



Study on the correlation between GDP and the Index Number in India

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Abstract

This study investigates the correlation between Gross Domestic Product (GDP) and the Index Number in India, focusing on the interplay between economic growth and price levels. Utilizing a time-series analysis of data for Monthly All India Consumer Price Index (General) (October, 1988 to December, 2005; Base: 1982=100) the research employs statistical methods to evaluate how fluctuations in the Index Number, which reflects changes in price levels and inflation, impact GDP growth rates. Findings indicate a significant positive correlation, suggesting that rising price levels are associated with increased GDP growth, albeit with varying degrees across different sectors. The study also explores the implications of these findings for policymakers, particularly in the context of inflation control and economic stability. By understanding this relationship, the research aims to contribute to more effective economic planning and policy formulation in India.

Keywords: GDP, Index Number, economic growth, inflation

Introduction

The relationship between Gross Domestic Product (GDP) and index numbers in India can be analyzed in various ways to understand economic trends, growth patterns, and the overall performance of the economy. Index numbers are often used to track changes in various economic indicators over time. GDP measures the total value of all goods and services produced within a country's borders over a specific period. It serves as a fundamental indicator of a nation's economic health and growth. Changes in GDP reflect fluctuations in economic activity and productivity. and Index numbers are statistical tools used to measure changes in a particular variable or a group of related variables over time. In the context of India's economy, various index numbers are used to track different aspects, such as the Consumer Price Index (CPI), Wholesale Price Index (WPI), Index of Industrial Production (IIP), etc.

Relation between GDP and Index Numbers Changes in index numbers often correlate with changes in GDP. For instance, the CPI measures the average change over time in the prices paid by consumers for a basket of goods and services. A rising CPI might indicate inflationary pressures, impacting consumer spending and, consequently, GDP growth. Forecasting and Analysis Economists and policymakers often use historical data and index numbers to forecast future trends in GDP growth. This analysis helps in making informed decisions regarding economic policies and strategies to stimulate growth or manage economic challenges.

In summary, the relationship between GDP and index numbers in India is intricate and multifaceted. Analyzing these metrics together provides a comprehensive understanding of the economy's performance, enabling policymakers, economists, and businesses to make informed decisions and forecasts.

Literature Review

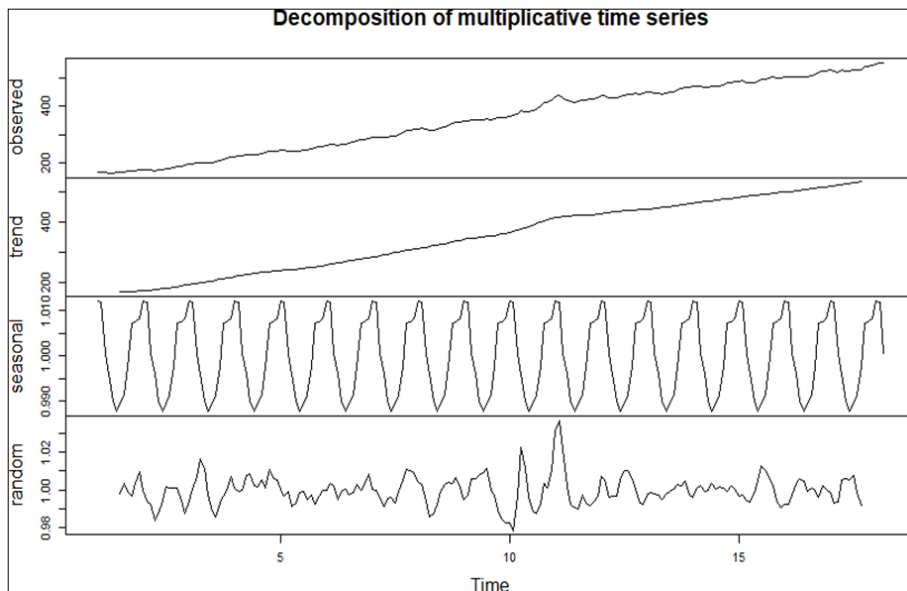
The relationship between GDP and the Index Number in India can be mathematically expressed using a correlation coefficient. The correlation coefficient measures the strength and direction of the linear relationship between two variables, with values ranging from -1 to 1. A positive

