Investment Driven Growth
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Abstract

In this report, relationship between **Gross Domestic Product (GDP)** and **Foreign Direct Investment (FDI)** is studied along with the change in GDP over the period of last 63 years. GDP is a broad measurement of the nation's overall economic activity including the monetary measure of the market value of all the final goods and services provided over a period of time, often annually whereas FDI is the inflow of investments in various sectors by business entity of other countries.

Foreign Direct Investment is an important factor in acquiring investments and influencing the GDPs in various industries. It plays a significant role in increasing the overall market values of goods and services. Inflow of FDI helps in predicting the GDP value of different industries as well as the overall market value.

Keywords: Gross Domestic Product (GDP); Foreign Direct Investment (FDI); Business Entity

1. Introduction

Gross Domestic Product is an aggregate measure of production equal to the sum of the gross values added of all resident and institutional units engaged in production. It provides measure about the contribution of each industry and sector to the economy of the country. GDP (nominal) per capita does not, however, reflect differences in the cost of living and the inflation rates of the countries. GDP is considered the **"world's most powerful statistical indicator of national development and progress"**.

Foreign Direct Investment is an inflow of assets in the form of controlling ownership in the business in one country from the entities of other countries. FDI includes **"mergers and acquisitions, building new facilities, reinvesting profits earned from overseas operations, and intra company loans"** as well as the sum of equity capital, long-term capital and short-term capital invested in the sectors. FDI also involves participation in management, joint-ventures, transfer of technologies and expertise.

We aim at drawing a mathematical relationship between Foreign Direct Investment and Gross Domestic Product of our country with the help of curve fitting model and also to create a time series model for forecasting the GDP values in various industries in India. These models help us to study the past behaviour determining the type and nature of variation in data as well as to compare the actual current performance with the expected ones (based on past performances).

2. Data Description

In this report, we have gathered data from **data.gov.in** (Open Government Data Platform of India) and have collected financial data of **Gross Domestic Product at Current Price** and **Foreign Direct Investment Equity Inflow**. Description for the data is:

2.1 Gross Domestic Product at Current Price

It provides information regarding the various macro-economic indicators along with contribution of various sectors to Gross Domestic Product, measured in **Indian Rupee in Crores** from financial year **1950-51** to **2013-14**. Different industries specified in the dataset are as follows:

- Agriculture, Forestry & Fishing

- Mining & Quarrying
- Manufacturing
- Electricity, Gas & Water Supply
- Construction
- Trade, Hotels & Restaurant
- Transport, Storage & Communication
- Financing, Insurance, Real Estate & Business Services
- Community, Social & Personal Services
- GDP at Factor Cost
- Consumption of Fixed Capital
- Net Factor Income from Abroad
- Net Domestic Product
- Gross National Income
- Net National Income
- Per Capita Income
- Net Indirect Taxes
- GDP at Market Prices
- NDP at Market Prices
- Total Final Consumption Expenditure
- Gross Capital Formation
- Exports
- Less Imports
- Gross Domestic Saving
- Net Capital Inflow
- Gross Capital Formation
- Other Current Transfers from Rest of the World (Net)
- Net National Disposable Income
- Gross National Disposable Income
- PFCE in the Domestic Market

Data contains GDP value per year for all the above industries providing us valuable information for development of Time Series Model and predicting the GDP for future years.

Industry	GDP at Current Prices (In Crore) - 1950-51	GDP at Current Prices (In Crore) - 1951-52	GDP at Current Pric
Agriculture, Forestry & Fishing	5262	5419	5212
Mining & Quarrying	75	84	86
Manufacturing	1110	1233	1165
Electricity, Gas & Water Supply	24	30	31
Construction	267	305	284
Trade, Hotels & Restaurant	638	678	689
Transport, Storage & Communication	374	421	414
Financing, Insurance, Real Estate & Business Services	1329	1428	1511
Community, Social & Personal Services	1141	1189	1231

Snapshot of Gross Domestic Product Data

2.2 Foreign Direct Investment Inflow Equity Inflow

It provides information regarding the Foreign Direct Investment Inflow measured in **US Dollar in Millions** from financial year **2000-01** to **2016-17**. Different industries specified in the dataset are as follows:
- Metallurgical Industries
- Mining

- Power
- Non-Conventional Energy
- Coal Production
- Petroleum & Natural Gas
- Boilers And Steam Generating Plants
- Electrical Equipments
- Computer Software & Hardware
- Electronics
- Telecommunications
- Information & Broadcasting (Including Print Media)
- Automobile Industry
- Air Transport (Including Air Freight)
- Sea Transport
- Ports
- Railway Related Components
- Industrial Machinery
- Machine Tools
- Agricultural Machinery
- Earth-Moving Machinery
- Miscellaneous Mechanical & Engineering Industries
- Commercial, Office & Household Equipments
- Medical And Surgical Appliances
- Industrial Instruments
- Scientific Instruments
- Mathematical,Surveying And Drawing Instruments
- Fertilizers
- Chemicals (Other Than Fertilizers)
- Drugs & Pharmaceuticals
- Textiles (Including Dyed,Printed)
- Paper And Pulp (Including Paper Products)
- Sugar
- Fermentation Industries
- Food Processing Industries
- Vegetable Oils And Vanaspati
- Soaps, Cosmetics & Toilet Preparations
- Rubber Goods
- Leather,Leather Goods And Pickers
- Glass
- Ceramics
- Cement And Gypsum Products
- Timber Products
- Defence Industries
- Consultancy Services
- Services Sector
- Hospital & Diagnostic Centres
- Education
- Hotel & Tourism
- Trading
- Retail Trading
- Agriculture Services
- Diamond,Gold Ornaments
- Tea And Coffee
- Printing Of Books
- Coir

- Construction (Infrastructure) Activities
- Construction Development
- Miscellaneous Industries

Data contains year wise FDIs in the above sectors providing us information regarding the inflow in different sectors that is valuable for understanding the relation between GDP and FDI in different industries and sectors over a defined period of time.

Sector	2000-01	2001-02	2002-03	2003-04	2004
METALLURGICAL INDUSTRIES	22.69	14.14	36.61	8.11	200.
MINING	1.32	6.52	10.06	23.48	9.92
POWER	89.42	757.44	59.11	27.09	43.3
NON-CONVENTIONAL ENERGY	0	0	1.7	4.14	1.27
COAL PRODUCTION	0	0	0	0.04	0
PETROLEUM & NATURAL GAS	9.35	211.07	56.78	80.64	102.
BOILERS AND STEAM GENERATING PLANTS	0	0	0	0.04	0.54
ELECTRICAL EQUIPMENTS	79.76	65.76	34.71	73.2	97.4
COMPUTER SOFTWARE & HARDWARE	228.39	419.39	314.24	368.32	527.

Snapshot of Foreign Direct Investment Data

3. Data Preprocessing

This step involves conversion of FDI measure from US Dollar in millions to Indian Rupee in crores, selections of relevant industries and sectors from GDP and FDI respectively and matching the respective set of sectors in FDI with relative GDP industries.

In first step, we converted the FDI measure by using the relation between US Dollar and Indian Rupee year wise, which have been calculated by a simple formula: **Exchange Rate (per year) = Sum of 1st Exchange Rate of each Month / 12**,
where exchange rate is the value of Indian Rupee per US Dollar. The table given below list the exchange rate from financial year **2000-01** to **2016-17**:

Financial Year	Exchange Rate ($1 =)
2000-01	₹ 45.08
2001-02	₹ 47.23
2002-03	₹ 48.57
2003-04	₹ 46.50
2004-05	₹ 45.12
2005-06	₹ 44.08
2006-07	₹ 45.19
2007-08	₹ 40.99
2008-09	₹ 43.79
2009-10	₹ 48.26

2010-11	₹ 45.58
2011-12	₹ 46.88
2012-13	₹ 53.89
2013-14	₹ 58.15
2014-15	₹ 61.15
2015-16	₹ 64.24
2016-17	₹ 67.25

Further, from the available macro-economic indicators we select the columns representing the contribution of particular industry to GDP in order to study the changes in the contribution as the FDI inflow in these sectors. The list of industries selected are:

- Agriculture, Forestry & Fishing
- Mining & Quarrying
- Manufacturing
- Electricity, Gas & Water Supply
- Construction
- Trade, Hotels & Restaurant
- Transport, Storage & Communication
- Financing, Insurance, Real Estate & Business Services
- Community, Social & Personal Services

In the last step, we matched the FDI sectors with the GDP industries that are influenced by the inflow of investments in these sectors, enabling us to create a regression model for each industry and studying the impact of FDI in the industries on GDP. The following tables provides the corresponding matching:

GDP Industries	FDI Sectors
Agriculture, Forestry & Fishing	- Agricultural Machinery - Fertilizers - Sugar - Fermentation Industries - Food Processing Industries - Vegetable Oils And Vanaspati - Rubber Goods - Leather,Leather Goods And Pickers - Timber Products - Agriculture Services - Tea And Coffee - Coir
Mining & Quarrying	- Mining - Coal Production - Diamond,Gold Ornaments
Manufacturing	- Metallurgical Industries - Boilers And Steam Generating Plants - Prime Mover (Other Than Electrical Generators) - Industrial Machinery

|	
	● Machine Tools ● Miscellaneous Mechanical & Engineering Industries ● Industrial Instruments ● Scientific Instruments ● Chemicals (Other Than Fertilizers) ● Photographic Raw Film And Paper ● Dye-Stuffs ● Textiles (Including Dyed,Printed) ● Paper And Pulp (Including Paper Products) ● Glue And Gelatin ● Glass ● Ceramics
Electricity, Gas & Water Supply	● Power ● Non-Conventional Energy ● Petroleum & Natural Gas
Construction	● Earth-Moving Machinery ● Mathematical,Surveying And Drawing Instruments ● Cement And Gypsum Products ● Construction (Infrastructure) Activities ● Construction Development
Trade, Hotels & Restaurant	● Hotel & Tourism
Transport, Storage & Communication	● Telecommunications ● Information & Broadcasting ● Automobile Industry ● Air Transport (Including Air Freight) ● Sea Transport ● Ports ● Railway Related Components
Financing, Insurance, Real Estate & Business Services	● Consultancy Services ● Services Sector ● Trading ● Retail Trading ● Miscellaneous Industries
Community, Social & Personal Services	● Electrical Equipments ● Computer Software & Hardware ● Electronics ● Commercial, Office & Household Equipments ● Medical And Surgical Appliances ● Drugs & Pharmaceuticals ● Soaps, Cosmetics & Toilet Preparations ● Hospital & Diagnostic Centres ● Education ● Printing Of Books

Note: Our study does not involves foreign investment inflow in **Defence Industries** as it directly does not contribute in the economic growth (GDP) of the country.

4. Preliminary Observations

In the preliminary observations, we analyse the trends in various sectors and industries of FDI and GDP respectively to understand and identify the best possible model that is best suited for the available datasets.

