Descriptive Statistics of the Variables

Variables	Mean	SD	Median	Skewness	CV(%)
Total Life Expectancy	79.9671	3.0660	81.2049	-0.489092	3.834
Total Life Expectancy (male)	77.610	3.4100	78.921	-0.624198	4.394
Total Life Expectancy (female)	82.471	2.9589	83.1	-0.609903	3.5878
Health expenditures (%GDP)	7.8763	2.672	7.83471	0.3719256	33.92

Source: The authors

Estimation

In this sub-section, we seek to estimate the relationship between life expectancy and healthcare expenditure in high-income countries. We have used a simple regression analysis with healthcare expenditure as the regressor. We construct two models – linear-linear and log-linear models to analyse the impact of healthcare expenditure on the life expectancy of males, females, and both.

Model 1: $Y_i = \alpha + \beta X_i + u_i \quad (i= 1, 2, 3, \ldots, 53) \qquad (1)$

where y is the dependent variable (life expectancy at birth), X is the explanatory variable (health expenditure as a percentage of GDP), β is the regression coefficient and u is the error term that follows N $(0, \sigma^2)$. We test

the null hypothesis H_0: $\beta = 0$ [health expenditure (% of GDP) doesn't affect life expectancy]

against the alternative hypothesis H_1: $\beta \neq 0$ [health expenditure (% of GDP) affects life expectancy]

In this framework, we have incorporated three regressions labeled as 1.a., 1.b. and 1.c. for total, male and female life expectancies respectively. The results have been given in Table 2.

Table 2: Regression Results for Models 1.a, 1.b and 1.c

Model	Dependent Variable	Estimated Equation	R^2	p-value
1. a.	Total Life Expectancy	$\hat{Y}_i = 0.5941X_i + 75.287$	0.2681	0.000
1. b.	Life Expectancy for Male	$\hat{Y}_i = 0.5523X_i + 73.25989$	0.1874	0.001
1. c.	Life Expectancy for Female	$\hat{Y}_i = 0.609712X_i + 77.6691$	0.3032	0.000

Source: The authors

We have run an OLS and Table 2 shows that health expenditure as a percentage of GDP explains the variation in life expectancy of people by 26.81%. While we see that in case of male life expectancy it is able to explain 18%; and that of female life expectancy it can explain 30% of the variations. We may say all the variables are significant as the p-values are extremely low. In general, our model states that if there is 1% increase in health care expenditure there is 0.59 years increase in life expectancy on an average and 0.5523 years and 0.6097 years in male and female respectively. There is increase in life expectancy with increase in health expenditure, we all came across the conceptual difference of growth and development. Life expectancy is an measure of development (Used in formulation of HPI and many other), i.e. average year a person is able to live given the present economic conditions. The results shows us that with an injection in the economy the increase in government expenditure causes an increase in life expectancy, which also shows that there was a dearth of healthcare facilities (there was a scope of improvement) covering that dearth is helping the countries to rise through the stairs of development.

Model 2: $\ln Y_i = \alpha + \beta X_i + u_i \ldots (2)$

Where "ln Y" is the dependant variable (log value of life expectancy at birth), X is the explanatory variables (health expenditure as percentage of GDP), β is the regression coefficient and u is the error term with an N $(0, \sigma^2)$.

H_0: β=0 [health expenditure (%GDP) doesn't affect log of life expectancy]

H_1: β≠0 [health expenditure (%GDP) affects log of life expectancy]

In this log-linear framework, we have incorporated three regressions labeled as 2.a., 2.b. and 2.c. for log values of total, male and female life expectancies respectively. The results have been given in Table 3.

Table 3: Regression Results for Models 2.a, 2.b and 2.c

Model	Dependent Variable	Estimated Equation	R^2	p-value
2.a.	Total Life Expectancy	$\widehat{\ln Y_1} = 0.0075098X_i + 4.321734$	0.2683	0.000
2.b.	Life Expectancy for Male	$\widehat{\ln Y_1} = 0.019237857X_i + 0.0842377$	0.1859	0.001
2.c.	Life Expectancy for Female	$\widehat{\ln Y_1} = 0.02086636X_i + 0.04769596$	0.3043	0.000

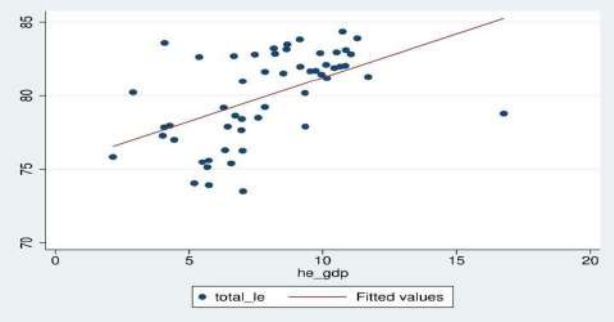
Source: The authors

Table 3 shows that the value of health expenditure as a percentage of GDP has been able to explain the log value of life expectancy of people by 26.83%. While we see that it is able to explain 18.59% of the log of male life expectancy and, 30.4% of the log of female life expectancy. We may say all the variables are significant as the p-values are extremely low.

In general, our model states that if there is a 1% increase in health expenditure then life expectancy would increase by 0.75 % on average and 1.9237 % and 2.0866 % for males and females respectively. We have applied a log-log model to obtain the percentage increase in life expectancy on an average (or the average growth of life expectancy). We came to see there is a significant increase in life expectancy that makes us believe that these countries still have a scope for development

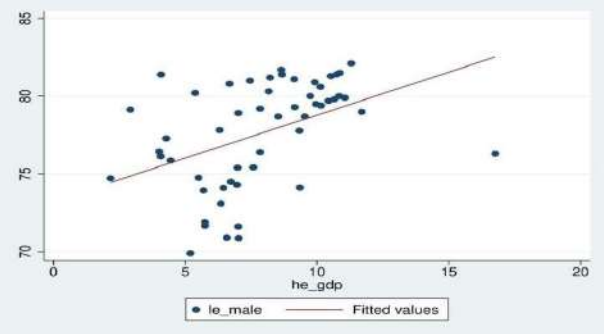
Graphical Analysis

As a preliminary analysis, in Figure 1 we plot a simple scatter plot of life expectancy against healthcare expenditures (as a percentage of GDP) for all the high-income countries in our sample. Panel A looks at average life expectancy, while in panels B and C, we inspect whether the relationship seems to vary between males and females.



