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INDIA'S HEALTHCARE SECTOR: A STUDY USING OLS MODEL

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ABSTRACT

The pandemic has accentuated the relevance of the healthcare sector and its interplay with other vital sectors of the Indian economy. It has showcased how a healthcare crisis can get transformed into an economic and social crisis. It implies, a well-equipped and advanced healthcare sector is a need of the hour, but this comes at a great expense. Life expectancy and infant mortality rate are significant indicators of human development and critical health outcomes. They are influenced by a range of socioeconomic and demographic factors, especially expenditure on healthcare. Therefore, a big question is how India's healthcare expenditure has impacted the country's infant mortality rate and life expectancy? This paper intends to administer OLS (Ordinary Least Squares) method on quantitative secondary data collected from various databases to derive two linear regression models. These models aid to quantify the effect of HEPC (healthcare expenditure per capita) in current US$ on LEAB (life expectancy at birth) in years and IMR below five years (infant mortality rate below five years) per 1000 live births between the years 2005 and 2017. The results obtained from the study meet the empirical evidence, that is, increased health expenditure lowers infant mortality rate and increases life expectancy. A strong correlation between the variables persists at a 5% level of significance. Concisely, an increase of US$ 1 in HEPC increases LEAB by 0.119782 years and reduces the IMR below five years by 0.9094 per 1000 live births.

Keywords- Healthcare expenditure, Infant mortality rate, Life expectancy, Regression

1. Introduction

1.1 Healthcare sector is an integral part of economy

Economic development is no longer confined to a process of persistent increase in per capita income. Other dimensions are now considered central aspects of this process; the most notable are improvements in the health sector. Health forms the basis for the socio-economic development of any economy. After all, the great Mohandas K. Gandhi once quoted, "It is health that is real wealth and not pieces of gold and silver." Living longer and having healthier living

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conditions has become a need of the hour for people. Healthier and hygienic surroundings contribute to better employee performance which in turn leads to higher productivity. As empirical evidence suggests, an advanced healthcare sector has considerable positive implications on economic growth, fertility behaviour and human capital investment. Therefore, analysing the healthcare sector of India becomes imperative to analyse societal development in India. India's healthcare system has witnessed an increase in HEPC (healthcare expenditure per capita) in current US$ over the last 15 years, which, in turn, has had a significant impact on certain key factors which are used as general indicators of national development. LEAB (life expectancy at birth) in years and IMR below five years (infant mortality rate below five years) per 1000 live births are two such vital factors. LEAB refers to the expected number of years a child is expected to live at the time of his/her birth. On the other hand, IMR below five years per 1000 live births refers to the number of infants per 1000 live births who die before the age of 5 due to some reason.

2. Literature Review

2.1 Insights from studies

Many studies examining the effect of spending on healthcare on life expectancy and infant mortality rate can be sighted. One example is the cross-country study of 22 developing countries by Anand and Ravallion (1993), which documents that expenditure on healthcare, essentially, matters for LEAB. The argument on the role of private and public health expenditure on infant mortality rate along the development process has important policy implications that matter to both government and concerned world organisations for the appropriate design of their health programs to reduce infant mortality rates in particular. Giving the importance of this argument, the fact that it has not been examined empirically creates a severe gap in the literature with an urgent need to fill it. Another significant motive for writing this paper is based on the fact that imprecise and misleading conclusions on the impact of healthcare expenditure on infant mortality might be drawn from studies that ignore the above argument. Life expectancy is an essential health outcome. Its extension is of great interest both to medical research and policy-making since it speaks about the performance of a healthcare system. Consequently, identifying and correlating different factors that influence life expectancy in different contexts has been the subject of numerous empirical studies. (Yavari and; Mehrnoosh, 2006) show that there is a strong positive correlation between life expectancy and per capita income and health expenditures. In addition, the Economic Survey of India 2020-21 also highlights a strong influence of increasing HEPC on LEAB. Prioritising healthcare in the central and state budgets is a need of the hour. It significantly affects how much health safety citizens get against financial hardships due to (OOP) out-of-pocket payments made for healthcare (WHO 2010). OOP payments made for health increases the chances of lower-middle-income groups slipping into

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poverty because of high health expenditures (O'Donnell et al., 2007; Berki 1986; van Doorslaer et al. 2006).

