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Modelling the Impact of Health on Economic Growth: Revisiting The Concept of the Preston Curve

KEYWORDS: Life Expectancy, Gross Domestic Product, Preston Curve, Auto Regressive Distributed Lag Model (ARDL), Wald Test

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ABSTRACT *This paper illustrates the impact of Life Expectancy on Economic Growth rates between the years 1965 to 2012 in India. This is a very significant topic of research because the economic ability and performance of nations could be enhanced by improving the health of its citizens. Previous studies have proven that the wealth of a country is highly dependent on the life expectancy of its inhabitants. The Preston Analysis forms the theoretical construct of the study. The relationship between Life Expectancy and Economic Growth is empirically tested in the paper, in addition to proving the validity of the Preston Curve in the Indian context. A quantitative study is undertaken using secondary statistics. After testing for stationarity, using the Augmented Dicky-Fuller test and Phillips-Perron Test the long-run relationship between Life Expectancy and Economic Growth has been analysed by using the Auto Regressive Distributed Lag model. It has been concluded that there is indeed a strong long-run relationship between Life Expectancy and Economic Growth and the empirical results have proven that a 1 per cent increase in Life Expectancy led to a 14 per cent increase in Economic Growth.*

Introduction:

It's a bitter reality that we live in a world that is growing closer all the time, hunger, under nutrition, and abject poverty is still rife. The poorest of the poor lack an influentially sufficient voice, in order to make their fundamental concerns to be heard. It's therefore essential that knowledge, political will, and action be brought together in the fight against these Health issues in our society, in order to build a Health Regime or a system that is strong enough to fight against all the problems mentioned above. In fact, a strong health system is a prerequisite for the growth of any economy. As Jonathan Miller (1978) aptly said, "Of all the objects in the world, the human body has a peculiar status: it is not only possessed by the person who has it, it also possesses and constitutes him. We can lose money, books and even houses and still remain recognizably ourselves, but it is hard to give any intelligible sense to the idea of a disembodied person".

While many achievements have been made in alleviating health issues worldwide, we still fall very far short of having a health system that could satisfy the needs of the poorest of the poor classes in the society. However, it is very important to note that Health systems are highly complex and are very hard to implement because the demands are very high and the resources needed to fulfil those demands are very low. It is indeed clear that Health is a very important component of an individual's welfare and standard of living. Anything that poses a threat to a person's health might lead to severe fallacies in his capabilities and habitual behaviour. Thus, a lot of significance can be attached to heath has a determinant of one's welfare and well-being. The 20th Century has seen very substantial gains in terms of health. Results have also shown that better health boosts utility and productivity in human beings, thus there is a strong need for Research and Development in the realm of Healthcare Economics.

Thus, Health has a special market for itself and the provision of healthcare demands a large involvement of governmental action as well. But developing countries like India have a limited public budget and the sectors in need of attention is also more. This leads to a general condition where governments tend to concentrate on spending that lead to economic growth because of the general perception that healthcare spending delays productive investments and hampers economic growth. The late twentieth century has witnessed remarkable gains in health. Governmental and Non-Governmental organizations have contributed heavily to this,

and thanks to factors like nutrition, sanitation, Innovations in Medical care the average span of human life is gradually increasing.

Samuel Preston analyzed the cross-country data on life expectancy and national incomes for the approximate periods- 1990, 1930 and 1960 respectively. It was observed by Preston that the curves showed an upward shift over time. For a given level of income, life expectancy was found to be highest in the year 1960. After studying the shifts in the curve to have multiple causes, Preston attributed about 15% of that to the gains in Life Expectancy to Income Growth, all though very little importance was given to attributed like Nutrition and Literacy. However, recent studies attach a lot of importance to these two attributes. Thus, the Preston Curve summarized that Higher Income Countries are found to be healthier than the Low Income Countries. This forms the theoretical basis of this study. It is however very clearly noted that good health leads to wealth. The direct relationship between health and income has been well documented, both nationally and internationally. But, these relationships have their own limitations where several other demographic and technological factors were found to influence the relationship respectively. Thus, it is very vital to understand the economic value of good health and the impact good health can have in a person's life.

Review of Literature:

The paper published by the World Health Organisation on Health and Economic Productivity (1999) discusses the emerging problems in Epidemics and infectious diseases.