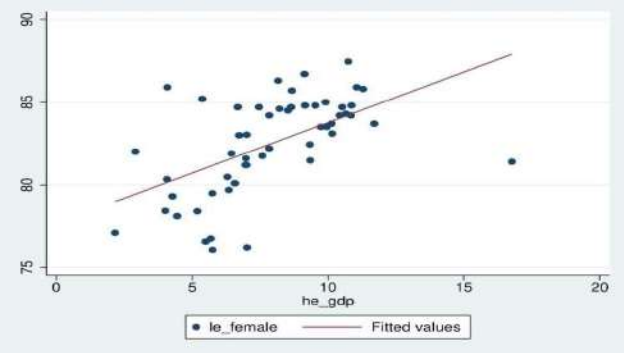
Source: The authors

Figure 1.A The Scatter Diagram between total life expectancy and health care expenditure as a percentage of GDP



Source: The authors

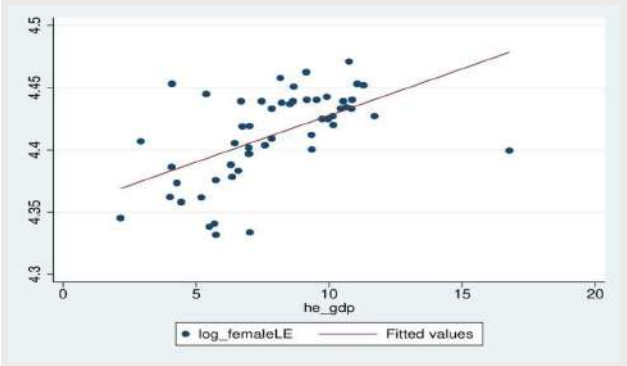
Figure 1.B. The Scatter Diagram between male life expectancy and health care expenditure as a percentage of GDP



Source: The authors

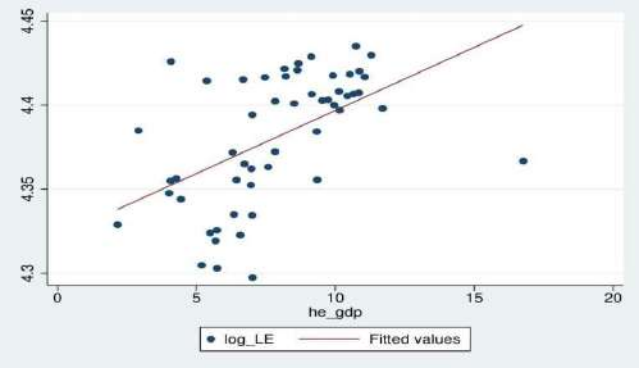
Figure 1.C. The Scatter Diagram between female life expectancy and health care expenditure as a percentage of GDP

In figure 2 we represent a simple scatter plot taking the log values of life expectancy against healthcare expenditures (as a percentage of GDP) for all the high income countries in our sample. Panel A looks at average life expectancy, while in panels B and C, we inspect whether the relationship seems to vary between males and females.



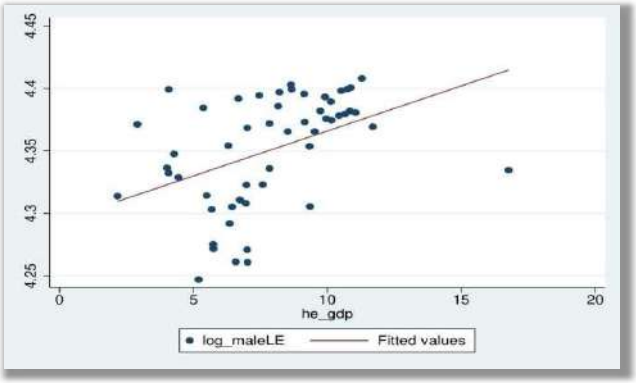
Source: The authors

Figure 2.A The Scatter Diagram between log values of female life expectancy and health care expenditure as a percentage of GDP



Source: The authors

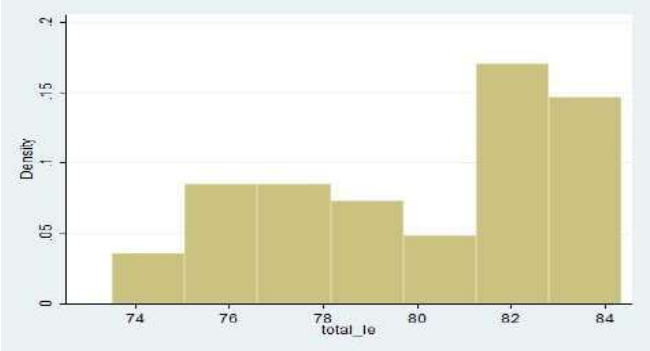
Figure 2.B The Scatter Diagram between log values of total life expectancy and health care expenditure as a percentage of GDP



Source: The authors

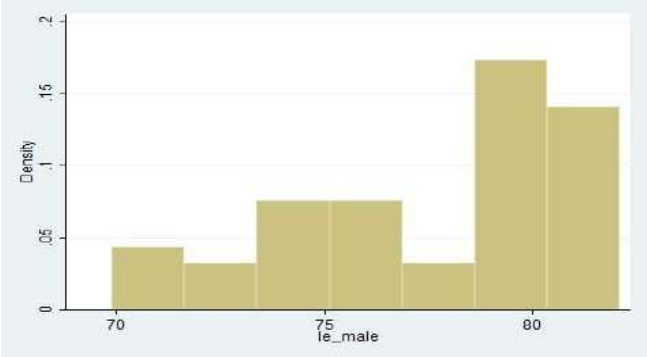
Figure 2.C The Scatter Diagram between log values of male life expectancy and health care expenditure as a percentage of GDP

In Figure 3, we plot the histograms of the available variables from model-1. So clearly we can see that our respective dependent variables are all negatively skewed. Our statement of skewness can also be supported by the reference from table-1. In panels A, B and C we plot the density against total life expectancy, male life expectancy and female life expectancy respectively.



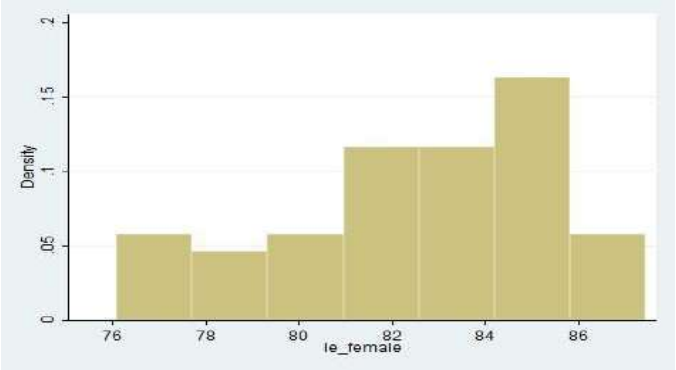
Source: The authors

Figure 3.A Histogram of Total Life Expectancy



Source: The authors

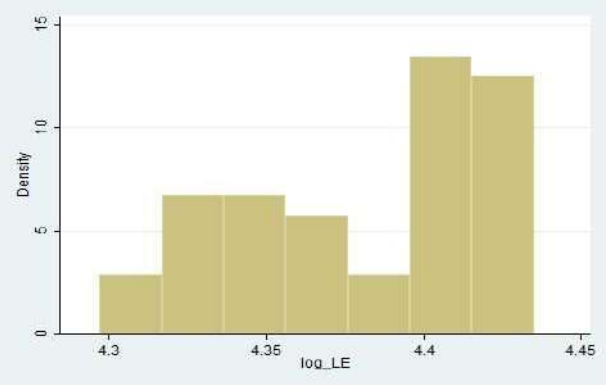
Figure 3.B Histogram of Male Life Expectancy



