Environmental Hazards and Life Expectancy in India: Evidence from GARCH Model

Kanishka 232pge007

Abstract

This paper investigates how the environmental hazards affects the life expectancy in India from 1990-2020.which factors determining the life expectancy and how they are affecting. This study adopted autoregressive conditional heteroscedastic(GARCH) model for estimating the year's observation. Observations. after the findings there is a need for government of India to adopt a policy which is stable and regulate the excessive c02 emissions from different factors.

Keywords

Air quality, carbon dioxide, environmental hazards, India, life expectancy, socio economic factors

Introduction

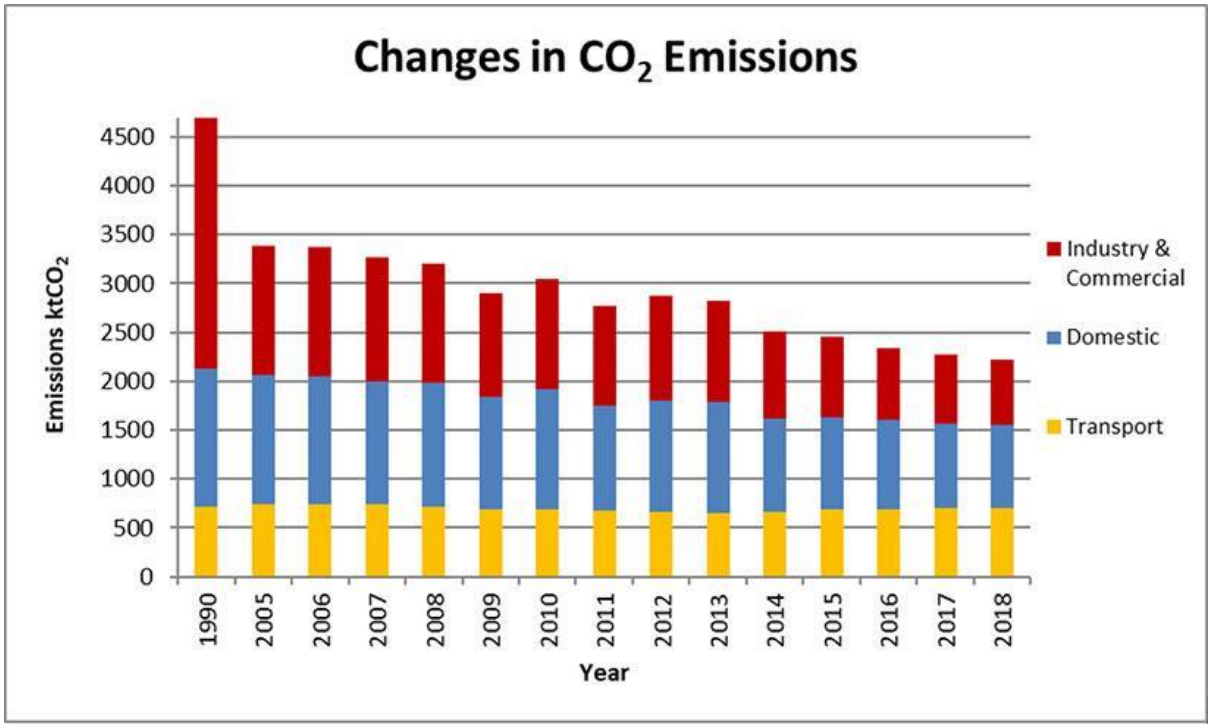
India stands at 132 in the human development index and income performance of 190 countries. The human development index tracking the global decline in human development. A large contribution to HDI is sharp decline in life expectancy from 72.8 years in 2019 and 71 years in 2021. Life expectancy is the average number of years a person born which can expect to live.

Some of the factors that affect the life expectancy are infant mortality rate, fertility rate, lifestyle, communicable and non-communicable disease.

Fig1 shows the change in co2 emissions in world from 1990-2018.that there is increase in life expectancy since 1990 to 70.8 and decline in infectious diseases.

A study from lance journal suggested that ‘healthy life expectancy’ rates in country has not witnessed ink in life expectancy as people more

Fig1



source- world bank

Life expectancy varies based on local conditions, being lower in less-developed countries due to high child mortality rates. In some cases, life expectancy at birth is lower than at age , often due to infectious diseases or inadequate access to clean water.