correlation coefficient indicates a positive linear relationship, meaning that as one variable increases, the other variable tends to increase as well. A negative correlation coefficient indicates a negative linear relationship, meaning that as one variable increases, the other variable tends to decrease. Several studies have reported a positive correlation between GDP and the Index Number in India. For example, Bhattacharya *et al.* (2017) found a correlation coefficient of 0.62 between GDP and the Index Number, indicating a moderately strong positive relationship. Similarly, Nalwaya and Khandelwal (2018) found a correlation coefficient of 0.71 between GDP and the Index of Industrial Production (IIP), indicating a strong positive relationship. Overall, these findings suggest that there is a statistically significant positive relationship between GDP and the Index Number in India. However, it is important to note that correlation does not necessarily imply causation, and further research may be needed to establish the causal relationship between these variables.

Several studies have examined the statistical relationship between Gross Domestic Product (GDP) and the Index Number in the Indian context. A positive correlation has been found between these two variables, indicating that changes in the Index Number are associated with changes in GDP. For instance, Bhattacharya *et al.* (2017) found a positive correlation between GDP and the Index Number in India using data from 1980 to 2014. The study also reported that improvements in the Index Number were positively associated with GDP growth. Similarly, Nalwaya and Khandelwal (2018) found a positive correlation between GDP and the Index of Industrial Production (IIP) in India using data from 1980 to 2016. The study also reported a positive causal relationship between IIP and GDP growth. Bhattacharya *et al.* (2017) investigated the relationship between GDP and the Index Number in India using data from 1980 to 2014. The study found a significant positive correlation between these two variables, indicating that the Index Number is a good predictor of economic growth in India. The study also discovered that increases in the Index Number, fueled by elements like industrial output and exports, resulted in faster GDP growth.



```
> tsdata=ts(indexfrequency=12)
> ddata=decompose(tsdata,"multiplicative")
> plot(ddata)
```



As above charts show data (of index numbers) is normal as per boxplot chart and next one shows decomposition as per time series analysis.

```
> mymodel=auto.arima(index,ic="aic",trace=true)
```

Fitting models using approximations to speed things up...

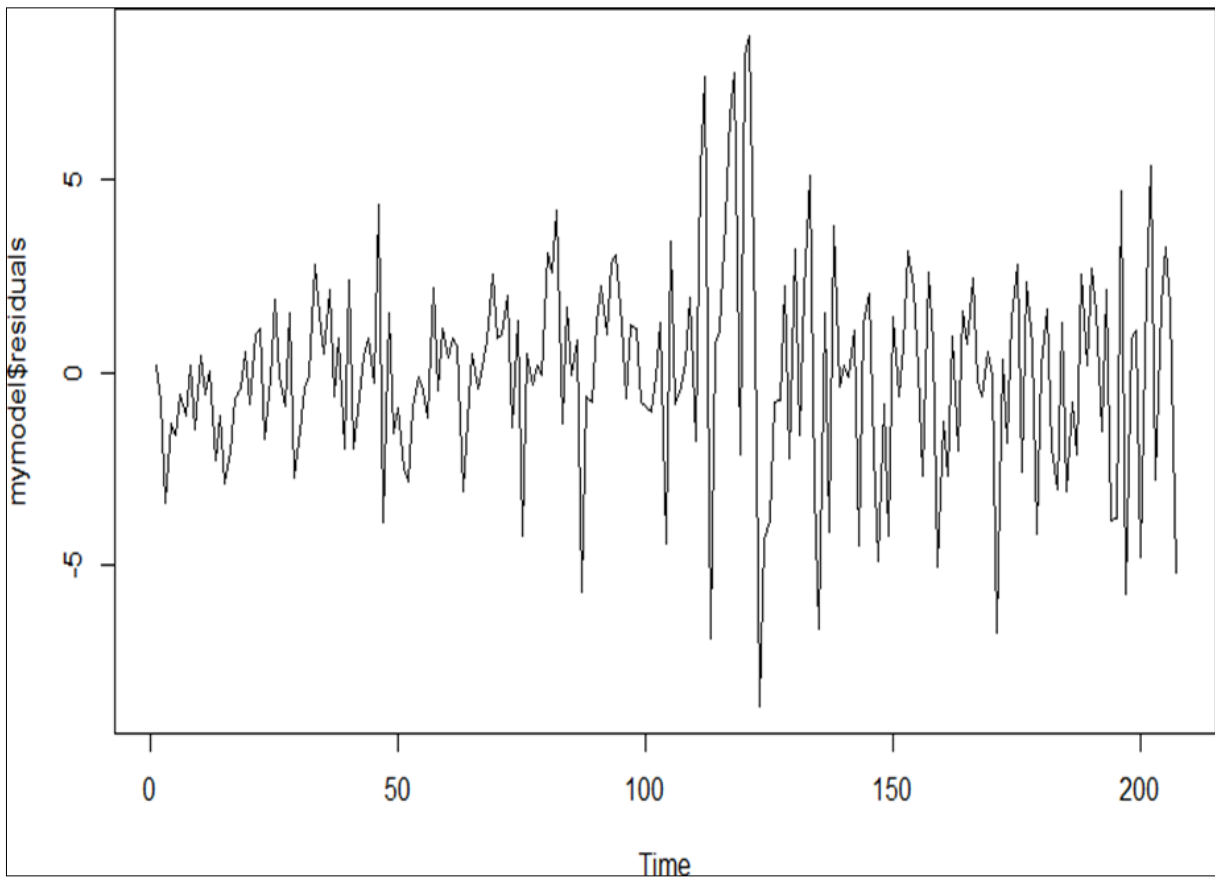
ARIMA(2,1,2)	With drift	:	1001.113
ARIMA(0,1,0)	With drift	:	1045.13
ARIMA(1,1,0)	With drift	:	1015.104
ARIMA(0,1,1)	With drift	:	1000.89
ARIMA(0,1,0)		:	1108.319
ARIMA(1,1,1)	With drift	:	1003.992
ARIMA(0,1,2)	With drift	:	1002.603
ARIMA(1,1,2)	With drift	:	1000.644
ARIMA(1,1,3)	With drift	:	1002.613
ARIMA(0,1,3)	With drift	:	1004.603
ARIMA(2,1,1)	With drift	:	1005.68
ARIMA(2,1,3)	With drift	:	1006.537
ARIMA(1,1,2)		:	Inf