Source: The authors

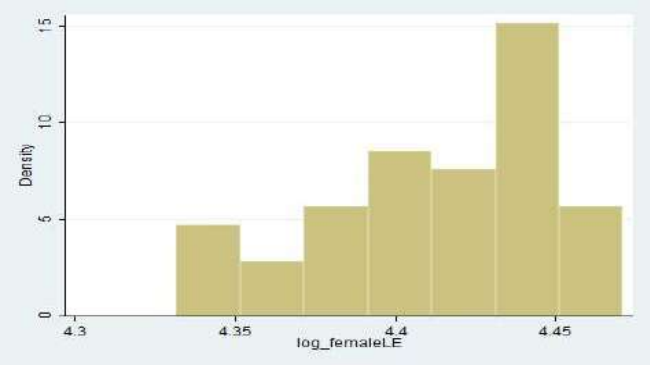
Figure 3.C Histogram of Female Life Expectancy

In Figures 4.A, 4.B and 4.C, we plot the histograms of the available variables from model-2. So clearly we can see that our respective dependent variables are all negatively skewed. Our statement of skewness can also be supported by the reference from table-1. In panel A, B and C we plot the density against the log values of Total Life Expectancy, Male Life Expectancy and Female Life Expectancy respectively.



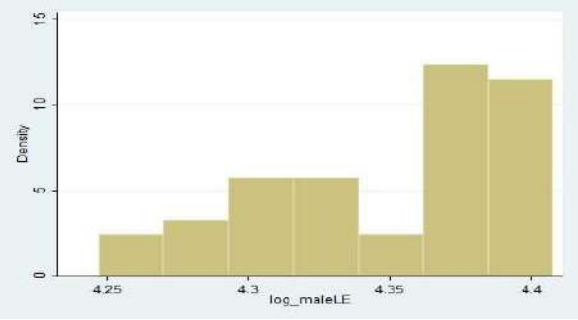
Source: The authors

Figure 4.A Histogram of Log of Total Life Expectancy



Source: The authors

Figure 4. B Histogram of Log of Female Life Expectancy



Source: The authors

Figure 4. C Histogram of Log of Male Life Expectancy

Correlation Check

Table 4: Correlation Coefficients between Life Expectancy (Male, female, Total) and Health Expenditure

	Total Life Expectancy	Life Expectancy for Male	Life Expectancy for Female
Health expenditures (%GDP)	0.5178	0.4329	0.5506

Source: The authors

Health expenditure (as a percentage of GDP) is correlated with Life Expectancy in total, for males and for females by 51.78%, 43.29% and 55.06% respectively. Similarly, we observe Health expenditure (as a percentage of GDP) is correlated with the log values of Life Expectancy in total, for males and for females by 51.80%, 43.12% and 55.17%. So we may infer that our choice of dependent and independent variables are not highly correlated.

Diagnostic Tests

Test for Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test to check for heteroskedasticity

H_0: Constant variance

Variables: fitted values of log of Total Life Expectancy

chi2(1) = 0.04

Prob>chi2 = 0.8407

Hence, we may not reject the null hypothesis. So we may conclude that there is no presence of heteroskedasticity. There is no presence of heteroskedasticity but the main problem we came across estimation is that the disturbance term does not follow a normal distribution. which is further confirmed by our next diagnostic test.

Test for Normality

Jarque-Bera normality test: 1.357 Chi(2) .5074

Jarque-Bera test for Ho: normality

Hence, we may reject the null hypothesis. So our residual does not follow a normal distribution.

Test for omitted variables and functional discrepancy

Ramsey RESET test using powers of the fitted values of log LE

Ho: model has no omitted variables

F(3, 48) = 4.54

Prob> F = 0.0070

Hence, we may reject the null hypothesis, which states our model may have omitted variables. Clearly life expectancy does not only depend on health care expenditure , pollution of countries, the percentage of old population , clean water and sanitation facilities, GDP of the country, etc. The role of government is sufficient or restricted to healthcare? What are the marginal factors that too affect the longevity of lives? Are not promotion to healthy lifestyles, control on drugs and

pharmaceuticals and cleaner technologies also important? Some questions remain unanswered which can be studied by incorporating more explanatory variables.

V Conclusion

In our study we tried to analyse the relationship between health expenditure (as a percentage of GDP) and life expectancy for high income countries. The expenditure made by government was observed to affect the life expectancy positively, as we might have expected. But our results had some inconsistency. Firstly, we have excluded many relevant variables, like per capita income, adult mortality rates, infant mortality rates, etc.

Next, we observe that there is no presence of heteroskedasticity. The dependent variable, Y_i does not follow normal distribution, so normality assumptions under the CLRM are not followed. Initially we had taken a cross-section data set of 83 countries, but we had missing data for 30 countries, eventually which we had to drop. This might have led to the problem of u_i not following normal distribution and thus, Y_i is also not following normal distribution. Hence, we cannot check the validity of the estimated regression coefficients for all our models, using the t-test statistic. More work needs to be done, to determine whether there is actually any correlation between healthcare expenditure and life expectancy. Specially with the collection of more data, and by including more relevant variables, affecting the life expectancy of people of high income countries. We see an opening to gain further insight by looking at variables related to the consumption of various goods. However, the available data is inadequate and therefore not useful for our objective.

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Students' Seminar on

Issues in Development Economics: Econometric Applications

A Report on the Papers Presented by the Students

Experiential Learning is suggested as a modern learning method where the students can learn through experience. The present seminar was intended to practice this method where the students would get the opportunity to learn the subject of Applied Econometrics by using real-life data. Further, the students were guided to write academic papers based on the results of their studies, and to present them in the seminar.

The students of Semester VI class (Batch 2020-23) were divided into eight groups and the students of each group investigated the relationship between one of the indicators of health status of people in a country, like infant mortality rate, adult mortality rate and life expectancy, and one of its possible determinants, like GDP per capita and government health expenditure as a percentage of GDP; the study was separately done for males and females also. A few groups examined the relationships for the low-income countries and the other groups investigated that for the high-income countries. Cross-section data on the relevant variables were collected from the website of the World Bank. The year 2019 was chosen because that is the latest year for which data were available for most of the countries. The students of each group wrote a paper based on the regression results obtained from the particular study and presented it in the seminar. Prof. Simontini Das and Mr. Darpajit Sengupta (Senior Research Fellow), both from Jadavpur University, evaluated the papers and gave their valuable comments. The suggestions and remarks made by them helped the students to revise their papers and submit the final versions. The students were greatly indebted to them.