Nevertheless, environmental hazards within the context of this study can be seen as an atmospheric waste which poses threats to the health and well-being of the population within a geographical location and environmental factors . Therefore, this study shows environmental hazards basically as CO2 emissions which can be further change into CO2 emissions from solid fuel consumption and CO2 emissions from liquid fuel consumption and hazardous substances. However, CO2 emissions are those originate from the burning of fossil fuels and the manufacture of cement which include CO2 produced during consumption of solid, liquid, and gas fuels and gas production.

literature review

An article on national-level analysis of life expectancy associated with the COVID-19 pandemic in India

Published by **frontiers** explains how the covid effected the life expectancy in India and shows total of 344599 died and their corresponding life expectancy was calculated. The conclusion of this article is Overall, it was estimated that COVID-19 has an impact on life expectancy by 0.12 years during the study period. Even though mortality due to COVID-19 was high, factors such as lockdown, vaccination, and accidents also had an influence on mortality. Thus, there is a need to assess the impact of COVID-19 on life expectancy in future.

Trends in inequality in length of life in India: a decomposition analysis by age and causes of death published **by Genus** in July 2017

Their objective of doing the paper is to find the cause of death to the inequality in life of length. they have studied the data for 15 states of India and decompose the inequality in length of life contribution age and death causes. this is the first study which was done on compelling study on inequality in length of life and in major states of India. the existing studies on life expectancy in India mostly discuss the differences in life expectancy across groups, for example, by sex or gender, rural-urban residence, and between states (**James and Syamala 2010; Saikia et al. 2011; Sauvaget et al. 2011**). A few studies have also published to decompose the changes in life expectancy into the contribution of mortality change in different age groups and different sectors.The decomposition results reveal that recent improvements in life expectancy in India are mainly due to mortality changes at the younger ages (Saikia et al. 2011; Singh and Ram 2003; Singh and Ladusingh 2010).

They have used the data from **GBD** (global burden of disease) GBD data is collected and analysed by a consortium of more than 1000 researchers in over 100 countries. The GBD data captures premature death and disability from more than 300 diseases and injuries in 188 countries, by age and sex, from 1990 to the present, allowing comparisons over time, across age groups

LE				G_0*100				
1981	**1991**	**2001**	**2011**	**1981**	**1991**	**2001**	**2011**	
North								
Punjab	62.52	63.75	68.41	69.62	23.21	21.39	21.92	20.16
Haryana	59.66	62.36	65.57	67.34	28.1	22.62	23.77	21.04
Rajasthan	53.05	60.55	67.16	71.67	28.09	28.12	28.39	25.4
Central								
Uttar Pradesh	50.81	57.28	63.49	65.65	32.43	26.32	27.79	23.83
Madhya Pradesh	49.43	54.58	58.76	62.66	31.9	27.35	24.09	20.87
North East								
Assam	52.93	55.41	57.76	62.23	27.17	24.58	22.75	19.92
East								
West Bengal	55.21	61.01	64.76	68.73	23.73	21.63	19.6	17.11
Odisha	52.24	54.77	59.2	63.78	30.42	27.69	24.13	20.71
Bihar	56.5	60.05	64.88	68.87	25.75	24.1	22.62	20.17
West								
Gujarat	53.93	59.95	63.81	66.32	28.1	21.94	21.26	19.29
Maharashtra	59.24	63.38	65.19	69.55	22.72	20.13	19.48	16.91
South								
Andhra Pradesh	55.41	59.38	62.38	65.37	24.65	21.74	21.05	18.61
Karnataka	59.36	60.47	63.02	66.67	23.21	22.06	21.46	18.13
Kerala	64.52	68.04	70.23	71.61	18.4	15.47	14.8	14.79
Tamil Nadu	55.83	61.06	65.47	71.98	26.05	20.12	18.99	16.46
India	50.76	59.31	62.86	66.29	32.47	23.48	22.09	19.3

They have found after their study that India's Life Expectancy Inches Up 2 Years to 69.7

One article published by the economics time of India. They have evaluated that India 'life expectancy inclined 69.7 from 2015-18 and forecast how the avg global life expectancy is calculated. It almost takes ten years to add two-year Life expectancy. They have found that life expectancy at age one and at age five in this time suggests high infant and under-five mortality could be the reason India finds it difficult to raise life expectancy at birth faster.