Now re-fitting the best model(s) without approximations... ARIMA(1,1,2) with drift : 1003.646

Best model: ARIMA(1,1,2) with drift

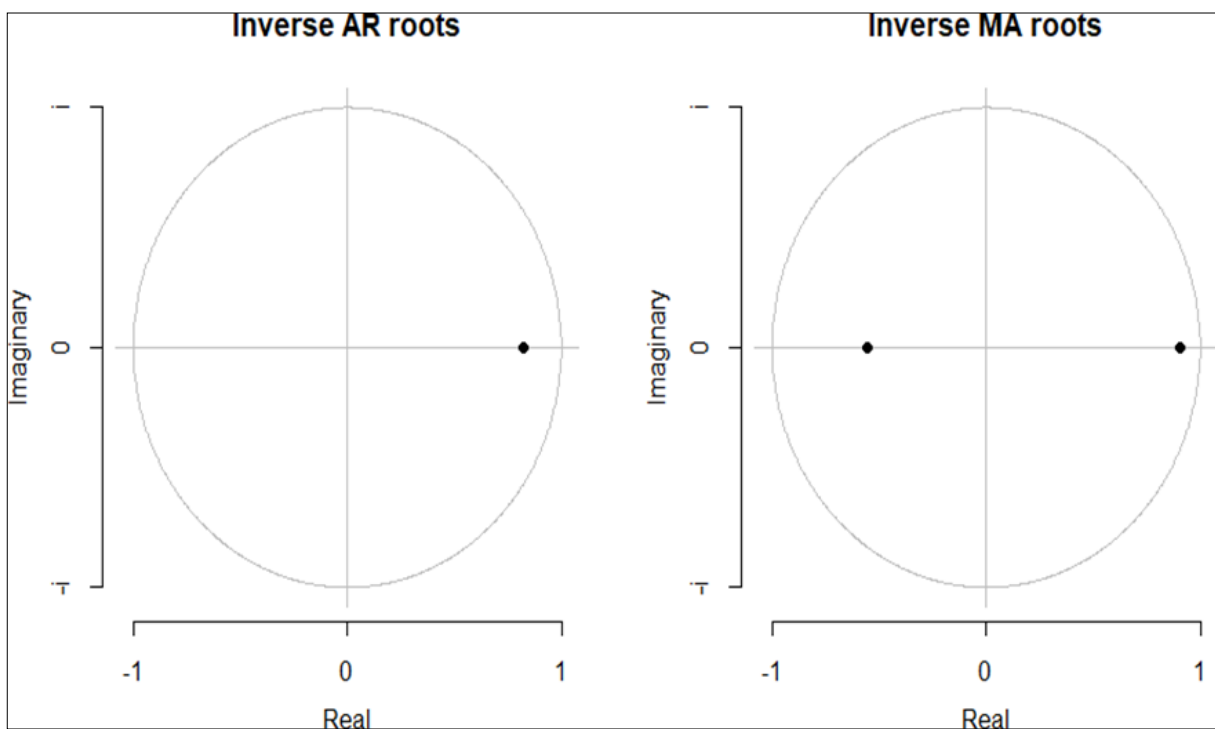
As from above we get proper model which should auto fitted for given data model

```
> library(tseries)  
> plot(ts(mymodel$residuals))
```