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The paper throws light on the fact that there is a severe need to reduce the burden of excess mortality in morbidity in developing countries and thus come up with a strong system to counter attack the aforementioned problems. This paper takes into considerations experiences from the 20th century in order to explore the inadequately explored problem of the relationship between Health and Economic Productivity.

Preston (1975) undertook an empirical analysis in order to estimate the degree of impact of economic factors to increases in Life Expectancy during the twentieth century. The evidence consisted of cross-sectional relationships between Life expectancy in the national level and income per capita, in the national level as well. The motive of this analysis is to quantitatively assess the realism of certain economic/demographic factors.

Bhargava, Jamison, Lau & Murray (2001), examined the impact of health on economic growth using indicators such as Adult Survival Rates and Gross Domestic Product at 5 year intervals from the year 1965 to 1990 respectively. The authors made use of panel data in order to model the impact of health on economic growth, and the overall results proved the importance of Adult Survival Rates on the growth level in poor countries.

Bloom & Canning (2003) propagated through their paper that health is not only a consumption good and also plays a very important role in a person's wellbeing. Health is also an investment good that tends to increase the future productive power of individuals and the economy as well. The authors correlated income and health, taken across the world in 1990.

The researcher carried out a Cross-Country study where a relationship was established between measures such as age-adjusted all-cause mortality, infant mortality, death from cancer, homicide etc. The concept of "inequality" is well cited by the researcher who finally postulated that the richer countries tend to be "healthier" because of a considerably lower level of inequality.

Kunits (2007) published a commentary article on the Preston Curve Analysis. The impact of the Preston Curve in the 21st century is being studied here, and the difference in Health policies in difference nations is also noted. The author then throws light on the diffusion of health-promoting techniques propagated by Samuel Preston, in his seminal paper. This paper points out the fact that the policy implications of the Preston Analysis isn"t as profound as it could have been.

Schnabel & Eilers (2009) examined in their study the impact of life expectancy in income growth for individual countries. It was noticed that the wealth of a country had strong nonlinear influence on the life expectancy of its inhabitants. A statistical framework was developed to model the relationship between the individual variables, using the conceptual base of the Preston Curve respectively.

Objective:
To analyse the long run relationship between Life Expectancy and Economic Growth and to test the validity of the Preston Curve in the Indian Context from the year 1965 to 2012.

Hypothesis:
H0: There is no long run relationship between Life Expectancy and Gross Domestic Product. H1: There exists a long run relationship between Life Expectancy and Gross Domestic Product.

Methodology:
The study is based on secondary data. The data has been collected from World Development Indicators (WDI) – The primary Data Pool of the World Bank. Time period of the study is 1965-2012. In this analysis Health is measured in terms of Life Expectancy and Economic Growth is measured in terms of Gross Domestic Product (GDP).

Model Specification
The ARDL model testing procedure starts with conducting the bound test for the null hypothesis of no Co-integration. The calculated F-statistic is compared with the critical value tabulated by Pesaran (1997) or Pesaran et. al. (2001). If the test statistics exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of whether the underplaying order of integration of the variables is zero or one. Similarly, if the test statistic falls below a lower critical value, the null hypothesis is not rejected. However, if the test statistic falls between these two bounds, the result is inclusive. The ARDL methods estimates $(p+1)^k$ number of regression in order to obtain optimal lag length for each variable, where p is the maximum number of lag to be used and k is the number of variables in equation.

The main limitation of the study is that there are several other factors affecting the impact of Life Expectancy on Economic Growth. These factors are not considered in this analysis.

Empirical Results:
The analysis of order of integration is important to apply the cointegration analysis. Thus, the present section entails to search out the existence of regular unit-roots. Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) have been utilized to test the presence of regular unit root.

