Forecasting GDP: A Linear Regression Model

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ABSTRACT

The study analyzes the method of Gross Domestic Product calculation in INDIA. Statistical methods have been used to analyze the data provided by the Reserve Bank of India. Graphs and charts are used to represent the calculated results in R. This paper seeks to predict future values of the Gross Domestic Product for the country, the steps that Reserve Bank of India and government must take in order to increase this value.

Keywords: GDP, growth rate, India, regression line

INTRODUCTION

Gross Domestic Product[1] is the value of final goods and services produced within a country in a given period. GDP is calculated on an annual basis. It is an indicator of the economic health of a country. It basically includes all of private and public consumption, government outlays, investments and difference between the exports and the imports within a region.
GDP=C+G+I+NX
Where C is the private consumption,
G is government spending,
I is the sum of all country's business spending (Investment), NX is exports-imports (NET).

METHODOLOGY

A. *Methods of GDP calculation*

GDP could be calculated in three ways. It could be the expenditure approach, where we use final spending on goods and services. Production approach, by calculating the market value of goods and services product or by income method which is the summation of the income received by all producers in the country.

B. *Hypothesis Testing*
Calculation of GDP is a complex process and its values are used in major policy decisions of the country. GDP values for future can be predicted using its values from the past.

C. GDP calculation at market and fixed price

There have been several debates as to what should be the base price in the calculation of GDP. Finally, India has adopted the use of market price to calculate its GDP. According to the fiscal value, Indian economy will grow by 7.4% this fiscal year outpacing China to become the world's fastest growing economy. Therefore a comparison between the calculated and the assumed GDP was done to outline the changes that have occurred

Data Analysis

A. Data extraction and Analysis[2][3]

The data for GDP calculation was obtained from the official website of Reserve Bank of India (RBI) in excel format. The changes in GDP calculation that have occurred in the past 50 years and the major changes that took place were analyzed.
The collected data from RBI's was converted into a .csv file from excel so that, it could be analyzed in R.
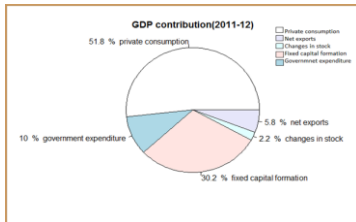
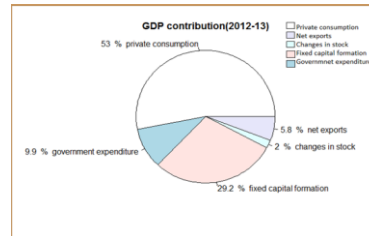*B. Analysis of GDP*

Figure 1

Figure 2

Based on the two pie charts above we see that the private consumption has increased.There is no change in the net exports, it remains constant. Though the change in stock has reduced by 0.2% . The government expenditure has reduces by 0.1%. but in the *Figure 3* we see that the government expenditure has increased to 10.7%
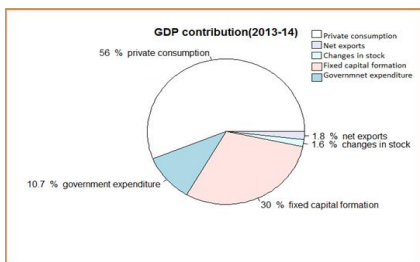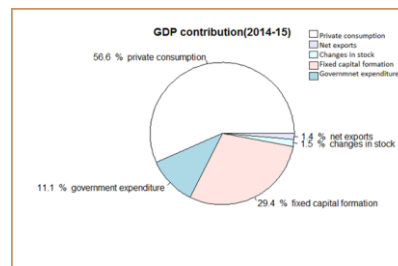

Figure 1

Figure 2

The Contribution of Private consumption is maximum in the GDP. Private Consumption in 2011-12, which was 51.8% which is now increased to 56.6% in the year 2014-15. We can also observe that the government expenditure has also increased over time.
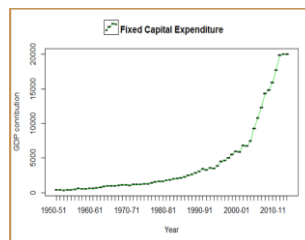