3. Data and Methods

3.1 About the statistical tool

The purpose of this paper is to carry out an intensive study of the impact of HEPC (in current US$) on LEAB (in years) and the mortality rate of infants below five years (per 1000 live births). The primary motive is to analyse how India's healthcare sector and the living conditions of people have improved between the years 2005 and 2017. In this scenario, HEPC refers to the expenditure incurred by the Indian government for an individual's good health (in current US$). We use simple linear regression as one of the main statistical methods to estimate the influence of explanatory or independent variable (HEPC) on dependent variables (LEAB) and (IMR below five years). The regression is carried out using GRETL's Ordinary Least Square (OLS) method. OLS is widely used to estimate the unknown parameter of a linear regression model as they are considered the best linear unbiased estimators. The objective of the OLS method is the minimisation of the difference between given values and predicted values. However, the classical linear regression model makes certain assumptions that need comprehension before performing regression:1) The regression model is linear in parameter; it may or may not be linear in the variables.2) The explanatory variable is stochastic and uncorrelated with the error term.3) Given the value of an explanatory variable, the mean value of the error term is zero.4) The variance of each error term is constant or homoscedastic.5) There is no autocorrelation, i.e. the correlation between two error terms is zero. 6) The regression model is correctly specified. 7) Error terms should be normally distributed.The data for LEAB (in years), HEPC (in current US$) and IMR below five years (per 1000 live births) have been obtained from the World Bank's Development Indicators.

4. Issues of Study

4.1 Major challenges of paper

A significant challenge with the healthcare system is its rigidity, as far as adjusting with the force of free markets is concerned. This rigidity arises due to specific inherent characteristics. These are as follows:

1) Demand uncertainty**:** The demand for healthcare services is driven by factors that are uncertain or not easy to predict. In addition, emergency health services have inelastic demand. In such uncertainty, the pooling of healthcare expenditures via health insurance can reduce risk at the macroeconomic level.

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2) Asymmetric information**:** In healthcare markets, Arrow (1963) explained that buyers of information (patients) are not aware of the value of the information until after it is bought and sometimes never. Therefore, for such services, low-quality providers must reduce their price to be competitive. In contrast, patients who must undergo an intricate surgery may find it very tough to evaluate its quality and therefore rely on the prestige of the hospital or doctor as a substitute for the quality. Therefore, as Akerl of (1970) states, when less information is available on the quality of a product before purchase, and the quality of the product is unpredictable, quality falls to the lowest level in an unregulated market. While reputation can partially attenuate this market failure, the design of healthcare systems must account for this market failure, which can otherwise lead to loss of consumer faith and resultant under-investment in healthcare. Finally, the paper has an unwanted limitation as the conclusions are based on limited observations due to the non-availability of time series data for more recent years. Furthermore, including some additional explanatory variables like expenditure on sanitation facilities could provide more insight into the variables in question and therefore, such variables reserves an area for further study.

5. OLS Model and Graph

5.1 Formation of OLS Model

We form two separate linear regression models where HEPC (in current US$) is defined as the independent variable and IMR below five years (per 1000 live births) and LEAB (in years) are dependent variables. It implies the random population regression function of both models can be written as follows:

Model 1: $Y_1 = \beta_1 + \beta_2 X + \mu_1$

Where, Y_1 = LEAB (in years)

β_1 = Intercept term of model

$1\beta_2$ = Slope coefficient of X in model

1X = HEPC (in current US$)

μ_1 = Disturbance/Error term of model 1

Model 2: $Y_2 = \beta_1 + \beta_2 X + \mu_2$

Where,

Y_2 = IMR below five years (per 1000 live births)

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β_1 = Intercept term of model

$2\beta_2$ = Slope coefficient of X in model

2X = HEPC (in current US$)