Over a 45- year time period, India had added about 20 years to its life expectancy at birth from 49.7 in 1970-75 to 69.7 by 2015-19. Odisha has had the highest increase, of over 24 years, from 45.7 to 69.8 years followed by

Tamil Nadu, where it increased from 49.6 to 72.6. Uttar Pradesh had the second lowest life expectancy of 65.6 in 2015-19, after Chhattisgarh with just 65.3. However, from having the lowest life expectancy in India of just 43 years in 1970-75, it has increased by 22.6 years in Uttar Pradesh.

A cross-sectional multi-centric community based study of elderly population aged 60 years and above conducted jointly by the Government of India and WHO Country Office in India has revealed that diseases like hypertension, diabetes mellitus, ischaemic heart disease, poor vision, difficulty in hearing, anaemia, arthritis, fall/fractures, bowel complaints, urinary complaints, depression, weight loss, asthma, chronic obstructive pulmonary disease, TB etc. are common among older patients. Using panel vector auto regression (VAR) model with data.

Also in Nigeria, Matthew, Osabohien, Fagbeminiyi, and Fasina (2018) employed time series data ranging from 1985 to 2016 in estimating the long-run effect of emissions of greenhouse gas (GHG) on health outcomes while using autoregressive distribution lag (ARDL) approach. The study identified CO2 and fossil fuels combustion as the major causes of GHG emissions (GHGE) with human activities escalating the GHG to the atmosphere. The study result showed that a relative increase in GHGE leads to a decline in health outcome which invariably causes a significant increase in mortality rate to about 146.6%.

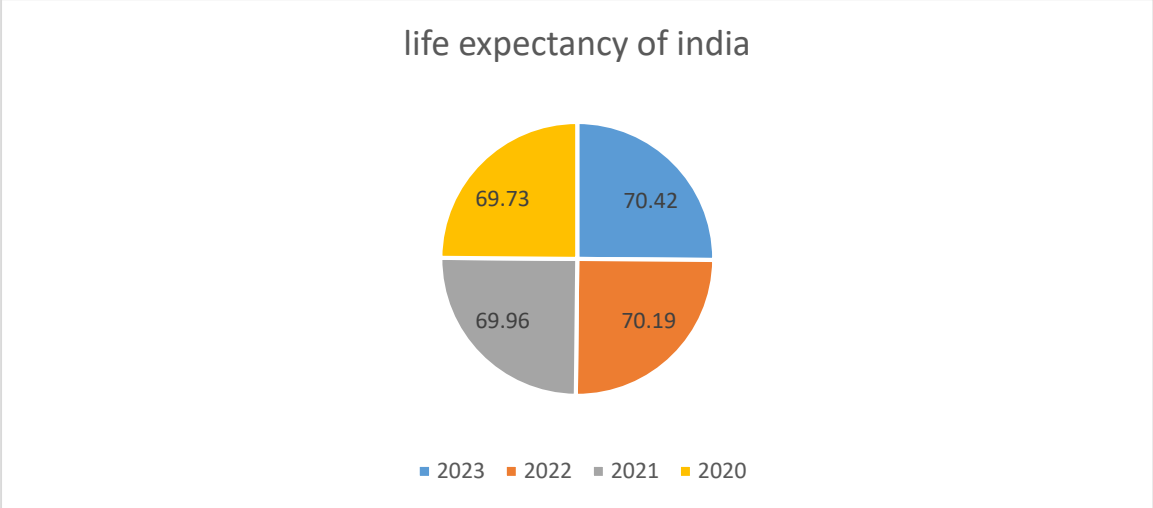
Impact of CO_2 emission on life expectancy in India: an autoregressive distributive lag (ARDL) bound test approach- sujoy das

In this study the conclusion is correlation between economic growth and emission necessities of both growth and environmental aspects. The concentration of co2 in atmosphere is increasing and becoming crucial for adoption of new policies and initiatives. Sudden reduction in emission is result of welfare implication.

DATA

- The current life expectancy for India in 2023 is **70.42** years, a 0.33% increase from 2022.
- The life expectancy for India in 2022 was **70.19** years, a 0.33% increase from 2021.
- The life expectancy for India in 2021 was **69.96** years, a 0.33% increase from 2020.