Figure 3

The trend of fixed capital formation indicates the growth of physical assets, which indicates future growth if it is increasing then it means more investment, more return in future.
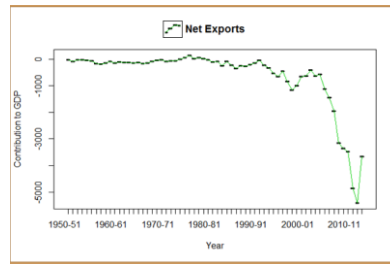
Figure 4

From the Graph we see that there is a high shift in net exports, during the 90's indicating that India has shifted from an exporter to an importing country. This also signifies that India is exploiting the International trade and is now less dependent on existing market. This will also lead to increase in competition in existing Market. The Net Export in 2011-12 was 5.8% and in 2014-15 it is reduced to 1.4%.
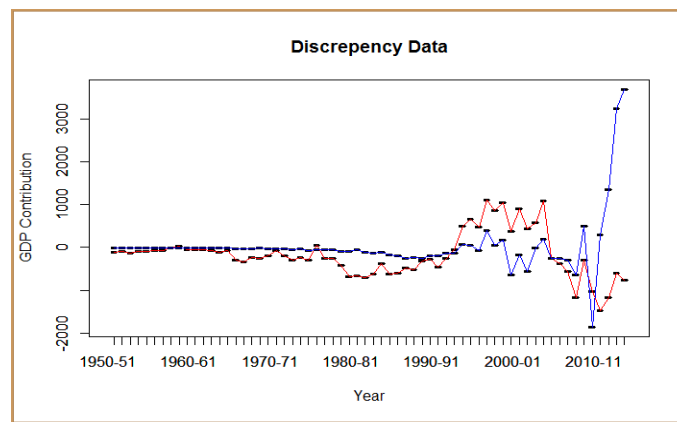

Figure 5

Discrepancies in the graph indicate that statistical errors are there, which indicates some residuals/errors are present.[5]There can be discrepancy in the expenditure estimate of GDP is the discrepancy included in final consumption, which is the total expenditure. This discrepancy is added to make sure that GDP in the expenditure side equals GDP measured by the income or output approach.

C. *Prediction of GDP Value*

Least Square Fitting
Readings from past 60 years of GDP data were plotted on
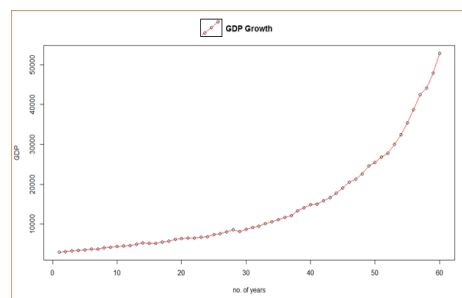Graph and patterns were observed.

Figure 6

X-Axis : 0 : GDP for year 1950-51
        60: GDP for year 2010-11
        Y-Axis : in billion rupees

Using polynomial regression in R, the polynomial equation of the curve was obtained for 60 years.

$$y = 1.246\, x^3 - 78.2\, x^2 + 1380.827\, x - 5123.5$$

D. Calculating the error

The expected values (obtained from RBI) and the calculated
Values were noted. This was followed by error calculation

Table 1

year	y(expected)	y(calculated)	error
2011	56330.49	70943.073	14612.583
2012	58998.49	76843.662	17845.172
2013	61958.41	83051.363	21092.953

E. The new formula

$$y_{predicted} = y_{calculated} - 14612.583 - 3232.5\,(n-1)$$

F. Predicting the value

$$y = 1.246\, x^3 - 78.2\, x^2 + 1380.827\, x - 5123.5$$

For 2014, $x = 64$,

$$y_{calculated} = 1.246\,(64)^3 - 78.2\,(64)^2 + 1380.827\,(64) - 5123.5$$

$$y_{calculated} = 89573.652$$

$$y_{predicted} = 89573.652 - 14612.583 - 3232.5\,(n-1)$$

$$y_{predicted} = 65217.969$$

Hence, the predicted value of GDP for the session 2014-15 is **65216.969.**

- The value of GDP is given for 2014-15 by RBI is 106569.25
- The major reason for this isn't the actual growth in GDP from the past year but the changes that have been made in the process of calculation of GDP for India. Two major changes have occurred in the mechanism for calculation of GDP in India.
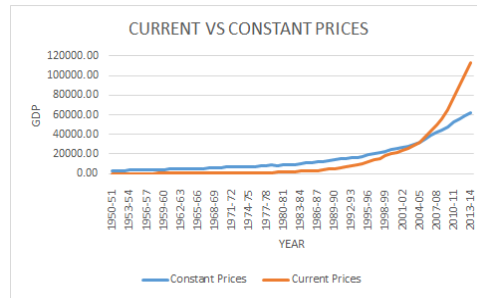
Figure 7