μ_2 = Disturbance/Error term of model 2

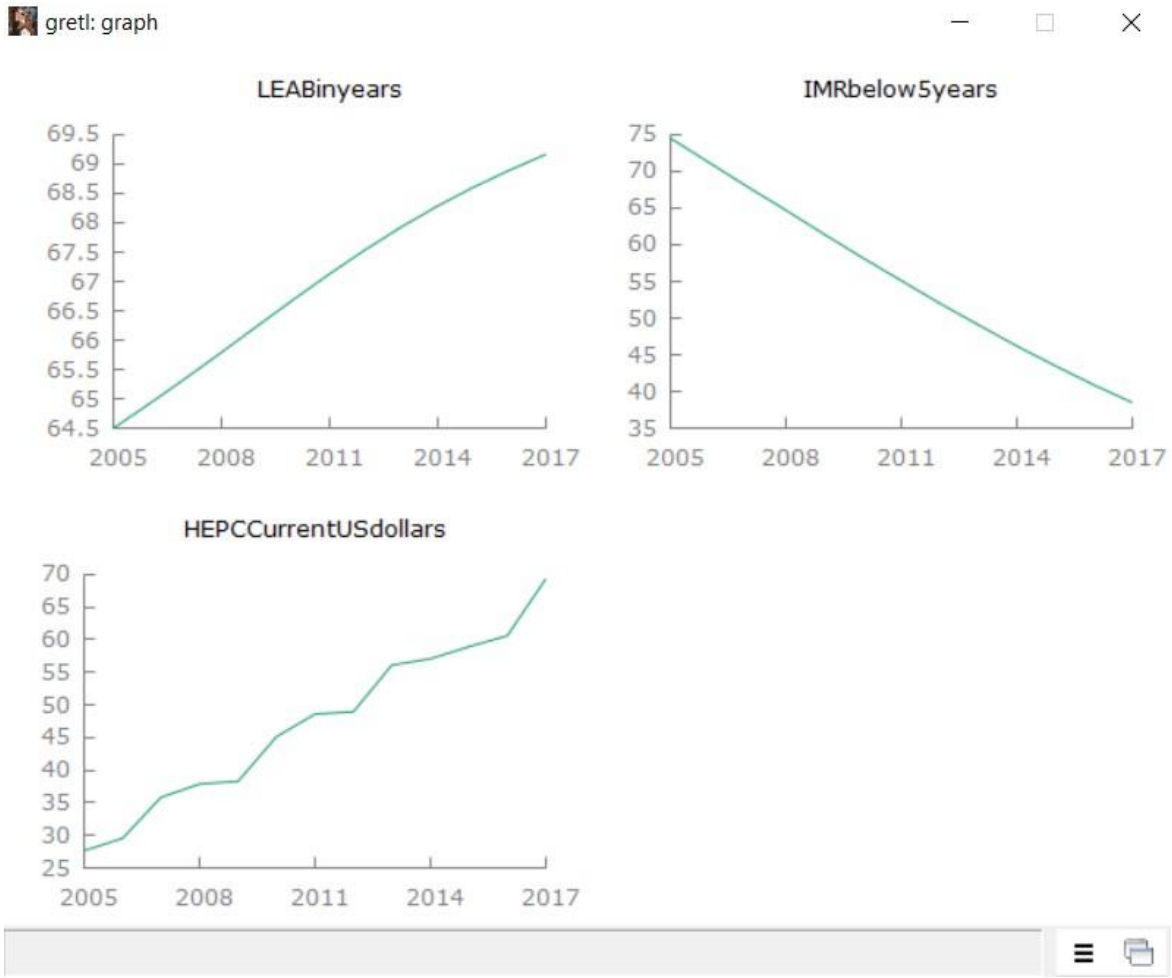

Figure 1: Time-series graphs of variables in play

Source: Computed from GRETL software

5.2 Elaborating the graph

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Figure 1 shows time-series graphs of the three variables .The X-axis portrays time (from 2005 to 2017), whereas the title of each graph also serves as the Y-axis label. The summary of the graphs can be stated as follows:

1) HEPC (in current US$) has been steadily increasing. In 2005, the HEPC was around US$ 27.5, whereas, in 2017, this number increased to approximately US$ 70. The data also experiences few troughs, but overall it is safe to say that HEPC of India has increased.