It is worth mentioning here that the objective of the seminar was not to conduct rigorous research works by the students; rather, a student was expected to learn how to carry on an econometric study using the software stata (which is within the syllabus), how to write an academic paper and how to present it in a seminar (which are beyond their curriculum). The students thus used two-variable models for their studies stating the limitations in the concluding remarks. It will be interesting to note the summary of the results of all papers together which is presented in Table 1 below:

Table 1: Summary of the Regression Results of the Studies

Dependent Variable	Independent Variable	Country-Type	Sign of Estimated Regression Coefficient	Significance at 1% level
AMR_female	GDPpc	Low-income	Negative	Insignificant*
AMR_male	GDPpc	Low-income	Negative	Insignificant
logAMR_female	logGDPpc	Low-income	Negative	Insignificant*
logAMR_male	logGDPpc	Low-income	Negative	Insignificant*
AMR_female	GDPpc	High-income	Negative	Insignificant
AMR_male	GDPpc	High-income	Negative	Insignificant
logAMR_female	logGDPpc	High-income	Negative	Insignificant
logAMR_male	logGDPpc	High-income	Negative	Insignificant
AMR_female	Health-exp-GDP	Low-income	Negative	Insignificant
AMR_male	Health-exp-GDP	Low-income	Negative	Insignificant
IMR_female	GDP-pc	High-income	Negative	Significant
IMR_male	GDP-pc	High-income	Negative	Significant
IMR_total	GDP-pc	High-income	Negative	Significant
logIMR_female	logGDP-pc	High-income	Negative	Significant
logIMR_male	logGDP-pc	High-income	Negative	Significant
logIMR_total	logGDP-pc	High-income	Negative	Significant
IMR_female	Health-exp-GDP	Low-income	Positive	Insignificant
IMR_male	Health-exp-GDP	Low-income	Positive	Insignificant
IMR_total	Health-exp-GDP	Low-income	Positive	Insignificant
IMR_female	Health-exp-GDP	High-income	Negative	Insignificant
IMR_male	Health-exp-GDP	High-income	Negative	Insignificant
IMR_total	Health-exp-GDP	High-income	Negative	Insignificant
LE_female	GDP-pc	Low-income	Positive	Insignificant*
LE_male	GDP-pc	Low-income	Positive	Insignificant*
LE_total	GDP-pc	Low-income	Positive	Insignificant*
logLE_female	logGDP-pc	Low-income	Positive	Insignificant
logLE_male	logGDP-pc	Low-income	Positive	Insignificant*
logLE_total	logGDP-pc	Low-income	Positive	Insignificant*
LE_female	Health-exp-GDP	High-income	Positive	Significant
LE_male	Health-exp-GDP	High-income	Positive	Significant
LE_total	Health-exp-GDP	High-income	Positive	Significant
logLE_female	Health-exp-GDP	High-income	Positive	Significant
logLE_male	Health-exp-GDP	High-income	Positive	Significant
logLE_total	Health-exp-GDP	High-income	Positive	Significant

We can note here the observations made from Table 1. First, the government expenditure on health facilities (as a percentage of GDP) has a significant positive (as expected) impact on the life expectancy of people in high-income countries. For males and females separately also same results are obtained. Second, for these countries GDP per capita has a significant negative impact on the infant mortality rate. Similar results are obtained when the study is done for males and females separately. Third, the impact of GDP per capita on the adult mortality rate in these countries is negative (as anticipated) but the estimated coefficient is insignificant. For low-income countries, although the estimated coefficients for the regressions of the adult mortality rate on GDP per capita, the adult mortality rate on government health expenditure, and life expectancy on GDP per capita are all insignificant at a one per cent level of significance, they have anticipated signs, which indicate improvement in health indicators following an increase in the determinants. For these countries, the estimated coefficient has an unanticipated positive sign when the infant mortality rate is regressed on government health expenditure, which would indicate a rise in infant mortality rate with an increase in government expenditure on health; however, it is not statistically significant.

As a concluding remark, it can be said that given the limited scope of the papers, the studies provide some insights into the issues that can be extended for effective research in this area.

Smita Nath

Econverge'22

held on 29, 30 September 2023

The Voice of the Organising Committee……

The idea for Econverge'22 was conceived on a scorching August afternoon. We were clueless then – the venue, mode, time, and budget, all were up in the air. We knew NOTHING. The only thing that we had was conviction. Econverge being an Economics departmental fest, we had a two-year legacy. Our seniors started a small amber that we tried to blow into flames.

The event was to be held in a span of two days but the planning began months before. The Core organizing committee was formed with seven third year students. The different teams amassed were as follows:

1. Souradeep Dhar – The Contents Team Head
2. Shruti Chatterjee & Manjira Nundy – The Logistic Heads
3. Debargha Som and Srijaa Mukherjee – The Sponsorship Heads
4. Anwesa Ghosh - Tech and Design Director
5. Ankush Roy - Director

Then began the main task of recruiting Event heads. Econverge'22 was to be different from its predecessors. Following Charles Darwin's idea of Evolution, we planned to evolve Econverge'22 into an Economics Fest, with events that would be diverse, and interesting. After several rounds of deliberations, seven events were finalized:

1. IPL Auction
2. Mock Stock Exchange
3. Lord of the Pitch
4. Quid Pro Quo
5. UNECE
6. Photography
7. Turncoat debate

Once the events were finalized a few third year students were put in charge with some second year students to assist them. This was a shift from the previous years but with the bigger scale of the programme more manpower was needed. The First Year students, though very enthusiastic, were given a pass for organizing and were more focused on participating in the different events.

With everything in place, we had to begin the tedious task of securing funds and sponsorships for Econverge'22. We were helped immensely by our Placement Officer Mr. Tridib Mohan Sir and were guided at all steps by our respected teacher Dr. Mausumi Manna Ma'am. The sponsorship team worked tirelessly for weeks to secure sponsors, such as IFB, LIC, Friends FM and Edugraph. We were also fortunate to receive substantial donations from our alumni.

In tandem with the sponsorship team the logistics and the design team with the support of the contents team worked nonstop for these one and a half months. It is due to their hard work that we got over 300 participants from 36+ colleges across the city. Also, a special mention must be made for Dr. Mausumi Manna Ma'am. She helped us, especially me, in every step of the way. From permissions to budgeting to ideas she was always standing tall behind us with her caring hand on our shoulders.

We would also like to thank Dr. Smita Nath, Dr. Sudeshna Ghosh and Dr. Smritikana Ghosh Ma'ams for their constant support and input throughout our preparations. We also would like to extend our gratitude to the Principal Ma'am, Vice-Principal Sir, all our Teachers and College staff. Without their help and guidance, Econverge'22 would not have been possible.

Finally, D-Day came on the 28th of September. Walking in through the college gate at 8.00 AM on the day was surreal. The Banner of Econverge'22 was flying high, a great reminder of the hard work we had put in. Everyone with their ID cards and badges looked regal and ready to go. The registrations began with fervor at 09.00 AM. We had decided to skip the opening ceremony for a grander closing ceremony.

After a small welcome speech in the seminar hall the day was open. The day had four events running side by side. The students moved to their respective rooms and the events began. The biggest attraction of the day was the IPL quiz held in the Seminar hall with over 200 participants. Friends FM did live coverage of the day along with a small interview with me.

Day 2 began quite the same. With Anwesa and Shruti manning the registration desk we began at 10 AM. The day saw a huge turnout with seven events running side by side in different rooms of the college. We had Mr. Rushvir Singh, our alumnus, and Dr. Sudeshna Ghosh ma'am to grace the Lord of the Pitch event as judges.