- The life expectancy for India in 2020 was 69.73 years, a 0.33% increase from 2019. Source- macro trend data



The current population of India in 2023 is **1,428,627,663**, a **0.81% increase** from 2022.The population of India in 2022 was **1,417,173,173**, a **0.68% increase** from 2021.The population of India in 2021 was **1,407,563,842**, a **0.8% increase** from 2020.The population of India in 2020 was **1,396,387,127**, a **0.96% increase** from 2019.

Healthcare expenditure

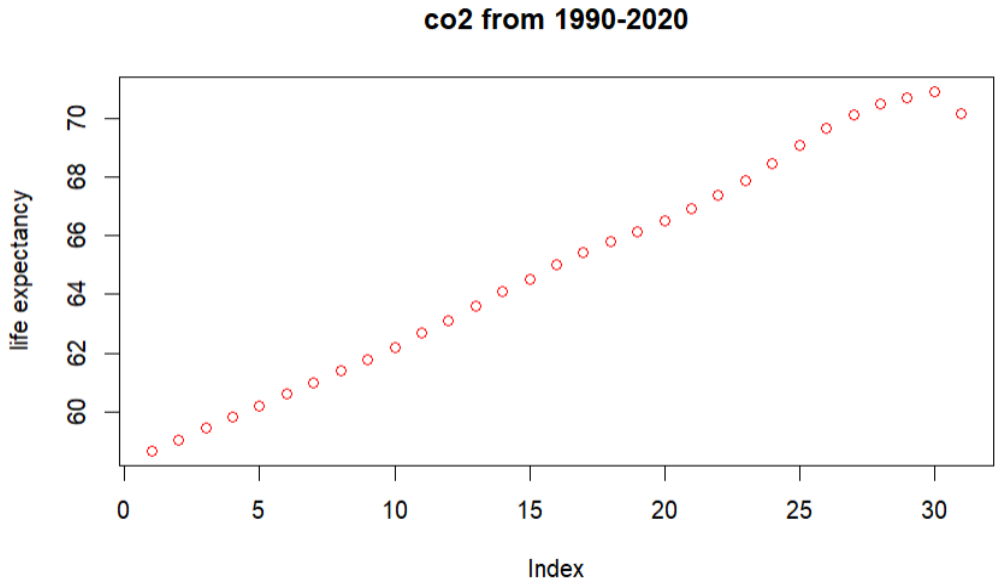
- India healthcare spending for 2020 was **$57**, a **6.66% decline** from 2019.
- India healthcare spending for 2019 was **$61**, a **5.14% increase** from 2018.
- India healthcare spending for 2018 was **$58**, a **1.42% increase** from 2017.
- India healthcare spending for 2017 was **$57**, a **5.11% decline** from 2016.
- As per the report titled SRS Based Life Table 2013-17 published by the Office of the Registrar General & Census Commissioner, Government of India, the average life expectancy at birth has increased from 49.7 during 1970-75 to 69.0 in 2013-17, registering an increase of 19.3 years during this period

Method

Garch model is generalized autoregressive conditional heteroscedasticity is a statistical model used in analysing time series data where the variance error is assumed to be correlated. This technique used to help the predict the volatility of returns. We are taking the data from world bank the life expectancy and co2 emission from 1990-2020 in India.