4.1 Foreign Direct Investment

We first observed that there is an increasing trend in FDI inflow in India during the time period under study have been displayed by the graph given below:
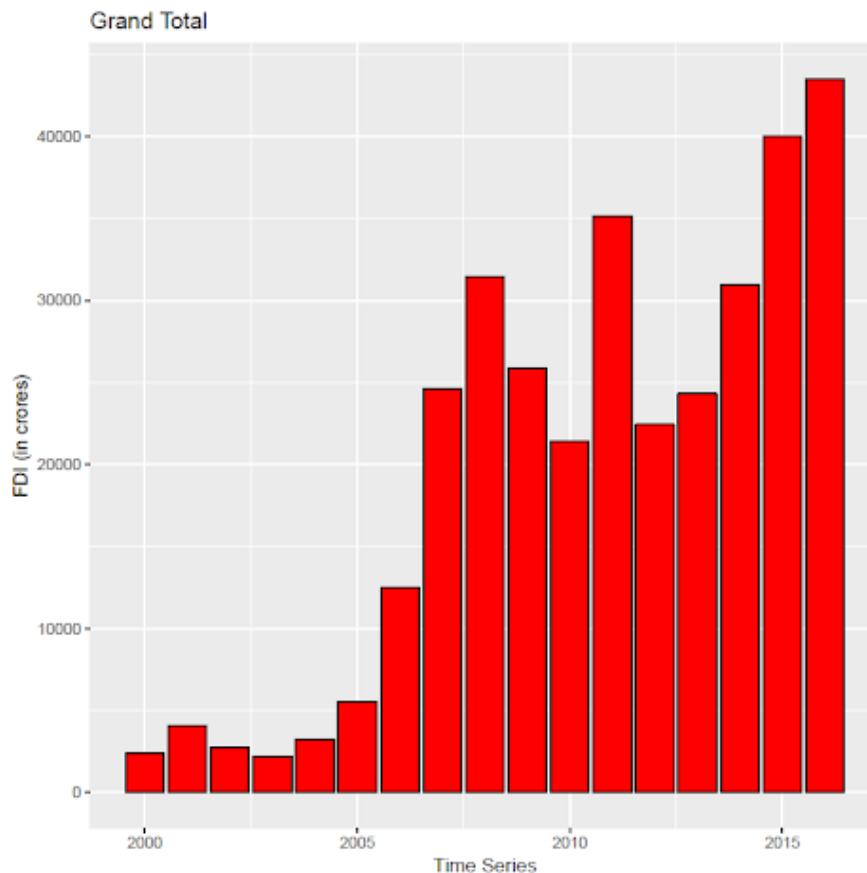

Total Foreign Direct Investment per year (in INR Crores)

Year 2007 has been a remarkable year for FDI inflow in India with total Investment increasing by 125% in comparison to the previous year and the inflow has steadily increased since then with slight fluctuations during 2008 - 2014. Mostly all the sectors. Many sectors like Metallurgical Industries, Automobiles, Telecommunications, etc. have attracted major investments while few sectors like Coal Production, Petroleum and Natural Gas, Retail, etc. have not been able to attract much investments during the time period under consideration. Data is also negatively skewed with high variability.

4.2 Gross Domestic Product

GDP also displays an increasing trend from the year 1950-2013 taken under consideration showing upward trend in the economical growth of the country, displayed in the graph below:
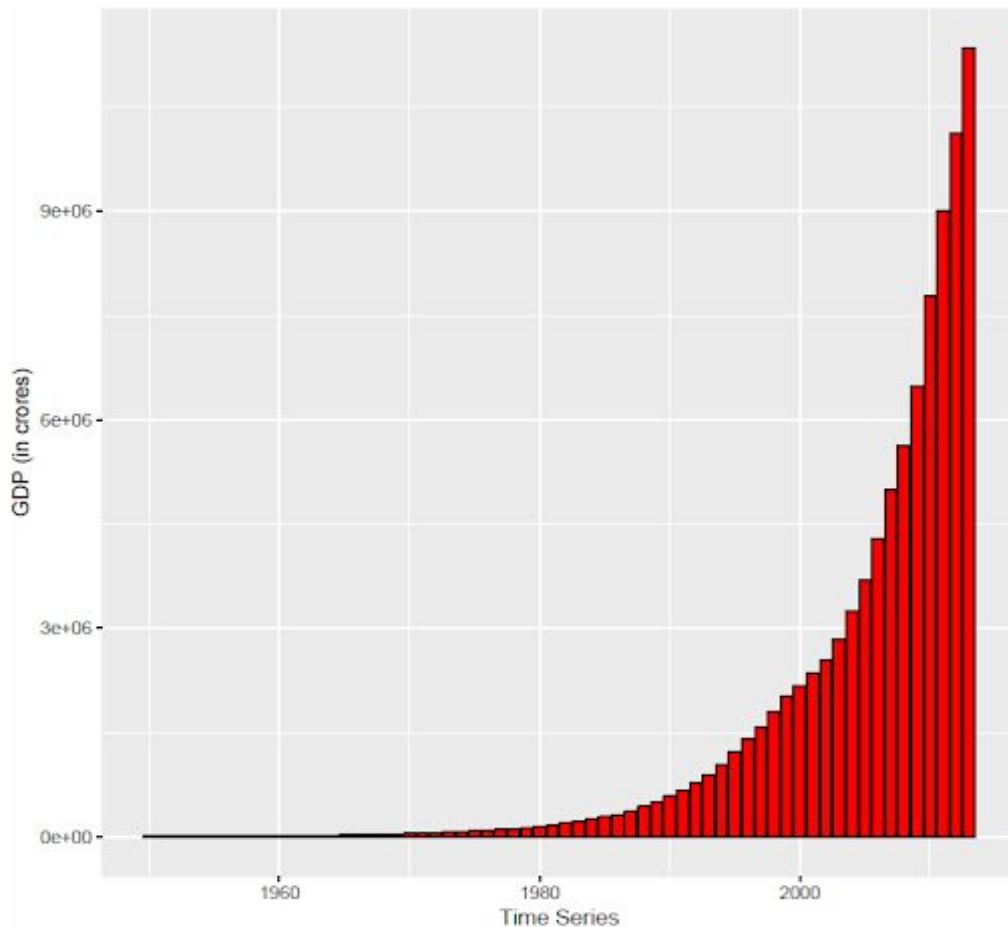
**Total Gross Domestic Product per year (in INR Crores)**

There are various macroeconomic indicators like National Income, Consumption of Fixed Capital, Exports, etc. which indicates the increase in economic prosperity for Individuals whereas other indicators like Individual & Government Incomes indicates the increase in government revenue during the time period under study.

## 5. Graphical Representations

In an initial analysis to investigate empirically, for an impact of FDI on GDP we fit a regression line on the standardized values and obtain the following result:

$$GDP = 2.792E-16 + 0.786 * FDI$$

with this initial regression model, we can conclude that FDI inflow does have a statistically significant impact on the GDP value. This relation is also depicted with the help of grouped line graph given below:
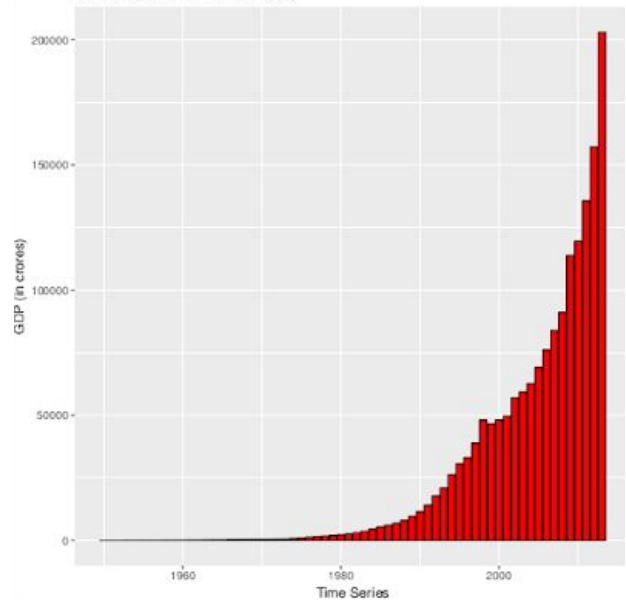
FDI vs GDP (Standardized)
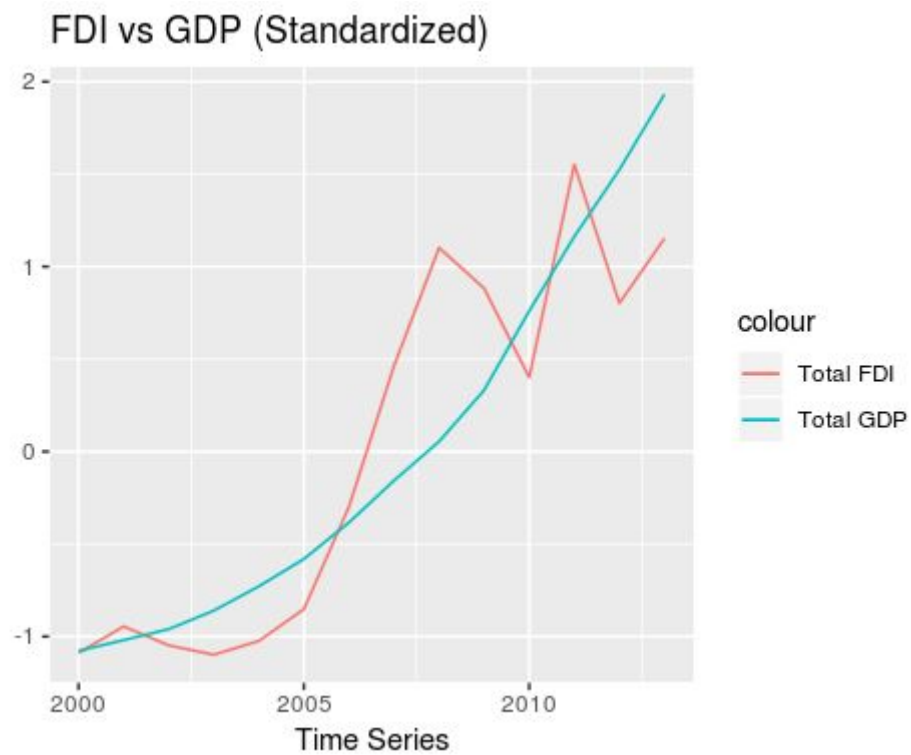
We plotted and analysed the trends of individual sectors and industries in FDI and GDP to understand the relation between sectors and with different industries. These plots help us to define our work and understand whether the regression model for individual industries with respect to related sectors will be valuable or not. Here we display the trend graphs for all the 9 sectors selected in GDP for studies.
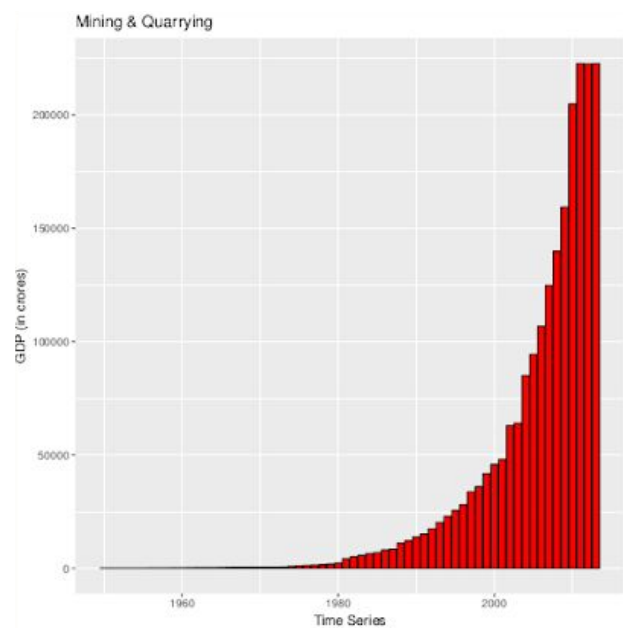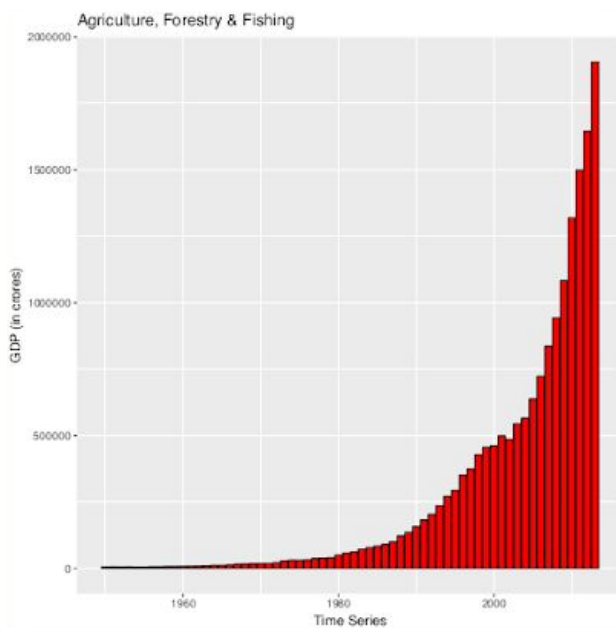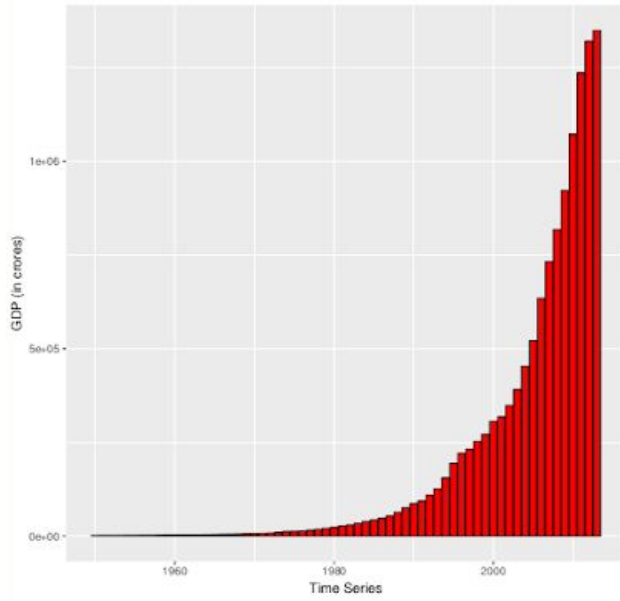
Agriculture, Forestry & Fishing
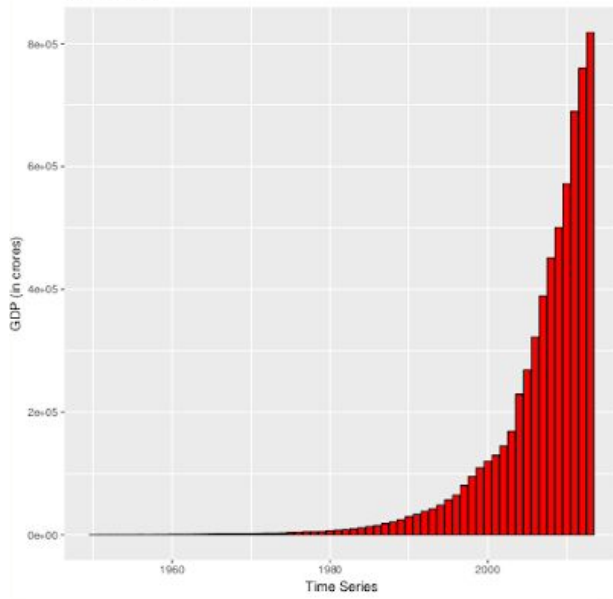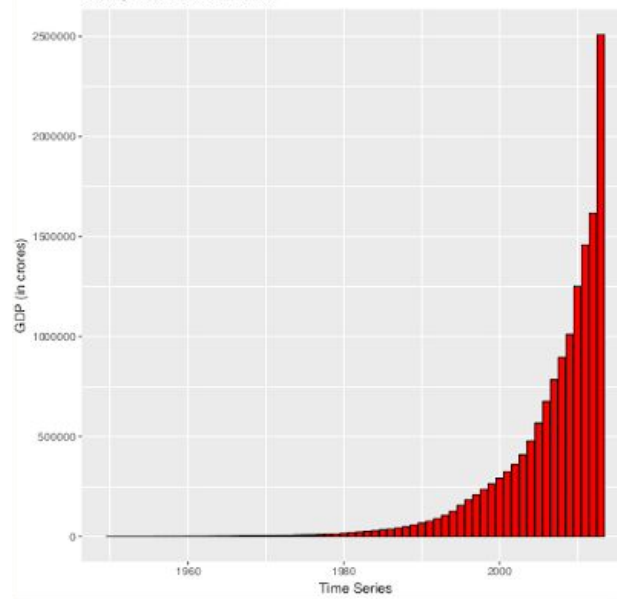

Mining & Quarrying
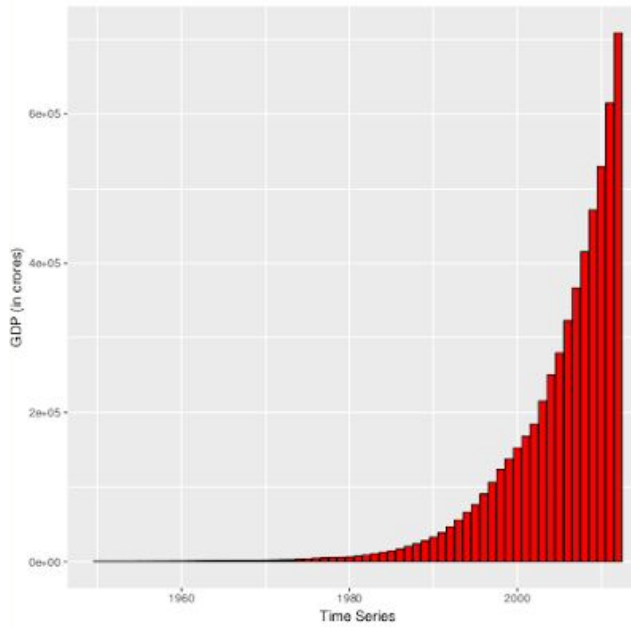
Manufacturing

Electricity, Gas & Water Supply

Construction

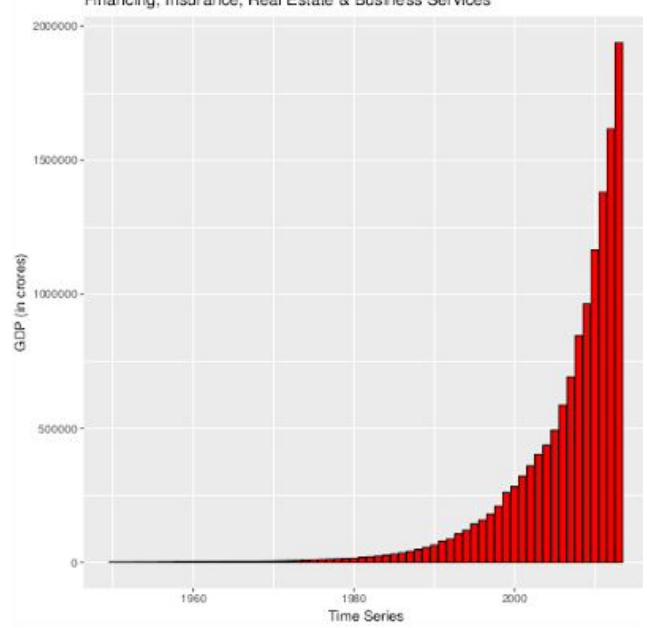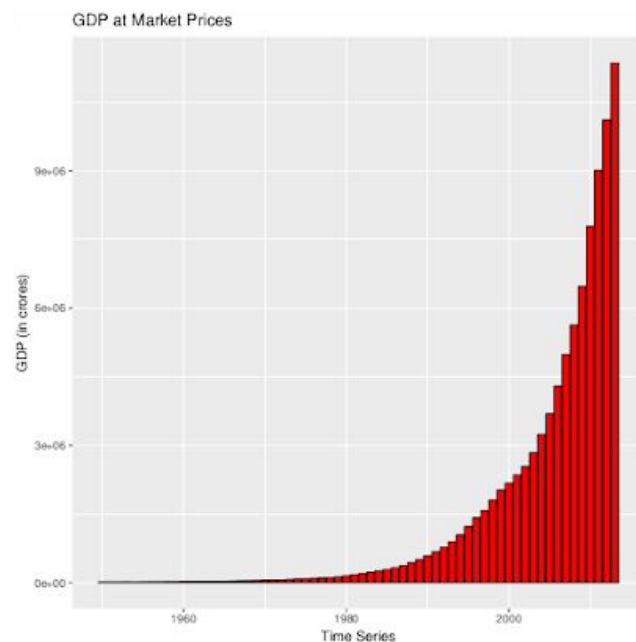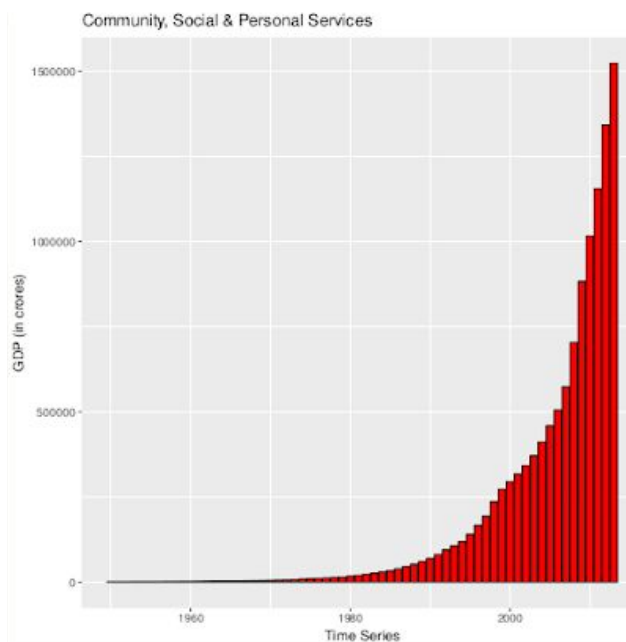Trade, Hotels & Restaurant

Transport, Storage & Communication

Financing, Insurance, Real Estate & Business Services

Community, Social & Personal Services

GDP at Market Prices

6. Time Series Modeling

In order to analyze the sectoral level movement of GDP independent of FDI we examine the time series data of selected industries during the financial year 1950-2013.