The day wound down with the Closing Ceremony held in the Mani Lal Bhaumik auditorium hosted by Anwesha Bairagi and myself. The closing ceremony began with the notes of encouragement and congratulations from the Principal Ma'am, Vice-Principal Sir, Bursar Ma'am, Senatus Secretary Ma'am and our Guest of Honour respected Mr. Swakshar Chattopadhyay Sir, a senior alumnus of the Economics Department.

The highlight of the day in addition to the Awards and Medals was the special tribute given to our HoD, Dr. Smita Nath Ma'am by the students, both past and present, and our Teachers. The day ended with a small presentation of saplings to our guests by the students as a show of gratitude and a promise of growth.

Finally, all I would like to add is that this tradition of ECONVERGE is something the Economics department of Scottish Church College is proud of and I am honoured that we could organize it. As we pass the baton to our juniors, we hope that the tradition grows and flourishes further.

Ankush Roy (Semester V, 2020-23 Batch)
Director, Econverge'22

Behind the Curtain… experiences of the students

Econverge'22 was one of its kind. It was indeed an enriching experience for me to work as the Head of Academics. The biggest takeaway for me from this experience was time management. We had a very short time to organize such an enigmatic fest yet we were able to pull things off by maintaining regular deadlines and fulfilling our responsibilities.
Anwesa Ghosh

Marvelous two days were spent at SCC. Econverge'22 was an emotion for me. Executing a fest of such a magnitude seemed impossible at first. Being the sponsorship co-head and treasurer for the event, the pressure was on. I am proud to lead a diligent team of my peers and juniors, for the two days and, at the fest's planning infancy. Without their support and faith, Econverge'22 would not have been possible. Not only sponsorship, heading an event, and hosting a college fest – were among the many 'firsts' that this event has given me. Also, the unconditional support given by our teachers is worthy of special mention. Truly, for all these people, I was able to etch an experience of a lifetime.
Debargha Som

Enthralled by the moments of various parts of the city brought under one roof, the organizing committee of "LOGISTICS & PR " won the hearts of the youth through their tireless strivings. The committee had been phenomenal in planning and executing the strategies. The experience and the willingness to learn had been an integral part of the success of the committee, where each and every member worked day and night to make it possible.
Shruti Chatterjee

Econverge was one of the major things which made me realize my capabilities as a person. It has been more than two months and all I can think about is how challenging it was and all the satisfaction it gave me by the end. It helped me improve my communication and time management skills as a whole. I have learnt how to make the best out of whatever the situation may be and to never give up. And at last, the success behind this Econverge lies in the immense hard work and team spirit of every other individual who was present there.
Souradeep Dhar

Event Reports

Mock Stock Exchange

Mock stock, a game that was a replica of the 90's stock market. It took place in two rounds. In the prelims, participants did paper trading through their trading view accounts. There were 37 participants out of which the top 10 of them with the highest profits made it to the finals. The prelims were in online mode.
On the final day, the top 10 participants were given 1 lakh rupees along with 15 shares each of 7

companies which were Nykaa, HDFC, TCS, ITC, Reliance, Bajaj Finserv and Nestle. They had to use their trading skills by either being bullish or bearish to earn the highest profits. The prices of the companies were changing in regular intervals on the basis of the news which was being projected

The basic idea was to create a real-life stock market like that of the 80s. We were amazed to see the trading skills of some participants. As the prices were changing constantly it was very difficult to predict who would win.

A team from THK Jain College used their skills magnificently and won the game with a profit of 310000 in just a time span of 1 hour. The second spot was bagged by a team from Vivekananda College with a profit of 275000 followed by Goenka College with a profit of 271000. It was a treat to watch all the participants enjoying themselves so much along with the professors who were there as the audience.

UNECE

The UNECE (United Nations Economic Commission for Europe) is one of the regional subsidiary bodies of ECOSOC. The committee had discussions on the 2030 agenda for sustainable development and supporting Green Recovery from Covid-19 and the Russia-Ukraine crisis.

There were more than 50 delegates who were a part of the committee and they came up with amazing points to enhance their country's stance. As the committee tried to come to a solution for the pertaining issues, it witnessed several heated debates between the delegates of Ukraine and Russia. The committee deeply delved into the sanctioning system of the EU with regards to Russia and the energy dependency of Europe on Russia. At the end of the 2nd day, the committee had a few crises to manage due to some developments that happened during the course of the committee.

The Best Delegate was awarded to the delegation of China (students of Scottish Church College), while the Joint High Commendation was awarded to the delegates of Germany (students of Jadavpur University) and Russia (students of The Bhawanipur Education Society College).

Awardees

Best Delegate - Nikhil R. Parshy, Raggaeshree Chanda (China), Scottish Church College

High Commendation -
Sayak Dasgupta (Germany) - Jadavpur University
Hreed Gupta (Russia) - The Bhawanipur Education Society College
1st Special Mention –
Sagnik Nag, Mainak Bhattacharya (Ukraine), Scottish Church College
2nd Special Mention -
Parthiv Mukherjee (USA), Scottish Church College
Shreemanti Datta, Madhusha De (Georgia), Loreto College
Honourable Mentions -
Manisha Ghosh, Anushka Halder (Italy), Scottish Church College
Ritobroto Chanda, Anirudh Dutta (Monaco), Ramkrishna Mission Vidyamandir, Belur

Lord of the Pitch

Lord of the Pitch was a business-focused event that showed the future entrepreneurs pitching their ideas and product to a panel of self-made investors. Typically, an entrepreneur asked for an amount in exchange for a percentage of ownership. The event truly captured the essence of the most talked about show SHARK TANK.

There were a total of 22 teams where each team had 10 minutes for their pitch and the tough task of selecting the finalists and winners for the event was carried out by 4 of our independent judges. Not only the participants competed amongst each other with their brilliant business plans but also tried to win over the hearts of the sharks and draw a negotiable investment from them. Not all the teams came away with an investor but one such pitch which startled our judges and blew the minds of both the other participants and organizers was given by the team from Shri Shikshaytan College, Pramiti is a business idea which tries to solve the major problem of collection, transportation and segregation of waste into wet and dry waste by making compost out of the wet waste which will be used in the agricultural sector. The second place was bagged by the team from The Bhawanipur Education Society College, Eduquade, an app which will design a students' graduation years with practical experience and skillful courses. Soon to be available in the Play Store.

The event incorporated both the aspect of true competition as well as appreciation and recognition of some extraordinary innovations. The audience could learn more about how to pitch, what investors look for, and how to prepare their ideas. We were supremely grateful for the time and support all of our judges and the participants have so generously given.

Awardees
1st - Esha Kaur, Akancha Kaushal, Lisha Nahata, Priyal Saraff, Shri Shikshayatan College
2nd - Harsh Agarwal, Jaya Goenka, Vanshika Kyal, The Bhawanipur Education Society College
3rd - Pursottam Choudhary, Payal Kumari, Sachi Kashyap, Goenka College of Commerce and Business Administration

Quid Pro Quo

Quid pro quo, a game of international trade stimulation, which actually had realistic booms and shocks. The participants' responses and strategies in the game mesmerized us. Each and every team had its own unique strategy for auctions, spot markets, and forex reserves. The

interesting things we came across are teams optimizing from resources, Manisha (a Scottish Church College student) optimized 4 triangles from each paper, which was the highest that could be earned from it (without any highly valued assets like compasses), they did not blindly follow the instructions, mended them with intelligence and honesty. The Bhawanipur Education Society College did a commendable job in monetary shocks, whereas Shri Shikshayatan had their own calm, peaceful strategy in the very beginning, they silently did their job but scored the highest amongst the developed countries. But hands down to Andrews in trading skills and convincing teammates for exchanges.