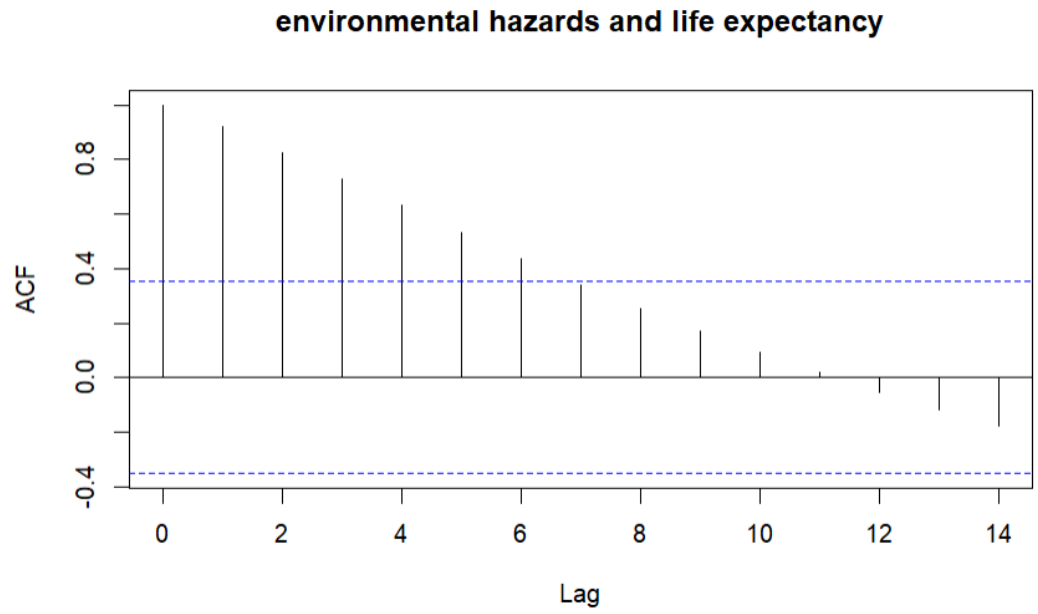
Empirical analytics and findings

The data mentioned the year from 1990-2020 and co2 emissions (metrics per ton) and life expectancy at birth.

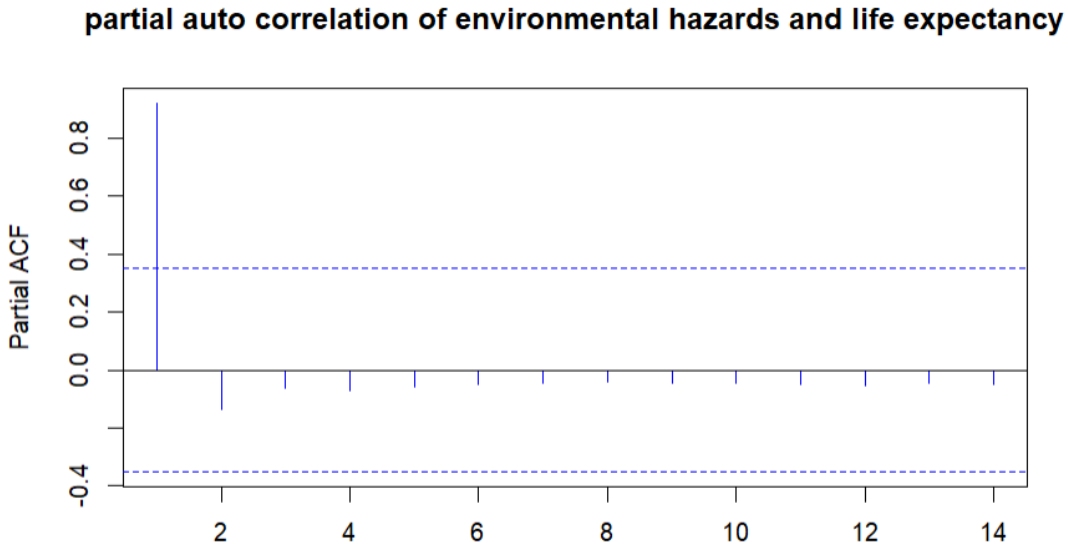


We can see that there is an increase in life expectancy from 1990 to 70.8 years owing many communicable and non-communicable disease. Life expectancy has improved by 8.68 years from 62.1 years in 2000 to 70.8 years in 2019.

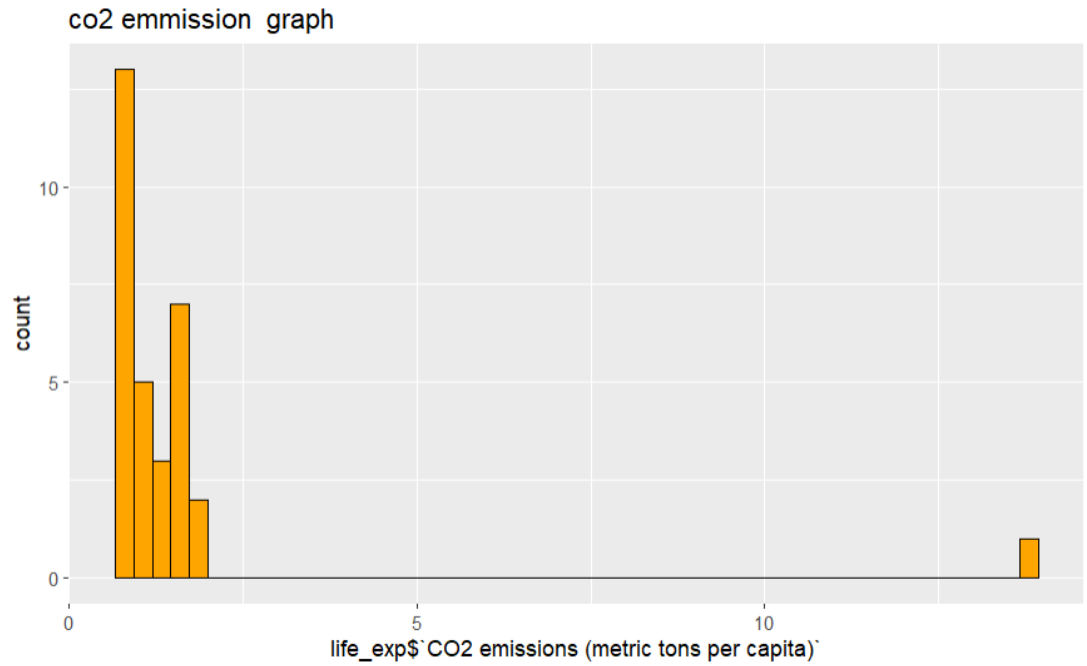
Acf plot for environmental hazards and life expectancy