The time series analysis of data enables us to study the past behavior of the phenomenon under study, i.e. determine the type and nature of the variation in data. It helps to compare the actual current performance with the expected ones (on the basis of past performance) and analyze the cause of such variation and enables us to predict or estimate or forecast the behavior of the phenomenon in future which is an essential part of business planning.

Trend is the general tendency of the variable under consideration to take increasing or decreasing values over a long period of time. It exists in time series data on any economic or business variable if there is a smooth, long run and general tendency of the variable take increasing or decreasing values over the given period. Trend is the long run component of time series data. If the variable does not show the tendency to take increasing or decreasing values then it is deemed to have no trend.

6.1 Choice of Estimate Trend Method

There are four methods to estimate trend
- Graphic Method
- Semi Average Method
- Method of Curve Fitting
- Method of Moving Average

Out of these four methods we select the method of curve fitting because of three reasons, which are as follows:
- It is characterized by the maximum degree of objectivity compared to other methods.
- The data fulfills all preconditions for a good curve fitting.
- Enables us to compute the trend values for all the given time period in the series.

The nature of data during the aforesaid periods is such that there is no need for the Seasonal and Cyclic decomposition, because it is annual data and does not seem to contain cyclical component. The data takes the form of a smooth exponential curve when plotted on a two dimensional graph against time.

6.2 Data Analysis Steps

We analyze and estimate the trend in the dataset within the financial year under consideration with the help of following step:

- Plotting the annual value against the corresponding year and draw a Bar Plot. Ascertain the nature of temporal movement of the value of the variable over the time periods.
- Propose an exponential trend relationship between GDP & sectoral values as the dependent variable and time as independent variables. Checking that the data satisfies the prescribed criteria for running regression of GDP & sectoral values on time and the for the entire sample period. We examine the goodness of fit in terms of adjusted R2 and 't' values at 95% level of significance.
- Obtain the fitted model i.e. estimate the value of the parameters of the model using the principle of least square estimation. The model layout is as follows:

$$y_t = a.b^t$$

$$log\ y_t = log\ a\ + t.log\ b$$

$$Y_t = A + t.B$$

Thus, obtaining estimate of A and B using the method of least squares i.e. by minimization of function $\sum (Y_t - A - t.B)^2$.

The estimate of original parameters is
$$a = antilog\,(A)$$

$$b = antilog\,(B)$$

The forecast of values is given as
$$y_t = \ log\ Y_t$$

- We make the estimation of GDP and other variables within the sample for all the years and plot them on graph to find the difference between the estimated line and the actual line with an intention of improvement if there is any wide difference.
- Assessing the fit of the model based on R^2 value and if the model explains the data well accept the model and use for predicting the value for future years.

6.3 Industry wise Time Series Model

In this section, we provide summary of all the 9 industries of GDP listed above along with time series graph depicting the relation between actual and predicted values with the help of grouped line graph.

6.3.1 Agriculture, Forestry & Fishing

```
Residuals:
    Min      1Q  Median      3Q     Max
-0.2738 -0.1329 -0.0436  0.1129  0.5839

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  7.88496    0.04448  177.26   <2e-16 ***
x            0.09943    0.00119   83.56   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1758 on 62 degrees of freedom
Multiple R-squared:  0.9912,    Adjusted R-squared:  0.9911
F-statistic:  6982 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 2657.0170 \times 1.1045^t$$

Adj. R^2 = 0.9911

The model explains 99.11% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**

6.3.2 Mining & Quarrying

```
Residuals:
      Min       1Q   Median       3Q      Max
  -0.56981 -0.17311  0.03543  0.14917  0.55049

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
  (Intercept) 3.627737   0.061580   58.91   <2e-16 ***
  x           0.139264   0.001647   84.54   <2e-16 ***
  ---
  Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

  Residual standard error: 0.2434 on 62 degrees of freedom
  Multiple R-squared:  0.9914,    Adjusted R-squared:  0.9913
  F-statistic:  7147 on 1 and 62 DF,  p-value: < 2.2e-16
```
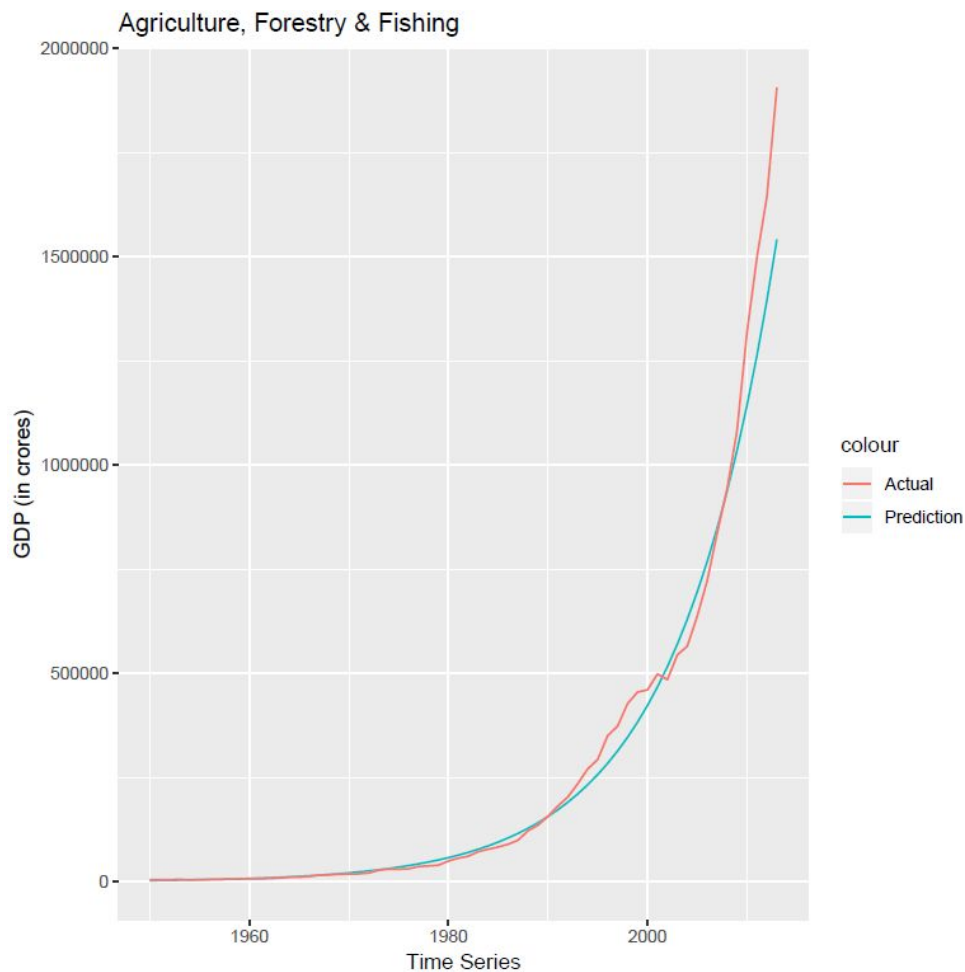
Model Summary

Mining & Quarrying

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 37.6276 \times 1.1494^t$$

Adj. R^2 = 0.9913

The model explains 99.13% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**

6.3.3 Manufacturing

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.25466 -0.10838 -0.00788  0.09295  0.44459

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.4476313  0.0373345   172.7   <2e-16 ***
x           0.1198940  0.0009987   120.0   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1476 on 62 degrees of freedom
Multiple R-squared:  0.9957,     Adjusted R-squared:  0.9956
F-statistic: 1.441e+04 on 1 and 62 DF,  p-value: < 2.2e-16
```
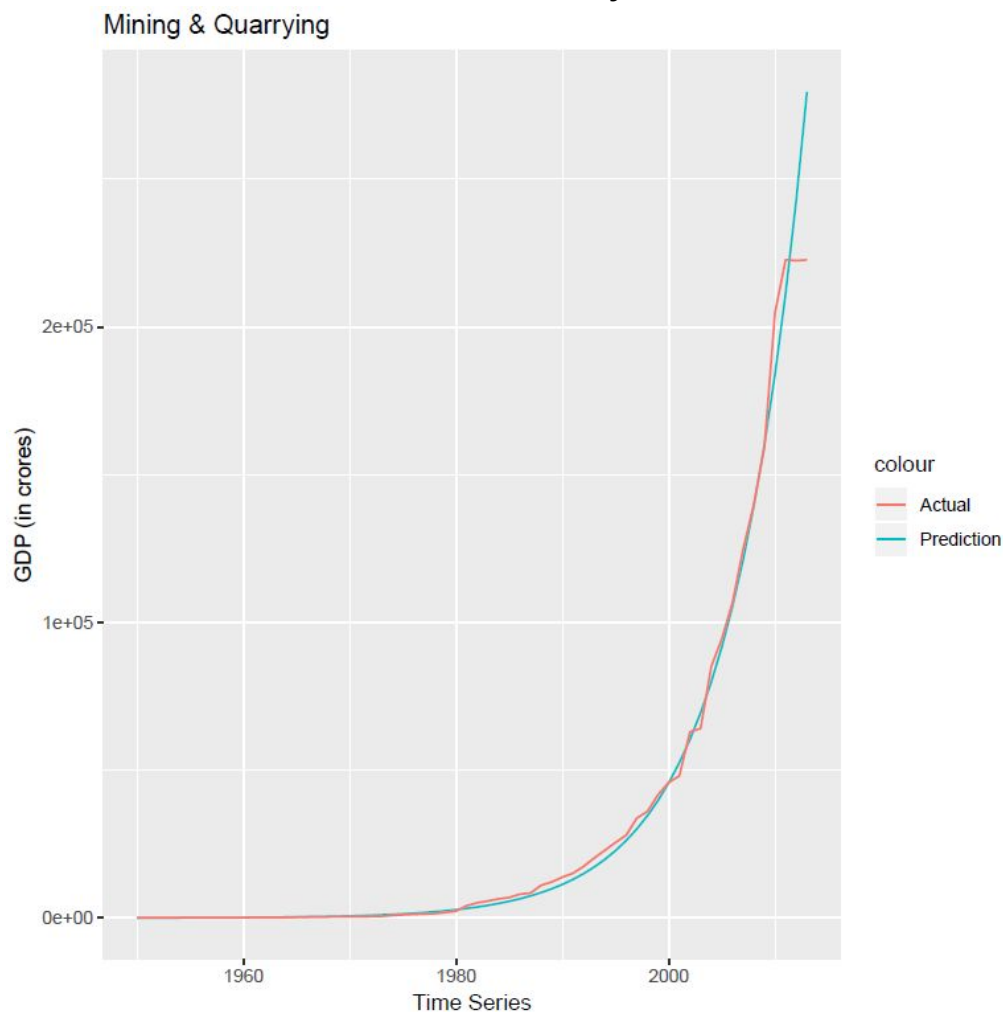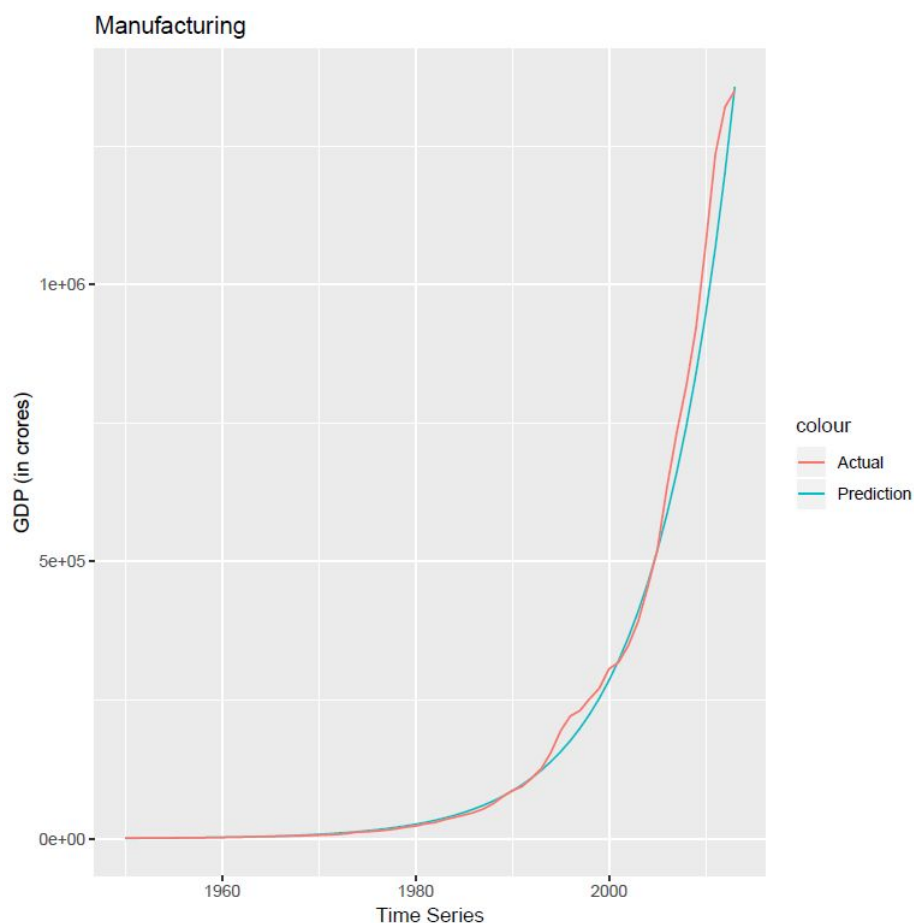
Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 631.2054 \times 1.1274^t$$