2) In relation with this, the LEAB (in years) has substantially increased and IMR below five years per 1000 live births has significantly reduced. From 64.5 years in 2005, the life expectancy of a child born in India has increased to more than 69 years in 2017. Similarly, the mortality rate, which was slightly lower than 75 per 1000 live births, has reduced to approximately 40 per 1000 live births.

Hence, the above graphs validate our claim that HEPC has substantially impacted both infant mortality rate and life expectancy. The previous studies conducted in the same aspect also prove to be accurate as expenditure on healthcare significantly affects significant health factors.

6. Results

Table 1: Summary statistics of variables in play

Variables	Mean	Median	Standard Deviation	Minimum	Maximum
LEAB(in years)	67	67.13	1.558	64.50	69.17
IMR below five years per 1000 live births	55.63	55.10	11.81	38.50	74.5
HEPC(in current US$)	47.23	48.60	12.84	27.67	69.32

Source: Computed from GRETL software

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Table 2: Combined results of Model 1 and Model 2

Dependent Variables	R-Squared	Correlation with independent variable (r)	Intercept value(t ratio)	Slope Coefficient(t ratio)	Number of Observations Studied
LEAB(years)	0.97514	0.9874	61.3474(218.0)	0.119782(20.78)	13
IMR below five years per 1000 live births	0.97822	-0.9890	98.5814(49.37)	-0.9094(-22.23)	13

Source: Computed from GRETL software

6.1 Summarising the results

Table 1 portrays the summary statistics, mainly mean, minimum, standard deviation, maximum and median of HEPC, LEAB and IMR below five years. On the other hand, Table 2 showcases the results ofthe two simple linear regression models derived using the Ordinary Least Squares (OLS) method. Model 1 studies the impact of HEPC (HEPC) on LEAB (LEAB), whereas Model 2 analyses the effect of (HEPC) on IMR below five years (IMR below five years) per 1000 live births. Since the intercept term and slope coefficient have t ratios greater than one, their corresponding values are statistically significant. A significance level of 5% is taken for both the regressions. In other words, there is only a 5% risk of concluding that the null hypothesis must be rejected. 'r' shown in table 2 portrays the correlation between the (HEPC) and (LEAB), and (HEPC) and (IMR below five years). Both (LEAB) and (IMR below five years) are positively and negatively correlated with (HEPC) respectively, as empirical evidence suggests. R-squared of 0.97514 between (LEAB) and (HEPC) indicates that 97.514% of the variation in (LEAB) is explained by (HEPC). On the other hand, an R-squared value of 0.97822 between (HEPC) and (IMR below five years) signifies that 97.822% of the variation in (IMR below five years) is explained by (HEPC). As for the slope coefficient, it implies that an increase of US$ 1 in

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(HEPC) increases the (LEAB) by 0.119782 years. Similarly, when (HEPC) increases by US$ 1, then it leads to a decrease in (IMR below five years) by 0.9094 per 1000 live births. The intercept value of 61.3474 indicates that when (HEPC) is fixed at zero, then the (LEAB) is 61.3474 years. Likewise, the intercept term of 98.5814 signifies that (IMR below five years) is 98.5814 per 1000 live births when (HEPC) is fixed at zero.

7. Conclusion

As stated before, this paper intended to study the impact of HEPC (in current US$) on LEAB (in years) and IMR below five years (per 1000 live births). The results obtained are in agreement with the empirical results. Increasing HEPC by the Indian government has aided in improving the LEAB and IMR below five years.

Precisely, an increase in US$ 1 of HEPC has improved the LEAB in India by approximately 0.12 years. Likewise, an increase of US$ 1 in health expenditure has resulted in a contraction in the infant mortality rate by approximately 1 per 1000 live births. Hence, it is clear that rising expenditure on healthcare is an effective tool for improving the living conditions of Indians.

8. Acknowledgement

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