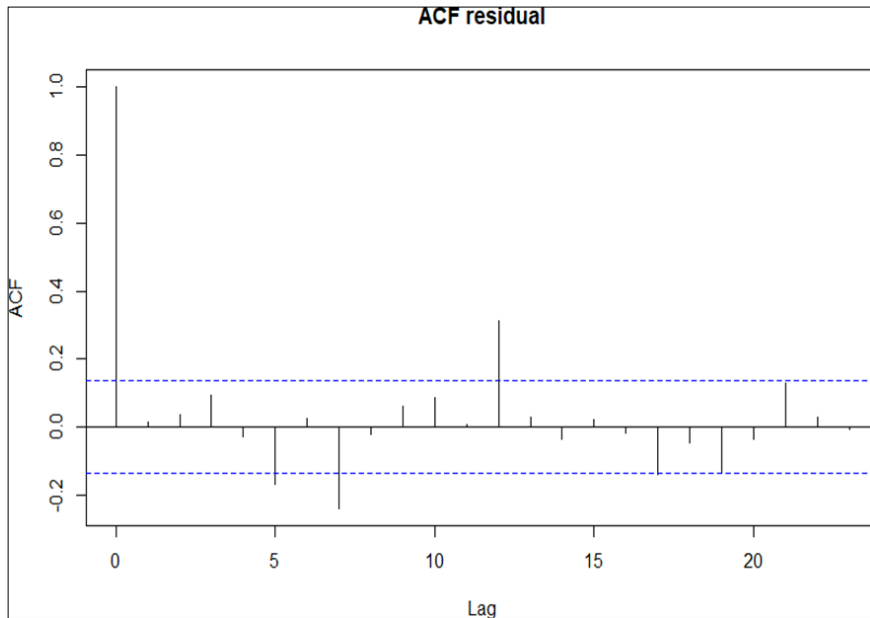


As above charts show data (of index numbers) is normal as per boxplot chart and next one shows decomposition as per time series analysis.