The Graph shows the GDP at current and constant prices. It is clear from the graph that the growth of GDP at current price has risen rapidly. Comparing it with the constant price we can observe that from year 2004-05 it surpass the growth rate at constant prices.

CONCLUSIONS

The GDP values as obtained by the model in this paper relate to the GDP values of the previous years as obtained from the database of RBI. However, the value obtained for the year 2014-15 is much lower than the value from RBI database. This discrepancy is due to changes in the technique of measurement of GDP this year.

One was a change in the base year for the calculation which is done routinely every five years. The other could be a new method to measure the output. In India GDP did not include what that the Government received. Now there is usage of indirect taxes such as sales tax and excise duty after deducting subsidy is also added into the GDP.

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APPENDIX

1. gdp=read.csv(file.choose(), nrows=64, skip=8, header= F)
2. attach(gdp)
3. plot(V1,V17)
4. par(new=T, col=2)
5. plot(V1,V16,main="Discrepencydata",xlab="Year",Ylab="GDP contribution (in billion rupees), col=2")
6. par(new=T, col=4)
7. plot(V1,V17)

8. names(V1)=c("private consumption","government expenditure","fixedcaptalformation","growth in stocks"," net exports")
9. percentlabels= round(100*V1/sum(V1),1)
10. gdp=read.csv(file.choose(), nrows=5, header=F)
11. pielabels= paste (percentlabels, "%", sep="",names(V1))
12. pie(V1,main="GDP contribution(2014-15",labels= pielabels, radius=2)
13. names(V1)=c("private consumption", "government expenditure", "fixed capital formation","changes in stock", "net exports")
14. plot.new()
15. plot.window(xlim=range(V1),ylim=range(V16))
16. plot.window(ylim=range(V16))
17. plot(V1,V16,ylim=range(V17), ylab="GDPContribution", xlab="Year",main="Discrepency Data")
18. par(new =T)
19. plot(V1,V16,ylim=range(V17), ylab="GDP Contribution", xlab="Year", main="Discrepency Data")
20. lines(V1,V16, col=2)
21. par(new =T)
22. plot(V1,V17)
23. lines(V1,V17, col=4)
24. plot(V1,V16,ylim=range(V17), ylab="GDP Contribution", xlab="Year",main="Discrepency Data")
25. lines(V1,V16,constant prices,col=2)
26. legend(-1,1.9,"constant prics")
27. net= V12-V14
28. plot(V1,net , ylim = range(net), main="Net Exports", xlab="Yaer", ylab="Contribution to GDP")
29. lines(V1, net, col=3)
30. plot(V1,net , ylim = range(net), main="Net Exports", xlab="Year", ylab="Contribution to GDP")
31. lines(V1, net, col=3)
32. ?distribution
33. dnorm(GDP)
34. attach(b)
35. dnorm(GDP)
36. sd(GDP, na.rm=T)
37. mean(GDP, na.rm=T)
38. hist(f)
39. hist(GDP)
40. lines(GDP)
41. lines(GDP)
42. names(d)
43. v=c(1:60)
44. lo = loess(V18 ~ v)
45. plot(v,V18)
46. lines(predict(lo), col=2, lwd=2)
47. lo
48. fit= nls(y~ exp(-x*c)*b)
49. fit= nls(y~ exp(-x*c)*b, data=dat, trace =T)
50. fit<- lm(V18~poly(v,3,raw=T))
51. fit<- lm(V18~exp(v))
52. rev(V18)
53. y~(0.5397*x^3)-(29.7465*x^2) +(649.7380*x) +977.5245
54. exponential.model = lm (log(b)~e)
55. summary(exponential.model)
56. r = lm (log(b)~e)
57. summary(r)
58. plot(lm.r)
59. plot(r)
60. plot(log(b)~g)