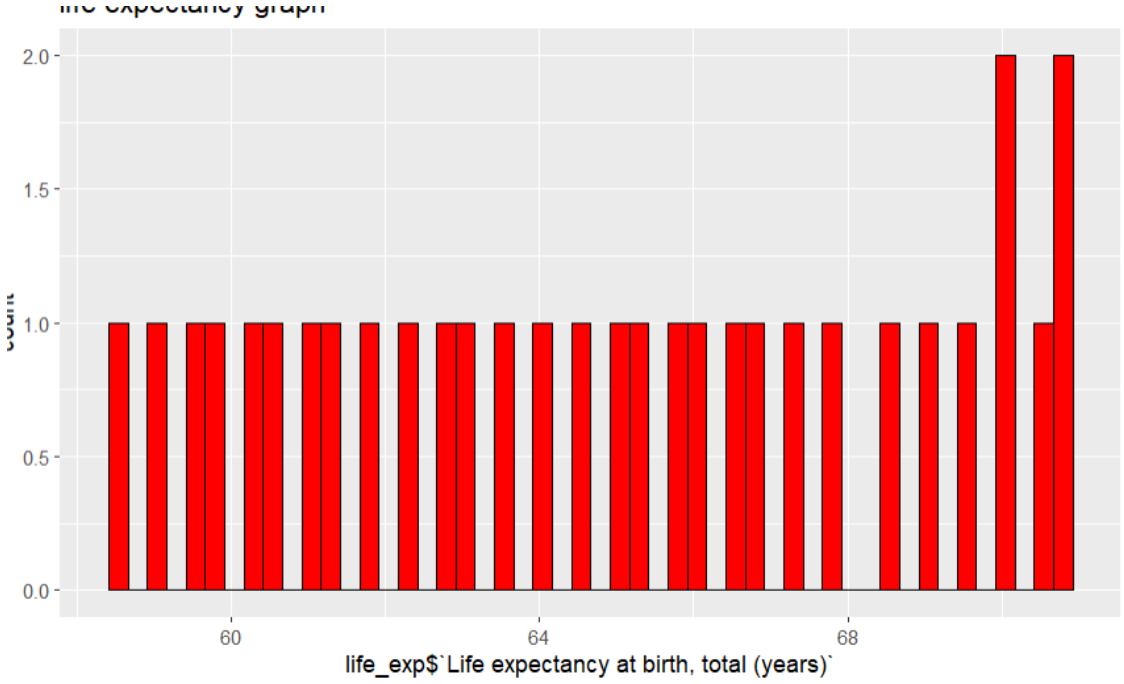


Partial acf plot



Plotting of co2 emission and life expectancy



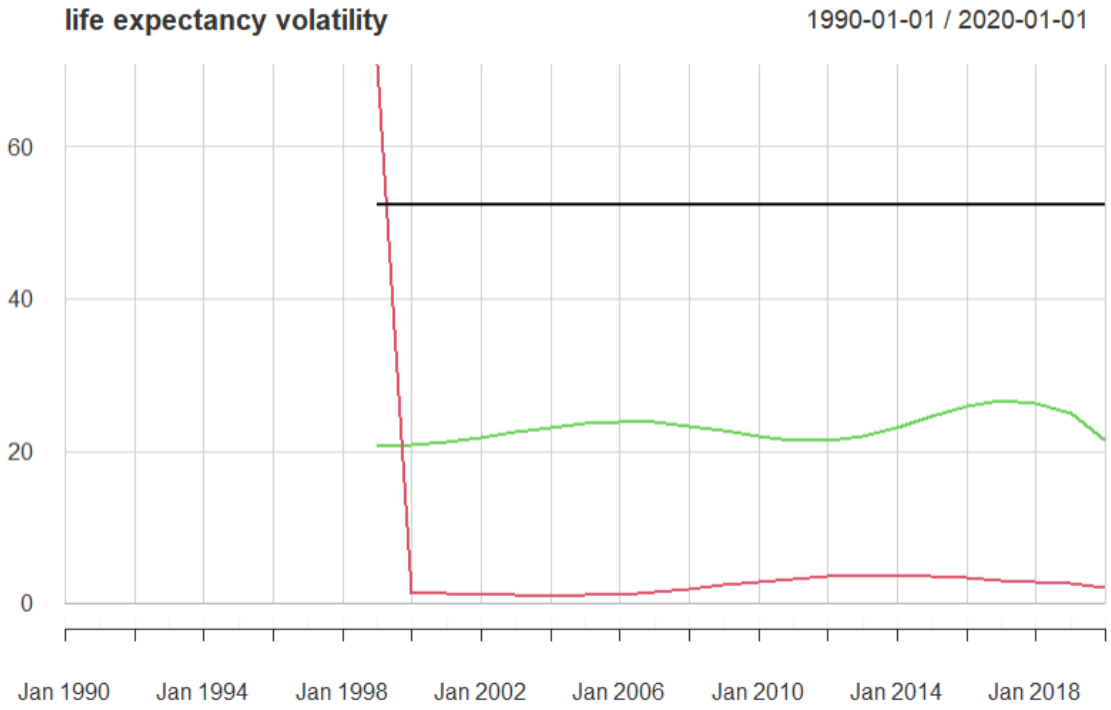


Garch model is believed to be extremely useful for modelling and forecasting assets return volatility over time.

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (1)$$

Where σ_t^2 is the conditional volatility, and ε_{t-1}^2 are squared unexpected returns for the previous period. ω would be positive always; and α and β would be non-negative (>=0). ε_{t-1}^2 are derived from a conditional mean equation that could be simple random walk model ($r_t = c + \varepsilon_t$), or AR (1) model ($r_t = c + \gamma * r_{t-1} + \varepsilon_t$), or any other ARMA model. But generally conditional mean equations are kept simple as it can cause convergence problems in GARCH estimation (Alexander, 2001). Where r_t is the returns from a financial series.

Here is the violatity of life expectancy in India



Garch model

	T value	Prob	
Sign bias	3.115870e+00	4.4343463-03	
Negative sign bias	3.854429e-01	7.030449e-01	
Positive sign bias	2.450790e+02	2.88133e-45	