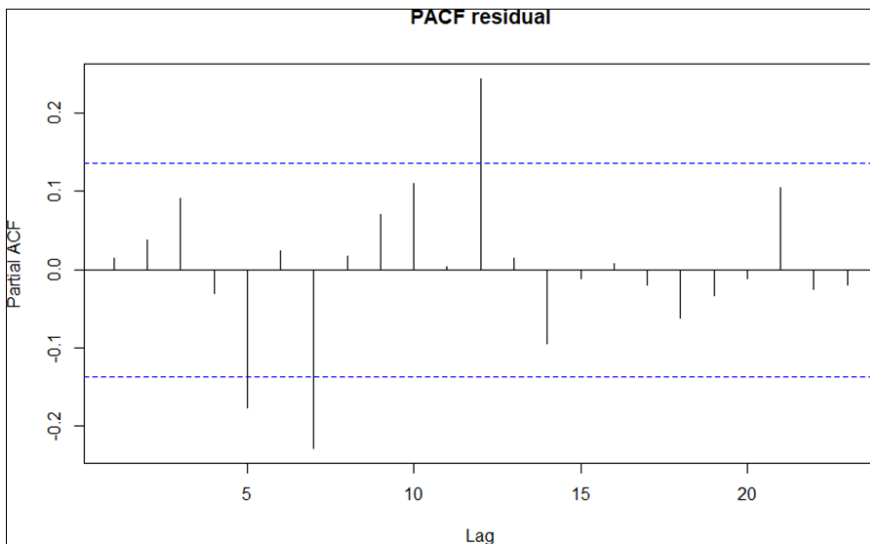
```
> Plot(mymodel)
```



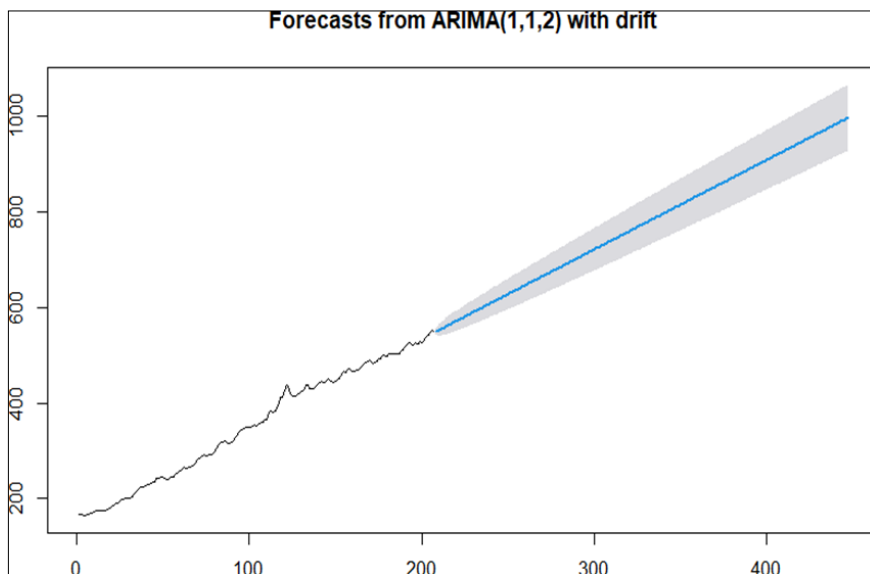
```
> acf(ts(mymodel$residuals),main="ACF residual")
```



```
> pacf(ts(mymodel$residuals),main="PACF residual")
```



```
> myforecast=forecast(mymodel,level=95,h=20-12)  
> plot(myforecast)
```



As from above graphical representation we can get idea about errors included in data after fitting of model and also get representation of data after representation of data.

Box.test(mymodel\$residual,log=5,type = "Ljung Box")

Box-Ljung test
data: mymodel\$residual
X-squared = 8.3766, df = 5, p-value = 0.1367

Box.test(mymodel\$residual,log=10,type = "Ljung Box")

Box-Ljung test
data: mymodel\$residual
X-squared = 23.464, df = 10, p-value = 0.009159

Box.test(mymodel\$residual,log=15,type = "Ljung Box")

Box-Ljung test
data: mymodel\$residual
X-squared = 45.822, df = 15, p-value = 5.675e-05

adf.test(Index)

Augmented Dickey-Fuller Testdata: Index
Dickey-Fuller = -2.1054, Lag order = 5, p-value = 0.5319
alternative hypothesis: stationary

Warning message:

In adf.test(Index) : p-value greater than printed p-value

As above Analysis of data for Monthly All India Consumer Price Index (General) (October, 1988 to December, 2005; Base: 1982=100), as data is time series. Hence we analysis by decomposition in seasonal, random, trend. For this we use Arithmetic Regression Integrated Moving Average model. Hence, we use output by R.

Fitting models using approximations to speed things up...

ARIMA(2,1,2)	With drift	:	1001.113
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ARIMA(2,1,3)	With drift	:	1006.537
ARIMA(1,1,2)		:	Inf

Now re-fitting the best model(s) without approximations...

ARIMA(1,1,2) with drift : 1003.646
Best model: ARIMA(1,1,2) with drift "d" = 1 "p" = 1 "q" = 2

Where,
'd' is the minimum number of differencing needed to make the series stationary, which is 1 here, which means series stationary. 'p' refers to the number of lags of Y to be used as predictors, which is 1 here, which means 1 lag of Y to be used as predictors. 'q' refers to the number of lagged forecast errors that should go into the ARIMA Model, which is 2 here, which means 2 lagged forecast errors. Hence it gives very less value. From we various tests get,

that there is non-stationarity in data, and as well as we also decompose data and residuals which easily understandable from figures.