Awardees

1st - Rishabh Rathi, Komal Thakur, Rihav Shaw, The Bhawanipur Education Society College

2nd - Spriha Mondal, Senjuti Das, Srinjoy Majumder, Jadavpur University

3rd - Ishita Choudhary, Megha Taparia, Sreya Das, Shri Shikshayatan College

Bidding Wars

Inspired by the auctions at the Indian Premier League, the Department of Economics of Scottish Church College came up with its very own players auction at Econverge'22, titled 'Bidding Wars'. With 200 players at stake, INR 80 Crore in hand, and 15 places to fill, teams had to battle their way out and outwit their opponents with their strategies. The event took place across two days and it had two rounds. The first round was an elimination Quiz Round, the top ten teams from the first round qualified for the main auction.

This was one of the most anticipated events and there were more than one hundred forty participants from twenty three colleges in the Quiz Round. The Quiz master for the day was Mounakh Roy, former Secretary of the Scottish Church College Quiz Club. There were a total of twenty questions in the quiz round and one team from Ashutosh College answered nineteen questions correctly to top the round.

After two days of intense bidding, the team from Jadavpur University was adjudged the winner, they were closely followed by teams from The Heritage College and the Bhawanipur Education Society College. Mahendra Singh Dhoni, the former Indian captain and right-handed wicketkeeper batter became the most expensive buy in the 2022 auction when a team from Ramakrishna Mission Residential College, Narendrapur representing Chennai Super Kings bought him for INR 16.75 Crore.

Awardees

1st - Indranil Kundu, Shahnowaj Mandal, Anirban Lala, Srinjoy Majumder, Jadavpur University

2nd - Ashutosh Baveja, Swapnonil Mukherjee, Anubhab Bhattacharya, Pranav Manot, The Heritage College

3rd - Yuvraj Mani Trivedi, Kaushal Kumar Singh, Harsh Daga, Shrey Mishra, The Bhawanipur Education Society College

Photography

"Photography is an austere and blazing poetry of the real" - Ansel Adams.

A photography event in an economic fest did trigger a lot of questions but again, we cannot deny that photographs tell us a story and can be interpreted differently.

The Photography Event in ECONVERGE had a good number of footfalls and students from

different colleges across the city participated in this event. The topic for the event was 'The Struggle of Small Businesses in a Developing Country.'
For round 1, our HoD Dr. Smith Nath judged all the submitted photos according to the five criteria.
On the 1st day of Econverge'22, all the photographs that were selected in the 1st round were displayed beside the registration desk, in front of the seminar hall. Everyone passing by took a keen interest in all the displayed photographs and voted for their most liked picture. At the end of the day, the heads of the event opened the ballot box and chose the top 10 photos according to the number of votes.
For the final round, the top 10 finalists were present in the college on the next day. This round was quite interesting as the participants had to explain their pictures and tell the story they wanted to portray through their pictures to the judges. We had Dr. Debashis Ghosh Sir from the Department of Sanskrit and also the teacher-in-charge for the Photography Club of SCC along with Kaushik Hafizee Sir, an actor and independent film maker, as our esteemed judges. No doubt all the participants did really come up to the level and gave their best in explaining and portraying their story. The judges were very cooperative and friendly. Kaushik Sir shared his story of how he once worked for a filmmaker who took a shot 25 times for precision whereas a normal shot is taken 10 - 15 times. Debashis Sir shared his experience on how he once stood near Rabindra Sadan for nearly 3 hrs to take a shot.
The judges were really happy with the hard work that the participants had given in clicking their pictures and alluded to it. We had the winner from St. Xavier's University and the runners-up were from Bhawanipore Education Society College.
Awardees –
1st - Arun Charlez, St. Xavier's College
2nd - Tanmoy Mondal, Dinabandhu Andrews College
3rd - Rithik Santhalia, The Bhawanipur Education Society College

Turncoat Debate

On the 28th of September, the first day of Econverge'22, the Turncoat event was held online. The event was judged by reputed alumni of the Economics department, Subir Talukdar and Shwambaditya Sen. Each participant had to speak both for and against their assigned topics, with a preparation time of 30 minutes. The participants, often with flair or wit, gave very substantial arguments on the topic, and skilfully explained themselves from the economic and socio-political aspect. The judges' feedback after every speech made the entire event even more interactive and educative. Overall, this unconventional debate form turned minds and wits on the Econverge platform, very successfully.
Awardees
1st - Aashi Agarwal, St. Xavier's College
2nd -Avik Mukherjee, Ramakrishna Mission Vivekananda Centenary College
-Jeewika Agarwal, Shri Shikshayatan College
3rd - Ritobroto Chanda, Ramkrishna Mission Vidyamandir, Belur Math
-Ananya Saha, St. Xavier's University

Proceedings of the Seminar on
Risk Management in Financial Sector
held on 21st March, 2023

First Session: Analysis of Risk and Return in the Context of Portfolio Management
Speaker: Professor Priya Dey, Department of Business Administration, S.C.C.

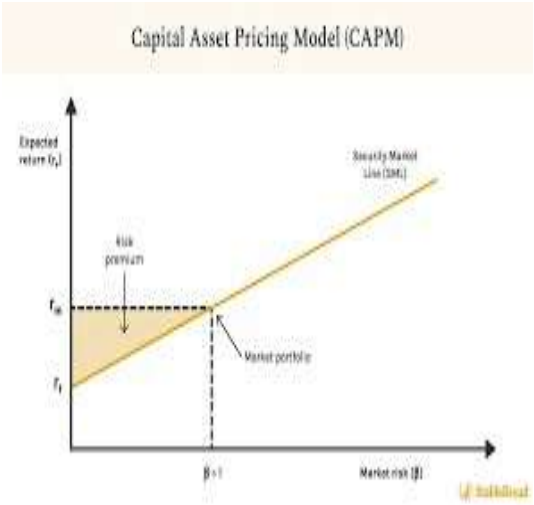
Summary:
What is Investing? Investing, broadly, is putting money to work for a period of time in some sort of project or undertaking in order to generate positive returns (i.e., profits that exceed the amount of the initial investment). It is the act of allocating resources, usually capital (i.e., money), with the expectation of generating an income, profit, or gains.
Types of investments: There are various types of investments available in the market. The most popular ones are stocks or equities, real estates, fixed deposits, gold and real estate. Mutual funds, Public Provident Fund, government bonds, corporate bonds, Exchange Traded Fund, and National Pension Scheme are few other well-known investment options. Each of these differs based on the returns they offer, level of risk, tenure, taxation, and whether the returns are guaranteed or market-linked.
What is a Financial Portfolio? A portfolio is a collection of financial investments like stocks, bonds, commodities, cash, and cash equivalents, including closed-end funds and exchange traded funds (ETFs). People generally believe that stocks, bonds, and cash comprise the core of a portfolio.
Types of Return: Return on revenue (ROR) is a measure of company profitability based on the amount of revenue generated. Return on revenue compares the amount of net income generated for each dollar of revenue. Return on revenue is one of the most important financial metrics in gauging the profitability of a company.
What is Return of Capital? The return of capital refers to the return of invested funds from an investment to an investor. This transfer of funds represents a return of the original investment, not any additional capital gain on the investment. A return of capital can occur when the activity in which an investment was originally made is being liquidated.
What is Risk? When one invests, choices are made about what to do with your financial assets. Risk is any uncertainty with respect to investments that has the potential to negatively affect financial welfare. For example, your investment value might rise or fall because of market conditions (market risk).
Types of Risk: Unsystematic risk is a risk specific to a company or industry, while systematic risk is the risk tied to the broader market. Systematic risk is attributed to broad market factors and is the investment portfolio risk that is not based on individual investments.