Table 1: Testing Unit-Root Using Augmented Dickey-Fuller Test

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Variables	Level			First Difference			Decision about Order of Integration
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None	
Le(gdp)	-3.57 (1.00)	-0.92 (1.00)	13.26 (0.99)	-6.70*** (0.00)	-8.06*** (0.000)	-0.73 (0.39)	I(1)
Le(LE)	-2.54 (0.11)	-2.46*** (0.007)	1.35 (0.94)	-2.29 (0.17)	-2.23 (0.45)	-2.05 (0.03)**	I(0)

*** - 1% level of significance
**-5% level of significance

Table 2: Testing Unit-Root Using Philips- Perron Test

Variables	Level			First Difference			Decision about Order of Integration
	Intercept	Trend and Intercept	None	Intercept	Trend and intercept	None	
Le(gdp)	3.54 (1.00)	-0.84 (0.95)	13.05 (1.00)	-6.79 (0.00)***	-8.11 (0.00)	-1.19 (0.04)**	I(1)
Le(LE)	-6.66 (0.00)***	-4.26 (0.007)***	5.67 (1.00)	-2.01 (0.27)	-1.43 (0.83)	-3.11 (0.002)***	I(0)

***- 1% level of significance **-5% level of significance *-10% level of significance

Since out both the unit root tests are showing the GDP is I(1) and life expectancy is I(0), the study selects ARDL model for analysis purpose.

Relationship between GDP and Life Expectancy
ARDL is usually preceded by a test of optimal lag length due to the estimated results are affected by the number of lag included. So, we must determine the maximum lag length before estimating the model. After analysing the unit root, the next step is to search the optimum lag-

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length. The optimum lag length may be observed using the SBC and AIC criterion; under this method SBC and AIC values of Vector Autoregressive (VAR) model estimated for various combinations of lag length are used. Table 3 provides SBC and AIC values of these models. As quoted in the econometrics literature that the lag-length corresponding to minimum SBC and AIC values is the optimum lag-length, we go with 4 lag length.

Table 3: Lag Length Selection for Cointegration Analyses Using VAR

Lag	LogL	LR	FPE	AIC	SC	HQ
0	72.80897	NA	0.000108	-3.454096	-3.370507	-3.423657
1	312.6962	444.6690	1.09e-09	-14.96079	-14.71002	-14.86947
2	361.9107	86.42547	1.20e-10	-17.16638	-16.74843	-17.01418
3	389.6193	45.95574	3.81e-11	-18.32289	-17.73777	-18.10982
4	397.1883	11.81505*	3.22e-11*	-18.49699*	-17.74469*	-18.22305*
5	400.9621	5.522618	3.30e-11	-18.48596	-17.56648	-18.15113
6	401.9036	1.285972	3.90e-11	-18.33676	-17.25011	-17.94106
7	403.1695	1.605443	4.57e-11	-18.20339	-16.94956	-17.74681
8	405.6370	2.8887765	11e-11	-18.12863	-16.70762	-17.61118

*** indicates lag order selected by the criterion**
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error

AIC: Akaike information criterion SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion
Before applying the ARDL test, the use of bound test is mandatory to check whether there exists long-run relationship among the variables under consideration or not. Table 4 provides the F-Statistics obtained; F statistics observed to be greater than upper bound values 5 percent level of significance. There is a long run relationship between Life Expectancy and Gross Domestic Product.

Table 4: ARDL Bounds Test

Equation	F statistics	
GDP as dependent	5.69*	
Critical Value Bounds	I(0)	I(1)
10%	4.05	4.49
5%	4.68	5.15
1%	6.10	6.73

Source: Pesaran(2001) for F-statistic

The long run relationship can be illustrated with the help of this equation,

GDP = (-1.33) + 14.18LE

Thus, a one per cent increases in Life Expectancy leads to a 14 per cent increase in Gross Domestic Product. Or, we can attribute 14% of the gains in Income levels to Life Expectancy.

Conclusion:
This paper analysed the impact of Health on Economic Growth using Life Expectancy and Gross Domestic Product as operational variables. It has been empirically proven that there exists a long run relationship between the two variables, suggesting that the economies that progress towards a higher income path tend to be healthier. The long run relationship also suggested that as Life Expectancy increases, Gross Domestic Product increases. This proves the validity of the Preston Curve in the Indian context, to recall Preston attributed a 15 per cent change in Income levels to Life Expectancy, keeping other influencing factors constant. It is rather important to note that there are several other Health Indicators that play a very

important role in determining Income levels of a nation. Like - Infant Mortality Rates, Fertility Rates, Population growth rates etc which is not included in this model. The Preston Curve successfully answers the question "Do healthier countries remain wealthier?" Thus, people born in wealthier countries tend to live longer than the ones born in poor countries. However, the test results have successfully proven the fact that the Indian subcontinent does react well to the Preston Analysis, where there is a strong relationship between health and wealth in the long run.

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