Join effect	6.248020e+04	0.000000e+00	

Dynamics

```
Conditional Variance Dynamics
-----------------------------------
GARCH Model      : sGARCH(1,1)
Mean Model       : ARFIMA(1,0,1)
Distribution     : std
```

Optimal parameters

	Estimated value	T value	P value	Std error
Mu	4.178754	2.79074	0.005259	1.497362
Ar1	0.988428	186.2177	0.00000	0.005308
Ma1	0.002694	0.50969	0.610269	0.005285
omega	0.0074030	0.46924	0.638898	0.015776
Alpha 1	0.00000	0.00000	1.00000	0.000252
Beta1	0.50582	1.35605	0.175084	0.050582
Shape	0.774538	3.00846	0.002626	3.00846

Garch model forecasting for 10 years and its positive because its showing the 1 value. The volatility is high because the values is positively high.

```
*-----------------------------------*
*       GARCH Model Forecast        *
*-----------------------------------*
Model: sGARCH
Horizon: 10
Roll Steps: 0
Out of Sample: 0

0-roll forecast [T0=1970-02-01]:
     Series   Sigma
T+1   1.606 0.08915
T+2   1.635 0.08915
T+3   1.665 0.08915
T+4   1.694 0.08915
T+5   1.723 0.08915
T+6   1.751 0.08915
T+7   1.779 0.08915
T+8   1.807 0.08915
T+9   1.834 0.08915
T+10  1.862 0.08915
```