Capital Asset Pricing Model (CAPM): Capital asset pricing model or CAPM is a specialised model used in business finance to determine the relationship between the expected dividends and the risk associated with investing in particular equity. When assessing CAPM, one can understand that expected returns on specific security are equal to the risk-free returns plus the addition of a beta factor. The CAPM was developed in the early 1960s by William Sharpe (1964), Jack Treynor (1962), John Lintner (1965a, b) and Jan Mossin (1966). The CAPM is based on the idea that not all risks should affect asset prices.

Assessing the capital asset pricing model requires a proper understanding of systematic and unsystematic risks. Systematic risks are general dangers, which are associated with the investment of any form. Wars, inflation rates, recessions, etc. are some of the examples of systematic risks.

Unsystematic risks, on the other hand, refer to specific perils associated with investing in a particular stock or equity. Thus, unsystematic risks are not perceived as threats, which are shared by the general market. CAPM deals mostly with systematic risks on securities, thereby predicting whether things can go wrong with particular investments.

Formula for CAPM



CAPM formula is given by –

Ra = Rf + Be x (Rm – Rf)

The different factors of this equation are –

- Ra = Expected dividend from investment
- Rf = Risk-free rate
- Be = Beta factor of the underlying transaction
- (Rm – Rf) = Current market risk premium

This entire formula considers the returns, which an investor is liable to receive due to their risk-taking ability and extended time of investment. The beta factor is determined as a risk in conjunction with current market conditions.

Therefore, if the risk associated with an investment is lower than the present conditions, the beta value will be less than 1. For risk equalling that of market conditions, a beta of this equation will always be equal to 1. Lastly, if the risk exceeds that of the established market norm, 'Be' value in the formula will be greater than 1.

Example of CAPM

A CAPM example can assist in evaluating how this formula works. Consider the following when trying to understand the various factors in CAPM calculation. An investor is considering buying stocks priced at Rs. 367, which offer annual returns of 4%. Assuming that a beta factor of 1.1 is associated with this particular stock, one can calculate the expected dividend earnings by considering the risk-free premium as 3% and investor expectation of market appreciation by 7% annually.

Arranging the various factors into the formula, one can arrive at the following conclusion –

Ra = 4% + 1.1 x (7% – 3%)

Ra = 8.4%

Consider another example of the CAPM model. In this next one, the investor is all set to buy stocks worth Rs. 455. Annual returns from such an investment are expected to be around 9%. Beta factor, in this case, is 0.8. Risk-free rate is 5%. This investor expects the market to increase in value by 8% within this next year.

Ra = 9% + 0.8 x (8% – 5%)

Ra = 11.4%

Role of Beta in CAPM

Beta is an integral factor in CAPM. It reflects the volatility of given security against the volatility of the stock market as a whole. For better understanding, consider that a share's price appreciates and depreciates in total sync with the market. In such a case, the beta factor would be one.

However, if the beta of a stock is 1.2, it is indicative of the stock prices rising by 12% when the market appreciates by 10%. Similarly, a negative beta (say of 0.7) indicates that the stock prices will rise by 7% when the market collectively grows by 10%.

The summation of beta and the risk premium of an investment is necessary when determining the amount of compensation, a particular investor is liable to receive for taking this additional risk.

How does CAPM Benefit Investors?

Listed below are some of the advantages of this model of risk-reward evaluation for investors –

- **Assumption of a diversified portfolio**

  This model assumes that an investor maintains a diversified investment portfolio, which can eliminate specific or unsystematic risks.
- **Convenient and simple**

  This model is built around the fact that it is extremely easy to use. The results from such a calculation are dependable and enable investors to decide one way or another when it comes to choosing particular equities.
- **Systematic risks can alter this calculation significantly**

  A beta factor in the capital asset pricing model considers any systematic risks associated with one's investment. Dividend discount model or DDM, which is another popular return predicting model, disregards the effects of such risks on returns. Since market risk is unforeseen and unpredictable, no investor can mitigate its effects in their entirety.

Drawbacks of CAPM

While CAPM is a dependable calculation model, followed by investors worldwide, it does present some drawbacks as well –

- **Risk-free rates tend to change frequently**

  Short-term government securities are responsible for generating the risk-free premium or rate used in CAPM calculations. A major problem of this model is that this risk-free rate is highly volatile, altering within a span of just a few days.
- **Risk-free rate is not a realistic factor**

  Individual investors cannot borrow or lend at the same rates as the government. Therefore, assuming a risk-free rate for calculation is not realistic. Thus, the actual return from an investment may be lower than what this CAPM model reveals.
- **Determining a beta can be challenging**

  Investors using this model of return calculation need to figure out a beta value, which reflects the security in question. Unfortunately, evaluating an accurate beta can be time-consuming and difficult. Therefore, in most cases, a proxy beta value is utilised. This ultimately accelerates return calculations but also diminishes its accuracy.

A capital asset pricing model suffers from similar problems when compared to other scientific models. It still provides an accurate overview of the kind of dividends that investors can expect when they park their funds by incurring some risk.

(Summary prepared by Professor Priya Dey)

Second Session: Navigating Risk in Financial Markets – Strategies and Techniques for Effective Risk Management

Speaker: Mr. Debojyoti Biswas, Risk Management Professional and Former Student of the Department of Economics, S.C.C.

Summary: [prepared by Shruti Chatterjee, Souradeep Dhar, Satakshi Nandy, Shreyasee Sarkar, Semester VI Students (Batch 2020-23)]

Risk management: Risk management is the identification, evaluation, and prioritisation of risks followed by coordinated and economical application of resources to minimise, monitor, and control the probability or impact of unfortunate events or to maximise the realisation of opportunities.

Types of Risk Management: Risk management is a critical aspect of financial markets, as investors are exposed to various types of risks that can significantly impact their investment returns. The following are some of the key risks that investors face in financial markets:

Market Risk is the risk that the value of an investment will decrease due to factors such as changes in interest rates, economic conditions, geopolitical events, and company-specific factors.

Credit Risk is the risk of default on a loan or bond by the borrower or issuer. This risk is typically associated with fixed-income securities, where investors lend money to the issuer in exchange for regular interest payments and the return of principal.