Adj. R^2 = 0.9956

The model explains 99.56% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**

6.3.4 Electricity, Gas & Water Supply

```
Residuals:
     Min      1Q   Median      3Q      Max
-0.45007 -0.12162 -0.01166  0.14977  0.45364

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.01751    0.05719   52.76   <2e-16 ***
x            0.14916    0.00153   97.50   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2261 on 62 degrees of freedom
Multiple R-squared:  0.9935,    Adjusted R-squared:  0.9934
F-statistic:  9507 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 20.4403 \times 1.1609^t$$

Adj. R^2 = 0.9934

The model explains 99.34% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**
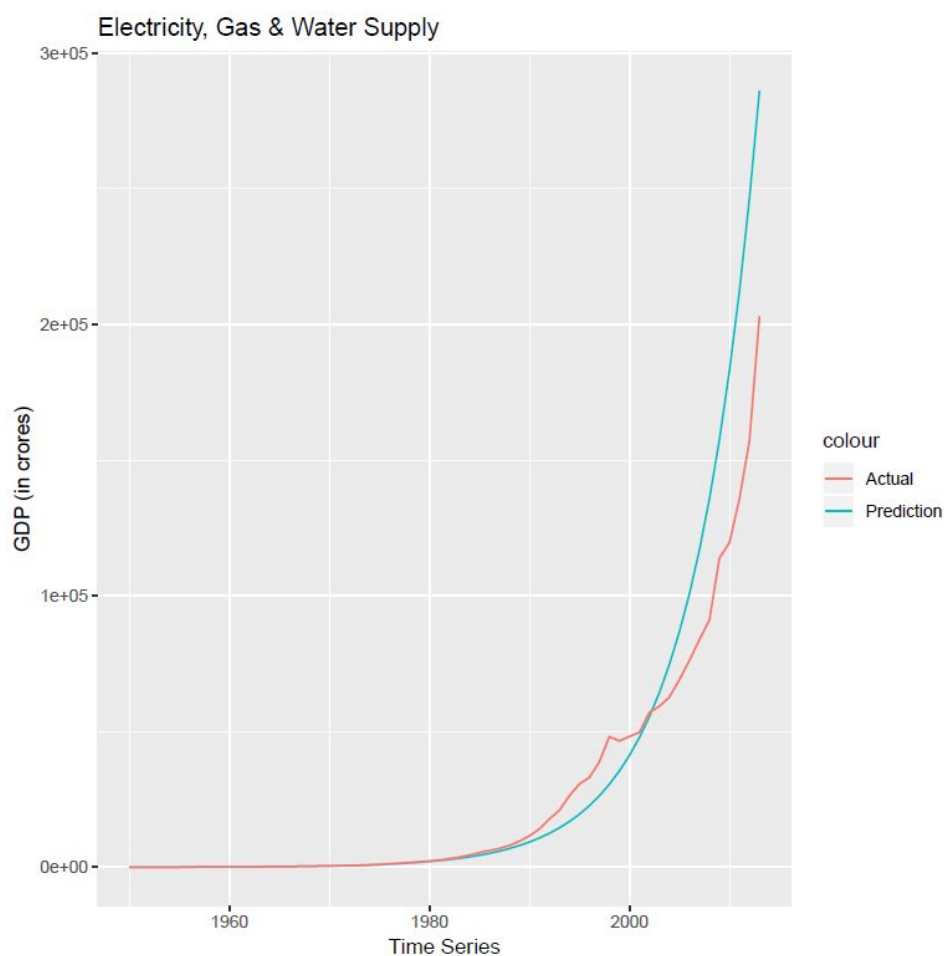
6.3.5 Construction

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.39059 -0.14413 -0.02055  0.13961  0.51193

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 4.944353   0.050606   97.70   <2e-16 ***
x           0.132014   0.001354   97.52   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2001 on 62 degrees of freedom
Multiple R-squared:  0.9935,    Adjusted R-squared:  0.9934
F-statistic:  9510 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 140.3799 \times 1.1411^t$$

Adj. R^2 = 0.9934

The model explains 99.34% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**
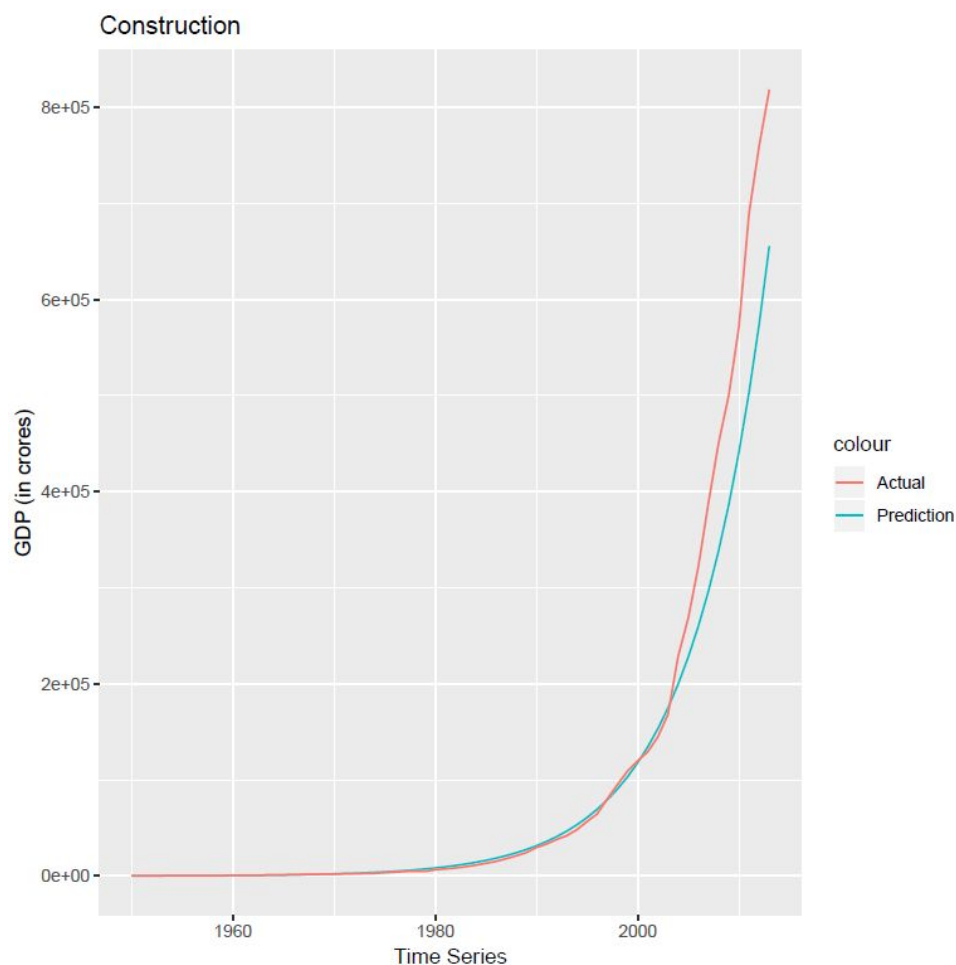
6.3.6 Trade, Hotels & Restaurant