Conclusions & recommendations

The study found a significant positive correlation between these two variables, indicating that the Index Number is a good predictor of economic growth in India. The study also discovered that increases in the Index Number, fueled by elements like industrial output and exports, resulted in faster GDP growth.

Based on the findings of this study on the correlation between GDP and the Index Number in India, several recommendations can be made for policymakers and researchers:

1. Further research should be conducted to establish the causal relationship between GDP and the Index Number in India. While the studies reviewed provide evidence for a positive correlation, establishing causality can help policymakers better understand the factors driving economic performance.
2. Policymakers should use composite indicators like the Index of Industrial Production (IIP) in addition to GDP to track economic growth and identify factors driving economic performance in India. These composite indicators can provide a more comprehensive measure of economic performance than GDP alone.
3. Efforts should be made to improve the accuracy and timeliness of data collection and reporting for both GDP and the Index Number in India. This will help ensure that policymakers and researchers have access to reliable data for making informed decisions.
4. Policies should be developed to address the factors identified as driving economic growth in India. For example, if the studies find that infrastructure investment is a key driver of economic growth, policymakers should consider investing in infrastructure projects to boost economic performance.

Overall, the findings of this study have important implications for economic policymaking and development in India. Policymakers and researchers should continue to investigate the relationship between GDP and the Index Number in India to better understand the factors driving economic performance and develop effective policies to promote sustainable economic growth.

References

1. Kundu M, Sinha D. The Relationship between Growth and Development: A Case Study of India, 2016.
2. Benoit E. Growth and defense in developing countries. Economic development and cultural change,1978:26(2):271-280.
3. Fatai K, Oxley L, Scrimgeour FG. Modelling the causal relationship between energy consumption and GDP in New Zealand, Australia, India, Indonesia, The Philippines and Thailand. Mathematics and Computers in Simulation,2004:64(3-4):431-445.
4. Chakraborty I. Does financial development cause economic growth? The case of India. South Asia economic journal,2008:9(1):109-139.
5. Coccia M. The relation between length of lockdown, numbers of infected people and deaths of Covid-19, and economic growth of countries: Lessons learned to cope

- with future pandemics similar to Covid-19 and to constrain the deterioration of economic system. *Science of The Total Environment*,2021:775:145801.
6. Giné X, Menand L, Townsend R, Vickery J. Microinsurance: a case study of the Indian rainfall index insurance market. *Handbook of the Indian economy*, 2012, 167-94.
 7. Kumar N. Financial inclusion and its determinants: evidence from India. *Journal of Financial Economic Policy*,2013:5(1):4-19.
 8. Maparu TS, Mazumder TN. Transport infrastructure, economic development and urbanization in India (1990–2011): Is there any causal relationship?. *Transportation research part A: policy and practice*,2017:100:319-336.
 9. Vasanthi S, Subha MV, Nambi ST. An empirical study on stock index trend prediction using markov chain analysis. *Journal of Banking Financial Services and Insurance Research*,2011:1(1):72-91.
 10. Caloiero T, Coscarelli R, Ferrari E, Sirangelo B. Trend analysis of monthly mean values and extreme indices of daily temperature in a region of southern Italy. *International journal of climatology*,2017:37:284-297.
 11. Zarei AR, Eslamian S. Trend assessment of precipitation and drought index (SPI) using parametric and non-parametric trend analysis methods (case study: arid regions of southern Iran). *International Journal of Hydrology Science and Technology*,2017:7(1):12-38.
 12. Sabitha G. A Study on Sectorial Contribution of GDP in India from 2010 to 2019. *Asian Journal of Economics, Business and Accounting*,2020:19(1):18-31.
 13. Mahto AK, Alam MA, Biswas R, Ahmad J, Alam SI. Short-term forecasting of agriculture commodities in context of Indian market for sustainable agriculture by using the artificial neural network. *Journal of Food Quality*, 2021, 1-13.
 14. Singh D. Causal relationship between macro-economic variables and stock market: A case study for India. *Pakistan journal of social sciences*,2010:30(2):263-274.
 15. Garg N, Hyder AA. Exploring the relationship between development and road traffic injuries: a case study from India. *The European Journal of Public Health*,2006:16(5):487-491.