Liquidity Risk is the risk that an investor may not be able to buy or sell an asset at the desired price or time. This risk is particularly relevant for investments that are not actively traded or for investors holding large positions in a particular asset.

Operational Risk is the risk of losses resulting from inadequate or failed internal processes, people, and systems or from external events. This risk includes fraud, errors, system failures, and disruptions due to natural disasters or cyber-attacks. To manage these risks, investors can use various risk management techniques such as diversification, hedging, and risk mitigation strategies. Diversification involves spreading investments across different asset classes, sectors, and regions to reduce exposure to any single risk factor. Hedging involves taking offsetting positions to reduce exposure to a specific risk. Risk mitigation strategies involve implementing procedures and controls to reduce the likelihood and impact of operational risks.

Delinquent Account: A delinquent account refers to an account that is past due or in arrears in payment. In other words, a delinquent account is an account that has not been paid on time or in full, and as a result, is considered overdue. This can apply to various types of accounts, including credit cards, loans, utility bills, and other forms of debt. When an account becomes delinquent, it can have negative consequences for the account holder, including late fees, interest charges, damage to credit scores, and even legal action in some cases. It is important to address delinquent accounts as soon as possible by contacting the creditor or lender to discuss payment options and avoid further consequences.

Collection of Information: Data collection of financial accounts refers to the process of gathering and recording information about financial transactions and balances. This data can include details about income, expenses, investments, loans, and other financial activities. Financial institutions such as banks and credit card companies collect data about their customers' financial accounts as part of their business operations. They use this data to manage accounts, assess risk, and make lending decisions. In addition, various government agencies may collect financial account data for regulatory or tax purposes. For example, the Internal Revenue Service (IRS) in the United States collects data about income and taxes paid by individuals and businesses. Data collection of financial accounts can be done manually, such as by recording transactions in a chequebook register, or electronically, such as through online banking or financial management software. It is important to keep accurate records of financial account data to help with budgeting, tax preparation, and financial planning.

Data Preparation: Data preparation is a critical step in risk management, as it forms the foundation for making informed decisions about potential risks. Effective risk management requires accurate and complete data, and therefore data preparation involves ensuring that the data used for risk analysis is reliable, consistent, and relevant. Here are some key considerations for data preparation in terms of risk management: identify and prioritise the data to determine which data sources are most relevant to the specific risk management goals and prioritise the collection and preparation of that data; collect and cleanse the data to ensure that it is accurate, complete, and consistent. This may involve removing duplicates, correcting errors, and filling in missing data points.

Next step is to validate the data. This is done to ensure that it is reliable and consistent with industry standards and regulations. This may involve cross-checking the data with external sources or subject matter experts. The task follows is to standardise the data to ensure that it is consistent and can be easily analysed. This may involve converting data into a common format

or using a standard data dictionary. Final task is to analyse the data to identify patterns and trends, and to gain insights into potential risks. This may involve using statistical methods or machine learning algorithms. Overall, effective data preparation is essential for successful risk management. By ensuring that the data is accurate, complete, and relevant, risk managers can make informed decisions and take proactive measures to mitigate potential risks.

Scorecard: In finance, a scorecard is a tool used to assess and evaluate the creditworthiness or risk of a borrower or an account. Scorecards are used by financial institutions, such as banks and credit card companies, to determine the likelihood of a borrower defaulting on a loan or credit card balance.

Use of Non-linear regression technique in risk management: Non-linear regression is a statistical technique used to model complex relationships between variables. In the context of risk management in financial markets, non-linear regression can be a useful tool for predicting and managing risk. One way that non-linear regression can be used in risk management is to model the relationship between various market factors and portfolio returns. By analysing historical data, non-linear regression can help identify the specific factors that are most strongly correlated with portfolio returns, and can be used to create models that predict how changes in those factors will affect future returns.

Another way that non-linear regression can be used in risk management is to model the behaviour of individual assets or securities. By analysing historical price data and other market factors, non-linear regression can be used to identify patterns or trends that may indicate future price movements. This information can then be used to manage risk by adjusting portfolio holdings or taking other measures to mitigate potential losses. Overall, non-linear regression is a powerful tool for risk management in financial markets, allowing investors and traders to identify and predict potential risks and take steps to minimise them.

Portfolio Segmentation: Portfolio segmentation is the process of dividing a company's investment portfolio into different segments or categories based on specific criteria. This process allows companies to better understand the performance of their investments and to make strategic decisions about future investments. There are several ways to segment a portfolio. Asset Class Segmentation involves dividing a portfolio into different asset classes, such as equities, fixed income, commodities, and alternative investments. This segmentation allows investors to diversify their portfolio and balance their exposure to different types of risks and returns. Another important segmentation method is Geographical Segmentation. This involves dividing a portfolio based on the geographic location of the investments. For example, an investor may segment their portfolio into North American, European, or Asian investments. This allows investors to diversify their exposure to different economies and geopolitical risks. Industry Segmentation involves dividing a portfolio based on the industry sectors in which the investments are located, such as technology, healthcare, or energy. This allows investors to identify potential opportunities and risks within specific sectors and adjust the portfolio accordingly.

There can be Market Capitalization Segmentation that involves dividing a portfolio based on the market capitalization of the investments, such as large-cap, mid-cap, or small-cap stocks. This allows investors to balance their exposure to different market segments and diversify risk. Risk Profile Segmentation involves dividing a portfolio based on the risk profile of the investments, such as conservative, moderate, or aggressive. This allows investors to tailor their

portfolio to their risk tolerance and investment goals. Investment Style Segmentation involves dividing a portfolio based on the investment style of the investments, such as value, growth, or income. This allows investors to target specific investment styles that align with their investment objectives. Overall, portfolio segmentation is a useful tool for investors to better understand the composition of their portfolio and make more informed investment decisions.

Variable clustering: Variable clustering is a statistical technique used to group similar variables together based on their correlations or associations. The goal of variable clustering is to simplify complex data sets and identify underlying patterns or relationships among variables. In variable clustering, a set of variables is analysed using statistical methods to determine which variables are most similar or closely related. These variables are then grouped together into clusters or subgroups based on their similarities. The resulting clusters can be used to identify trends or patterns in the data and to make more informed decisions. Variable clustering can be applied to various fields, including marketing, finance, and healthcare.

In marketing, variable clustering can be used to segment customers into groups based on their buying behaviour or preferences. In finance, variable clustering can be used to identify relationships between different financial variables, such as interest rates and stock prices. In healthcare, variable clustering can be used to identify patient subgroups based on their medical history or clinical characteristics. Overall, variable clustering is a powerful tool for analysing complex data sets and identifying underlying relationships among variables. It can help to simplify data analysis, improve decision-making, and provide insights into complex phenomena.

Conclusion: Financial institutions such as banks and investment firms have regulatory requirements for risk management, including stress testing and capital adequacy requirements. These methods are adopted by the financial sectors to protect assets from potential loss, to mitigate these potential risks for better future planning and avoid any financial ruin which could lead to significant losses. So, risk management has become an integral part of the banking sector thereby making it an essential step for any institutions trying to make a financial decision.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