```
Residuals:
     Min      1Q  Median      3Q      Max
-0.34865 -0.11970 -0.03678  0.10289  0.63299

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 5.691299   0.050889  111.84   <2e-16 ***
x           0.134047   0.001361   98.47   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2012 on 62 degrees of freedom
Multiple R-squared:  0.9936,    Adjusted R-squared:  0.9935
F-statistic:  9697 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 296.2782 \times 1.1434^t$$

Adj. R^2 = 0.9935

The model explains 99.35% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**
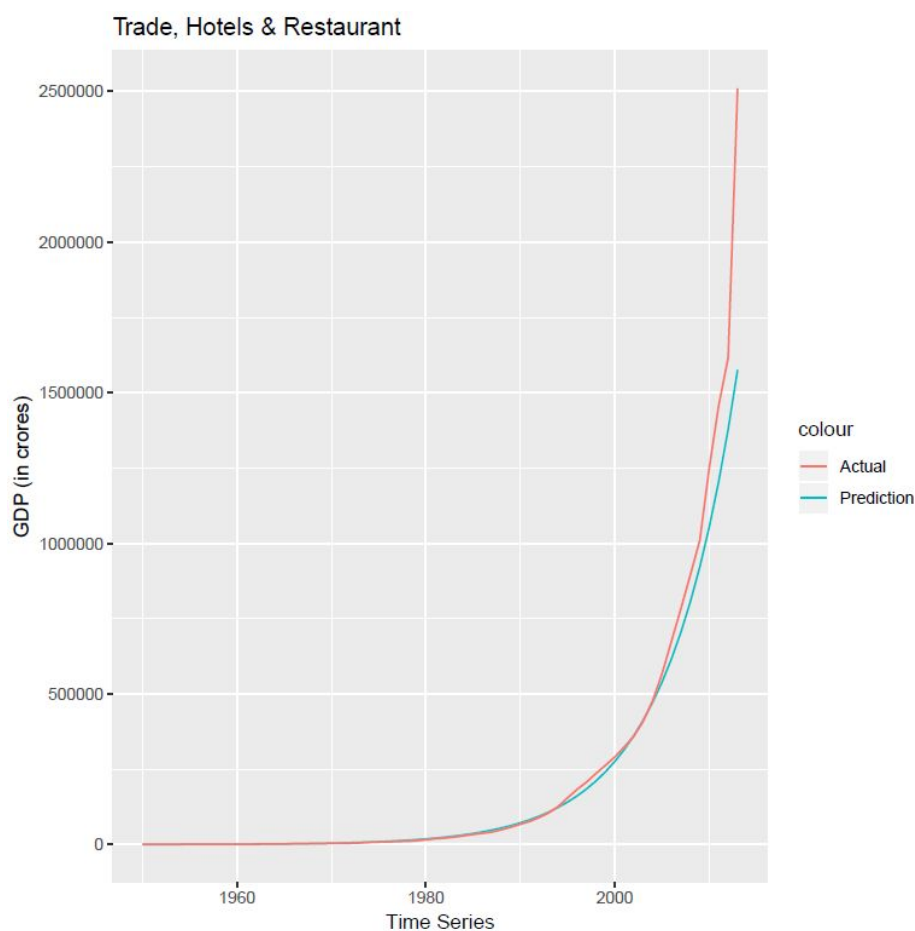
6.3.7 Transport, Storage & Communication

```
Residuals:
     Min      1Q   Median      3Q      Max
-0.44911 -0.23367  0.03504  0.16583  0.62814

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.16709    0.06590   78.41   <2e-16 ***
x            0.12902    0.00179   72.06   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2584 on 61 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.9884,    Adjusted R-squared:  0.9882
F-statistic:  5193 on 1 and 61 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 175.4037 \times 1.1377^t$$

Adj. R^2 = 0.9882

The model explains 98.82% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**
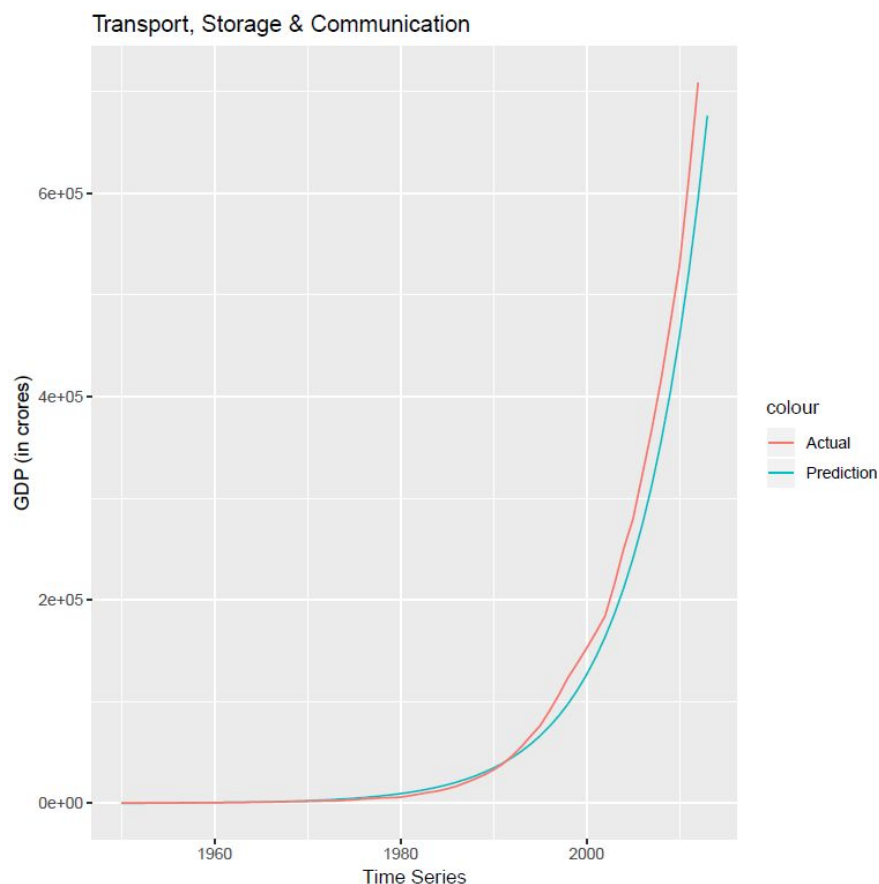
6.3.8 Financing, Insurance, Real Estate & Business Services

```
Residuals:
    Min     1Q  Median      3Q     Max
-0.4555 -0.2844  0.0156  0.1881  0.6095

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.465772   0.074871   86.36   <2e-16 ***
x           0.116946   0.002003   58.39   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.296 on 62 degrees of freedom
Multiple R-squared:  0.9821,    Adjusted R-squared:  0.9819
F-statistic:  3410 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 642.7605 \times 1.1241^t$$

Adj. R^2 = 0.9819

The model explains 98.19% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**

6.3.9 Community, Society & Personal Services

```
Residuals:
     Min      1Q   Median      3Q      Max
-0.27977 -0.17319 -0.00932  0.11841  0.63660

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.282752   0.052885  118.80   <2e-16 ***
x           0.120309   0.001415   85.04   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2091 on 62 degrees of freedom
Multiple R-squared:  0.9915,    Adjusted R-squared:  0.9914
F-statistic:  7232 on 1 and 62 DF,  p-value: < 2.2e-16
```
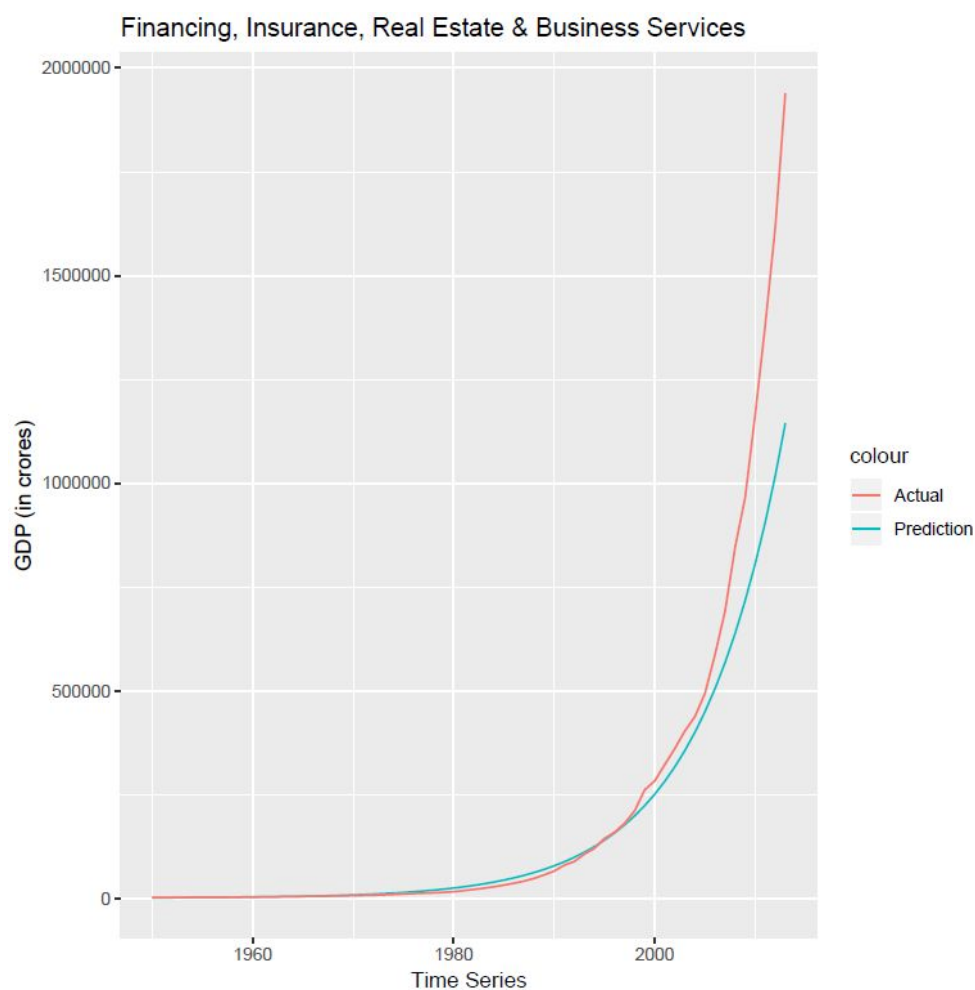
Model Summary
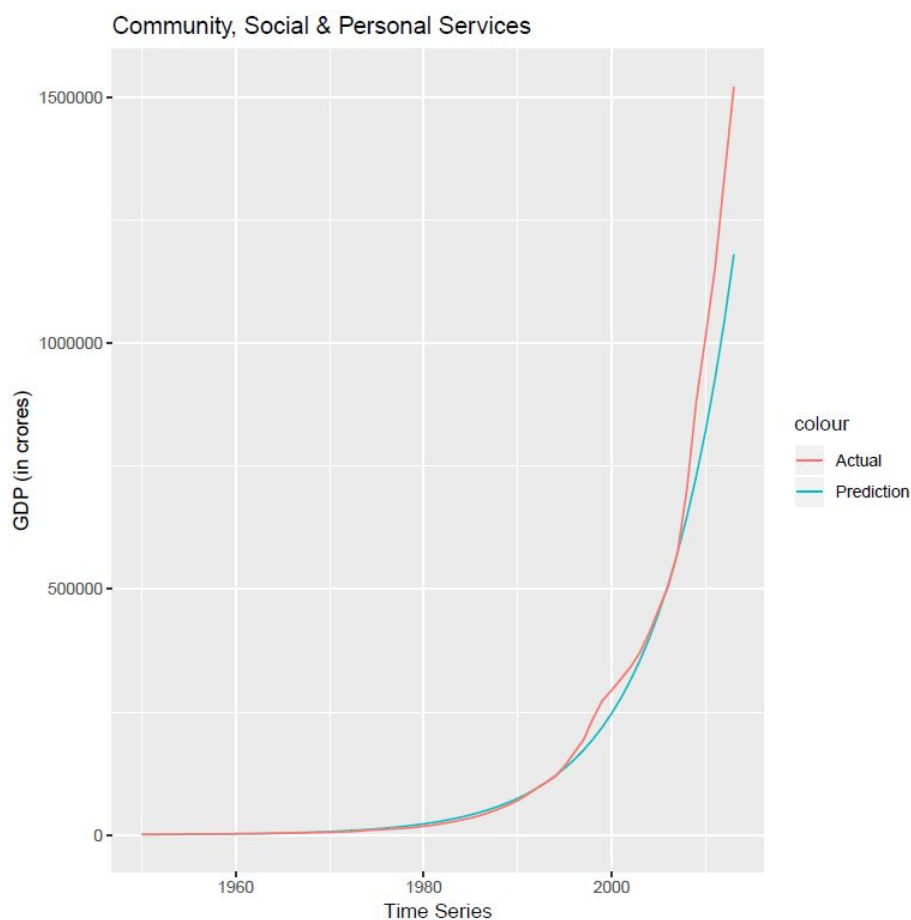
Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 535.2595 \times 1.1278^t$$