Weighted ljung box test on residuals

```
Weighted Ljung-Box Test on Standardized Residuals
------------------------------------
                        statistic p-value
Lag[1]                      1.407  0.2355
Lag[2*(p+q)+(p+q)-1][5]     1.418  0.9990
Lag[4*(p+q)+(p+q)-1][9]     1.432  0.9978
d.o.f=2
H0 : No serial correlation

Weighted Ljung-Box Test on Standardized Squared Residuals
------------------------------------
                        statistic p-value
Lag[1]                  6.048e-05  0.9938
Lag[2*(p+q)+(p+q)-1][5] 1.394e-03  1.0000
Lag[4*(p+q)+(p+q)-1][9] 6.138e-03  1.0000
d.o.f=2

Weighted ARCH LM Tests
------------------------------------
            Statistic Shape Scale P-Value
        - -
```

Pearson test

```
Adjusted Pearson Goodness-of-Fit Test:
------------------------------------
  group statistic p-value(g-1)
1    20     16.10       0.6508
2    30     26.10       0.6203
3    40     39.97       0.4270
4    50     44.81       0.6437

Elapsed time : 0.431715
```

RESULT

Fig 1 shows descriptive statistics or information on the individual variables in the model. Variables are carbon dioxide and life expectancy However, the mean value of the CO2, that is, carbon dioxide emission from liquid fuel consumption, is approx. 1.49with the median value of ppm; The standard deviation (SD) and the probability values are about 4.43 ppm and 7.73 ppm, respectively. The forecasting is showing that the life expectancy will be a positive slope based on carbon emission.

In summary, the influence of carbon dioxide (CO2) on life expectancy is fluctuated, with its direct and indirect effect. However, its connection to climate change introduces a problem of environmental challenges that significantly impact public health and well beings. The rise in CO2 levels contributes to global warming, leading to more frequent and hazardous, extreme weather events and threat disease and disease patterns, and the deterioration of air and water quality. These environmental threats have effect on respiratory health, the spread of diseases, and disruptions in food and water availability. Addressing the issues associated with CO2 emissions requires coordinated efforts on a global scale, emphasizing strategies to mitigate climate change, encourage sustainable practices, and enhance the resilience of vulnerable communities. Through the adoption of cleaner energy sources, improvements in air quality, and the implementation of climate-resilient measures, societies can work towards lessening the indirect consequences of CO2 on life expectancy and fostering a healthier and more sustainable future.

Policy and government interventions

After observing the data there should be a need of policy for better life expectancy. One government policy which was proposed is National health policy would be aiming to increase the life expectancy and reduce fertility rate and provide free medications. This policy promotes public health expenditure to 2.5 percent of gdp.

As developing country it's important for the factors that affect the standard of living and life expecting, health sectors. Government can increase the budgetary in the sector of health sector and take protocols for reduce environmental hazards. Such as c02 can be really serious health related issue on human and wellbeing's as well. It can be death causing disease sometimes.

Well function environmental agency or department can track the disruptions and their outcome affecting the well beings. After covid things like can happen in future so there should be adequate supply of medicines.

Health system preparedness system, ayushman Baharat Pradhan mantra Jan arogya yojna launched in 23 September it's the largest scheme in the world. Designed to provide financial aids to risk protections. It provides a cover of 5 lakhs per family per year for secondary and tertiary care of hospitalization.

Ministry of AYUSH has developed the Champion Services Sector Scheme for Medical Value Travel to promote medical tourism in traditional medicine. There are three sub-schemes under the Champion Services Sector scheme for medical value Travel. Ministry of AYUSH is implementing a Centrally Sponsored Scheme of National AYUSH Mission to provide cost-effective AYUSH Services by upgrading AYUSH Hospitals, Dispensaries and AYUSH educational institutions, setting up new AYUSH hospitals and teaching institutions and also operationalization of 12,500 AYUSH Health & Wellness Centres. Source – government of India health sector)

Government of India launched a policy called NET-ZERO set a target by 2070. Launched by prime minister Narendar Modi. The aim for this policy is to use renewable energy. India Is the largest third largest emitter of greenhouse gases. The ministry of environment, forest, and other department activities has to help to change and develop policies and programmes to achieve net zero by 2070.

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