Adj. R^2 = 0.9914

The model explains 99.14% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**

6.3.10 GDP at Market Price

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.29256 -0.15830 -0.00488  0.11095  0.61881

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 8.513486   0.049944  170.46   <2e-16 ***
x           0.117365   0.001336   87.85   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1974 on 62 degrees of freedom
Multiple R-squared:  0.992,    Adjusted R-squared:  0.9919
F-statistic:  7717 on 1 and 62 DF,  p-value: < 2.2e-16
```

Model Summary

Actual vs Predicted GDP Value

The fitted model is given by the equation

$$y_t = 4981.5001 \times 1.1245^t$$

Adj. R^2 = 0.9919

The model explains 99.19% of the variability of the data indicating a good fit to the data. All the values are found to be highly significant. While plotted on graph, the estimated line coincides with the actual line; **hence the model can be used for forecasting.**
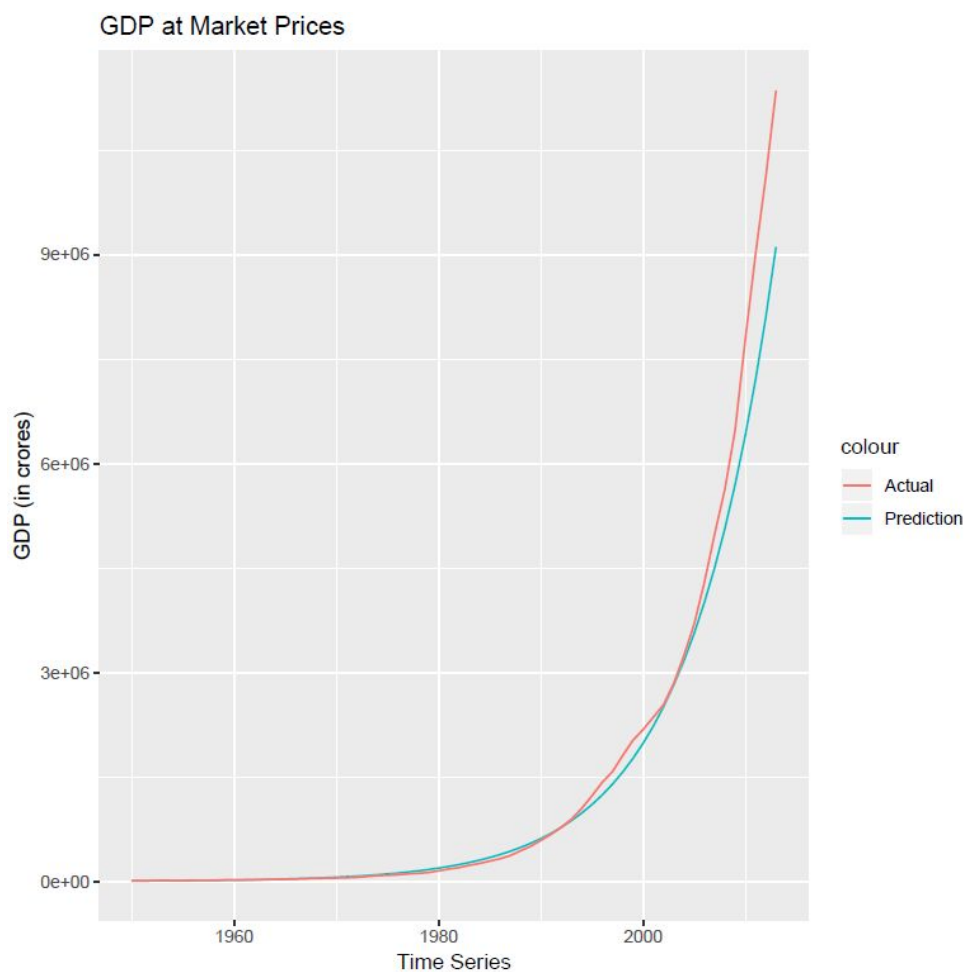
6.4 Forecast

The trend equation provides a good fit to the data. It gives a result supporting the belief that economic reform causes a boost in the GDP. It gives however an adjusted R^2 as high as 99.6%. All the 't' values are found highly significant. While plotted on graph, the estimated GDP line just coincides with the actual line. So this estimation can be used for the purpose of GDP forecasting. This model has tracked well the path of past movements in the value of the variable. The sector comprising Trade, Transport, Storage and Communication is found to contribute the maximum and the sector comprising Financing, Insurance, Real Estate and Business Services is found to contribute the minimum to the GDP trend under study.

Predicted values for different industries for period 2014-18 using the model for each industry respectively is given below

(in ₹ 000 Crores)

Sector	2014-15	2015-16	2016-17	2017-18
Agriculture, Forestry & Fishing	1702.94	1880.96	2077.60	2294.79
Mining & Quarrying	321.22	369.22	424.39	487.80
Manufacturing	1529.95	1724.83	1944.53	2192.22
Electricity, Gas & Water Supply	332.12	385.54	447.57	519.56
Construction	748.09	853.67	974.14	1111.61
Trade, Hotels & Restaurant	1801.95	2060.43	2356.00	2693.96
Transport, Storage & Communication	769.55	875.53	996.11	1133.29
Financing, Insurance, Real Estate & Business Services	1286.27	1445.85	1625.22	1826.84
Community, Social & Personal Services	1332.89	1503.30	1695.49	1912.25

(in ₹ 000 Crores)

Year	Projected GDP (Market Prices)	Actual GDP (Market Prices)
2014-15	10244.28	10527.67
2015-16	11520.00	11386.15
2016-17	12954.59	12196.01
2017-18	14567.83	13010.84

GDP (Market Price)
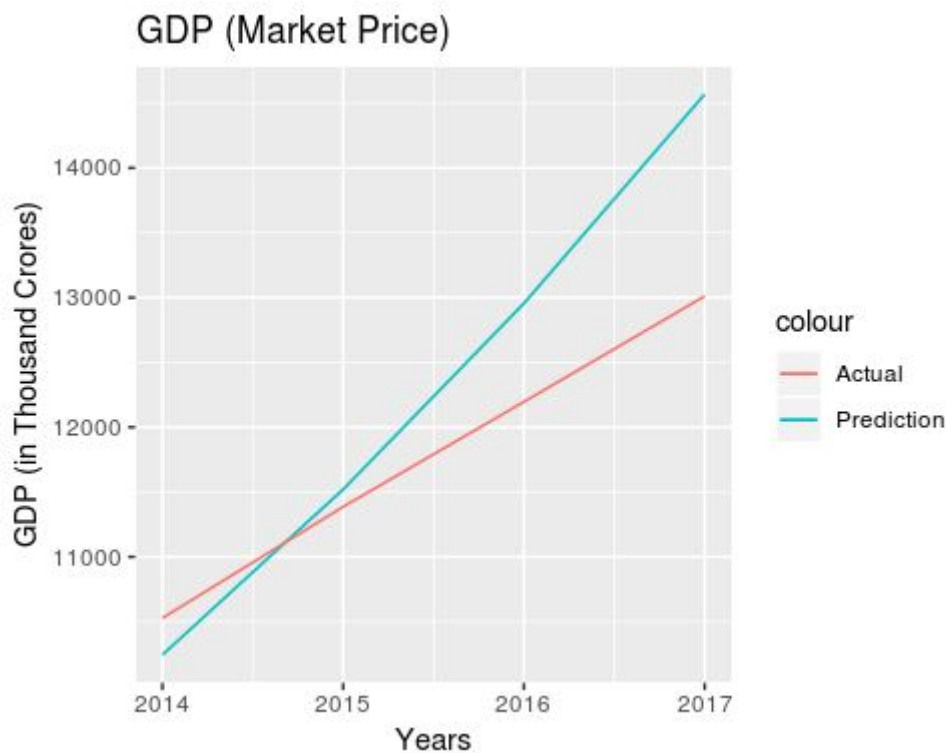
Actual vs Predicted GDP Value

7. Regression Modelling

Foreign Direct Investment inflow is a predominant and vital factor in influencing the contemporary process of global economic development. The study attempts to analyze the important dimensions of FDI in India and works out the trends & patterns, main determinants and investment flows to India. The study examines the role of FDI on economic growth in India for the period 2000 - 2013.

The study is important for a variety of reasons. First of all, it was during July 1991 India opened its doors to private sector and liberalized its economy. Secondly, the experiences of South-East Asian countries by liberalizing their economies in 1980s became stars of economic growth and development in early 1990s. Thirdly, India's experience with its first generation economic reforms and the country's economic growth performance were considered safe havens for FDI which led to second generation of economic reforms in India in first decade of this century. Fourthly, there is a considerable change in the attitude of both the developing and developed countries towards FDI. They both consider FDI as the most suitable form of external finance. Last, increase in competition for FDI inflows particularly among the developing nations.

7.1 Model Building

Further, to study the impact of foreign direct investment on economic growth, models were framed and fitted for different sectors of the economy. The economic growth model depicts the contribution of foreign direct investment to economic growth. Economic growth is proxied by contribution of the particular sector to GDP. **The Model tries to measure the contribution of particular sector to GDP when we know the FDI in that sector.**

Regression Analysis (Multiple Regression) was carried out using relevant econometric techniques. Multiple regression model was used to measure the impact of FDI flows on economic growth (proxied by GDP growth) in India. Data under consideration is highly concentrated towards right thus indicating high Negative Skewness further, variability

in data is very high, thus Z - score transformation has to be applied on series for stabilizing variability in data and reducing the extent of Skewness.

The Fitted Model is of the form:
$$Y = X\beta$$

Y = Vector of Observations on Dependent Variable
X = Matrix of Observations on Independent Variable
β = Vector of Coefficients of Regression

Method of Least square estimation was used to obtain the estimates of Coefficients of Regression for each sector.

7.1.2 Standardized Coefficients
A variable is said to be standardized if we subtract the mean value of the variable from its individual values and divide the difference by the standard deviation of that variable.

Standardized Coefficients are obtained from regression on standardized variables but in order to understand the real effect of independent variable on dependent variable, we transform the standardized coefficients to unstandardized coefficients using the relation,

$$\beta = \beta^* \left(\frac{S_x}{S_y} \right)$$

Where,

S_x = sample standard deviation of the X regressor
S_y = sample standard deviation of the regressand
β = Unstandardized Coefficient
β* = Standardized Coefficient

7.2 Industry wise Regression Model
This section list all the regression models for GDP industries listed above. It provides complete information about the impact of various sectors of FDI on a particular industry in GDP based on the matching .

7.2.1 Agriculture, Forestry & Fishing

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Agricultural Machinery	0.01	37.14	169.24
Fertilizers	-0.15	-475.96	152.43
Sugar	0.00	-78.33	19.99
Fermentation Industries	0.93	369.41	1205.89
Food Processing Industries	0.24	19.08	6037.39
Vegetable Oils And Vanaspati	1.06	2919.43	174.70
Rubber Goods	-0.87	-414.68	1009.55

Leather,leather Goods And Pickers	0.03	221.50	63.03
Timber Products	0.55	5010.55	52.54
Agriculture Services	-0.32	-99.28	1545.99
Tea And Coffee	-0.13	-1314.58	46.82
Coir	-0.27	-111451.72	1.17

Positively Correlated	Negatively Correlated
- Agricultural Machinery - Fermentation Industries - Food Processing Industries - Vegetable Oils And Vanaspati - Leather, Leather Goods And Pickers - Timber Products	- Fertilizers - Sugar - Rubber Goods - Agriculture Services - Tea And Coffee - Coir

As the value of the positively correlated variable increases the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease.

An increase in investment in Timber Products leads to maximum increase in contribution of Agriculture, Forestry & Fishing to GDP. On the other hand, increase in investment in coir leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.2 Mining & Quarrying

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Mining	0.30	40.04	502.45
Coal Production	-0.28	-1061.77	18.01
Diamond,gold Ornaments	0.55	307.18	120.54

Positively Correlated	Negatively Correlated
- Mining - Diamond, Gold Ornaments	Coal Production

An increase in investment in Diamond, Gold Ornaments leads to maximum increase in contribution of Mining & Quarrying to GDP. On the other hand, increase in investment in coal production leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.3 Manufacturing

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Metallurgical Industries	0.01	37.14	169.24
Boilers And Steam Generating Plants	-0.15	-475.96	152.43
Electrical Equipments	0.00	-78.33	19.99
Industrial Machinery	0.93	369.41	1205.89
Machine Tools	0.24	19.08	6037.39
Miscellaneous Mechanical & Engineering Industries	1.06	2919.43	174.70
Industrial Instruments	-0.87	-414.68	1009.55
Scientific Instruments	0.03	221.50	63.03
Chemicals	0.55	5010.55	52.54
Textiles	-0.32	-99.28	1545.99
Paper And Pulp	-0.13	-1314.58	46.82
Glass	-0.27	-111451.72	1.17
Ceramics	0.19	223.62	325.85

Positively Correlated	Negatively Correlated
- Metallurgical Industries - Boilers And Steam Generating Plants - Industrial Machinery - Machine Tools - Textiles - Paper And Pulp - Chemicals - Ceramic	- Electrical Equipments - Industrial Instruments - Miscellaneous Mechanical & Engineering Industries - Scientific Instruments - Glass

An increase in investment in Diamond, Gold Ornaments leads to maximum increase in contribution of Mining & Quarrying to GDP. On the other hand, increase in investment in

coal production leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.4 Electricity, Gas & Water Supply

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Power	0.57	9.70	2710.00
Non-conventional Energy	0.52	13.65	1741.84
Petroleum & Natural Gas	-0.17	-2.93	2670.75

Positively Correlated	Negatively Correlated
● Power ● Non-Conventional Energy	● Petroleum & Natural Gas

An increase in investment in Non-Conventional Energy leads to maximum increase in contribution of Electricity, Gas & Water Supply to GDP. On the other hand, increase in investment in Petroleum and natural gas leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.5 Construction

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Earth-moving Machinery	0.12	302.00	94.99
Mathematical, Surveying And Drawing Instruments	0.34	8459.18	9.66
Cement And Gypsum Products	0.07	15.41	1087.26
Construction (infrastructure) Activities	0.70	154.79	1087.48
Construction Development	0.16	4.54	8546.59

Positively Correlated	Negatively Correlated
● Earth-moving Machinery ● Mathematical, Surveying And Drawing Instruments ● Cement And Gypsum Products ● Construction (infrastructure) Activities ● Construction Development	

Investments in all the above-mentioned sectors leads to an increase in contribution of construction sector on GDP with maximum increase occurring with investment in mathematical, surveying and drawing instruments, holding the other variables constant.

7.2.6 Trade, Hotel & Restaurant

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Hotel & Tourism	0.53	72.79	4555.68

Positively Correlated	Negatively Correlated
● Hotel & Tourism	

An increase in investment Hotel & Tourism directly leads to increase in contribution of Trade, Hotels and restaurant in the GDP. Thus, our theoretical belief is further strengthened by the empirical results.

7.2.7 Transport, Storage & Communication

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Telecommunications	-0.83	-34.44	4140.07
Information & Broadcasting	1.23	171.78	1232.18
Automobile Industry	0.14	7.88	2942.75
Air Transport (including Air Freight)	0.03	23.95	185.84
Sea Transport	0.47	181.69	442.86
Ports	-0.05	-7.14	1100.93
Railway Related Components	-0.17	-83.41	354.45

Positively Correlated	Negatively Correlated
● Information & Broadcasting (including Print Media) ● Automobile Industry ● Air Transport (including Air Freight) ● Sea Transport	● Telecommunications ● Ports ● Railway Related Components

An increase in investment in Sea transport leads to maximum increase in contribution of Transport, Storage & Communication to GDP. On the other hand, increase in investment

in railway related components leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.8 Financing, Insurance, Real Estate & Business Services

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Consultancy Services	-0.06	-55.57	574.93
Services Sector	0.11	5.31	11362.54
Trading	0.75	175.22	2251.03
Retail Trading	0.36	3440.55	55.36
Miscellaneous Industries	-0.13	-29.91	2218.10

Positively Correlated	Negatively Correlated
● Services Sector ● Trading ● Retail Trading	● Consultancy Services ● Miscellaneous Industries

An increase in investment in retail trading leads to maximum increase in contribution of Financing, Insurance, Real Estate & Business Services to GDP. On the other hand, increase in investment in consultancy services leads to maximum decrease in contribution, holding the other variables in the model constant.

7.2.9 Community, Social & Personal Services

Variable	Standardized Coefficients	Unstandardized Coefficients	Standard Deviation
Intercept	0.00	#N/A	#N/A
Computer Software & Hardware	0.28	38.82	2909.60
Electronics	0.06	63.79	386.41
Commercial, Office & Household Equipments	0.54	2355.18	93.16
Medical And Surgical Appliances	0.40	494.93	330.51
Drugs & Pharmaceuticals	-0.10	-6.54	5945.25
Soaps, Cosmetics & Toilet Preparations	0.10	112.55	357.50
Hospital & Diagnostic Centres	1.79	689.65	1058.51
Education	-0.20	-175.70	471.23

| Printing Of Books | -1.42 | -3216.44 | 180.93 |

Positively Correlated	Negatively Correlated
● Computer Software & Hardware ● Electronics ● Commercial, Office & Household Equipments ● Medical And Surgical Appliances ● Soaps, Cosmetics & Toilet Preparations ● Hospital & Diagnostic Centres	● Drugs & Pharmaceuticals ● Education ● Printing Of Books

An increase in investment in commercial, office and household equipments leads to maximum increase in contribution of Community, Social & Personal Services to GDP. On the other hand, increase in investment in printing of books leads to maximum decrease in contribution, holding the other variables in the model constant.

7.3 Model Analysis

As the value of the positively correlated variable increases the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease. Further independent variable with high absolute value of coefficient has significant impact on the dependent variable.

We observe that the increase in flow of foreign direct investment in India is accompanied by increase in economic growth of the country indicated by escalation of Gross Domestic Product, thus data provide us sufficient evidence to accept the hypothesis that FDI has a positive impact on economic growth of the country. Further we also observe that increased economic growth made India a major attractor of investments. Thus, GDP and FDI have circular relationship i.e. increase in one factor leads to increase in the other.

8. Conclusion

It can be stated that investments from different countries in India has a significant impact on the growth of economic value of India. We can observe that GDP had drastically increased after India opened doors to private sectors accompanied by the country's economic growth reforms making India a safe haven for FDI inflow. FDI investments in various sectors like Agriculture Machinery, Mining Metallurgical Industry, Power, etc. have a positive impact on the GDP value whereas investment in sectors like Sugar, Fertilizers, Coal Production, Electrical Equipments, Ports, etc. have a negative impact.

Further, it can be stated that Foreign Direct Investment inflow can be a win-win situation for both the parties involved. The investor can gain cheaper access to products/services and the host country can get valuable investment unattainable locally.

On the other hand excessive repatriation of profits to parent companies from local subsidiaries, exploitation of host countries limited natural resources along with uneven playing field for indigenous firms of host country make Foreign Direct Investment an trail of occlusion for economic growth at micro as well as macro level.

Hence, within a well regulated framework FDI can be a major boon for a country.